ROGIER M. HANSELAAR

Raising Capital

on PRICING LIQUIDITY & INCENTIVES

Raising capital:

On pricing, liquidity, and incentives

Raising Capital: On pricing, liquidity, and incentives

Kapitaal ophalen: over beprijzing, liquiditeit, en prikkels

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Contents

Chapter 1

Introduction

Financial markets are important. They aggregate information, allocate capital, and allow for consumption smoothing and risk sharing. These functions are instrumental to generating affluence in society. Primary markets form a distinct type of financial markets, that have a particular direct impact on real economic activity. In this thesis, I show how the operation of primary equity markets depends on market liquidity and stereotypes, and how the primary market for contingent convertible bonds can generate adverse incentives that have consequences for real economic activity.

To see the functions of financial markets in action, consider a company issuing new shares on financial markets. The markets aggregate information on demand for the shares of potential investors; the supply of and demand for the shares together determine a price per share, which in turn determines how much capital is allocated to the firm for investment. For investors, financial markets offer the opportunity to smooth consumption by investing now, in return for increased cash flow in the future. For the shareholders of the company prior to the new issue, the financial markets allow them to share the risk of new investment over a broader investor base.

Well functioning financial markets generate affluence in society. They allocate capital to firms for investment, in accordance with investors' expectations on the investment's future cash flows. Firms with higher expected returns on investment are given more capital than those with lower expected returns. For society as a whole, funds are allocated to maximize wealth growth. Further, well functioning financial markets allow investors to smooth their consumption by investing; and in a world of decreasing marginal utility, this generates increased affluence. Finally, by facilitating risk sharing, well functioning financial markets make high-risk investments feasible, enlarging the set of option over which wealth growth can be maximized.

Primary markets form a distinct type of financial markets. On primary markets, firms issue new securities to raise capital. Firms can subsequently invest the resulting proceeds in real assets to further develop their business. Activity on primary markets is interesting, as trades on these markets directly affect capital flows to companies and impact the distribution of resources in the economy. Moreover, trades also change the mix of security types, and with that the set of incentives to which shareholders and management are subject. These changes in incentives can impact decision making. Through both channels, activity on primary markets can have real economic consequences.

In this thesis, I zoom in on the functioning of these primary markets. I show how the pricing of shares in initial public equity offerings is affected by stereotypes about industries, how market liquidity affects equity issuance activity, and how changed incentives due to the issuance of contingent convertible bonds influence real economic choices in European banks. In the remainder of this introduction, I discuss the role of these topics in the discussion on the functioning of primary markets.

1.1 Pricing securities

If prices of securities do not reflect their true value, this can adversely affect economic growth. Whether prices of securities reflect their true value, has attracted substantial research and debate over time. To help understand a price deviation from fundamentals, human behavior needs to be modelled. Chapter 2 contributes to this debate by highlighting the role of stereotypes about industries in the pricing of new shares on the U.S. primary market.

A price of a security can be considered to reflect its true value, if it reflects all available information regarding expected return and risk. In that case, the market for that security is 'efficient' (Fama, 1970). If primary markets are not efficient, prices do not reflect their true value, and economic growth is not maximized. To see this, recall that the pricing of new securities directly affects capital inflow. As a result of distorted prices, some firms raise more cash than they should while others raise less. Capital flows disproportionately to lower quality firms and investment projects. Overall, capital is not allocated to maximize growth. Additionally, the risk-return trade-off deteriorates, deterring investors to shoulder risks. At the macro level, there is a sub-optimal level of investment, resulting in lower economic growth. For existing shareholders looking to share risks, finding other shareholders becomes more difficult.

Whether prices of securities equal their true value has attracted substantial academic attention. Hayek (1945) argues that (financial) markets aggregate relevant information more efficiently than any central planner could, and produce prices that trump other considerations in the planning of investment and future production. Fama (1970) refines this argument by distinguishing different gradations of price efficiency, based on what information is incorporated in the prices. He argues that there is evidence that prices incorporate all publicly available relevant information.

However, the idea that prices reflect fundamental values has drawn criticism in public and academic discourse. A recent article in the Financial Times states: "If the five-year plan was the Soviet bloc's grand lie, here is that of capitalism: that the market values of financial and other assets accurately reflect the economic value they represent" (Financial Times, 2017). In academia, there is also substantial criticism on the efficient market gospel. Shiller (1981) stresses that real stock prices are much more volatile than would be expected if markets were efficient. Surveying more recent developments, Barberis and Thaler (2003) argue that agents deviate from rational decision making in various ways and that this can have adverse consequences for the correct pricing of financial assets, even in the presence of fully rational agents.

To understand why mispricing would occur, irrational behaviour needs to be modelled (Hirshleifer, 2001). Recently, Bordalo, Coffman, Gennaioli, and Shleifer (2016) introduced a model that captures how people form stereotypes, amongst others about financial assets. In chapter 2[1], I investigate the merits of this model in the context of the primary equity markets in the U.S. Specifically, I investigate the extent to which first-day returns of IPOs in the U.S. can be explained by stereotypes formed around industries based on past first-day returns of IPOs by investors. The findings challenge the view that first-day returns are fully determined by rational deliberations. They raise the question to what extent prices in the primary equity markets are efficient and, with that, to what extent this market allocates capital well.

1.2 Market liquidity

The liquidity of an asset is often defined as the ease with which the asset can be traded. The liquidity of primary markets can affect the prices of new

[1]Chapter 2 is based on the paper 'Stereotypical IPO underpricing', which is single-authored work. It is available on my website (www.rogierhanselaar.nl).

securities, and with that (adversely) affect economic growth. Even in efficient markets where prices incorporate all information, it can be difficult to trade against those prices if markets are illiquid. The absence of liquidity can have consequences for funding decisions and the allocation of capital. Chapter 3 investigates whether liquidity matters for the issuance of new shares.

In an illiquid (but efficient) market, there typically are few buyers and sellers willing to trade at the market price at any particular time. Trading larger quantities of shares against the market price in one go, is therefore difficult. An investor who wishes to make a large change to his or her position in an illiquid market, can spread out trades over time. However, if the investor needs a more immediate execution of trades, other investors need to be enticed to take the opposite side of the trade. To be able to buy or sell more immediately, the investor needs to offer, respectively, a mark-up or discount to the price. As a result, shares may trade for prices different than those that reflect the fundamental value of the asset. For the investor wishing to make a large change to his or her position, market illiquidity shows up as increased trading costs.

A lack of liquidity can deter investors from investing in projects, regardless of expected returns (Levine, 1997). This is visible in the secondary stock market, where investors tend to require higher returns for less liquid stocks and for stocks that run the risk of becoming less liquid (Amihud and Mendelson, 1986, Amihud et al., 2006, Holden et al., 2014). However, the extent to which liquidity has an impact on the real economy, depends on the extent to which it affects funding decisions. Those funding decisions take place amongst others in the primary stock markets.

In chapter 3[2], I investigate whether changes in stock market liquidity affect the issuance of new shares. The findings show that liquidity is indeed important, and has different effects depending on the type of issuing firm. The results suggest that that liquidity affects funding liquidity more generally, can influence the allocation of capital, and with that can have an effect on the real economy.

1.3 Incentives from issuance

The types of securities a firm issues can affect its investment decisions. In response to the 2008 financial crisis, regulation has been developed to encourage banks to issue Contingent Convertible bonds, also known as CoCos, to make the financial system safer. Chapter 4 shows that the issuance of CoCos makes banks choose more risky investments, at odds with the objective of a safer financial system, and highlights that primary market activity can alter incentives with real economic consequences.

Financing decisions of a firm do not affect its investment behavior, in a frictionless world (Modigliani and Miller, 1958). When there are frictions, due to the presence of taxes, bankruptcy risk, implicit government guarantees, or other factors, the mix of securities financing the firm will affect decisions regarding investment. To see how financing may affect investment decisions, consider an imaginary firm funded with little equity and much debt. If the firm invests in a risky project, the shareholders will receive a large pay off in good times. In bad times, only part of the losses will be absorbed by the shareholders, the rest is absorbed by the debt holders. If additionally, the

[2]Chapter 3 is based on the paper 'Do firms issue more equity when markets become more liquid?', which is joint work with René Stulz and Mathijs van Dijk. It is available on SSRN, and forthcoming in the Journal of Financial Economics. I was actively involved in developing the hypotheses and methodology, and in doing the data work, data analysis, and writing for this paper.

government (implicitly) guaranteed to keep the firm afloat in bad times, the losses for shareholders in bad times would be even smaller. As such, this specific mix of equity and debt, whether with additional government guarantees or not, generates an asymmetric pay off to shareholders and incentivizes the firm to take more risk than might be optimal from the perspective of other investors and governments (Jensen and Meckling, 1976).

In response to the 2008 financial crisis, regulation has been developed to encourage banks to issue CoCos, to make the financial system safer and shield governments from having to step in in bad times. CoCos are bonds that are converted to equity or (partially) written off when a bank makes large losses. The conversion imposes the losses on the investors holding the CoCos, and in case of a conversion to equity, (partly) on the existing shareholders. This leaves the bank in better shape and reduces the chance that governments needs to step in to save the bank.

However, a beneficial overall effect of using CoCos for funding banks, partly rests on the assumption that investment choices of banks are not affected by funding decisions. In the real world, this assumption is not necessarily justified. Chapter 4[3] provides evidence that this assumption indeed does not hold, and shows that banks tend to take on more risky loans after issuing CoCos. It highlights how the mix of securities issued on primary markets can affect incentives and have real economic consequences.

[3]Chapter 4 is based on the paper 'Risk-taking implications of contingent convertible bonds', which is joint work with Amiyatosh Purnanandam and Stefan Zeume. At the time of writing, a first draft is available on my website (www.rogierhanselaar.nl), as well as on that of Amiyatosh Purnanandam's (webuser.bus.umich.edu/amiyatos/). I was actively involved in developing the hypotheses and methodology, and in doing the data work, data analysis, and writing for this paper.

1.4 Closing remarks

This thesis focusses on primary market functioning and highlights how the pricing of shares in initial public equity offerings is affected by stereotypes about industries, how market liquidity affects equity issuance activity, and how changed incentives due to the issuance of contingent convertible bonds influence real economic choices in European banks. By fostering greater understanding of primary market functioning, this thesis may find its use as an input in the debate on the extent to which financial markets need steering and adjustment in our continuous striving to generate ever greater affluence in society.

Chapter 2

Stereotypical IPO underpricing

ABSTRACT

I investigate the extent to which IPO underpricing in the U.S. can be explained by stereotypes formed by investors based on past industry underpricing. I apply the theory of stereotype formation put forward by Bordalo, Coffman, Gennaioli, and Shleifer (2016) for the construction of stereotypes. I find that IPO underpricing, as well as IPO demand as proxied by first-day turnover and IPO price revisions, are positively and significantly related to stereotypical industry underpricing. The effect of stereotypical industry underpricing is stronger for IPOs with more retail ownership. It is not significantly affected when controlling for other explanations. Price changes due to stereotypical industry underpricing are negatively related to post-IPO stock performance. These findings challenge the view that underpricing is fully a result of rational deliberations and support the view that underpricing is partly driven by boundedly rational demand side factors.

2.1 Introduction

Pricing an IPO is tough. It is hard to form expectations about future cash flows and growth opportunities of firms that are young, opaque and without track record. Historical data show that IPOs exhibit underpricing on average: share prices tend to jump up on the first day of trading. From 1990 until 2014, IPOs were underpriced on average by 21%; in the years 1999 and 2000 this increased to an average of 67%. While these figures may suggest that IPO prices are too low, there is a large literature arguing underpricing compensates for risk and prices are right on average (e.g., Rock, 1986, Tinic, 1988), and there are even papers arguing IPO prices are higher than they should be (e.g., Purnanandam and Swaminathan, 2004). Given that IPO supply is inelastic relative to investor demand, understanding demand is crucial to understanding IPO prices. So how do investors set their demand? While sophisticated investors may estimate future cash flows, growth opportunities and risks, empirical work by Kaustia and Knüpfer (2008) shows that retail investors base their demand for future IPOs on underpricing in previous IPOs; past underpricing (co-)determines expectations about future IPOs.

In this paper, I investigate the role of stereotypes in the formation of these expectations. Bordalo, Coffman, Gennaioli, and Shleifer (2016) show how humans form stereotypes about groups (of people, industries, etc.) by overemphasizing more representative outcomes of these groups. I apply their model in the context of IPOs to structure how investors form expectations about industries based on underpricing. I expect stereotypes to be particularly relevant in the context of IPOs, as the IPO market is deemed especially sensitive to sentiment (e.g., Helwege and Liang, 2004, Ritter and Welch, 2002). My main finding is that IPOs in industries with higher stereotypical industry underpricing draw higher demand from investors and show higher underpricing.

This paper is the first to look at the role of stereotyping in the IPO market, and one of the first to empirically apply the stereotype model of Bordalo, Coffman, Gennaioli, and Shleifer. There are several reasons why I believe it is of interest. First, while there is a rich literature on IPO underpricing (e.g. Rock (1986), Benveniste and Spindt (1989), Tinic (1988), Ritter (1991), Hughes and Thakor (1992), Brennan and Franks (1997), Stoughton and Zechner (1998), Loughran and Ritter (2002), Purnanandam and Swaminathan (2004) Ljungqvist, Nanda, and Singh(2006)), there have only been a few papers in the IPO literature that explicitly test behavioral models (e.g. Loughran and Ritter (2002), Kaustia and Knüpfer (2008)). The results in this paper challenge the view that underpricing is solely a result of rational deliberations regarding e.g. information asymmetries or risk. Second, the null hypothesis of rational expectations can be explicitly tested, as rational expectations exist as a special case within the stereotype framework.[1] Third, the pricing of securities in the IPO market is crucial for the efficiency with which capital is allocated in the economy. Any irrational behavior that affects pricing, may result in overall welfare loss because positive NPV projects are potentially not undertaken, while negative NPV projects potentially are. Finally, the results provide an explanation for why IPOs in some industries are more 'fashionable' than IPOs in other industries at certain times.

Using data on 5,197 U.S IPOs from 1990 to 2014, I calculate stereotypical

[1]The special case is that of rational expectations as mechanical extrapolation. Under many rational explanations, underpricing is constant over time, or at least, underpricing in the recent past is close to current underpricing. Moreover, taking past underpricing may be a good proxy for expected underpricing in the absence of new information or changes in fundamentals in a rational world.

industry underpricing using the 5 Fama-French industries for each IPO in the sample. In line with the theory by Bordalo, Coffman, Gennaioli, and Shleifer (2016), I define stereotypical industry underpricing as the set of most representative returns within an industry at a particular point in time. I split up the distribution of underpricing in a particular industry into three parts: a low, medium and high first-day return. I calculate representativeness by dividing the probability density of a particular first-day return in the industry of interest by the probability density of that first-day return in other industries. The most representative first-day returns together form the stereotype, the others are discarded. Whether the one, two or three most representative first-day returns end up in the stereotype is estimated empirically. This allows me to test whether the stereotypes are equal to fully rational expectations (the case when all three first-day returns end up in the stereotype), or whether limits to recall are present (the case when only the one or two most representative first-day returns end up in the stereotype).

I first relate IPO underpricing to stereotypical industry underpricing. I find that IPO underpricing is significantly positively related to stereotypical industry underpricing, both economically and statistically; a 1% increase in stereotypical industry underpricing is associated with an increase in IPO underpricing of about 0.32% depending on the specification. This result are robust to the inclusion of a divers set of controls, consisting of firm characteristics, offer characteristics, insider trading, and general market conditions

In each of the regressions, I estimate the limits to recall parameter and test whether I can reject full recall, i.e. the situation in which all parts of the underpricing distribution are taken into account and expectations are fully rational. In each regression full recall is rejected, which implies that stereotypical industry underpricing is significantly different from rational expectations about industry underpricing and that the stereotype narrative is different from a story of underpricing persistence.

To examine whether this effect stems from an increase in demand, I subsequently run regressions with share turnover on the first day of trading as the dependent variable rather than underpricing. I find that share turnover on the first day of trading is also significantly and positively related to stereotypical industry underpricing. A 1 % increase in stereotypical industry underpricing is associated with an increase in IPO underpricing of about 0.30% depending on the specification. For each specification full recall is rejected.

So why do issuers not take full advantage of any excess demand arising from these stereotypes? The work by Ljungqvist, Nanda, and Singh (2006) explains why this may be optimal from an issuer's point of view. Regular (in the sense of repeat involvement in the IPO market) institutional investors to whom shares are allocated in an IPO sell them on to occasionally exuberant investors not involved in the initial allocation. The issuer only *partly* capitalizes on the trading gains of the regular investors, as regular investors need to be compensated for the risk involved with the fact that exuberance is fleeting. Underpricing follows as a result. Cornelli, Goldreich, and Ljungqvist (2006) provide empirical evidence in support of this idea, by showing that small, less sophisticated investors seem to exhibit irrational behavior that is related to increased underpricing and decreased long-run performance.

According to Ljungqvist, Nanda, and Singh's model, there are three additional hurdles to clear for the stereotype hypothesis: first, excess demand generated by stereotypical industry underpricing should also be associated with an increased IPO offer price, as issuers do *partly* capitalize on investor exuberance. To test this implication, I run regressions with the offer price revision as the dependent variable rather than underpricing. I find that stereotypical industry underpricing is also significantly and positively related to price revisions, economically as well as statistically, and that full recall is again rejected.

Second, underpricing generated by stereotypical industry underpricing should be more present around IPOs with little institutional investor ownership post-IPO, given that irrational non–institutional investors are the source of the excess demand in the model. To test this, I split up the sample of IPOs based on institutional ownership post-IPO and rerun the regressions for a sample with high institutional ownership and a sample with low institutional ownership. For the sample with high institutional ownership, I find that there is no consistent effect of stereotypical industry underpricing and that full recall cannot be rejected. For the sample with low institutional ownership, I find stronger effects than for the full sample.

Third, underpricing and price revisions that arise because of excess demand generated by stereotypical industry underpricing should be associated with decreased post-IPO stock performance, as excess demand is fleeting and stock prices are expected to revert to their fundamental value in the long run. To test this implication, I run two-stage least squares regressions of IPO long-run performance on underpricing and price revision, in which I instrument underpricing and price revision by stereotypical industry underpricing. I find that the parts of underpricing and price revision explained by stereotypical industry underpricing positively affect long-run performance over a one year horizon and negatively over a 2 and 3 year horizon, as expected.

In robustness tests, I look at whether in-sample overfitting is driving the results by comparing out-of-sample predictions of the stereotype model versus a fully rational model without limits to recall; I find that the stereotype model produces significantly better predictions. Next, I look at whether the effect is stronger in hot markets than in cold markets and find that the effect is stronger in hot markets, and absent in cold markets. I then look at whether stereotypes are particular to the tech-years 1999 and 2000 and absent in other years, but find the effect of stereotypes to be strong in both. Finally, I look at whether stereotypes are stronger in specific industries, and find that stereotypes are predominantly concentrated in the tech industry and the health industry, and that the effect is absent in the consumer and manufacturing industries.

2.2 Hypothesis Development

Explanations for IPO underpricing have been sought in multiple directions. Ljungqvist (2007) and Ritter and Welch (2002) have each grouped these explanations in different categories: asymmetric information, institutional characteristics, control considerations, and agency and bounded rationality explanations. Asymmetric information theories explain underpricing by showing what dynamics may arise out of different information sets held by the issuer, underwriter and investors (e.g., Benveniste and Spindt, 1989, Rock, 1986). Institutional characteristics theories explain why underpricing may be present as a result of features of the market place, such as litigation risk or limited investor protection (e.g., Tinic, 1988, Hughes and Thakor, 1992). Theories centering around control considerations show how underpricing may be used by the management to influence monitoring by shareholders or to extract private benefits (e.g., Brennan and Franks, 1997, Stoughton and Zechner, 1998). Agency and behavioral theories argue that the behavior of issuers or investors may be influenced by incentive conflicts or by bounded rationality, and that underpricing may arise as a result (e.g., Loughran and Ritter, 2002, Ljungqvist et al., 2006).

While there is evidence that theories on asymmetric information, control considerations and institutional settings partly explain the underpricing puzzle, Ritter and Welch (2002) argue that it is debatable whether these explanations can sufficiently explain the large variation in underpricing across time and industries. Illustrative is the underpricing in the years 1999-2000; in these years underpricing not only jumped up with respect to other years, it also did so unevenly across industries. Ritter and Welch (2002) and Ljungqvist (2007) deem agency and behavioral theories to be promising in explaining such underpricing behavior. However, there are only few behavioral theories tested in the IPO context.

In the behavioral paradigm, investors use shortcuts, often called heuristics, when they need to make quick decisions with only limited cognitive resources (Hirshleifer, 2014). A basic heuristic is classification, in which an investor evaluates the features of the category to which an investment belongs rather than the features of the investment itself. In the context of underpricing, an investor who is judging whether an IPO is likely to have a good first-day return, looks at the category to which the IPO belongs rather than the IPO itself to form expectations about its performance. A likely way in which IPOs are categorized is by industries, as IPOs in the same industry have more in common relative to those in other industries, industry categorizations are widely used in finance practice, and there is ample anecdotal evidence of bounded rational investor behavior along industry lines in the IPO context, e.g. the dot-com bubble.

In setting their demand for an IPO, investors likely form expectations about performance. The most prominent performance measure of IPOs is underpricing; underpricing is eye-catching as it produces large returns in absolute terms over a short time-span, it is often reported on in news articles (see e.g., Financial Times, 2014, 2015b,a, 2016), and it has a large influence on other performance measures such as holding period returns. Moreover, Kaustia and Knüpfer (2008) show that retail investors determine their demand for upcoming IPOs based on underpricing of past IPOs.

In line with Bordalo, Coffman, Gennaioli, and Shleifer's theory, I form stereotypical industry underpricing based on the most representative parts of the recent underpricing distribution of IPOs in a particular industry relative to the recent underpricing distribution of IPOs in other industries. These stereotypes are not necessarily accurate, in that the most representative parts of the distribution are not necessarily the most likely parts. However, they contain *stereotypical* past IPO performance and are in that way hypothesized to drive future industry demand.

To illustrate how stereotypes about IPOs may work, consider the following stylized example regarding tech IPOs. Assume that an IPO may have either a low, medium or high first-day return [2], and that the distributions of past first-day returns are given in Table 2.1 below.

[2] I use underpricing and first-day returns interchangeably.

Table 2.1. Stylized stereotypical first-day returns.

This table shows stylized probability density distributions of IPO first-day returns of Tech IPOs and Other IPOs. Representativeness is calculated by dividing the probability densities of Tech IPOs by the probability densities of non-tech IPOs. The most representative first-day returns form the stereotype.

First-day return	Low	Medium	High
Tech IPOs	35%	45%	20%
Other IPOs	20%	70%	10%
Representativeness	1.75	0.64	2.00

The rows labeled ‘Tech IPOs’ and ‘Other IPOs’ contain the distribution of first-day returns of tech IPOs and the distribution of first-day returns of non-tech IPOs, respectively. The last row of the table contains the representativeness of each return, calculated by dividing the probability density of tech IPOs by the probability density of non-tech IPOs. The last row shows that the high first-day return is the most representative first-day return for tech IPOs. For the purpose of this example, assume investors suffer from limited recall, and are only able to recall the most representative return for tech-IPOs: the high return. However, only about 20% of tech IPOs have high first-day returns; the bulk of the tech IPOs has medium sized first-day returns. Moreover, closer inspection shows that on average tech IPOs do not have higher returns, but rather *lower* returns.[3] Thus, in this example tech IPOs are stereotypically IPOs with high first-day returns, but the stereotype is inaccurate.

Such stereotypes may influence demand for IPOs in a particular industry. As the expected first-day return of tech IPOs is lower than the expected first-

[3]Here, low and high first-day returns are equally distant from the medium first-day return, i.e. $|R_{low} - R_{med}| = R_{high} - R_{med}$

day return of other IPOs, there should be no reason to *rationally* prefer tech IPOs over other IPOs. Rather, demand for other IPOs should be higher than demand for tech IPOs. However, if investors form stereotypes, investors will only focus on the most representative parts of the first-day return distribution and will prefer tech IPOs over other IPOs, depending on the severity of the limits to recall. In that case, stereotypes may generate excess demand for tech IPOs, resulting in higher underpricing for those IPOs.

In this framework, investors suffer to a varying degree from limits to what they can recall about recent underpricing. If limits to recall are present, expectations formed by investors incorporate only the most representative first-day returns, as these are easier to recall, and discard the least presentative first-day returns. Expectations formed in this way are not rational, in that they consist only of a selection of all relevant information. If limits to recall are not present, investors do recall the whole first-day return distribution and the expectations they form do take into account all information; in that special case the expectations can be said to be rational. The fact that rational expectations are nested in the stereotype framework, allows for the testing of the presence of limits to recall.

Representativeness is closely related to salience as in Bordalo, Gennaioli, and Shleifer (2013) in that often the most representative attributes are also the most salient. However, the concepts work through slightly different mechanics. While salience describes how attention is allocated between attributes *that are already in mind*, representativeness accounts for which attributes *come to mind* in the first place. Moreover, while the salience of an attribute is determined by how much it differs from other attributes, the representativeness of an attribute is determined by how frequently it is encountered relative to other attributes. So it could be that an industry has a high first-day return that is much larger than the other first-day returns (very salient), but that the high first-day return is just as frequent as a medium or low first-day return (not representative). In such a situation, a high return for that industry would be salient but not stereotypical.

The accuracy of stereotypes about IPO underpricing is determined by the extent to which returns that are objectively most likely are included in the stereotype. If the most representative returns of an industry are its least likely returns, then the stereotype formed on these most representative returns is inaccurate. If the most representative returns of an industry are its most likely returns, the stereotype is more accurate. In the case of full recall the stereotype is fully accurate in that it takes into account all information.

In the case that there are limits to recall, stereotypes may produce time- and industry-varying base rate neglect and confirmation bias. In the light of IPO pricing, base rate neglect may be an important driver of underpricing in that it dictates that investors may tend to act on specific information (up-side potential of IPOs in an industry at a certain time) while neglecting general information about IPO performance (average riskiness); confirmation bias may be important as well, as investors may tend to stick to their original judgments even when given new information contradicting these judgments.

As stereotypes may influence expectations investors hold about IPO performance, they may increase demand for IPOs in industries with stereotypically high underpricing and decrease demand for IPOs in industries with stereotypically low underpricing. As demand is positively related to underpricing and IPO supply is inelastic, stereotypical industry underpricing may positively affect underpricing in future IPOs. Hence I hypothesize that:

H1: Stereotypical industry underpricing is positively related to underpricing

Similarly, if stereotypical industry underpricing affects demand, then it should also be positively related to a demand proxy such as share turnover on the first-trading day. Hence I hypothesize that:

H2: Stereotypical industry underpricing is positively related to demand as proxied by share turnover on the first-trading day.

If these hypotheses hold, a new question arises: how come that issuers do not take advantage of situations in which there is excess demand, by adjusting offer prices such that any excess demand is taken advantage of? Ljungqvist, Nanda, and Singh (2006) explain why issuers may choose not to *fully* take advantage of excess demand. In their model, there are two type of investors. The first type of investors is an institutional investor that buys IPO stocks directly from the issuer against the offer price. This type of investor is a regular investor, in the sense that he or she is repeatedly involved in the IPO market. The second type of investors is a retail investor who can only obtain IPO stock by buying it from the regulars after the initial offering has taken place. This second type of investor is occasionally exuberant about IPOs, but his or her exuberance may disappear relatively quickly. The regular investors obtain trading gains by buying stocks at the IPO offer price, and selling these on to the exuberant retail investors who offer them prices above the offer price.

Ljungqvist, Nanda, and Singh (2006) show that it is optimal for issuers to only *partly* capitalize on these trading gains, as the regular investors need to be compensated for the risk involved with the fact that the exuberance of the retail investors is fleeting. The regular investors run the risk of ending up with expensive shares in their inventory for which there is little demand. As the issuers only partly capitalize on the excess demand, underpricing follows.

Ljungqvist, Nanda, and Singh's (2006) model contains three additional testable predictions. First, the model implies that issuers do *partly* capitalize on excess demand by adjusting offer prices. Hence I expect the following hypothesis to hold:

H3: Stereotypical industry underpricing is positively related to price revisions

Second, according to the model, any excess demand is generated by retail non-institutional investors. Thus, the effect of stereotypical industry underpricing should be stronger for IPOs with little institutional investor ownership post-IPO and should be weaker for IPOs with much institutional ownership post-IPO. Hence I expect the following hypothesis to hold:

H4: The effect of stereotypical industry underpricing on underpricing is stronger for IPOs with less institutional ownership and weaker for IPOs with more institutional ownership.

Third, according to the model, any excess demand is fleeting and stock prices are expected to revert to their fundamental value in the long run. Hence I expect the following hypothesis to hold:

H5: Stereotypical industry underpricing is negatively associated with long-run stock performance.

2.3 Data and Methods

I obtain data on all U.S. IPOs for the period from 1990 until 2014. I obtain IPO dates, SIC codes, offer prices, price revisions, and IPO related control variables from SDC and age data from the Field-Ritter dataset of company founding dates accessed via Jay Ritter's website [4]. I remove all non-main tranches, and all firms that had more than one IPO in the sample, had SIC codes 49 or 60 (financial firms and utilities), or did not offer primary shares.

Subsequently I obtain return data, delisting returns and trading volume for all domestic common non-penny stock in the CRSP universe. I remove all IPOs that did not have a match in CRSP. In the merged data, I compare all IPO dates from SDC with the dates at which CRSP coverage begins and remove all IPOs for which these do not match.

Finally, I download market returns from CRSP. I take industry definitions from Kenneth French's website. My final sample consists of 5197 IPOs.

2.3.1 Underpricing

To calculate the underpricing (UP_{i,j,t_i}) of a particular IPO i in industry j at time t_i, I follow the literature (e.g., Ritter and Welch, 2002) and compute the return between the offer price (P_{offer},from SDC) and the first-day closing price (P_{close}, from CRSP):

$$UP_{i,j,t_i} = \frac{P_{i,j,t_i,close} - P_{i,j,t_i,offer}}{P_{i,j,t_i,offer}} \tag{2.1}$$

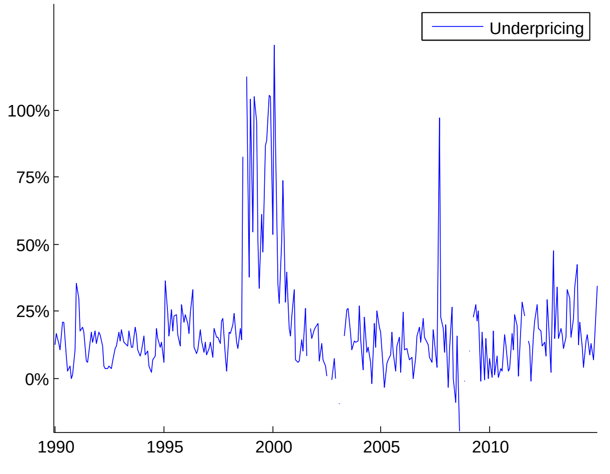
Table 2.2 shows summary statistics of underpricing. It contains the annual number of IPOs, the annual mean and median underpricing, and the annual standard deviation of underpricing. The number of IPOs fluctuates strongly over time, peaking in the mid-nineties and hitting the bottom in 2008. The mean level of underpricing also fluctuates strongly over time, peaking in the years 1999 and 2000 and hitting the bottom in 2008. This large variation is illustrated in Figure 2.1; this figure shows the monthly average underpricing

[4] https://site.warrington.ufl.edu/ritter/ipo-data/. This website also contains corrections to the SDC data, which I apply.

of all IPOs for the period from 1990 until 2014; a value of '1', implies a 100% increase in the stock price on the first day of trading. The 'dot-com' years immediately catch the attention by the huge average underpricing that exceeded 100% in multiple months. In comparison, the fluctuation in underpricing in other years may seem small, though this is a bit misleading. For instance, in the year 1994 underpricing was modest with underpricing only slightly above 0%, while in the year 1995 underpricing approached 40%.

Figure 2.1. Average underpricing per month over the period 1990-2014.

This figure shows the average underpricing per month in the U.S. over the period 1990-2014. The y-axis shows the levels of underpricing, where a value of 100% implies a first-day return of 100%; the x-axis shows the time. Underpricing is calculated as the return from the IPO offer price to the closing price on the first day of trading. Data on IPOs is obtained from SDC; first day closing prices are obtained from CRSP.



There is also substantial time variation in cross-industry dispersion in underpricing. This can be seen in Figure 2.2. The figure shows the difference in average underpricing between the five Fama-French industries (Manufacturing, Consumer, High-Tech, Health and Other) for the years 1990 until 2014. Depending on the year, the dispersion varies greatly. In the dot-com years

Table 2.2. Summary statistics of underpricing

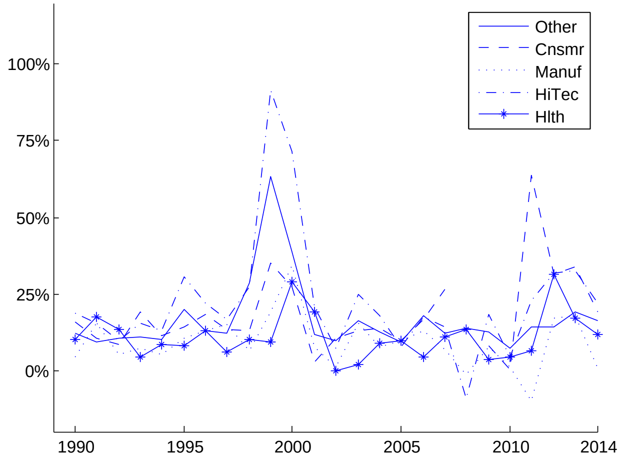
This table reports the number of IPOs, the average underpricing , the median underpricing and the standard deviation of underpricing by year of U.S. IPOs in the period from 1990 until 2014. Underpricing is calculated as the return from the IPO offer price to the closing price on the first day of trading. Data on IPOs are obtained from SDC; first day closing prices are obtained from CRSP.

Year	N_{IPOs}	mean(%)	median(%)	st.dev.(%)
1990	124	12.3	6.7	17.3
1991	290	13.5	8.3	18.7
1992	414	9.7	3.6	18.9
1993	521	13.3	6.3	22.0
1994	404	10.2	5.0	18.7
1995	425	21.2	12.5	28.0
1996	601	17.1	10.6	25.2
1997	378	13.6	9.3	20.1
1998	216	22.5	10.7	53.2
1999	382	73.4	42.6	95.2
2000	290	58.1	28.7	79.3
2001	51	14.2	13.5	15.9
2002	49	7.3	2.7	17.1
2003	52	14.9	13.9	15.0
2004	136	12.4	7.4	17.7
2005	124	9.1	5.5	14.3
2006	121	13.7	9.1	21.7
2007	119	13.5	7.6	23.1
2008	16	6.5	-2.1	21.2
2009	32	11.0	5.7	17.0
2010	75	6.6	2.0	14.3
2011	62	14.2	15.0	18.6
2012	85	17.7	10.9	23.9
2013	112	21.1	13.1	29.2
2014	133	15.9	7.2	30.5

1999 and 2000, tech IPOs had an average underpricing of 82% while health related IPOs had an average underpricing of 'only' 24%. In the year 1992, health related IPOs had an average underpricing of 13% while manufacturing related IPOs had a not so different average underpricing of 5%. In sum, there is much variation to explain.

Figure 2.2. Average underpricing per industry per year over the period 1990-2014.

This figure shows the average underpricing per industry per year in the U.S. over the period 1990-2014. The 5 Fama-French industries are used to categorize IPOs. The y-axis shows the levels of underpricing; the x-axis shows the years. Underpricing is calculated as the return from the IPO offer price to the closing price on the first day of trading. Data on IPOs is obtained from SDC; first day closing prices are obtained from CRSP.



2.3.2 Stereotypes

Stereotypical industry underpricing is formed based on underpricing in the industry j relative to underpricing in other industries $-j$. At each particular IPO i in j at time t_i, the first-day returns of all individual IPOs in j in the prior year are grouped together and form a distribution. The same holds for the first-day returns of all individual IPOs not in j in the prior year, which form the distribution of the contrast group. Similar to the example of Table I, the distribution of underpricing is cut up into three quantiles based on the distribution of the contrast group; this yields a 'low','medium', and 'high' return.

The choice for three quantiles is partly dictated by the data. To be able to calculate representativeness of the quantiles of the distribution reliably, a sufficient number of observations per quantile is required. So while more quantiles may make a stereotype more sophisticated, it also leaves fewer observations per quantile, making the estimates of the representativeness of the quantiles more noisy. This in turn would make stereotypes with more severe limits to recall more noisy relative to stereotypes with less severe limits to recall, and would bias against finding evidence in favor of stereotypes. Another reason for the choice of three quantiles is that it is simple and intuitive and may better fit real world stereotyping.

For each quantile q, its representativeness for the IPOs in industry j at time t_i is calculated as:

$$REP(q, j, t_i) = \frac{P(UP_{k,j,t_k} \in q | t_i - 250 < t_k < t_i - 1)}{P(UP_{k,-j,t_k} \in q | t_i - 250 < t_k < t_i - 1)} \tag{2.2}$$

Due to limits to recall, only the d most representative quantiles are recalled when an investor forms expectations about industry underpricing; these d quantiles end up in the stereotype about industry j. In case $d = 1$ this can be more formally written as:

$$ST_{j,t_i,d} = \begin{cases} \overline{UP}_{k,j,t_k|k\in q_1, t_i-250<t_k<t_i-1} & \text{if } argmax_q(REP(q,j,t_i)) == 1 \\ \overline{UP}_{k,j,t_k|k\in q_2, t_i-250<t_k<t_i-1} & \text{if } argmax_q(REP(q,j,t_i)) == 2 \\ \overline{UP}_{k,j,t_k|k\in q_3, t_i-250<t_k<t_i-1} & \text{if } argmax_q(REP(q,j,t_i)) == 3 \end{cases} \tag{2.3}$$

Here, $\overline{UP}_{k,j,t_k|k\in q, t_i-250<t_k<t_i-1}$ equals the average over all underpricing within quantile q of industry j over the past year with respect to time t_i. So, if for example the right tail of the underpricing distribution of industry j is most representative, the most representative quantile will be q_3, ST_{j,t_i} will be equal to the average underpricing in quantile 3, and underpricing will stereotypically be high.

In case $d = 2$, the two most representative quantiles end up in the stereotype:

$$ST_{j,t_i,d} = \begin{cases} \overline{UP}_{k,j,t_k|k\in q_1\cup q_2, t_i-250<t_k<t_i-1} & \text{if } argmax_q(REP(q,j,t_i)) == 1,2 \\ \overline{UP}_{k,j,t_k|k\in q_1\cup q_3, t_i-250<t_k<t_i-1} & \text{if } argmax_q(REP(q,j,t_i)) == 1,3 \\ \overline{UP}_{k,j,t_k|k\in q_2\cup q_3, t_i-250<t_k<t_i-1} & \text{if } argmax_q(REP(q,j,t_i)) == 2,3 \end{cases} \tag{2.4}$$

In case $d = 3$, all quantiles end up in the stereotype, and stereotypical industry underpricing collapses to average industry underpricing:

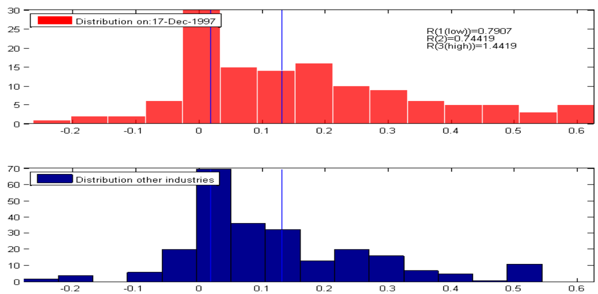
$$ST_{j,t_i,d} = \overline{UP}_{k,j,t_k|t_i-250<t_k<t_i-1} \tag{2.5}$$

Stereotype creates time-varying cross-industry dispersion in expectations about underpricing and with that in demand for IPOs. It has the potential to contribute to explaining why underpricing at a certain time is much higher in

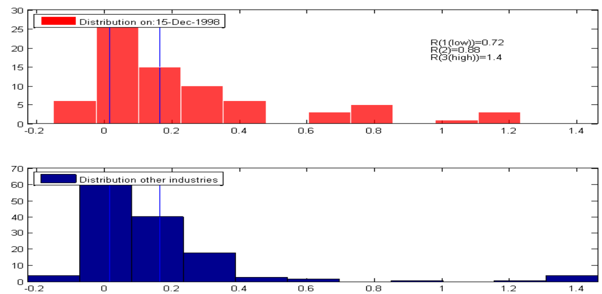
IPOs in some industries rather than in IPOs in others. How stereotypes may change over time is illustrated by looking at the distributions of tech IPOs versus non-tech IPOs, and how the resulting representativeness of the terciles changes over time. The 'dot-com' years 1999 and 2000 may be particularly interesting to look at; as can be seen in Figure 2.2 the average underpricing per industry diverged pronouncedly during that episode. Figure 2.3a shows the distribution of Tech IPOs (top, in red) and the distribution of IPOs in other industries (bottom, in blue) at the end of 1997. The blue lines indicate the percentiles that cut up the underpricing distributions into terciles, based on the distribution of underpricing of IPOs in the non-tech industries. For each tercile, the representativeness for recent IPOs of each underpricing quantile is calculated; the results are on the right in the top histogram. This figure shows that at the end of 1997, the high and the low returns are most representative for tech IPOs; in other words, tech IPOs are stereotypically risky.

Figure 2.3. Histograms of underpricing in the tech industry versus histograms of underpricing in other industries, at different points in time.

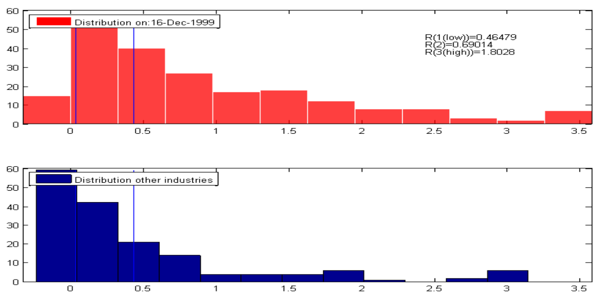
This figure contains 4 panels that each show the histogram of IPO underpricing in the tech industry (at the top of each panel in red) and the histogram of IPO underpricing in other industries (at the bottom of each panel in blue) at a specific moment in time. Within each panel, the y-axis shows the number of IPOs; the x-axis shows the level of underpricing where a level of 0.1 implies an underpricing of 10%. The vertical lines denote terciles, calculated on the bottom histogram of each panel, that divide the top histogram into a low, medium and high return. The numbers in the top right corner of each panel denote the representativeness of each return for IPOs in the tech industry. The 5 Fama-French industries are used to categorize IPOs into industries. Underpricing is calculated as the return from the IPO offer price to the closing price on the first day of trading. Data on IPOs is obtained from SDC; first day closing prices are obtained from CRSP.



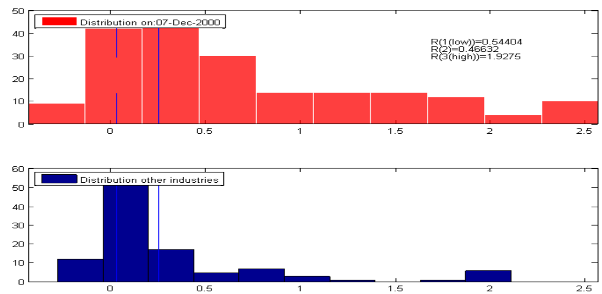
(a) Histograms at the end of 1997



(b) Histograms at the end of 1998



(c) Histograms at the end of 1999



(d) Histograms at the end of 2000

When progressing through time, the stereotype shifts. Figure 2.3b shows that by the end of 1998 the right tail of the distribution of underpricing in tech IPOs is still most representative, and that the middle of the road return has become more representative than the low return. Now, tech IPOs are stereotypically less risky and on top of that still have high returns. The new stereotype for tech IPOs becomes even more pronounced by the end of 1999 (Figure 2.3c), before the stereotype changes again in 2000 (Figure 2.3d): while the extreme right tail is still most representative at the end of 2000, the low return has become more representative than the middle of the road return. Tech IPOs are stereotypically risky again.

This example illustrates how stereotypes about underpricing change over time. Investors who suffer from limits to recall, may form their expectations about industry underpricing using these stereotypes and set their demand for future IPOs accordingly.

2.3.3 Long-run performance

Long-run performance for IPO i and industry j is calculated (similar to e.g., Ritter, 1991) as the annualized buy and hold return from the IPO date t_i up until time t_i+h, where h refers to the horizon over which long-run performance is evaluated:

$$LRP_{i,j,t_i} = \frac{\prod_{s=t_i}^{t_i+h}(1+r_{i,j,s})}{h+1} \times 250 \tag{2.6}$$

Here $r_{i,j,s}$ is the return of firm i in industry j at time s. In case a firm delists in the horizon over which long-run performance is calculated, I include the delisting return in my calculations. When a delisting is related to performance and the delisting return is missing, I set the delisting return to -55% as is advised by Shumway and Warther (1999). I use raw returns rather than log-returns and correspondingly the product rather than the sum, as IPO (first-day) returns may sometimes be too large to let the approximate equality $log(1 + r) = r$ hold. I divide the returns by the horizon over which they are calculated, to allow for easy comparison across horizons. I multiply these average daily returns by 250 to allow them to be interpreted as annualized returns.

To correct for general market movements, I create measures of long-run performance in excess of the CRSP equal weighted market returns. I use the equal weighted market portfolio rather than the value weighted market portfolio as it gives more weight to small stocks. The excess long-run performance for IPO i in industry j at time t_i with respect to benchmark the equal weighted market portfolio is calculated as:

$$LRP_{i,j,t_i,EW} = LRP_{i,j,t_i} - \frac{\prod_{s=t_i}^{t_i+h}(1 + r_{EW,s})}{h + 1} \times 250 \tag{2.7}$$

2.3.4 Turnover, price revision and controls

Following Krigman, Shaw, and Womack (1999), I calculate share turnover of IPO i in industry j on its first trading day t_i as the volume of shares traded (VOL_{i,j,t_i}) divided by the number of shares issued ($ShIss_{i,j,t_i}$):

$$Turnover_{i,j,t_i} = \frac{VOL_{i,j,t_i}}{ShIss_{i,j,t_i}} \tag{2.8}$$

I use the number of shares issued rather than the number of shares outstanding after the offering, as done in Krigman et al. (1999). The issued shares are traded at least once on the first day, and can be traded without problem, whereas the other shares are not necessarily available for trade, for example due to a lock-up agreement, or out of control considerations. As the fraction of shares that are retained by original owners for these purposes varies from IPO to IPO, the number of shares outstanding is not a great scaling factor. The turnover variable can be interpreted as the average number of times an issued share is traded on the first trading day.

Following e.g., Loughran and McDonald (2013), I calculate price revision of an IPO as the relative change from the original middle of the filing price range ($MFile_{i,j,t_i}$) to the eventual offer price ($P_{i,j,t_i,offer}$):

$$PrcRev_{i,j,t_i} = \frac{P_{i,j,t_i,offer} - MFile_{i,j,t_i}}{MFile_{i,j,t_i}} \tag{2.9}$$

This variable can be interpreted as the increase in the offer price during the bookbuilding process.

The rich literature on underpricing has identified multiple variables that may affect underpricing. One important class of control variables is the class of ex-ante risk factors, which play a role in asymmetric information models, principal-agent models, and signaling models. More risky firms tend to require higher underpricing. There are multiple characteristics that may proxy for ex-ante risk; I use firm age (Loughran and Ritter, 2004; Ljungqvist and Wilhelm, 2003) from the Field-Ritter dataset of company founding dates, and firm size (Ritter, 1984), industry (e.g. Benveniste, Ljungqvist, Wilhelm, and Yu, 2003), the price-to-book ratio and the offer size from SDC.

Following Ljungqvist and Wilhelm (2003), I construct a dummy for the primary use of proceeds being operating expenses from data on use of proceeds from SDC; firms burning cash at a high rate may be riskier, requiring higher underpricing. I construct a dummy for high underwriter reputation (Carter and Manaster, 1990) from data on underwriters from SDC that equals one for IPOs in which the underwriter is in the top 20 of underwriters in terms of the number of IPOs underwritten. The involvement of high reputation underwriters may be an indication of quality and reduce underpricing, or it may indicate increased placement power and boost demand, increasing underpricing. Similarly, I include a dummy for venture capital involvement which may signal quality and reduce risk, potentially also reducing underpricing (Megginson and Weiss, 1991, Barry et al., 1990). Finally I include a dummy that indicates the presence of a syndicate managing the offer rather than a single underwriter, which may improve information production and reduce underpricing (Corwin and Schultz, 2005).

I control for the change in insider holdings (Spiess and Pettway, 1997), the participation ratio (the fraction of secondary shares offered relative to the pre-IPO shares outstanding) and the dilution factor (the fraction of primary shares offered relative to the pre-IPO shares outstanding), which all play a role in principal-agent models. I expect them to reduce underpricing, as more insider selling and more potential dilution will increase incentives to monitor pricing, reducing underpricing (Habib and Ljungqvist, 2001).

To proxy for supply side effects on pricing, I include the logarithm of the number of IPOs over the last year up to the date of the IPO; a large supply of IPOs may absorb demand and reduce underpricing. I control for average recent underpricing to account for the evidence that IPOs come in waves (Helwege and Liang (2004), Pastor and Veronesi (2005)) and that these waves have a dominant effect on underpricing, to account for any potential confounder that co-varies with the average level of underpricing, and to allow the stereotype variable to explain why underpricing is higher in some industries at certain times than in others. Finally, I include industry dummies as there may be differences in average underpricing between industries. These differences may arise because some industries have riskier future cash flows than others, or because some industries are more prone to informational frictions.

2.3.5 Methods

I estimate the relation between stereotypes and underpricing using a set-up with controls and industry dummies:

$$UP_{i,j,t_i} = ST_{j,t_i,d} + C_{i,t_i} + UP_{\mu,t_i} + \log(N_{IPOs}) + D_j + \epsilon_{i,t_i} \quad (2.10)$$

Here UP_{i,j,t_i} is the observed underpricing of IPO i in industry j that takes place at time t_i; $ST_{j,t_i,d}$ is the stereotypical underpricing of industry j at time t_i with recall parameter d; C_{i,t_i} is the set of firm specific control variables; $\log(N_{IPOs})$ is the logarithm of the number of IPOs over the year prior to time t_i; UP_{μ,t_i} is the average level of underpricing over the year prior to time t_i; and D_j are industry dummies. I cluster the errors by industry, as error terms may be correlated within industries because of industry specific trends or developments.

To investigate to what extent the stereotypes formed on past underpricing suffer from limited recall, I estimate the above regression with stereotypes allowing for different values for the limits-to-recall parameter d. If $d \neq 3$, I test whether it is significantly different from $d = 3$ using a likelihood ratio test.

2.3.6 Remarks on endogeneity

The theory of stereotypes imposes substantial structure on how investors form expectations based on recent underpricing. In the IPO context, the theory allows for little room to mitigate potential endogeneity concerns by exploiting an exogenous shock. However, there are strong arguments why stereotypical industry underpricing is not endogenous to current firm underpricing. First, simultaneity as a source of endogeneity is unlikely to be an issue here. Stereotypical industry underpricing and current firm underpricing are not determined in equilibrium; stereotypical industry underpricing is a function of recent underpricing and is known *before* firm underpricing of the upcoming IPO is realized.

Second, any measurement error is likely to either be absorbed by the controls or to bias regressions against finding a result. Stereotypical industry underpricing is a function of recent underpricing. If there is some structural time-varying measurement error in underpricing that might cause a spurious relation between stereotypical industry underpricing, it would be absorbed by the variable concerning the average level of recent underpricing that is included in each regression. In case there is random measurement error, this may bias against finding a positive relation rather than the opposite.

Third, omitted variable bias is unlikely to be a source of endogeneity. The industry dummies take care of any omitted industry specific effect, the average level of recent underpricing absorbs any time-varying omitted variables that affect overall underpricing, and the host of control variables proxy for the most prominent alternative explanations from the literature. Moreover, stereotypical industry underpricing changes non-linearly when representativeness has shifted enough for a different part of the underpricing distribution to enter the stereotype. These changes are particular to stereotypes and are arguably unlikely to be correlated to any omitted variable.

2.4 Results

2.4.1 Underpricing

To investigate the effect of stereotypical industry underpricing on firm underpricing, I run regressions of firm underpricing on stereotypes, controls, and general market conditions with errors clustered by industry. The results are in table 2.3. Specification (1) shows that stereotypical industry underpricing is significantly positively related to firm underpricing when controlling for firm characteristics and general market conditions. The economic effect is large: a 1% increase in stereotypical industry underpricing is associated with an increase in underpricing of 0.32%; alternatively, a 1 standard deviation increase in stereotypical industry underpricing is accompanied by an increase in underpricing of 0.21 standard deviations. The limit to recall parameter d equals 2; the likelihood-ratio test indicates that d is significantly different from the null hypothesis of d equal to 3.

These results indicate that stereotypical industry underpricing is strongly associated with underpricing of IPOs within that industry. The test on the limits to recall parameter indicates that these stereotypes are significantly different from rational expectations formed on recent industry underpricing. Both findings combined support the idea that investors use stereotypes in forming their expectations about industry underpricing and that they only focus on the most representative parts of the underpricing distribution within the industry, rather than the whole distribution.

The firm characteristics show that younger firms tend to suffer significantly more underpricing than older firms, and is in line with findings by Loughran and Ritter (2004) and Ljungqvist and Wilhelm (2003), while firm size and the price to book value per share do not seem to affect underpricing.

Table 2.3. Regressions of underpricing on stereotypical industry underpricing.

This table contains the results of non-linear least squares regressions of IPO underpricing on stereotypical industry underpricing. Underpricing of IPO i in industry j at time t_i, UP_{i,j,t_i}, is calculated as the return from the IPO offer price (from SDC) to the closing price on the first day of trading (from CRSP). Stereotypical industry underpricing of industry j at time t_i is the average of the d most representative terciles of the distribution of recent underpricing of industry j. The parameter d is the limits-to-recall parameter that determines how much of the full underpricing distribution of industry j is incorporated into the stereotype about industry underpricing. Other independent variables cover firm characteristics, offer characteristics, insider selling and general conditions. Variable defintions are in the appendix. Each regression includes 2-digit SIC code dummies. The last row contains the results of likelihood-ratio tests of the null-hypothesis that d equals 3. Significance at the 10%, 5% and 1% is indicated by *,**, and *** respectively, based on standard errors clustered by 2-digit SIC codes.

Dependent variable	UP_{i,j,t_i}					
	(1)	(2)	(3)	(4)	(5)	(6)
$ST_{j,t_i,d}$	0.315***	0.370***	0.336***	0.359***		0.383***
Firm Characteristics						
Age	-0.002***				-0.001***	-0.001***
log(Total Assets)	0.005				-0.027**	-0.027***
Price/Book Value Per Share	0.000				0.000	0.000
Offer Characteristics						
$D_{High\ Rep\ Underwriter}$		0.052**			0.037*	0.041*
$D_{Use\ Of\ Proceeds=OPEX}$		-0.105			-0.044	-0.061
Gross Proceeds		0.032*			0.065**	0.077***
$D_{Venture\ Backed}$			0.096***		0.042***	0.040**
$D_{Syndicated}$			-0.050**		-0.072***	-0.088***
Insider Selling						
Change Insider Stake				0.001	0.000	0.000
Dilution Factor				-0.003	0.000***	0.000
Participation Ratio				-0.063*	-0.004	-0.002
General Conditions						
$\log(N_{IPOs})$	-0.140***	-0.105***	-0.125***	-0.130***	-0.034***	-0.149***
UP_{μ,t_i}	0.461***	0.404***	0.478***	0.207***	0.480***	-0.003
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	2,372	3,652	3,718	2,252	2,068	1,860
R^2	0.15	0.16	0.15	0.11	0.12	0.17
d	2	2	2	2	NA	2
LR-test (H0: d equals 3)	5.06**	13.02***	9.40***	4.99**	NA	8.48***

In specification (2) and (3), offer characteristics are included as controls. These specifications show that a reputable underwriter increases underpricing, in line with findings by Loughran and Ritter (2004), and support the idea that IPOs with a reputable underwriter have a larger investor pool to tap from and reach more potential demand. Gross proceeds are also positively related to underpricing in line with findings by Loughran and Ritter (2004), as raising larger sums of money from investors may require steeper discounts to get the marginal investors across the line. The primary use of proceeds being operating expenditures does not have a significant effect, contrary to the idea put forward by Ljungqvist and Wilhelm (2003) that these firms are ex-ante more risky. Venture backing of an IPO seems to positively affect IPO underpricing, which goes against the idea that venture capital involvement signals quality and reduces risk (Megginson and Weiss, 1991, Barry et al., 1990). Finally, syndication seems to negatively affect underpricing in line with the idea that it improves information production and thus lowers underpricing, as found by Corwin and Schultz (2005).

In specification (4), insider selling variables are included as controls. The participation ratio negatively affects underpricing, in line with the idea that pre-IPO shareholders with a larger stake in the game will bargain harder about pricing and thus reduce underpricing, as predicted by Habib and Ljungqvist (2001). The change in insider holdings and the dilution factor do not seem to affect underpricing, which goes against previous findings in Ljungqvist and Wilhelm (2003) and Spiess and Pettway (1997) obtained on specific subsamples.

General market conditions are included in each of the specifications (1-4). The logarithm of the number of IPOs in the past year is indeed strongly negatively related to underpricing, in line with the idea that a large supply of IPOs implies that less investor demand remains unfulfilled, decreasing underpricing. The average underpricing over the recent year is strongly positively related to current underpricing, in line with the findings that there is persistence in underpricing (e.g., Helwege and Liang, 2004, Pastor and Veronesi, 2005).

In specification (5), all controls are included without stereotypical industry underpricing. Firm size is now negatively related to firm underpricing, in line with the idea that larger firms are less opaque and easier to price, reducing ex-ante risk. The participation ratio is not significant anymore; the dilution factor seems to be positively and significantly related to underpricing, contrary to expectations, but this effect disappears again in specification (6). Interesting to note in specification (5) is the strong reduction in the effect of the number of IPOs when stereotypical industry underpricing is not included. This may occur in a situation in which demand is not adequately proxied for; it points at the demand side channel through which stereotypical industry underpricing has its effect.

Finally, in specification (6) all controls are included. In each of the above specifications, the effect of stereotypical industry underpricing remains stable; the limits-to-recall parameter d consistently and significantly indicates the presence of limits to recall. All in all, stereotypical industry underpricing seems to offer an explanation for firm underpricing that is complementary to existing explanations in the literature.

Summing up, stereotypical industry underpricing is significantly positively related to IPO underpricing, both economically as well as statistically, and is significantly different from rational expectations about industry underpricing.

This effect is unchanged when controlling for other explanations from the literature. These findings confirm hypothesis H1 and suggest that underpricing is partly explained by boundedly rational demand side factors.

2.4.2 Turnover

To test hypothesis H2 that stereotypical industry underpricing indeed affects underpricing via an increase in demand, I run regressions with turnover on the first trading day as dependent variable; each of these regressions again includes various controls, and has errors clustered by industry. Specification (1) of table 2.4 shows that stereotypical industry underpricing is significantly positively related to turnover when controlling for firm characteristics and general market conditions. The limits-to-recall parameter d equals 2, which implies that again limits to recall are present. The economic effect of stereotypical industry underpricing is substantial: a 1 standard deviation increase results in a 0.12 standard deviations increase in turnover. These findings support the idea that demand is positively related to industry stereotypes.

To account for potentially confounding factors, I add the offer characteristics and insider selling variables to the regressions in the specifications (2-4) and (6). None of the controls significantly affect the relation between stereotypical industry underpricing and turnover. Interestingly, specification (6) shows that most of the variables that are significant in the underpricing regressions are also significant and have the same sign in the turnover regressions. The determinants of firm underpricing are similar to the determinants of turnover, suggesting that firm underpricing and demand are intimately linked. All in all, these results are in line with hypothesis H2 and show that demand is strongly positively related to stereotypical industry underpricing.

Table 2.4. Regressions of turnover on stereotypical industry underpricing.

This table contains the results of non-linear least squares regressions of share turnover on the first trading day on stereotypical industry underpricing. First-day share turnover of IPO i in industry j at time t_i, Turnover$_{i,j,t_i}$, is calculated by dividing the volume of shares traded on the first trading day (from CRSP) by the number of shares issued at the IPO (from SDC). Stereotypical industry underpricing of industry j at time t_i is the average of the d most representative terciles of the distribution of recent underpricing of industry j. The parameter d is the limits-to-recall parameter that determines how much of the full underpricing distribution of industry j is incorporated into the stereotype about industry underpricing. Other independent variables cover firm characteristics, offer characteristics, insider selling and general conditions. Variable defintions are in the appendix. Each regression includes 2-digit SIC code dummies. The last row contains the results of likelihood-ratio tests of the null-hypothesis that d equals 3. Significance at the 10%, 5% and 1% is indicated by *,**, and *** respectively, based on standard errors clustered by 2-digit SIC codes.

Dependent variable	$Turnover_{i,j,t_i}$					
	(1)	(2)	(3)	(4)	(5)	(6)
$ST_{j,t_i,d}$	0.272***	0.331***	0.284***	0.320**		0.286***
Firm Characteristics						
Age	-0.004***				-0.001	-0.002***
log(Total Assets)	0.043***				-0.040*	-0.054***
Price/Book Value Per Share	0.000				0.000	0.000
Offer Characteristics						
$D_{High\ Rep\ Underwriter}$		0.184***			0.134***	0.127***
$D_{Use\ Of\ Proceeds=OPEX}$		0.009			-0.023	0.011
Gross Proceeds		0.088***			0.161***	0.205***
$D_{Venture\ Backed}$			0.203***		0.092***	0.098***
$D_{Syndicated}$			0.187***		0.072	0.046
Insider Selling						
Change Insider Stake				0.001	0.000	0.000
Dilution Factor				-0.022*	0.000***	0.000
Participation Ratio				0.255***	-0.015	-0.018
General Conditions						
log(N_{IPOs})	-0.309***	-0.217***	-0.262***	-0.325***	-0.082**	-0.305***
UP_{μ,t_i}	1.176***	0.992***	1.122***	1.081***	1.196***	0.720***
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	2,371	3,652	3,652	2,252	2,068	1,860
R^2	0.26	0.27	0.26	0.19	0.25	0.30
d	2	2	2	2	NA	2
LR-test (H0: d equals 3)	7.96***	15.13***	11.82***	4.84**	NA	3.57*

2.4.3 Price Revision

My results so far suggest that stereotypical industry underpricing affects firm underpricing through demand, and that the stereotypes differ significantly from rational expectations formed on recent industry underpricing. According to Ljungqvist, Nanda, and Singh (2006), issuers partly exploit any potential excess demand by raising offer prices. I expect any deficit demand either to be incorporated into offer prices or to result in canceled IPOs. Hence, I expect stereotypical industry underpricing to be positively related to offer prices.

To test this, I run regressions with price revision on the left hand side. The results are shown in table 2.5. Specification (1) shows that stereotypical industry underpricing indeed significantly and positively affects price revisions when controlling for firm characteristics and general market conditions. The economic magnitude is non-negligible: a 1% increase results in a 0.07% increase in the offer price; equivalently a 1 standard deviation increase results in a 0.14 standard deviation increase in the offer price. The estimated limits-to-recall parameter d equals 2, implying that the stereotypes are again not fully rational. These findings support the idea that issuers indeed partly incorporate demand generated by stereotypes by adjusting offer prices.

To account for potentially confounding factors, I add the offer characteristics and insider selling variables to the regressions in the specifications (2-4) and (6). None of the controls significantly affect the relation between stereotypical industry underpricing and turnover. Looking at specification (6), the effects of the controls are of similar sign and significance as those in the regressions with underpricing as dependent variable with the exceptions of: the dummy indicating the use of proceeds being operating expenses, the dummy indicating the presence of a high reputation underwriter, the dummy indicat-

Table 2.5. Regressions of price revision on stereotypical industry underpricing.

This table contains the results of non-linear least squares regressions of offer price revision on stereotypical industry underpricing. Offer price revision of IPO i in industry j at time t_i, Price Revision$_{i,j,t_i}$, is calculated as the percentage change from the mid point of the filing range to the IPO offer price (both from SDC). Stereotypical industry underpricing of industry j at time t_i is the average of the d most representative terciles of the distribution of recent underpricing of industry j. The parameter d is the limits-to-recall parameter that determines how much of the full underpricing distribution of industry j is incorporated into the stereotype about industry underpricing. Other independent variables cover firm characteristics, offer characteristics, insider selling and general conditions. Variable defintions are in the appendix. Each regression includes 2-digit SIC code dummies. The last row contains the results of likelihood-ratio tests of the null-hypothesis that d equals 3. Significance at the 10%, 5% and 1% is indicated by *,**, and *** respectively, based on standard errors clustered by 2-digit SIC codes.

Dependent variable	$PrcRev_{i,j,t_i}$					
	(1)	(2)	(3)	(4)	(5)	(6)
$ST_{j,t_i,d}$	0.073**	0.067*	0.107*	0.105**		0.151***
Firm Characteristics						
Age	-0.001				-0.001**	-0.001**
log(Total Assets)	0.003				-0.039***	-0.040***
Price/Book Value Per Share	0.000				0.000	0.000
Offer Characteristics						
$D_{High\ Rep\ Underwriter}$		0.015			0.013	0.009
$D_{Use\ Of\ Proceeds=OPEX}$		-0.056			-0.054*	-0.064*
Gross Proceeds		0.045***			0.112***	0.119***
$D_{Venture\ Backed}$			0.034**		-0.007	-0.005
$D_{Syndicated}$			-0.005		-0.071***	-0.071***
Insider Selling						
Change Insider Stake				0.000	0.000	0.000
Dilution Factor				-0.004	-0.003	-0.004
Participation Ratio				0.071*	0.005	0.010
General Conditions						
$\log(N_{IPOs})$	-0.129***	-0.116***	-0.116***	-0.147***	-0.132***	-0.143***
UP_{μ,t_i}	0.068	-0.028	0.009	-0.059	-0.085*	-0.252***
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	1,870	2,801	2,801	1,797	1,622	1,564
R^2	0.04	0.08	0.04	0.04	0.15	0.17
d	1	1	2	1	NA	2
LR-test (H0: d equals 3)	3.48*	4.18**	3.40*	5.30**	NA	3.66*

ing whether a syndicate underwrites the IPO, and average past underpricing. The use of proceeds being operating expenses is significantly associated with lower price revisions; neither the involvement of a high reputation underwriter, venture capital backing, nor the average past underpricing are related to price revisions.

In each of specifications (1-4) and (6), the limits to recall parameter equals either 1 or 2 and is significantly different from full recall. Overall, these results provide evidence that hypothesis H3 holds and supports the idea that higher stereotypical underpricing affects demand that is partly incorporated by issuers through adjusting offer prices.

2.4.4 Institutional ownership

The model of Ljungqvist, Nanda, and Singh (2006) predicts that IPOs with a large share of non-institutional investors post-IPO should be more affected by stereotypes than IPOs with a small share of non-institutional investors. To test this prediction, I construct post-IPO institutional ownership from 13-F fillings and split up the sample of IPOs with 13-F information around the median of post-IPO institutional ownership. Mean (median) institutional ownership is 0.22 (0.19). I run regressions of firm underpricing on stereotypical industry underpricing, controls, and general market conditions with clustering on industries. Specifications (1-4) and (6) of panel A of table 2.6 show the results of those regressions for the sample with high institutional ownership post-IPO. They show that only occasionally there is a significant effect of stereotypical industry underpricing on firm underpricing; moreover, the limits-to-recall parameter d is only sometimes equal to 2 and never significantly different from 3, the situation with full recall. These results show that there is no consistent effect of stereotypical industry underpricing on firm underpricing.

Specifications (1-4) and (6) of panel B show results of the same regressions for the sample with low institutional ownership post-IPO. Stereotypical industry underpricing is positively and significantly related to firm underpricing in each specification. The economic magnitude of the effect is larger than in the full sample regressions: a 1% increase in stereotypical industry underpricing is associated with an increase in firm underpricing between 0.40% and 0.51%. The limits-to-recall parameter equals 2 consistently and full recall is rejected systematically. These results provide support for hypohtesis H4 and are in line with the idea that stereotypes are held more by non-institutional investors than by more sophisticated institutional investors.

2.4.5 Long-run performance

The results so far provide support for the story that stereotypical industry underpricing affects demand, and that this is incorporated partly in the offer price and for the rest in underpricing on the first trading day. However, while stereotypical industry underpricing may positively affect stock prices in the short run, stock prices should revert back to their fundamental values in the long-run according to Ljungqvist, Nanda, and Singh (2006).

To test this prediction, I run two-stage least squares regressions of IPO long-run performance on underpricing and on price revisions, both instrumented by stereotypical industry underpricing. I calculate long-run performance as annualized buy-and-hold returns in excess of the equal weighted CRSP universe over periods varying in length from 1 to 3 years. For the regressions with underpricing, I calculate long-run performance starting from the *closing* price on the first trading day. For the regressions with price revision, I calculate long-run performance starting from the *offer* price. Table

Table 2.6. Regressions of underpricing on stereotypical industry underpricing, given institutional ownership.

This table consists of two panels that contain results of non-linear least squares regressions of IPO underpricing on stereotypical industry underpricing for different sub-subsamples. Panel A contains results for the sub-sample of IPOs with above median institutional ownership; panel B contains results for the sub-sample of IPOs with below median institutional ownership. Institutional ownership is calculated from 13F-filings obtained from Thomson Reuters. Underpricing of IPO i in industry j at time t_i, UP_{i,j,t_i}, is calculated as the return from the IPO offer price (from SDC) to the closing price on the first day of trading (from CRSP). Stereotypical industry underpricing of industry j at time t_i is the average of the d most representative terciles of the distribution of recent underpricing of industry j. The parameter d is the limits-to-recall parameter that determines how much of the full underpricing distribution of industry j is incorporated into the stereotype about industry underpricing. Other independent variables cover firm characteristics, offer characteristics, and general conditions. Variable defintions are in the appendix. Each regression includes 2-digit SIC code dummies. The last row contains the results of likelihood-ratio tests of the null-hypothesis that d equals 3. Significance at the 10%, 5% and 1% is indicated by *,**, and *** respectively, based on standard errors clustered by 2-digit SIC codes.

Panel A: High institutional investor ownership

Dependent variable	UP_{i,j,t_i}					
	(1)	(2)	(3)	(4)	(5)	(6)
$ST_{j,t_i,d}$	0.406	0.232**	0.246***	0.406		0.599**
Firm Characteristics						
Age		-0.002**			-0.001***	-0.001***
log(Total Assets)		-0.019***			-0.038**	-0.056***
Offer Characteristics						
$D_{High\ Rep\ Underwriter}$			-0.005		-0.001	-0.011
Gross Proceeds			0.028**		0.106***	0.138***
$D_{Venture\ Backed}$				0.078***	0.066***	0.078***
$D_{Syndicated}$				-0.163***	-0.039	-0.050
General Conditions						
$\log(N_{IPOs})$	-0.036*	-0.046**	-0.022	-0.048**	0.011	-0.006
UP_{μ,t_i}	0.325	0.513*	0.437*	0.302	0.582***	0.007
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	951	765	946	951	1,382	763
R^2	0.12	0.14	0.13	0.13	0.15	0.17
d	3	2	2	3	NA	3
LR-test (H0: d equals 3)	-	0.37	0.72	-	NA	-

Panel B: Low institutional investor ownership

Dependent variable	UP_{i,j,t_i}					
	(1)	(2)	(3)	(4)	(5)	(6)
$ST_{j,t_i,d}$	0.511***	0.455***	0.480***	0.488***		0.514***
Firm Characteristics						
Age	-0.005***				-0.003**	-0.004***
log(Total Assets)	0.033*				-0.035**	-0.036**
Offer Characteristics						
$D_{High\ Rep\ Underwriter}$		0.070			0.046	0.074*
Gross Proceeds		0.094**			0.152***	0.207***
$D_{Venture\ Backed}$			0.148***		0.102***	0.108***
$D_{Syndicated}$			-0.061		-0.156**	-0.243***
General Conditions						
$\log(N_{IPOs})$	-0.223***	-0.157***	-0.200***	-0.205***	0.031	-0.167***
UP_{μ,t_i}	0.228***	0.211**	0.284***	0.340***	0.689***	-0.006
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	975	1,241	1,244	1,244	1,330	975
R^2	0.14	0.16	0.15	0.14	0.15	0.20
d	2	2	2	2	NA	2
LR-test (H0: d equals 3)	4.98**	5.45**	5.09**	5.90**	NA	5.47**

2.7 show the result of these regressions.

Specification (1) of panel A shows that long-run performance measured over one year is significantly positively related to the part of underpricing that is explained by stereotypical industry underpricing. The economic magnitude is large: an increase in fitted underpricing of 1% results in an increase in stock price performance of 0.54%. It indicates that over a relatively short horizon of 1 year, stereotypical industry underpricing positively affects stock prices through underpricing. Specification (2) shows that the sign flips when long-run performance is measured over a period of two years. Now fitted underpricing is significantly negatively related to long-run performance. An increase of 1% in fitted underpricing results in a decrease in annualized stock price performance of 0.48%. Specification (3) shows a similar story where long-run performance is measured over 3 years; an increase of 1% in fitted

Table 2.7. Regressions of long-run performance on stereotypical industry underpricing.

This table contains two panels with the results of regressions of long-run performance on fitted underpricing $\widehat{UP}_{i,j,t_i}$ and fitted price revision $\widehat{PrcRev}_{i,j,t_i}$. In panel A long-run performance, $LRP_{i,j,t_i+1,EW}$, is calculated as the annualized buy and hold return in excess of the equal weighted CRSP universe from the *closing price* at the end of the first trading day until one, two or three years later; in panel B long-run performance,$LRP_{i,j,t_i,EW}$, is calculated as the annualized buy and hold return in excess of the equal weighted CRSP universe from the *offering price* at the end of the first trading day until one, two or three years later. The regressions are estimated using two-stage least squares with stereotypical industry underpricing as instrument for underpricing (panel A) and price revision (panel B). In the first stage regression the variable to be fitted is excluded from the independent variables. Independent variables include underpricing, price revision, firm characteristics, offer characteristics and general conditions. Variable definitions are in the appendix. Each regression includes 2-digit SIC code dummies. Significance at the 10%, 5% and 1% is indicated by *,**, and *** respectively, based on standard errors clustered by 2-digit SIC codes and corrected for first-stage estimation uncertainty in the fitted variables $\widehat{UP}_{i,j,t_i}$ and $\widehat{PrcRev}_{i,j,t_i}$.

Panel A: Underpricing and long-run performance excluding first-day returns

Dependent variable	$LRP_{i,j,t_i+1,EW}$					
	(1): one year	(2): two years	(3): three years	(4): one year	(5): two years	(6): three years
$\widehat{UP}_{i,j,t_i}$	0.536**	-0.479**	-0.517**	0.558**	-0.443*	-0.482**
UP_{i,j,t_i}				-0.023	-0.037*	-0.035**
Firm Characteristics						
Age	0.001	-0.001	-0.001	0.001	-0.001	-0.001
log(Total Assets)	0.026**	0.035***	0.033***	0.025**	0.034***	0.032***
Offer Characteristics						
$D_{High\ Rep\ Underwriter}$	0.178***	0.095***	0.039	0.179***	0.097***	0.041
Gross Proceeds	0.021	0.023	0.019	0.023	0.027*	0.022
$D_{Venture\ Backed}$	0.079	0.106**	0.066***	0.081	0.109**	0.069***
$D_{Syndicated}$	0.059	0.069	0.101**	0.057	0.065	0.097**
General Conditions						
$\log(N_{IPOs})$	-0.048	0.211**	0.187**	-0.050	0.207**	0.183*
UP_{μ,t_i}	-1.032***	-0.553***	-0.144	-1.025***	-0.542***	-0.134
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	2,783	2,783	2,783	2,783	2,783	2,783
R^2	0.04	0.03	0.03	0.04	0.03	0.03

Panel B: Price Revision and long-run performance including first-day returns

Dependent variable	$LRP_{i,j,t_i,EW}$					
	(1): one year	(2): two years	(3): three years	(4): one year	(5): two years	(6): three years
$\widehat{PrcRev}_{i,j,t_i}$	0.403	-3.077	-2.790*	0.120	-3.351	-2.979*
$PrcRev_{i,j,t_i}$				0.284**	0.274	0.189*
Firm Characteristics						
Age	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
log(Total Assets)	0.019	0.025*	0.019	0.030*	0.035**	0.026*
Offer Characteristics						
$D_{High\ Rep\ Underwriter}$	0.258***	0.256**	0.092	0.251***	0.249**	0.087
Gross Proceeds	0.045**	0.001	0.023	0.016	-0.027	0.003
$D_{Venture\ Backed}$	0.095*	0.113***	0.125***	0.094*	0.111***	0.124***
$D_{Syndicated}$	0.016	0.082	0.122*	0.030	0.096	0.132*
General Conditions						
$\log(N_{IPOs})$	0.167**	0.405***	0.380***	0.201***	0.438***	0.403***
UP_{μ,t_i}	-0.421*	0.088	0.438***	-0.382	0.125	0.464***
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	2,025	2,025	2,025	2,240	2,236	2,230
R^2	0.03	0.04	0.03	0.04	0.03	0.02

underpricing results in a decrease in annualized stock price performance of 0.52%.

In specification (4-6) of panel A similar regressions are run, but now with firm underpricing added to the set of explanatory variables. The results from specifications (1-3) are qualitatively unchanged: the part of underpricing explained by stereotypical industry underpricing still has the same effect as in specifications (1-3) both statistically and economically. [5]

Panel B contains the results of two-stage least squares regressions of long-run performance on the part of price revision explained by stereotypical industry underpricing. Specification (1) shows that the coefficient of fitted price revision has a positive sign, but is not significant. Specification (2) shows that the sign flips as expected, but still fitted price revision is not significant. How-

[5] In panel A, it is hard to cleanly separate the effect of stereotypical industry underpricing that runs via underpricing, from the effect that runs via price revisions. The coefficient of fitted underpricing may also reflect part of the effect of stereotypical industry underpricing that is incorporated in price revisions. The regressions are interesting nonetheless, as the absence of any result would be informative.

ever, in specification (3) fitted price revision is significantly negatively related to long-run performance, as expected. The economic magnitude is large: an increase in fitted price revision of 1% results in a decrease in average annualized stock performance of 2.8%.

Specifications (4-6) of panel B have price revision added to the set of explanatory variables. The results from specifications (1-3) are qualitatively unchanged: the part of underpricing explained by stereotypical industry underpricing still has the same effect as in specifications (1-3) both statistically and economically. Interestingly, the effect of price revision, i.e. the part that is *not* explained by stereotypical industry underpricing, is consistently positive and significant.[6] This would be in line with the idea that in a world stripped of non-rational behavior with risk-averse investment banks, a noisy positive signal on firm quality would result in a positive price revision as well as a positive return after the stock is trading.

Overall, the coefficients show signs that are in line with expectations. Moreover, the parts of underpricing and price revision that are explained by stereotypical industry underpricing both have a significant negative effect on long-run stock performance with large economic magnitude. It supports hypothesis H5 that stereotypical industry underpricing affects stock performance negatively on the long-run.

[6] In panel B, the effect of stereotypical industry underpricing that runs via price revisions is more cleanly identified. Long-run performance is measured from the offer price rather than the closing price. If the coefficient reflects any effect of stereotypical industry underpricing that runs via underpricing, the effect likely biases the coefficient towards zero rather than in the opposite direction.

2.4.6 Robustness checks

2.4.6.1 Overfitting

As the structure imposed by the theory of stereotypes is quite specific, there is little reason to believe that the results are driven by overfitting; particularly as the hypothesized effects of stereotypical industry underpricing on the other dependent variables are similarly confirmed. On the other hand, there may be concerns that stereotypical industry underpricing may just be picking up persistence in industry underpricing, even though the null of $d == 3$ is rejected in-sample, and that the in-sample rejection of $d == 3$ is due to sample selection bias and is a characteristic of the current sample.

To test this, I perform an out-of-sample forecasting analysis and compare a simple model for underpricing, that consists of stereotypical industry underpricing and general market conditions, to the same model with the restriction that the limits-to-recall parameter d equals 3. In the restricted model there are no limits-to-recall, the stereotype variable equals average industry underpricing, and underpricing is solely explained by persistence in underpricing.

I use an expanding estimation-sample with start sizes varying from 30% to 70% of the full sample size. Iteratively, I estimate both models in-sample on the data within the estimation-sample, make for each model a one-step-ahead out-of-sample forecast, and expand the estimation-sample with one observation. If the effect of stereotypical industry underpricing presented in tabel 2.3 were a result of overfitting, the out-of-sample forecasts of the stereotype model would be further off from the corresponding true underpricing values than the out-of-sample forecasts of the more basic persistence model. If the effect of stereotypical industry underpricing were not a result of overfitting, the forecasts of the stereotype model would be closer to the true underpricing

Table 2.8. Out-of-sample mean squared prediction errors.

This table shows mean squared prediction errors for IPO underpricing of an out-of-sample forecasting analysis. The base model consists of general market conditions (2-digit SIC code fixed effects, the average level of underpricing in the year up to the IPO, the logarithm of the number of IPOs in the year up to the IPO) and stereotypical industry undepricing. Underpricing of IPO i in industry j at time t_i, UP_{i,j,t_i}, is calculated as the return from the IPO offer price (from SDC) to the closing price on the first day of trading (from CRSP). Stereotypical industry underpricing of industry j at time t_i is the average of the d most representative terciles of the distribution of recent underpricing of industry j. The parameter d is the limits-to-recall parameter that determines how much of the full underpricing distribution of industry j is incorporated into the stereotype about industry underpricing. Variable definitions are in the appendix. The base model is estimated both with varying d and with d fixed to equal 3. An expanding window approach is used with varying estimation-sample start sizes. Diebold-Mariano tests are presented that test the null hypothesis of equal forecasting performance.

Dependent Variable:	UP_{i,j,t_i}	
Estimation-sample start size	Model	
30%	MSPE: d estimated	0.637
	MSPE: d equals 3	0.653
	DM-test statistic	7.11***
40%	MSPE: d estimated	0.714
	MSPE: d equals 3	0.736
	DM-test statistic	8.20***
50%	MSPE: d estimated	0.891
	MSPE: d equals 3	0.915
	DM-test statistic	6.94***
60%	MSPE: d estimated	1.234
	MSPE: d equals 3	1.269
	DM-test statistic	6.58***
70%	MSPE: d estimated	1.238
	MSPE: d equals 3	1.246
	DM-test statistic	1.05

values than the forecasts of the more basic persistence model.

Table 2.8 shows mean squared prediction errors (MSPEs) of the forecasts of both models. For each estimation-sample start size, the MSPE of the stereotype model is lower than the MSPE of the more basic persistence model. It indicates that the forecasts of the stereotype model are closer to the true underpricing values, and that the additional restriction on the limits to recall in the persistence model is hurting forecasting performance. The Diebold-Mariano (Diebold and Mariano, 1995) test statistics confirm this and show that the out-of sample forecasting performance of the unrestricted model is significantly better than that of the restricted model, for all estimation-sample start sizes with the exception of the 70% sample start sizes. Overall, these findings imply that overfitting does not drive the results.

2.4.7 Hot markets, cold markets, dot-com years and non-dot-com years

In the IPO market there are periods with high volume and high underpricing, characterized as hot markets, and periods with low volume and low underpricing, characterized as cold markets (Helwege and Liang (2004)). When underpricing is high, the differences in the underpricing distribution between industries may become more pronounced; when underpricing is lower on average, the differences may become smaller. Accordingly, stereotypes about industry underpricing may be stronger in hot markets and weaker in cold markets.

To investigate this, I determine whether months are hot or cold by calculating a centered moving average of IPO volume per month, with a window of 3 months. I do so by first calculating the number of IPOs per month. For each month, I subsequently calculate the average over the number of IPOs in the months prior, concurrent, and after. I divide the resulting centered moving average of IPO volume into terciles, discarding the middle tercile and labeling the high volume months 'hot' and the low volume months 'cold'. Terciles are calculated separately for the periods 1990-2000 and 2001-2014, as there is a sharp drop in overall IPO volume around the split.

Specification (1) and (2) of table 2.9 show the results of regressions of underpricing on stereotypical industry underpricing in hot and cold markets, respectively. Specification (1) shows that stereotypical industry underpricing is significantly positively related to underpricing in hot markets. The limits to recall parameter equals 2 and is significantly different from 3, indicating the presence of limits to recall. In cold markets, the coefficient in front of stereotypical industry underpricing is small, negative and insignificant. These findings support the idea that the effect of stereotypes is weaker in cold markets and stronger in hot markets.

Another interesting issue is whether the effect of stereotypical industry underpricing on firm underpricing is particular to the dot-com years 1999 and 2000. In these years underpricing reached record highs and for these years there is ample anecdotal evidence of boundedly rational behavior. To investigate this, I split up the sample into dot-com-years and non-dot-com years. Specification (3) and (4) of table 2.9 show the results of regressions of underpricing on stereotypical industry underpricing for these subsamples. Specification (3) shows that the effect of stereotypical industry underpricing is positive and significant. The limits to recall parameter d equals 2, but it is not significantly different from 3; this may be due to the relatively small number of observations in the regression. Specification (4) shows that the effect of stereotypical industry underpricing is also positive and significant.

Table 2.9. Regressions of underpricing on stereotypical industry underpricing in hot markets, cold markets, dot-com years, and non-dot-com years.

This table contains the results of non-linear least squares regressions of IPO underpricing on stereotypical industry underpricing for IPOs taking place in hot markets, cold markets, dot-com years or non-dot-com years. Hot and cold markets are determined by dividing a series of centered 3 month moving averages of IPO volume into terciles, discarding the middle tercile and labelling the high volume months 'hot' and the low volume months 'cold'. Terciles are calculated separately for the periods 1990-2000 and 2001-2014. Dot-com years are defined to be the years 1999 and 2000, non-dot-com years the rest. Underpricing of IPO i in industry j at time t_i, UP_{i,j,t_i}, is calculated as the return from the IPO offer price (from SDC) to the closing price on the first day of trading (from CRSP). Stereotypical industry underpricing of industry j at time t_i is the average of the d most representative terciles of the distribution of recent underpricing of industry j. The parameter d is the limits-to-recall parameter that determines how much of the full underpricing distribution of industry j is incorporated into the stereotype about industry underpricing. Other independent variables cover firm characteristics, offer characteristics, and general conditions. Variable defintions are in the appendix. Each regression includes 2-digit SIC code dummies. The last row contains the results of likelihood-ratio tests of the null-hypothesis that d equals 3. Significance at the 10%, 5% and 1% is indicated by *,**, and *** respectively, based on standard errors clustered by 2-digit SIC codes.

Dependent variable		UP_{i,j,t_i}		
	(1): Hot	(2): Cold	(3): Dot-com	(4): Non-Dot-com
$ST_{j,t_i,d}$	0.390***	-0.091	0.128***	0.117***
Firm Characteristics				
Age	-0.002***	-0.006*	-0.011***	-0.001***
log(Total Assets)	-0.016	-0.033	-0.038**	-0.025**
Offer Characteristics				
$D_{High\ Rep\ Underwriter}$	0.048**	0.275***	0.058*	0.070**
Gross Proceeds	0.069***	0.103**	0.408***	0.041***
$D_{Venture\ Backed}$	0.081***	0.095**	0.344***	0.013
$D_{Syndicated}$	-0.094***	-0.097	-0.313	-0.056**
General Conditions				
$\log(N_{IPOs})$	0.017	-0.356	1.375**	-0.072***
UP_{μ,t_i}	0.656***	0.427	-3.032***	0.204
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	1,481	385	565	2,254
R^2	0.21	0.14	0.18	0.06
d	2	1	2	1
LR-test (H0: d equals 3)	6.58**	0.45	0.59	5.35**

The limits to recall parameter d equals again to 1 and is now significantly different from 3. Overall, I find no evidence that the effect of stereotypical industry underpricing is particular to the dot-com years; based on these results it seems even that the effect is stronger outside of the dot-com years.

2.4.8 Industries

Some industries may be more sensitive to stereotypes than others, for instance due to being more opaque. Along those lines, I would expect consumer and manufacturing industries to be less affected by stereotypes, and high-tech and health to be more affected by stereotypes. IPOs in the 'Other' category may either be less sensitive to stereotypes as they belong to a less coherent industry group, or more sensitive to stereotypes as they may be more opaque due to belonging to a more mixed industry group.

Table 2.10 shows the result of regressions of underpricing on stereotypical industry underpricing and controls, for sub-samples based on industry. Specifications (1) and (2) contain the results for consumer and manufacturing industries; in neither of the specifications the coefficient of stereotypical industry underpricing is significant. Specifications (3) and (4) contain the results for high-tech and health IPOs; in both specifications the effect of stereotypical industry underpricing is positive and significant. The limits to recall parameter d equals 2 and 1 respectively, and is significantly different 3. Specification (5) contains the results for other IPOs; the coefficient of stereotypical industry underpricing is positive and significant. The limits to recall parameter d equals 2, but is not significantly different from 3.

These results show that the effect of stereotypical industry underpricing is mainly concentrated in high-tech and health IPOs, and perhaps to some extent in other IPOs. The effect is not present in the less opaque consumer

Table 2.10. Regressions of underpricing on stereotypical industry underpricing for different industries.

This table contains the results of non-linear least squares regressions of IPO underpricing on stereotypical industry underpricing for different industries, defined using the Fama-French 5 industry definitions. Underpricing of IPO i in industry j at time t_i, UP_{i,j,t_i}, is calculated as the return from the IPO offer price (from SDC) to the closing price on the first day of trading (from CRSP). Stereotypical industry underpricing of industry j at time t_i is the average of the d most representative terciles of the distribution of recent underpricing of industry j. The parameter d is the limits-to-recall parameter that determines how much of the full underpricing distribution of industry j is incorporated into the stereotype about industry underpricing. Other independent variables cover firm characteristics, offer characteristics and general conditions. Variable defintions are in the appendix. Each regression includes 2-digit SIC code dummies. The last row contains the results of likelihood-ratio tests of the null-hypothesis that d equals 3. Significance at the 10%, 5% and 1% is indicated by *,**, and *** respectively, based on standard errors clustered by 2-digit SIC codes.

Dependent variable			UP_{i,j,t_i}		
	(1): Cnsmr	(2): Manuf	(3): HiTec	(4): Hlth	(5): Other
$ST_{j,t_i,d}$	0.199	0.538	2.527***	0.217**	0.339*
Firm Characteristics					
Age	-0.001***	-0.001***	-0.009***	0.000	-0.002**
log(Total Assets)	-0.024*	-0.025*	-0.041**	-0.004	-0.019
Offer Characteristics					
$D_{High\ Rep\ Underwriter}$	0.064	-0.044***	0.077***	-0.011	0.060
Gross Proceeds	0.053*	0.050*	0.194***	0.048**	0.051
$D_{Venture\ Backed}$	0.018	0.017	0.127***	-0.014	0.149***
$D_{Syndicated}$	-0.058***	0.014	-0.191*	-0.120*	-0.085*
General Conditions					
$\log(N_{IPOs})$	-0.161	-0.185***	-0.054	-0.035**	-0.092**
UP_{μ,t_i}	0.188	0.061	-2.823***	0.297	0.278***
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	549	167	1,108	273	722
R^2	0.10	0.14	0.26	0.10	0.10
d	1	3	2	1	2
LR-test (H0: d equals 3)	4.59**	-	11.32***	3.95**	1.26

and manufacturing industries.

2.5 Conclusion

In this paper, I show that firm underpricing is strongly related to stereotypical industry underpricing. I further show that demand, as proxied for by first-day turnover, is also positively related to stereotypical underpricing and that the effect of stereotypical underpricing seems to mainly originate from non-institutional investors. The increased demand from stereotypical underpricing is partly taken advantage of by issuers through raising offer prices. The parts of offer price changes and first-day returns that are due to stereotypical industry underpricing are negatively related to post-IPO stock performance measured over horizons of 2 and 3 years. These results are in line with predictions of the model of Ljungqvist, Nanda, and Singh (2006).

These findings are supportive of a demand side explanation of IPO underpricing. They support a view in which investors use stereotypes as a heuristic to determine their expectations about underpricing in future IPOs, and with that, their demand for stocks in future IPOs. They challenge a view in which underpricing is solely a result of rational deliberations regarding e.g. information asymmetries or risk. The implications of these results are that there are inefficiencies in the way capital gets allocated during IPOs.

The effects of stereotypical industry underpricing on firm underpricing and price revision may comprise only a part of the potential effect of stereotypes. It is possible that the original offer price set by the investment bank is already taking into account demand generated by stereotypes, even before it is further adjusted during the book building process. In the current set-up, that is difficult to measure.

There are two ways in which the effect of stereotypes on pricing may be mitigated. Firstly, better information provision to potential investors may reduce limits-to-recall, which may allow investors to form better expectations about future underpricing and set demand accordingly. Secondly, fewer restrictions on short selling stock may allow traders that suffer less from limits-to-recall to counter any excess demand generated by traders holding stereotypes, and may deter issuers from exploiting any excess demand in the first place.

Appendix to chapter 2: Variable definitions and data sources

Variable	Description	Source
Dependent variables		
UP_{i,j,t_i}	The return from the offer price to closing price at the end of the first day of trading. I remove all non-main tranches, companies with more than one IPO in the sample, companies with SIC codes 49 and 60 (financial and utility firms), and companies that did not offer primary shares.	SDC, CRSP, own computations
$Turnover_{i,j,t_i}$	The volume of shares traded on the first trading day divided by the number of shares issued at the IPO. I remove all non-main tranches, companies with more than one IPO in the sample, companies with SIC codes 49 and 60 (financial and utility firms), and companies that did not offer primary shares.	SDC, CRSP, own computations
$PrcRev_{i,j,t_i}$	The percentage change from the original middle of the filing price range to the final offer price. I remove all non-main tranches, companies with more than one IPO in the sample, companies with SIC codes 49 and 60 (financial and utility firms), and companies that did not offer primary shares.	SDC, CRSP, own computations
$LRP_{i,j,t_i,EW}$	The annualized buy-and-hold return from the IPO until 1-5 years after the offering in excess of the CRSP equal weighted market portfolio. I follow the advise by (Shumway and Warther, 1999) in dealing with delistings. I use raw returns rather than log-returns and correspondingly the product rather than the sum, as IPO (first-day) returns may sometimes be too large to let the approximate equality $log(1+r) = r$ hold.	SDC, CRSP, own computations

Appendix to chapter 2, continued

Variable	Description	Source
Independent variables		
$ST_{j,t_i,d}$	Stereotypical industry underpricing that is equal to the average underpricing of the d most representative parts of the industry underpricing distribution. The underpricing distributions of a particular industry at a specific time consists of underpricing of all IPOs within that industry that took place over the last year.	SDC, CRSP, own computations
Age	The age of the firm at the time of its IPO.	Field-Ritter dataset
log(Total Assets)	The logarithm of the book value of total assets in the year prior to the IPO.	SDC, own computations
Price/Book Value Per Share	The offer price divided by the book value per share prior to the IPO	SDC
log(Gross Proceeds)	The logarithm of the total dollar amount of proceeds of the IPO.	SDC, own computations
$D_{Venture\ Backed}$	A dummy that equals one if the IPO is backed by venture capital	SDC
$D_{Syndicated}$	A dymmy that equals one if the IPO is managed by a syndicate of underwriters	SDC
$D_{Use\ of\ Proceeds==OPEX}$	A dummy that equals one if the use of proceeds equals operating expenses, and zero otherwise.	SDC, own computations
$D_{High\ Rep\ Underwriter}$	A dummy that equals one if the underwriter is a high reputation underwriter, and zero otherwise. An underwriter that is in the top 20 of underwriters in terms of the number of IPOs underwritten is deemed a high reputation underwriter.	SDC, own computations
Change Insider Stake	The change in insider holdings at the IPO, calculated as the difference between post IPO insider holdings and pre-IPO insider holdings	SDC, own computations
Dilution Factor	The fraction of primary shares issued with respect to shares outstanding before the IPO	SDC, own computations
Participation Ratio	The fraction of secondary shares issued with respect to shares outstanding before the IPO	SDC, own computations
$log(N_{IPOs})$	The logarithm of the number of IPOs over last year up to the date of the IPO.	SDC, own computations
UP_{μ,t_i}	The average level of underpricing in the last year up to the date of the IPO.	SDC, CRSP, own computations

Chapter 3

Do firms issue more equity when markets become more liquid?

Joint work with René Stulz and Mathijs van Dijk

ABSTRACT

Using quarterly data on IPOs and SEOs for 37 countries from 1995 to 2014, we show that changes in equity issuance are positively related to lagged changes in aggregate local stock market liquidity. This relation is as economically significant as the well-known relation between equity issuance and lagged stock returns. It survives the inclusion of proxies for market timing, capital market conditions, growth prospects, asymmetric information, and investor sentiment. Changes in liquidity are less relevant for issuance by firms with greater financial pressures, and by firms in less financially developed countries.

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3.1 Introduction

There is a large literature showing that aggregate stock market liquidity changes over time within countries (e.g., Chordia, Sarkar, and Subrahmanyam, 2005; Lesmond, 2005). Greater stock market liquidity means that it is easier to sell shares without affecting their price. We therefore expect that increases in stock market liquidity should be associated with increases in equity issuance. In this paper, we investigate this hypothesis using a sample of 37 countries from 1995 to 2014. We find strong support for the hypothesis that equity issuance increases following improvements in stock market liquidity.

As a firm's shares trade in a less liquid market, investors have to be given more of a discount to absorb these shares. We would therefore expect that equity issuance is more costly for existing shareholders when a firm's stock is less liquid because an increase in the supply of shares has a greater price impact. As issuance becomes more costly, firms are expected to issue less equity, everything else equal. The liquidity of a firm's common stock can worsen because aggregate liquidity worsens or because of idiosyncratic shocks. Idiosyncratic liquidity shocks could be caused by shocks to observed or unobserved firm attributes, so that it is difficult to identify the impact of liquidity as opposed to the impact of shocks to factors that affect liquidity as well as other firm characteristics. For instance, adverse information about a firm could increase information asymmetry which would lower liquidity. Since one would expect an increase in information asymmetry to make it more expensive for a firm to issue equity, identification of the liquidity effect on equity issuance when liquidity changes because of information asymmetry would be challenging. An additional complicating factor is that most individual firms issue equity rarely, so that tests at the firm level are unlikely to have much power.

In this paper, we resolve the identification issue in assessing the role of liquidity in the issuance decision by focusing on equity issuance at the country level and by examining the relation between changes in aggregate equity issuance and changes in aggregate liquidity. Aggregate liquidity could affect a firm's decision to issue equity because there are strong common factors in liquidity (e.g., Chordia, Roll, and Subrahmanyam, 2001) and because aggregate liquidity could proxy for the general capacity of the market to absorb new shares. An additional advantage of studying the relation between changes in equity issuance and changes in liquidity at the country level instead of the firm level is that reverse causation is far less of a concern since new issues tend to represent a small fraction of the overall market.

Like earlier papers that investigate equity issuance globally, such as Henderson, Jegadeesh, and Weisbach (2006) and Kim and Weisbach (2008), we obtain data on equity issues from SDC and include both initial public offerings (IPOs) and seasoned equity offerings (SEOs). Our dataset has 2,901 country-quarters. The measure of equity issuance we focus on is the number of equity issues (IPOs and/or SEOs) by country in a given quarter. We use the Amihud (2002) price impact proxy (estimated quarterly for each country based on stock level data) as our key liquidity measure. Since neither the number of issues nor aggregate liquidity is a stationary variable, we take first differences and run regressions of changes in equity issuance on changes in liquidity. We demean and standardize each of the country level variables by country, which enhances comparability across countries. Demeaning also takes care of country fixed effects, which may be important since recent studies (e.g., Doidge, Karolyi, and Stulz, 2013; Kim and Weisbach, 2008; McLean, Zhang, and Zhao, 2011) note that countries differ along many dimensions that affect equity issuance. All of our regressions use quarterly data and include time fixed effects.

When we regress changes in equity issuance on lead, contemporaneous, and lagged changes in liquidity, we find that while the coefficient on lead liquidity changes is not significant, contemporaneous liquidity changes as well as the first three lagged liquidity changes have a positive and significant coefficient. Based on the three lagged coefficients, a one standard deviation shock to liquidity is associated with an economically substantial 0.14 standard deviation cumulative shock to equity issuance over the subsequent three quarters. Since a large literature shows that liquidity and market returns are related (e.g., Amihud and Mendelson, 1986; Amihud, Hameed, Kang, and Zhang, 2015), our tests also include these variables side-by-side. Doing so is especially important because market returns are used to explain variation in equity issuance by many studies (e.g., Henderson, Jegadeesh, and Weisbach, 2006; Huang and Ritter, 2016) and are often interpreted as a proxy for market timing. We find positive and significant coefficients for contemporaneous as well as the first three lagged market returns. These coefficients indicate that a one standard deviation shock to returns is associated with a 0.13 standard deviation cumulative shock to issuance over the next three quarters. Not only is the relation between liquidity changes and changes in equity issuance economically and statistically significant when we allow for a relation between changes in equity issuance and stock returns, but the economic significance of the liquidity coefficients is thus as large as the economic significance of the coefficients on market returns.

After having established that changes in equity issuance are positively related to liquidity changes, we examine whether this relation can be explained by variables known to be correlated with aggregate liquidity that could affect equity issuance on their own. For example, U.S. studies predicting aggregate seasoned equity issuance (e.g., Choe, Masulis, and Nanda, 1993) and the aggregate rate at which firms go public (e.g., Lowry, 2003) show that equity issuance is affected by the state of capital markets and aggregate economic activity, which are variables known to be related to liquidity as well.

Our first battery of tests therefore controls for proxies for general capital market conditions, such as market volatility, turnover, and liquidity risk. It is already known from the literature that aggregate equity issuance is lower when market volatility is higher (e.g., Schill, 2004). While we find a negative contemporaneous coefficient of market volatility in our regressions, the coefficient is insignificant and its inclusion does not affect the sum of the coefficients on the liquidity variables. Similarly, market turnover is negatively related to equity issuance, but the inclusion of market turnover in the regression has no impact on the sum of the coefficients on liquidity. We find no evidence that equity issuance is related to lagged liquidity risk, but it is positively related to lead liquidity risk. Our evidence is thus consistent with firms timing liquidity risk, but adding liquidity risk has no impact on the coefficients on liquidity changes.

Since at least Amihud and Mendelson (1986), it is known that liquidity is related to valuation. Specifically, higher liquidity is associated with lower discount rates and higher valuations. It follows that one channel through which liquidity could affect issuance is the valuation channel. We want to establish that liquidity impacts issuance separately from the valuation channel. In other words, we want to show that there is a price pressure channel of the impact of liquidity. Our approach is to control for lead, contemporaneous, and lagged valuation measures. Our benchmark regressions already control for lead, contemporaneous, and lagged returns as proxies for market timing. Next, we additionally include a number of direct proxies for the level of market valuation. Market-to-book is used in studies of market timing (e.g., Loughran and Ritter, 1995 ,1997; Baker and Wurgler, 2002; DeAngelo, DeAngelo, and Stulz, 2010). There is evidence that more liquid firms in the U.S. have a higher market-to-book ratio (Fang, Noe, and Tice, 2009). After controlling for liquidity and market returns, we find that the coefficients on contemporaneous and lagged market-to-book are not significant. However, the coefficient on the lead of market-to-book is positive and significant. Adding market-to-book to our regressions leaves our inferences are unchanged. The addition of other variables that capture market conditions also does not change our inferences about the impact of market liquidity.

Recent research shows that liquidity is a predictor of economic activity (e.g., Næs, Skjeltorp, and Ødegaard, 2011). Since at least Miller (1963), poor economic activity has been associated with lower equity issuance. We find that when we control for proxies for future levels of economic activity, the coefficients on the liquidity measures remain economically and statistically significant.

We then turn to tests that focus more directly on the nature of the mechanism that explains the relation between liquidity and equity issuance. For firms, an equity issuance has costs and benefits. Firms in good financial condition can more easily postpone an equity issue if they believe that it will be less costly in the future compared to firms that might be unable to pay their bills without new funding. Huang and Ritter (2016) find that immediate cash needs are "the primary predictor for net debt issuances and an important predictor for net equity issuances." They consider firms with low profitability and high leverage to be firms that do not have a choice but to issue equity. When we separate firms into those with positive return on assets (ROA) and those with negative ROA, we expect firms with negative ROA to be less affected by liquidity changes because they may have greater immediate cash needs and would find it much more difficult to issue debt. We find that this is the case.

We also explore whether the relation between changes in equity issuance and changes in liquidity differs across countries and across time. Countries differ in the ease with which firms can issue equity. We expect firms in more financially developed countries to be better able to react to changes in liquidity. We find that this is the case. An obvious concern is that our results could be driven by the financial crisis. When we remove the 2008-2011 period from our sample, a period that includes the peak of the European sovereign crisis as well as what is often referred to as the credit crisis, our results are similar.

Our paper contributes to several literatures. Our primary contribution is to the equity issuance literature. We find that liquidity is an important determinant of equity issuance across the world. Though much of the recent literature on equity issuance has focused on market timing motivations for equity issuance, we show that liquidity's economic significance as a determinant of equity issuance is of the same magnitude as the economic significance of variables that proxy for market timing. A growing recent literature emphasizes the interaction between market liquidity and funding liquidity, following the work of Brunnermeier and Pedersen (2009). The empirical literature on this interaction has focused on financial institutions. The results in this paper suggest that market liquidity affects funding liquidity more generally.

There is a large literature that builds on the finding in Shleifer (1986) that a firm's stock price increases when it experiences an increase in demand because of being added to a stock index such as the S&P 500. Studies with access to data about demand curves for stocks find that demand curves are downward-sloping (e.g., Bagwell, 1992; Kandel, Sarig, and Wohl, 1999. If demand curves for stocks were perfectly elastic, we would not expect to find a relation between equity issuance changes and changes in liquidity. Braun and Larrain (2009) provide cross-country evidence on the impact of large issuances by showing that large IPOs in emerging markets have permanent adverse price impacts on correlated stocks. We contribute to this literature by presenting evidence indicating that downward-sloping demand curves may affect equity issuance.

Several papers investigate how stock liquidity affects some aspects of the equity issuance process. In particular, Butler, Grullon, and Weston (2005) show that underwriters charge more when liquidity is lower and Gao and Ritter (2010) demonstrate that underwriters affect the slope of the demand function for shares through their marketing activities. Our paper adds to that literature by showing that aggregate liquidity has a powerful relation with security issuance.

Finally, there is a large literature on the role of liquidity in the pricing of financial assets. In this paper, we provide evidence consistent with the view that the role of liquidity extends beyond the boundaries of financial markets and that it has a pervasive impact on corporate financial policies. While Fang, Noe, and Tice (2009) and Lipson and Mortal (2009) show that stock liquidity is related to a firm's capital structure, such a finding does not necessarily mean that firms are more likely to issue equity in more liquid markets. Our contribution therefore helps understand one mechanism whereby more liquid firms have less leverage, namely that higher liquidity makes it less costly to issue equity.

3.2 Data and methods

3.2.1 Issuance data

We obtain equity issuance data from the Securities Data Company (SDC). We select all public issues that take place between 1995 and 2014 in the 37 developed and developing countries in our sample. We start our sample in 1995 because issuance data in SDC is sparse for a number of countries before 1995. We drop all issues in which non-common stock is issued and in which no primary shares are offered. We also exclude all issues from utilities and financial firms (SIC codes 49 and 6), as equity issuance by such firms may be affected by regulations. We only include the main tranche of each issue when there are multiple tranches, to avoid double counting and problems with issues distributed across multiple exchanges or countries.

We remove foreign issues by comparing the country of domicile of the firm to the location of the exchange on which the shares are issued. If information on the location of the exchange is missing in SDC, it is supplemented with information on exchange location from Datastream. We discard tiny issues, defined as issues in which the number of shares issued is less than one percent of the number of shares outstanding after the issue.

For issues in the U.S., we distinguish between those that take place on the New York Stock Exchange (NYSE), Nasdaq, and other markets. We keep issues on the first two markets and treat them as separate "countries." We discard the equity issues on the other U.S. markets. For issues in other countries, we eliminate all issues that did not take place on a main market. Issues taking place on non-main markets are often subject to different (lighter) sets of rules that are enforced by exchanges rather than by national regulators. Vismara, Paleari, and Ritter (2012) show that issues on such markets are sometimes closer to private placements than to public offerings, and that such issues tend to be smaller in size. By filtering out issues on non-main markets, we obtain a more homogeneous sample in terms of regulation and issue size.

To identify main markets, we proceed as follows. We first link the SDC market names to standardized market codes (Market Identifier Codes, or MICs) where possible; we discard SDC market names that cannot be linked to a MIC. We then classify the remaining markets in our sample into main markets and non-main markets as follows. For markets in Europe, we follow the classification made by Vismara, Paleari, and Ritter (2012), who discuss the rise and fall of second markets in Europe in detail. For markets elsewhere, we classify markets based on information obtained from internet searches (e.g., exchange websites, news items). Finally, we use only the main markets that are part of the exchange with the largest issuance proceeds. In five of the countries in our sample, the main market is the result of a merger of separate markets that took place during our sample period. In these cases, we include issues on the merged market as well as on all "predecessor" markets, but we do a robustness check dropping these five countries from the sample. We refer to the Internet Appendix for a detailed discussion of our procedure to classify markets into main markets and non-main markets.

We aggregate the number of issues by country (and in the case of the U.S. per exchange) and by quarter based on the issue date, and use it as the main variable in our regressions. For each country, we set all quarters without issues in SDC before the first quarter with a positive number of issues to missing; we set all quarters without issues after the first quarter with a positive number of issues in SDC to zero, as we assume that SDC coverage has started as of that date.

3.2.2 Stock market data

We obtain daily data on prices, returns, volume, and shares outstanding for individual common stocks for the U.S. from CRSP, and for the other countries in our sample from Datastream, over the period from 1995 to 2014. We aim to be conservative in what securities we consider common stocks. For the data from CRSP, this is done by only including shares with share code 10 or 11. For the data from Datastream, we use the list of common stocks compiled by Hou and van Dijk (2017), which closely follows the data filters in Hou, Karolyi, and Kho (2011).

We restrict the sample by only including stocks that are traded on a main market, to be consistent with the equity issuance data and to avoid problems with differences in trading mechanisms and conventions, similar to Karolyi, Lee, and van Dijk (2012). Just like for equity issues, we split up U.S. stocks into those that trade on the NYSE and those that trade on Nasdaq. For Brazil and Germany, we only use data from 2000 onwards. For Brazil, there is a change in trading definitions in 1999. Daily trading volume data is not readily available for Germany before 2000 (Karolyi, Lee, and van Dijk, 2012). We refer to the Internet Appendix for a description of how we verify that the main markets identified in Datastream match those identified in SDC.

3.2.2.1 Stock level liquidity

We use the price impact measure developed by Amihud (2002) as our (il)liquidity measure. The Amihud measure is designed to capture the marginal impact of a unit of trading volume on the stock price. It is computed as the daily ratio of the absolute stock return over the local currency trading volume of the stock. This measure stays close to the intuitive description of liquid markets as those that accommodate trading with the least effect on price (e.g., Kyle, 1985).

Amihud (2002) shows that this measure is strongly positively related to microstructure estimates of illiquidity for the U.S. stock market. Lesmond (2005) reports a high correlation between the Amihud measure and bid-ask spreads in 23 emerging markets. Hasbrouck (2009) and Goyenko, Holden, and Trzcinka (2009) show that the Amihud measure performs well relative to other proxies in capturing high-frequency measures of liquidity based on U.S. data. Fong, Holden, and Trzcinka (2017) show that the Amihud measure is among the best monthly price impact proxies to capture high-frequency price impact measures based on global data. In contrast to high-frequency measures of liquidity, we can readily compute the Amihud measure using daily data for a large number of countries. Many recent empirical studies use the Amihud measure to assess stock market liquidity, both for the U.S. and for other countries (e.g.,Acharya and Pedersen 2005; Spiegel and Wang 2005; Avramov, Chordia, and Goyal 2006; Kamara, Lou, and Sadka 2008; Watanabe and Watanabe 2008; Beber and Pagano 2013; Amihud, Hameed, Kang, and Zhang 2015).

In constructing the Amihud measure, we stay close to the procedure described in Karolyi, Lee, and van Dijk (2012). We set all non-trading days, non-trading months, and outliers to missing. We consider a day to be a non-trading day if more than 90% of the stocks on a given exchange have a daily return equal to zero; we consider a month for a particular stock to be a non-trading month if zero-return days make up more than 80% of the total number of days in the month. We define a daily return for a particular stock as an outlier if it is in the top or bottom 0.1% of the cross-sectional distribution of daily returns on that day within the same country.

We calculate the Amihud measure per stock per day as:

$$Liq_{i,d} = -10,000 \times \ln\left(1 + \frac{|R_{i,d}|}{P_{i,d} \times VO_{i,d}}\right) \tag{3.1}$$

where $R_{i,d}$ is the return of stock i on day d, $P_{i,d}$ is the price, and $VO_{i,d}$ is the trading volume in number of shares. In Equation 3.1, we take natural logs of the standard Amihud proxy (absolute stock return divided by local currency trading volume) to reduce the impact of outliers, and we multiply the resulting measure by -10,000 to make it increasing in liquidity and to avoid very small values. The Amihud measure takes on values of negative infinity on days when there is no trading volume on a particular day for a particular stock; we set these values to missing. We average the liquidity over all trading days per month to obtain a monthly measure of liquidity for stock i.

3.2.2.2 Stock level returns

We calculate monthly returns per stock from Datastream's return index (RI) and CRSP's holding period returns (RET). We use the filter suggested by Ince and Porter (2006) and discard a monthly stock return if $(1+R_{i,m})(1+R_{i,m-1}) \leq 0.5$, where $R_{i,m}$ is the return of stock i in month m and where $R_{i,m}$ or $R_{i,m-1}$

is larger than 300

3.2.2.3 Stock level turnover

To measure turnover, we follow Karolyi, Lee, and van Dijk (2012). We calculate our turnover series as:

$$Turn_{i,d} = \ln\left(1 + \frac{UVO_{i,d}}{NOSH_{i,d}}\right) - \frac{1}{100}\sum_{k=1}^{100} \ln\left(1 + \frac{UVO_{i,d-k}}{NOSH_{i,d-k}}\right) \tag{3.2}$$

where $UVO_{i,d}$ is the unadjusted trading volume of stock i on day d, and $NOSH_{i,d}$ is the unadjusted number of shares outstanding. The second term on the right hand side of the equation is a moving average of past turnover; our turnover series is a deviation in turnover from this moving average. A similar approach is taken in other studies (e.g., Griffin, Nardari, and Stulz, 2007; Lo and Wang, 2000).

3.2.2.4 Additional filters on stock market data and aggregation to the country level

We set all monthly stock level liquidity, returns, and turnover values to missing if the stock has a monthly price at the end of the previous month in the top or bottom 1% of the cross-sectional distribution within a country, or if the stock has a monthly return, monthly liquidity, or monthly turnover in the current month in the top or bottom 1% of the cross-sectional distribution within a country.

To obtain country level series, we average the monthly stock level liquidity, returns, and turnover across all stocks within a country, weighting the stock level series with their market capitalization. Subsequently, we average the monthly country level variables across the months within a quarter to obtain quarterly country level variables. Finally, we winsorize the quarterly country level time-series of liquidity and turnover at the 1st and 99th percentile by country.

The country level Amihud liquidity proxy improves mechanically with increases in stock market capitalization. To remedy this, we follow Acharya and Pedersen (2005) and scale the liquidity series by country with the ratio of the market capitalization lagged by one quarter and the first available market capitalization for that country in the sample period:

$$Liq\_Scaled_{c,q} = liq_{c,q} \times \frac{MV_{c,0}}{MV_{c,q}} \tag{3.3}$$

where $liq_{c,q}$ is the liquidity in country c at quarter q, and $MV_{c,q}$ is the total market value in country c at quarter q.

3.2.3 Other variables

We obtain estimates of quarterly return volatility by country as the standard deviation of daily market returns within a quarter. We construct a quarterly time-series of liquidity risk by country as the conditional volatility of country level liquidity based on a GARCH(1,1) model estimated by country over the whole sample period. To obtain country level proxies for idiosyncratic volatility and stock price synchronicity, we follow Morck, Yeung, and Yu (2000) and first estimate a regression of daily individual stock returns on daily market returns per quarter for each individual stock. We require at least 15 non-missing observations per regression. From these regressions, we calculate the R2 per stock per quarter, and the idiosyncratic volatility per stock per quarter. We take the average of these series, weighted by market capitalization, to obtain the average country level R2 as well as country level idiosyncratic volatility. To obtain our measure of stock price synchronicity, we logistically transform the average country level R^2 to prevent that its values always fall within the interval [0,1]. We obtain data on the country level price-to-book value (PTBV), price-earnings ratio (PE), and dividend yield (DY) from Datastream. As proxies for macroeconomic conditions, we download data on GDP growth, sales growth, a leading economic indicator, and closed-end funds from the IMF, OECD, and Bloomberg. A detailed description of all variable definitions and data sources is included in the Appendix of this paper.

3.2.4 Unit roots, first differencing

For each country, the number of issues and the liquidity variables are tested for stationarity using Augmented Dickey-Fuller (ADF) tests. For several countries, non-stationarity cannot be rejected for one or both variables. This may be due to the low power of the ADF tests to reject the null of non-stationarity or due to the variables being truly non-stationary in nature. To avoid any potential issues related to non-stationarity, we take the first difference of both the number of issues by country and of country level liquidity. After taking first differences of the number of issues and the liquidity variables, non-stationarity of both variables is rejected for all countries in the sample.

Due to differences in trading volume definitions and currency values, the means and standard deviations of the country level liquidity variable are not comparable across countries. To enhance comparability, we therefore demean and standardize each of the (changes in the) country level variables included in the regressions by country. A beneficial side effect of this transformation is that it facilitates the interpretation of the regression coefficients later on.

3.2.5 Summary statistics

Table 1 provides summary statistics for our sample. We have 22 exchanges from developed countries, representing 21 countries. We have 16 emerging countries. In total, we have 37 countries and 38 markets. The number of issues per country varies greatly. Australia has the largest number of issues and Portugal has the smallest number. In total, we have 45,840 issues. More than three quarters of the issues are in developed countries. Of the total number of equity issues, 35,401 are SEOs and 10,439 are IPOs. The U.S. has the most IPOs. Table 1 shows the average and standard deviation of stock returns. All countries have positive arithmetic average returns over our sample period. The lowest standard deviation of returns is for New Zealand and the highest is for India. On average, emerging markets have a higher arithmetic average return and a higher standard deviation over our sample period.

The level of the Amihud liquidity measure is not comparable across countries because of differences in trading volume definitions and currency units. However, the standard deviation of the measure scaled by the absolute value of the mean gives a sense of the volatility of Amihud liquidity that is comparable across countries. Canada has the lowest (standardized) volatility of Amihud liquidity among developed countries. Amihud liquidity is considerably more volatile in emerging countries. Amihud liquidity volatility scaled by the absolute value of the mean averages 0.650 in developed countries and 1.066 in emerging countries.

Table 3.1. Summary statistics

This table reports the total number of equity issues (IPOs and SEOs from SDC), the number of IPOs, the number of SEOs, the time-series average and standard deviation (based on quarterly data) of local stock market returns (expressed in % per day), the standard deviation of local market liquidity scaled by the absolute value of the time-series average, and the time-series average of local market volatility for each of the 38 markets (37 countries; Nasdaq and NYSE are included separately) in our sample. The sample covers the period 1995Q1-2014Q4 (with the exception of Brazil and Germany, for which the data start in 2000Q1; Egypt, for which the data start in 1996Q4, and Russia, for which the data start in 2000Q1). Market returns are value-weighted average returns of common stocks from CRSP for the U.S., and from Datastream for the other countries. Market liquidity is the value-weighted average across stocks of the average daily estimates by month of Amihud's (2002) price impact proxy for individual stocks – computed as the absolute stock return divided by local currency trading volume (and multiplied by -10,000 to obtain a measure that is increasing in liquidity). Market volatility is the standard deviation of daily market returns within a quarter. The table also depicts the total number of equity issues and the average of the other variables for developed countries and for emerging countries, as well as the grand total / average for developed and emerging countries jointly.

	# equity issues	**# IPOs**	**# SEOs**	**market returns**		**market liquidity**	**market volatility**
				mean	st.dev.	st.dev. /|mean|	mean
Developed countries							
Australia	17,558	1,516	16,042	0.061	0.114	0.537	0.018
Austria	72	28	44	0.053	0.19	0.425	0.011
Belgium	155	62	93	0.05	0.18	0.68	0.011
Canada	2,233	282	1,951	0.072	0.123	0.357	0.009
Denmark	178	54	124	0.068	0.165	0.891	0.02
Finland	163	53	110	0.077	0.212	0.481	0.013
France	700	325	375	0.062	0.159	0.425	0.011
Germany	737	301	436	0.033	0.176	0.386	0.012
Hong Kong	1,999	450	1,549	0.071	0.203	0.773	0.014
Israel	108	23	85	0.073	0.176	0.564	0.011
Italy	238	123	115	0.057	0.179	1.89	0.014
Japan	1,773	389	1,384	0.039	0.161	0.515	0.012
New Zealand	222	49	173	0.051	0.111	0.382	0.008
Norway	445	106	339	0.073	0.176	0.844	0.012
Singapore	900	281	619	0.052	0.177	0.709	0.011
Spain	127	28	99	0.052	0.161	0.621	0.012
Sweden	420	65	355	0.073	0.165	0.698	0.013
Switzerland	137	42	95	0.052	0.136	0.491	0.01
The Netherlands	188	42	146	0.06	0.187	0.856	0.013
United Kingdom	1,754	379	1,375	0.057	0.114	0.639	0.01
United States: Nasdaq	6,346	2,685	3,661	0.096	0.185	0.621	0.014
United States: NYSE	2,068	613	1,455	0.065	0.113	0.523	0.01
Total/average	38,521	7,896	30,625	0.061	0.162	0.65	0.012

Table 3.1, continued

	# equity issues	# IPOs	# SEOs	market returns		market liquidity	market volatility
				mean	st.dev.	st.dev. /|mean|	mean
Emerging countries							
Brazil	251	71	180	0.126	0.2	2.368	0.014
Chile	194	20	174	0.06	0.153	1.304	0.008
Colombia	52	3	49	0.104	0.294	0.631	0.012
Egypt	159	18	141	0.071	0.27	0.952	0.014
Greece	162	103	59	0.035	0.307	0.991	0.018
India	2,303	1,040	1,263	0.095	0.31	0.599	0.012
Indonesia	331	197	134	0.138	0.297	1.927	0.016
Malaysia	1,120	427	693	0.053	0.216	0.811	0.01
Mexico	71	20	51	0.088	0.152	0.929	0.012
Philippines	204	57	147	0.075	0.206	1.169	0.012
Poland	300	164	136	0.072	0.218	1.039	0.014
Portugal	39	7	32	0.038	0.2	0.7	0.011
Russia	209	17	192	0.082	0.3	1.707	0.02
South Africa	154	24	130	0.082	0.136	0.548	0.01
South Korea	1,182	170	1,012	0.07	0.268	0.504	0.016
Thailand	588	205	383	0.064	0.252	0.88	0.014
Total/average	7,319	2,543	4,776	0.078	0.236	1.066	0.013
Developed and emerging countries							
Grand total/average	45,840	10,439	35,401	0.068	0.193	0.825	0.013

3.3 Does liquidity help explain time-variation in equity issuance?

Table 2 shows the results of panel regressions of changes in equity issuance on changes in liquidity, market returns, and lagged issuance changes. The change in equity issuance is the quarterly change in the equity issuance count variable, i.e., the number of IPOs and SEOs. There is no need to include country fixed effects since all variables are demeaned. To be conservative, we include quarter fixed effects – analogous to one dummy for each year-quarter combination (as opposed to four quarterly dummies) – to account for any common global trends, although they subsume some of the time-variation in equity issuance that could potentially be due to liquidity changes, such as the global drop in liquidity in the last quarter of 2008. An additional benefit of quarter fixed effects is that they account for potential seasonality, as prior studies (e.g., Lowry, 2003) argue that there may be institutional reasons that cause equity issuance to be less intense in the first calendar quarter. We report both the overall R2 and the within R2 that indicates the fraction of variation in the dependent variable after removing quarter fixed effects that can be explained by the independent variables. Standard errors are clustered by country and by quarter.

Model (1) of Table 2 includes the one-quarter lead change in market liquidity, the contemporaneous change, four quarterly lagged changes, the same leads and lags for market returns, and one lag of the change in the equity issuance count variable. We include market returns as it is well-accepted that equity issuance is related to market performance. We include lagged equity issuance changes because equity issuance can be partly explained by recent equity issuance. The coefficients on contemporaneous liquidity changes and

Table 3.2. Panel regressions of changes in equity issuance on changes in market liquidity and market returns

This table reports coefficient estimates of panel regressions using quarterly data from 38 countries (NYSE and Nasdaq counted separately) over the period 1995Q1-2014Q4. The dependent variable is the change in the number of equity issues (common stock IPOs and SEOs from SDC). Independent variables include lead, contemporaneous, and lagged changes in local market liquidity, local market returns, and lagged dependent variables. Variable definitions are in the Appendix. All variables are demeaned and standardized by country, so any coefficient can be interpreted as the effect in standard deviations on the dependent variable of a one standard deviation shock to the independent variable corresponding to that coefficient. Standard errors are clustered by country and quarter. Significance at the 1%, 5% and 10% level is indicated by ***, **, and *.

Dependent variable:				Δ ***number of issues (t)***			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ *market liquidity (t+2)*			0.00				
Δ *market liquidity (t+1)*	-0.01	-0.02	-0.02			-0.03	
Δ *market liquidity (t)*	0.10***	0.08***	0.08***	0.09***		0.09***	
Δ *market liquidity (t-1)*	0.07***	0.08**	0.08**	0.08**		0.08***	
Δ *market liquidity (t-2)*	0.03*	0.07***	0.07***	0.06***		0.07***	
Δ *market liquidity (t-3)*	0.04***	0.08***	0.08***	0.07***		0.08***	
Δ *market liquidity (t-4)*	0.00	0.02	0.02			0.02	
Δ *market liquidity (t-5)*			0.01				
Δ *market liquidity (t-6)*			0.00				
Δ *market liquidity (t-4:t-1)*					0.20***		
market returns (t+1)	0.01	0.01	0.00				0.00
market returns (t)	0.09***	0.11***	0.11***	0.11***			0.12***
market returns (t-1)	0.07***	0.10***	0.10***	0.10***			0.11***
market returns (t-2)	0.02	0.05*	0.05	0.06**			0.05
market returns (t-3)	0.03	0.07***	0.07***	0.07***			0.06***
market returns (t-4)	0.02	0.04	0.04				0.02
market returns (t-4:t-1)					0.24***		
Δ *number of issues (t-1)*	-0.40***	-0.56***	-0.56***	-0.56***	-0.55***	-0.55***	-0.55***
Δ *number of issues (t-2)*		-0.37***	-0.36***	-0.37***	-0.36***	-0.35***	-0.37***
Δ *number of issues (t-3)*		-0.23***	-0.24***	-0.23***	-0.23***	-0.22***	-0.24***
Quarter fixed effects	yes	yes	yes	yes	yes	yes	yes
$N_{observations}$	2,837	2,831	2,787	2,864	2,880	2,831	2,853
$N_{countries}$	38	38	38	38	38	38	38
R^2_{within} (%)	17.4	26.9	26.7	26.7	24.8	25.4	25.8
R^2 (%)	28.8	37.0	37.0	36.7	35.1	35.7	35.9

the first three lags of liquidity changes are all positive and statistically significant. With the scaling we use, the one-quarter lagged liquidity coefficient of 0.07 indicates that a one standard deviation increase in liquidity in quarter t 1 is associated with an increase in equity issuance in quarter t corresponding to 7% of the standard deviation of equity issuance. A contemporaneous change in liquidity has a slightly bigger impact, at 0.10. The sum of all six liquidity coefficients is 0.23. The lead change in liquidity is not significant, so that firms do not appear to be able to time liquidity changes.

The coefficients on market returns are generally insignificant except for the contemporaneous coefficient which is 0.09 and the first lag which is 0.07. The sum of all six return coefficients in Model (1) is 0.24. Again, the lead coefficient is not significant, so that firms do not appear to be able to time aggregate market movements.

We see that the first lag of the dependent variable is highly significant with a negative coefficient. The coefficient is -0.40, so that a one standard deviation increase in equity issuance implies a decrease of almost half that increase the next quarter, indicating strong mean reversion in equity issuance.

In Model (2), we use three lags of the dependent variable and find that all of them are significant. With three lags of the dependent variable, the contemporaneous change in market liquidity as well as the first three lags are again significant. If we add further lags of the dependent variable to Model (2) (not tabulated), the coefficients on the additional lags drop sharply and our inferences are unaffected.

We now consider the economic significance of the liquidity effects in more detail. The sum of the coefficients on the liquidity variables is a straightforward indication of the overall effect of variation in liquidity on variation in equity issuance that we use throughout the paper. In Model (2), the sum of all six liquidity coefficients is 0.31. Since the coefficients can be interpreted as the effect in standard deviations of the dependent variable when the independent variables are shocked by one standard deviation, the liquidity effects are economically sizable. An alternative way to assess economic significance is to trace the effect of a one-time, one standard deviation shock to liquidity on the development evolution of equity issuance over subsequent quarters. To do so, we have to take into account the impact of the lags of the dependent variable because shocks to liquidity not only affect future equity issuance directly, but also indirectly through the lagged dependent variable. Taking these effects into account, the three significant liquidity coefficients at lags one through three in Model (2) indicate that a one standard deviation shock to liquidity is associated with an economically substantial 0.14 standard deviation cumulative shock to equity issuance over the subsequent three quarters.

The three significant return coefficients in Model (2) indicate that a one standard deviation shock to returns is associated with a 0.13 standard deviation cumulative shock to issuance over the next three quarters, which is similar to the effect of a shock to liquidity. We note that the fact that the sum of the lagged dependent variables is more negative than -1 does not indicate that there is more than mean reversion in the number of issues. A one standard deviation increase in issuance is associated with a 0.56 decrease in issuance over the next quarter, a 0.056 decrease over the next two quarters, and a 0.01 increase over the next three quarters. In other words, there is strong mean reversion in the dependent variable quarter-to-quarter, but, due to the interaction of the negative coefficients on the lagged dependent variable at different lags, the cumulative effect of a shock to the dependent variable actually almost dampens out two and three quarters ahead.

In Model (3), we add one additional lead change in market liquidity and two additional lagged changes. Doing so has no material impact on our inferences and the added variables do not have significant coefficients. When we remove the lead changes for market liquidity and market returns in Model (4), our inferences are also not affected. In Model (5), instead of using lags of market liquidity changes and market returns, we use the cumulative change in liquidity and the cumulative market return from quarter t-4 to t-1. We find that the coefficients on the cumulative change in market liquidity and on the cumulative market return are similar (0.20 versus 0.24) and that both coefficients are significant at the 1

In all the regressions shown so far, we include both changes in market liquidity and stock returns. An obvious concern is that these variables are correlated, in that it is known from the literature that improvements in liquidity are associated with positive stock returns (e.g., Amihud and Mendelson, 1986; Chordia, Huh, and Subrahmanyam, 2009; Bali, Peng, Shen, and Tang, 2014). Model (6) shows estimates when we omit stock returns. We see that the coefficients on liquidity changes are mostly unaffected. When we omit changes in liquidity in Model (7), we find that the coefficients on returns are mostly unchanged as well. It follows that our inferences about the economic importance of liquidity changes relative to stock returns in explaining variation in equity issuance are not sensitive to the correlation between liquidity changes and returns. However, we note that both the within R2 and the overall R2 of Model (7) are slightly greater than those of Model (6).

3.4 Is the relation between liquidity and equity issuance due to other factors?

The results in the previous section show that equity issuance is positively related to liquidity, even after controlling for market returns. It is well-known that liquidity is related to financial market conditions as well as to macroeconomic conditions (e.g., Chordia, Roll, and Subrahmanyam, 2001; Chordia, Sarkar, and Subrahmanyam, 2005; Næs, Skjeltorp, and Ødegaard, 2011) and that financial market conditions and macroeconomic conditions are related to equity issuance (e.g., Lowry, 2003). Hence, it could be the case that our liquidity variables proxy for other factors that affect equity issuance and are correlated with liquidity. In this section, we investigate whether the effects of liquidity can be explained by other financial and economic variables, including capital market conditions, (expected) economic activity, asymmetric information, and investor sentiment.

3.4.1 Market conditions, liquidity, and equity issuance

We turn first to regressions that add variables that proxy for market conditions to our benchmark regression. The results are shown in Table 3, where Model (1) is our benchmark regression (Model (2) of Table 2) reproduced to make comparisons easier.

In Model (2) of Table 3, we add lead, contemporaneous, and lagged changes in market volatility to our benchmark model that includes market liquidity and returns. Our measure of market volatility is the standard deviation of daily market returns during that quarter. We know that liquidity is negatively related to volatility (e.g., Chordia, Sarkar, and Subrahmanyam, 2005), and Schill (2004) shows that there are fewer equity issues in volatile

Table 3.3. Panel regressions of changes in equity issuance on changes in market liquidity: Controlling for market conditions

This table reports coefficient estimates of panel regressions using quarterly data from 38 countries (NYSE and Nasdaq counted separately) over the period 1995Q1-2014Q4. The dependent variable is the change in the number of equity issues (common stock IPOs and SEOs from SDC). Independent variables include lead, contemporaneous, and lagged changes in local market liquidity, local market returns, changes in local market volatility, changes in local market turnover, changes in local market liquidity risk, changes in the local market-to-book ratio, changes in the local price-earnings ratio, changes in the local dividend-price ratio, changes in the local dividend yield, and lagged dependent variables. Variable definitions are in the Appendix. In Model (1) of this table, we reproduce the benchmark regression Model (2) of Table 2. All variables are demeaned and standardized by country, so any coefficient can be interpreted as the effect in standard deviations on the dependent variable of a one standard deviation shock to the independent variable corresponding to that coefficient. Standard errors are clustered by country and quarter. Significance at the 1%, 5% and 10% level is indicated by ***, **, and *.

times using U.S. data. It is thus possible that the effects of liquidity in Table 2 capture the role of market volatility. Surprisingly, none of the changes in market volatility have a significant coefficient in our global dataset. Adding changes in market volatility to the regression has no material impact on our inferences about the relation between equity issuance and market liquidity from Table 2.

Baker and Stein (2004) argue that market liquidity is a sentiment indicator and that periods of positive sentiment coincide with intense equity issuance. Using turnover as a liquidity proxy, they show that liquidity is positively correlated with aggregate time-variation in U.S. equity issuance. Model (3) of Table 3 shows that the relation between liquidity and equity issuance in our global sample is not driven by turnover since adding turnover changes has no material impact on the coefficient on market liquidity changes. It is interesting to note that, controlling for market liquidity changes, turnover

3.3, continued

Dependent variable:	*Δ number of issues (t)*							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ *market liquidity (t+1)*	-0.02	-0.01	-0.01	-0.02	-0.01	-0.01	-0.01	-0.01
Δ *market liquidity (t)*	0.08***	0.08***	0.08***	0.09***	0.08***	0.08***	0.07***	0.08***
Δ *market liquidity (t-1)*	0.08**	0.08**	0.08**	0.09***	0.08**	0.08**	0.07**	0.07**
Δ *market liquidity (t-2)*	0.07***	0.08***	0.07***	0.07***	0.07***	0.07***	0.06***	0.06***
Δ *market liquidity (t-3)*	0.08***	0.08***	0.07***	0.07***	0.07***	0.06***	0.06***	0.05***
Δ *market liquidity (t-4)*	0.02	0.02	0.01	0.02	0.01	0.01	0.01	0.01
market returns (t+1)	0.01	0.01	0.02	0.01	0.02	0.02	0.02	0.04*
market returns (t)	0.11***	0.11***	0.11***	0.11***	0.07***	0.11***	0.07**	0.04
market returns (t-1)	0.10***	0.09***	0.08***	0.1***	0.07***	0.08***	0.05*	0.02
market returns (t-2)	0.05*	0.06**	0.05*	0.06*	0.03	0.03	0.03	0.01
market returns (t-3)	0.07***	0.08***	0.06***	0.08***	0.05	0.05*	0.06*	0.04
market returns (t-4)	0.04	0.04	0.03	0.04	0.04	0.04	0.05	0.04
Δ *market volatility (t+1)*		0.05						0.07**
Δ *market volatility (t)*		-0.02						-0.01
Δ *market volatility (t-1)*		0.01						-0.02
Δ *market volatility (t-2)*		0.04						0.02
Δ *market volatility (t-3)*		0.05						0.02
Δ *market volatility (t-4)*		0.03						0.01
Δ *market turnover (t+1)*			-0.08***					-0.10***
Δ *market turnover (t)*			-0.15***					-0.16***
Δ *market turnover (t-1)*			-0.10**					-0.08*
Δ *market turnover (t-2)*			-0.09*					-0.06
Δ *market turnover (t-3)*			-0.04					-0.02
Δ *market turnover (t-4)*			0.00					0.02
Δ *market liquidity risk (t+1)*				0.06**				0.06**
Δ *market liquidity risk (t)*				0.01				0.01
Δ *market liquidity risk (t-1)*				-0.01				-0.01
Δ *market liquidity risk (t-2)*				0.01				0.00
Δ *market liquidity risk (t-3)*				0.01				0.00
Δ *market liquidity risk (t-4)*				0.01				0.01
Δ *market-to-book ratio (t+1)*					0.05**			0.05**
Δ *market-to-book ratio (t)*					0.04			0.01
Δ *market-to-book ratio (t-1)*					0.02			0.01
Δ *market-to-book ratio (t-2)*					0.04			0.03
Δ *market-to-book ratio (t-3)*					0.01			0.00
Δ *market-to-book ratio (t-4)*					0.00			0.01
Δ *price-earnings ratio (t+1)*						0.01		-0.01
Δ *price-earnings ratio (t)*						0.04**		0.03
Δ *price-earnings ratio (t-1)*						0.05*		0.03
Δ *price-earnings ratio (t-2)*						0.05***		0.04*
Δ *price-earnings ratio (t-3)*						0.01		0.00
Δ *price-earnings ratio (t-4)*						0.01		0.01
Δ *dividend-yield (t+1)*							-0.08***	-0.07***
Δ *dividend-yield (t)*							-0.09***	-0.07***
Δ *dividend-yield (t-1)*							-0.06***	-0.05*
Δ *dividend-yield (t-2)*							-0.04	-0.03
Δ *dividend-yield (t-3)*							0.00	-0.01
Δ *dividend-yield (t-4)*							0.01	0.01
Δ *number of issues (t-1)*	-0.56***	-0.56***	-0.57***	-0.56***	-0.57***	-0.57***	-0.57***	-0.58***
Δ *number of issues (t-2)*	-0.37***	-0.37***	-0.38***	-0.37***	-0.39***	-0.38***	-0.39***	-0.39***
Δ *number of issues (t-3)*	-0.23***	-0.23***	-0.23***	-0.24***	-0.24***	-0.24***	-0.24***	-0.24***
Quarter fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
$N_{observations}$	2,831	2,831	2,831	2,825	2,671	2,673	2,673	2,666
$N_{countries}$	38	38	38	38	36	36	36	36
R^2_{within} (%)	26.9	27.2	27.5	27	27.6	27.7	28	29.3
R^2 (%)	37.0	37.3	37.6	37.2	37.1	37.1	37.4	38.6

changes have negative coefficients. The lead, contemporaneous, and two of the lagged coefficients are significant.

Model (4) shows that the contemporaneous relation between liquidity and equity issuance survives controlling for a proxy for liquidity risk (conditional liquidity volatility based on a GARCH(1,1) model estimated by country). Adding liquidity risk changes has no material impact on our estimates of the coefficients on liquidity changes.

Although we control for potential market timing effects using lead, contemporaneous, and lagged market returns, many studies use the market-to-book ratio as a proxy for market timing (e.g., DeAngelo, DeAngelo, and Stulz, 2010). Huang and Ritter (2016) use Tobin's q instead of market-to-book, but the two measures are typically highly correlated. Since more liquid firms in the U.S. have a higher market-to-book ratio (Fang, Noe, and Tice, 2009), we want to make sure that liquidity is not picking up the effect of market-to-book. We use a measure of the aggregate market-to-book ratio, which is obtained by summing up the market capitalization of all individual stocks in a country and dividing by the sum of equity book values. Again, our inferences are not meaningfully affected by controlling for changes in the market-to-book ratio. The sum of the coefficients on market-to-book changes is 0.16, which is smaller than the sum of the coefficients for market liquidity of 0.30. (We note that coefficients can be directly compared across independent variables because they are standardized.) Perhaps not surprisingly, adding market-to-book has an adverse impact on the significance of the coefficients on market returns. Another measure of valuation that may be relevant for market timing is the price-earnings ratio. Again, adding that variable has no material impact on our results, as can be seen in Model (6). Lastly, we use the dividend-yield ratio. Not surprisingly, a higher dividend-yield ratio is negatively related to equity issuance changes. The lead, contemporaneous, and one-quarter lagged coefficients are significant. However, our inferences about the relation between equity issuance changes and liquidity changes are unaffected.

The last regression in Table 3, Model (8), uses all the variables introduced in Models (2) to (7). Obviously, these variables are correlated. It is noteworthy that adding all these variables to our benchmark model increases the within R2 by only 2.4% relative to Model (1). When we add all these variables, the magnitude of the coefficients on lagged liquidity changes is little affected. The contemporaneous and first three lags of liquidity changes still have significant coefficients. It is noteworthy that in this specification the lead of market returns has a positive significant coefficient, but none of the other market return variables have significant coefficients.

Though we do not reproduce the results in the table, we also estimate Model (2) of Table 2 adding proxies for the closed-end fund discount, which is used as a measure of sentiment (Lee, Shleifer, and Thaler, 1991). We construct the country closed-end fund discount variables in the same way as Karolyi, Lee, and van Dijk (2012). They construct time-series of local closed-end country fund discounts for 22 of the countries in our sample based on a sample of 42 closed-end funds. Unfortunately, because of the limited availability of the closed-end fund discounts, our sample drops in half. Adding these variables has no impact on our inferences.

3.4.2 Macroeconomic conditions, liquidity, and equity issuance

It is well-known that expectations about macroeconomic conditions are related to equity issuance as well as to liquidity. In Table 4, we investigate the relation between changes in equity issuance and changes in market liquidity when we control for changes in various proxies for macroeconomic conditions. Admittedly, some of the variables used in Table 4 could fit equally well in Table 3. As with Table 3, we reproduce our benchmark regression Model (2) of Table 2 in the first column of the Table to make comparisons easier.

Table 3.4. Panel regressions of changes in equity issuance on changes in market liquidity: Controlling for macro conditions

This table reports coefficient estimates of panel regressions using quarterly data from 38 countries (NYSE and Nasdaq counted separately) over the period 1995Q1-2014Q4. The dependent variable is the change in the number of equity issues (common stock IPOs and SEOs from SDC). Independent variables include lead, contemporaneous, and lagged changes in local market liquidity, local market returns, business cycle proxies (GDP growth, sales growth, and leading economic indicator growth), asymmetric information proxies (changes in local stock price synchronicity and changes in idiosyncratic volatility), and lagged dependent variables. Variable definitions are in the Appendix. In Model (1) of this table, we reproduce the benchmark regression Model (2) of Table 2. All variables are demeaned and standardized by country, so any coefficient can be interpreted as the effect in standard deviations on the dependent variable of a one standard deviation shock to the independent variable corresponding to that coefficient. Standard errors are clustered by country and quarter. Significance at the 1%, 5% and 10% level is indicated by ***, **, and *.

Recent studies show that liquidity forecasts economic activity (e.g., Næs, Skjeltorp, and Ødegaard, 2011) and we know from the equity issuance literature that firms issue more equity in anticipation of better economic conditions. Following Lowry (2003), we proxy for expectations about economic conditions using GDP growth in Model (2) and sales growth in Model (3) of Table 4. Lowry introduces these variables as proxies for the demand for capital. Adding the lead, contemporaneous, and four lags of GDP growth does not affect the coefficients on market liquidity materially and does not change our inferences. None of the coefficients on GDP growth are significant. Surprisingly, the coefficients are not only statistically insignificant, but they

3.4, continued

Dependent variable:	***Δ number of issues (t)***						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ *market liquidity (t+1)*	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Δ *market liquidity (t)*	0.08***	0.08***	0.07***	0.08***	0.08***	0.08***	0.06***
Δ *market liquidity (t-1)*	0.08**	0.04*	0.05*	0.06**	0.09***	0.08**	0.05*
Δ *market liquidity (t-2)*	0.07***	0.07***	0.07***	0.08***	0.07***	0.07***	0.08***
Δ *market liquidity (t-3)*	0.08***	0.07***	0.07***	0.07***	0.08***	0.08***	0.09***
Δ *market liquidity (t-4)*	0.02	0.02	0.02	0.02	0.02	0.02	0.03
market returns (t+1)	0.01	-0.02	-0.02	-0.02	0.00	0.01	-0.03
market returns (t)	0.11***	0.10***	0.11***	0.10***	0.11***	0.10***	0.10***
market returns (t-1)	0.10***	0.07**	0.06**	0.06**	0.10***	0.09***	0.05
market returns (t-2)	0.05*	0.07*	0.07*	0.07*	0.05*	0.05*	0.07
market returns (t-3)	0.07***	0.07***	0.07***	0.08***	0.08***	0.07***	0.09***
market returns (t-4)	0.04	0.02	0.02		0.04	0.04	0.02
GDP growth (t+1)		0.00					-0.02
GDP growth (t)		-0.03					0.00
GDP growth (t-1)		0.03					0.05
GDP growth (t-2)		-0.02					-0.03
GDP growth (t-3)		-0.02					-0.08
GDP growth (t-4)		0.03					0.08*
sales growth (t+1)			0.00				0.01
sales growth (t)			0.04				0.04
sales growth (t-1)			-0.05				-0.05
sales growth (t-2)			-0.05**				-0.05**
sales growth (t-3)			0.04*				0.05***
sales growth (t-4)			0.00				-0.01
leading economic indicator growth (t+1)				0.03			0.15
leading economic indicator growth (t)				0.13			-0.46*
leading economic indicator growth (t-1)				-0.31			0.74**
leading economic indicator growth (t-2)				0.48			-0.69*
leading economic indicator growth (t-3)				-0.56			0.43
leading economic indicator growth (t-4)				0.45			-0.14
Δ *idiosyncratic volatility (t+1)*				-0.17	0.03		0.02
Δ *idiosyncratic volatility (t)*					-0.01		-0.07
Δ *idiosyncratic volatility (t-1)*					0.01		0.01
Δ *idiosyncratic volatility (t-2)*					0.07***		0.05
Δ *idiosyncratic volatility (t-3)*					0.02		0.01
Δ *idiosyncratic volatility (t-4)*					0.02		0.05*
Δ *stock price synchronicity (t+1)*						0.04	0.06**
Δ *stock price synchronicity (t)*						0.00	-0.01
Δ *stock price synchronicity (t-1)*						-0.01	-0.01
Δ *stock price synchronicity (t-2)*						-0.01	-0.02
Δ *stock price synchronicity (t-3)*						0.01	0.04
Δ *stock price synchronicity (t-4)*						0.01	0.04
Δ *number of issues (t-1)*	-0.56***	-0.58***	-0.58***	-0.58***	-0.56***	-0.56***	-0.58***
Δ *number of issues (t-2)*	-0.37***	-0.38***	-0.39***	-0.37***	-0.37***	-0.37***	-0.38***
Δ *number of issues (t-3)*	-0.23***	-0.25***	-0.25***	-0.25***	-0.24***	-0.23***	-0.25***
Quarter fixed effects	yes	yes	yes	yes	yes	yes	yes
$N_{observations}$	2,831	2,322	2,155	2,303	2,815	2,815	2,091
$N_{countries}$	38	32	30	31	38	38	29
R^2_{within}(%)	26.9	28.5	28.6	28.3	27.2	27.0	29.4
R^2 (%)	37.0	40.3	41.3	40.0	37.3	37.1	42.1

are economically small as well. In Model (3), we reach similar conclusions when we add sales growth. In Model (4), we include the composite leading economic indicator of the OECD (only available for OECD countries). None of the coefficients are significant. Adding the leading indicator has no material impact on our inferences.

It is well-documented that the liquidity of a stock is inversely related to the degree of asymmetric information about the stock's value. More asymmetric information is also likely to lead to greater costs of raising equity capital, so changes in information asymmetries could influence liquidity and equity issuance simultaneously and in the same direction. As argued in the introduction, this identification issue is unlikely to be of great concern in our analysis of the relation between aggregate liquidity and aggregate equity issuance. Nonetheless, it may be the case that market-wide fluctuations in information asymmetries affect aggregate liquidity and aggregate issuance at the same time and in a similar way. In Model (5) of Table 4, we include a proxy for market-wide variation in information asymmetries, namely a measure of aggregate idiosyncratic volatility. The idiosyncratic volatility proxy is computed as the value-weighted average of the residual volatility from market model regressions run for each individual stock within a country. We find again that our inferences from Table 2 are unaffected when we add changes in idiosyncratic volatility. The only coefficient that is significant for idiosyncratic volatility changes is the coefficient for lag two, which is positive with a value of 0.07. In Model (6), we add "stock price synchronicity" changes as an alternative proxy for information asymmetries. Stock price synchronicity is computed as the value-weighted average R2 from market model regressions run for each individual stock within a country. Morck, Yeung, and Yu (2000) argue that greater stock price synchronicity is associated with less-informative stock prices. Our inferences are not affected by the inclusion of stock price synchronicity.

In Model (7) of Table 4, we include all control variables from Models (2)-(6) simultaneously. Although we lose degrees of freedom due to a considerable reduction in the sample size because variables are missing for some country-quarters, the coefficients on contemporaneous and the first three lags of liquidity changes remain significant. Overall, the results in Tables 3 and 4 suggest that the positive relation between market liquidity and aggregate equity issuance is unlikely to be due to economic or financial variables that are unrelated to the aggregate demand elasticity of the stock market, but could simultaneously affect liquidity and equity issuance for other reasons.

3.5 The determinants of the relation between equity issuance and liquidity change

In this section, we investigate the determinants of the relation between equity issuance changes and liquidity changes by exploring how the relation differs across countries, firm and issue types, time, and type of liquidity shocks. We also investigate whether there is a relation between changes in equity issuance proceeds (as opposed to counts) and liquidity changes.

Table 3.5. The determinants of the relation between changes in equity issuance and changes in liquidity

This table reports coefficient estimates of panel regressions using quarterly data from 38 countries (NYSE and Nasdaq counted separately) over the period 1995Q1-2014Q4. The dependent variables are the change in the number of equity issues and the change in the proceeds from equity issues (common stock IPOs and SEOs from SDC). Independent variables include lead, contemporaneous, and lagged changes in local market liquidity, local market returns, and lagged dependent variables. In Panel A, Model (1) reproduces the benchmark regression Model (2) of Table 2. In Models (2) and (3), the sample of issues is split into those by firms with positive and negative return on assets (ROA) in the year of the issue. In Models (4) and (5), the countries are split into financially developed and financially emerging, based on their average stock market capitalization to GDP over the sample period. Model (6) is the same as Model (1) but excludes the crisis period 2008Q1-2011Q4. Model (7) only includes the crisis period. In Panel B, Model (1) again reproduces the benchmark regression Model (2) of Table 2. In Models (2)-(5), the sample of issues is split into SEOs and IPOs; in Models (3) and (5), the crisis period is excluded. In Models (6) and (7), changes in proceeds are used as the dependent variable; in Model (7) the crisis period is excluded. Variable definitions are in the Appendix. All variables are demeaned and standardized by country, so any coefficient can be interpreted as the effect in standard deviations on the dependent variable of a one standard deviation shock to the independent variable corresponding to that coefficient. Standard errors are clustered by country and quarter (except in Model (5) of Panel B, where only clustering by quarter is used). Significance at the 1%, 5% and 10% level is indicated by ***, **, and *.

Table 3.5, continued

Panel A: Sample splits of ROA>0 vs. ROA<0, fin. developed vs. emerging, and without crisis vs. crisis only							
Dependent variable:	Δ ***number of issues (t)***						
	(1) full sample	(2) ROA>0	(3) ROA<0	(4) Financially Developed	(5) Financially Emerging	(6) without crisis	(7) crisis only
market liquidity (t+1)	-0.02	-0.01	-0.02	-0.02	-0.02	-0.04	0.01
Δ *market liquidity (t)*	0.08***	0.08***	0.05*	0.12***	0.04	0.08***	0.08*
Δ *market liquidity (t-1)*	0.08**	0.08***	0.04	0.14***	0.02	0.08***	0.08
Δ *market liquidity (t-2)*	0.07***	0.06***	0.02	0.06*	0.07*	0.07***	0.08**
Δ *market liquidity (t-3)*	0.08***	0.06***	0.05*	0.1***	0.06**	0.09***	0.06**
Δ *market liquidity (t-4)*	0.02	0.00	0.02	0.06	-0.02	0.01	0.04
market returns (t+1)	0.01	-0.02	0.04*	0.02	-0.02	-0.01	0.09
market returns (t)	0.11***	0.10***	0.06**	0.13***	0.08**	0.10***	0.14**
market returns (t-1)	0.10***	0.08**	0.05*	0.08*	0.11***	0.10***	0.06
market returns (t-2)	0.05*	0.04	-0.03	0.05	0.06	0.08**	-0.12**
market returns (t-3)	0.07***	0.02	0.02	0.10***	0.07**	0.07***	0.07
market returns (t-4)	0.04	0.05	-0.01	0.06	0.03	0.07*	-0.17***
Δ *number of issues (t-1)*	-0.56***	-0.60***	-0.64***	-0.51***	-0.63***	-0.54***	-0.61***
Δ *number of issues (t-2)*	-0.37***	-0.40***	-0.40***	-0.31***	-0.46***	-0.37***	-0.39***
Δ *number of issues (t-3)*	-0.23***	-0.21***	-0.2***	-0.24***	-0.25***	-0.23***	-0.25***
Quarter fixed effects	yes	yes	yes	yes	yes	yes	yes
$N_{observations}$	2,831	2,869	2,869	1,552	1,279	2,224	607
$N_{countries}$	38	38	38	20	18	38	38
R^2_{within} (%)	26.9	28.6	29.9	25.3	32.1	26.3	31.0
R^2 (%)	37.0	36.3	33.1	38.8	42.6	34.7	44.2

Table 3.5, continued

Panel B: Sample splits of SEOs vs. IPOs (with and without crisis) and proceeds as dependent variable							
Dependent variable:	Δ ***number of issues (t)***					Δ ***proceeds (t)***	
	(1) full sample	(2) SEOs	(3) SEOs without crisis	(4) IPOs	(5) IPOs without crisis	(6) full sample	(7) without crisis
Δ *market liquidity (t+1)*	-0.02	-0.02	-0.05*	-0.01	-0.02	-0.01	-0.04**
Δ *market liquidity (t)*	0.08***	0.09***	0.06**	0.02	0.05	0.02	0.01
Δ *market liquidity (t-1)*	0.08**	0.08**	0.07***	0.05***	0.07***	0.00	0.02
Δ *market liquidity (t-2)*	0.07***	0.05**	0.03**	0.07***	0.09***	0.01	0.03
Δ *market liquidity (t-3)*	0.08***	0.08***	0.07***	0.03**	0.06***	0.03	0.05**
Δ *market liquidity (t-4)*	0.02	0.01	0.00	-0.01	-0.01	-0.02	-0.02
market returns (t+1)	0.01	0.01	-0.01	0.00	0.00	0.00	0.01
market returns (t)	0.11***	0.11***	0.07**	0.05	0.07**	0.07**	0.05*
market returns (t-1)	0.10***	0.06**	0.08***	0.09***	0.08***	0.12***	0.13***
market returns (t-2)	0.05*	0.03	0.07**	0.02	0.03	0.03	0.05
market returns (t-3)	0.07***	0.06**	0.04**	0.06**	0.06*	0.07***	0.06**
market returns (t-4)	0.04	0.00	0.02	0.07**	0.08***	0.03	0.06*
Δ *number of issues (t-1)*	-0.56***	-0.55***	-0.56***	-0.63***	-0.63***		
Δ *number of issues (t-2)*	-0.37***	-0.37***	-0.39***	-0.35***	-0.36***		
Δ *number of issues (t-3)*	-0.23***	-0.23***	-0.21***	-0.19***	-0.20***		
Δ *proceeds (t-1)*						-0.65***	-0.65***
Δ *proceeds (t-2)*						-0.45***	-0.45***
Δ *proceeds (t-3)*						-0.25***	-0.24***
Quarter fixed effects	yes	yes	yes	yes	yes	yes	yes
$N_{observations}$	2,831	2,797	2,190	2,587	2,037	2,831	2,225
$N_{countries}$	38	38	38	38	38	38	38
R^2_{within} (%)	26.9	26.4	26.9	30.2	30.5	32.1	32.4
R^2 (%)	37.0	33.0	32.2	41.3	40.3	38.9	37.8

Firms may have to issue equity with different degrees of urgency. In particular, DeAngelo, DeAngelo, and Stulz (2010) show that many firms that issue equity would have a cash flow deficit without the equity issue. Huang and Ritter (2016) show more generally that firms that are likely to run out of funds issue securities. They take the view that, among firms that are likely to run out of funds, firms with low profitability and high leverage are firms that have no choice but to issue equity. We expect that if a firm has to issue equity with a great degree of urgency, variation in liquidity will not have much impact on its decision. To investigate this hypothesis, we split issuing firms into issuers that have positive return on assets in the year of the issue (ROA, obtained from Datastream) versus issuers that have negative return on assets. Firms with negative ROA are unlikely to postpone issuing equity because the market has become less liquid as they may require new funds simply to stay afloat.

We show the results in Panel A of Table 5. As before, Model (1) reproduces our benchmark model for comparison. Model (2) shows the regression estimates for the sub-sample of issuers with positive ROA. The coefficients on contemporaneous liquidity changes as well as the first three lags of liquidity changes are positive and significant. The sum of the coefficients on liquidity changes is 0.27. When we turn to the coefficients on market returns, the contemporaneous market return and the first lag are significant. The sum of the coefficients is 0.27. It follows that for these firms there is a strong relation between equity issuance changes and liquidity changes. When we turn to firms with negative ROA in Model (3), only the coefficients on contemporaneous and lag three of market liquidity changes are (marginally) significant. The sum of the coefficients is 0.16. Essentially, there is a much weaker relation between equity issuance changes and market liquidity changes for these firms. The coefficients on market returns are also smaller, but the lead, contemporaneous, and first lag of market returns have a significant coefficient. None of the coefficients exceeds 0.06.

We next investigate how the issuance/liquidity relation is affected by a country's financial development. There are good reasons to think that the equity issuance decision is different in financially developed countries versus other countries. In more financially developed countries, we expect firms to be better able to issue equity rapidly and take advantages of changes in circumstances. In such countries, the stock market is more established and deeper. There is a vast literature showing that firms in less financially developed countries often find it advantageous to issue equity outside their country, taking advantage of better developed stock markets (e.g., Henderson, Jegadeesh, and Weisbach, 2006). Our measure of financial development is the average of the annual ratio of aggregate stock market capitalization to GDP over our sample period (obtained from the World Bank) and we define financially developed countries as the ones in the top half of the sample based on this measure.

Model (4) in Panel A of Table 5 estimates the benchmark model for financially developed countries. The market liquidity change variables have significant positive coefficients contemporaneously and at lags one through three. The sum of the coefficients of 0.46 is almost 50% higher than that of the benchmark model. The sum of the coefficients on the stock return variables is only slightly larger than in the benchmark model, at 0.44. Hence, the economic importance of the coefficients on liquidity changes is substantial for financially developed countries, and about the same as the economic importance of the coefficients on stock returns. Turning to the less financially developed (or financially emerging) countries in Model (5), we see that no coefficient on liquidity changes is significant except for the second and third lag. The sum of the coefficients on liquidity changes is 0.15. The sum of the coefficients on stock returns is slightly smaller than in the benchmark regression, so we find that for less financially developed countries, there appears to be a much weaker relation between equity issuance changes and liquidity while there is a slightly weaker relation between equity issuance and stock returns. In unreported tests, we estimate Models (2)-(5) of Table 5 with additional variables, including leading economic indicators, turnover, changes in the price-earnings ratio, and changes in idiosyncratic volatility, and our conclusions are unchanged.

We consider next whether the impact of changes in liquidity on equity issuance is different during the financial crisis. We examine how our results depend on the crisis by identifying a crisis period from 2008 to 2011. This period is chosen to include the credit crisis and the European sovereign debt crisis. If we estimate the benchmark regression excluding the crisis period, the sum of the liquidity coefficients is 0.29. These estimates are shown in Model (6). We estimate the same model for the crisis period. The results are shown in Model (7). We find that the coefficients on the contemporaneous, and lags two and three of the liquidity coefficients are significant and the sum of the coefficients is 0.35. It follows that changes in liquidity during the crisis period have a similar effect as those outside of the crisis.

The regressions shown so far are based on the number of initial public offerings (IPOs) and seasoned equity issuances (SEOs) combined. An obvious question is whether our inferences hold separately for IPOs and SEOs. We show results in Panel B of Table 5. As before, the first regression in Panel

B reproduces our benchmark regression. Model (2) estimates our benchmark regression for SEOs only. We find that lags one, two and three as well as contemporaneous liquidity changes are significant. When we exclude the crisis period from the SEO sample in Model (3), we find that lead liquidity changes are also significant. This finding could be consistent with the idea that since it tends to be possible to execute SEOs at relatively short notice, firms may be able to time their SEOs ahead of decreasing market liquidity. Models (4) and (5) show that, with and without the crisis period, for IPOs, only the coefficients on the first three lags of liquidity changes are significant. The fact that contemporaneous and lead liquidity changes do not significantly affect IPOs fits with the idea that it is more costly to time IPOs than SEOs to take advantage of changes in liquidity. Overall, we conclude that the effect of liquidity on issuance obtains for both SEOs and IPOs.

Our last investigation in Panel B of Table 5 looks at the relation between the aggregate proceeds from equity issues (instead of the number of issues) and liquidity. In most countries, proceeds are noisy since an issue by a large firm can make a big difference in the total amount of proceeds. In contrast, whether a large firm issues instead of a small firm has no impact on the number of issues. Model (6) shows that when we include the crisis period there is no relation between changes in aggregate proceeds and changes in market liquidity. When we exclude the crisis period in Model (7), only the third lag of liquidity changes has a positive and significant coefficient. The lead of liquidity changes has a negative and significant coefficient, which is consistent with market timing.

3.6 Robustness

As a first additional check of the robustness of our main results, we investigate whether taking into account the effects of liquidity changes allows for better out-of-sample predictions of changes in equity issuance by performing a one-step-ahead forecasting exercise. While relevant in itself, this exercise also shows whether the liquidity effects found in the analyses so far are stable as opposed to sample-specific. To this end, we divide the sample period into an in-sample part and an out-of-sample part. We first estimate coefficients in-sample using a panel regression with quarter fixed effects, and subsequently use the estimated coefficients to make a one-quarter-ahead out-of-sample forecast of changes in equity issuance. We then compare the forecasts to the actual values in the out-of-sample part, expand the in-sample estimation window by one quarter and repeat the exercise. We continue until we reach the end of the sample period.

Panels A, B, and C of Table 6 show the mean-squared prediction errors (MSPEs), for in-sample starting periods of, respectively, the first 30%, 50%, and 70% of the sample period. Each panel contains two pairs of models. Model (1) is a benchmark model that represents a naive forecast: the forecast of next quarter's equity issuance changes equals the average change in equity issuance over the in-sample estimation window. In contrast, in Model (2), the forecast of next quarter's change in equity issuance is a function of the three significant lags of liquidity changes from Model (2) of Table 2. In Panels A, B and C, the MSPE is lower in Model (2) than in Model (1), both when the crisis period is included in the sample and when it is not. Diebold-Mariano tests (Diebold and Mariano, 1995) show that these decreases in prediction errors are significant. In other words, using liquidity changes to predict next quarter's equity issuance changes significantly improves forecasting performance relative to the naive forecast.

Table 3.6. Out-of-sample prediction of changes in equity issuance with changes in liquidity

This table reports mean-squared prediction errors (MSPEs) of out-of-sample forecasts of changes in the number of issues (common stock IPOs and SEOs from SDC) using quarterly data from 38 countries (NYSE and Nasdaq counted separately) over the period 1995Q1-2014Q4. Iteratively, coefficients are estimated in-sample using a panel regression with quarter fixed effects, and are used to make an one-quarter ahead out-of-sample forecast of equity issuance changes. After each iteration, the in-sample window is expanded by one quarter. In Panel A, the in-sample estimation window initially includes the first 30% of the sample period; in Panel B, the first 50%; in Panel C, the first 70%. Independent variables include lagged changes in market liquidity, lagged market returns, and lagged changes in the number of issues. Results are presented both with and without the crisis period 2008Q1-2011Q4. Variable definitions are in the Appendix. All variables are demeaned and standardized by country. The columns labelled "DM-test" indicate whether the model is significantly different from the model indicated in parentheses, based on Diebold-Mariano (1995) tests. Significance at the 1%, 5% and 10% level is indicated by ***, **, and *.

Panel A: In-sample estimation window of first 30% of sample period					
	Dependent variable:	Δ ***number of issues***			
		with crisis		without crisis	
Model	Independent variables	MSPE	DM-test	MSPE	DM-test
(1)	*average (Δ number of issues (1:t))*	1.0851		0.9293	
(2)	Δ *market liquidity (t-1:t-3)*	1.0677	(1): ***	0.9086	(1): ***
(3)	Δ *number of issues (t-1:t-3)* *+ market returns (t-1:t-3)*	0.7853		0.6806	
(4)	Δ *number of issues (t-1:t-3)* *+ market returns (t-1:t-3)* *+* Δ *market liquidity (t-1:t-3)*	0.7823	(3): –	0.6705	(3): **

Model (3) is again a benchmark and contains three lags of changes in the number of issues as well as three lags of market returns. Model (4) adds three lags of changes in market liquidity to Model (3). In Panel A, the MSPE of Model (4) is slightly lower than the MSPE in Model (3) when the crisis is included in the sample, though the difference is not statistically significant. However, when the crisis is excluded, the MSPE of Model (4) is

Table 3.6, continued

Panel B: In-sample estimation window of first 50% of sample period					
	Dependent variable:	***Δ number of issues***			
Model	Independent variables	with crisis		without crisis	
		MSPE	DM-test	MSPE	DM-test
(1)	*average (Δ number of issues (1:t))*	1.2437		0.921	
(2)	*Δ market liquidity (t-1:t-3)*	1.2200	(1): ***	0.8966	(1): ***
(3)	*Δ number of issues (t-1:t-3)* *+ market returns (t-1:t-3)*	0.8885		0.6663	
(4)	*Δ number of issues (t-1:t-3)* *+ market returns (t-1:t-3)* *+ Δ market liquidity (t-1:t-3)*	0.8843	(3): –	0.6614	(3): –

Table 3.6, continued

Panel C: In-sample estimation window of first 70% of sample period					
	Dependent variable:	***Δ number of issues***			
Model	Independent variables	with crisis		without crisis	
		MSPE	DM-test	MSPE	DM-test
(1)	*average (Δ number of issues (1:t))*	1.4155		1.1053	
(2)	*Δ market liquidity (t-1:t-3)*	1.3905	(1): ***	1.0772	(1): ***
(3)	*Δ number of issues (t-1:t-3)* *+ market returns (t-1:t-3)*	1.0306		0.7865	
(4)	*Δ number of issues (t-1:t-3)* *+ market returns (t-1:t-3)* *+ Δ market liquidity (t-1:t-3)*	1.0305	(3): –	0.7766	(3): *

lower, and significantly so, indicating that including liquidity variables in the forecasting model significantly improves forecasting performance. In Panel B, the MSPE of Model (4) is slightly lower than the MSPE in Model (3) regardless of whether the crisis is included. However, neither of the differences are significant. In Panel C, the MSPE of Model (4) is marginally lower than the MSPE in Model (3) when the crisis is included in the sample, though not significantly so. However, when the crisis is excluded, the MSPE of Model (4) is significantly lower, again indicating that adding the liquidity variables improves forecasting performance.

Overall, these results suggest that including liquidity changes in the prediction model improves out-of-sample prediction of changes in equity issuance. The extent to which it improves performance depends on the in-sample size, and on whether the crisis period is included in the analysis. Including liquidity changes never significantly deteriorates forecasting performance. We conclude that the liquidity effects uncovered in this paper are stable rather than sample-specific and that liquidity may be useful in predicting issuance activity.

In addition to the various robustness checks of our regressions we report throughout the paper, we implement a battery of further robustness checks. We report the results in Table 7. Model (1) of Table 7 reproduces our benchmark regression for comparison.

As we discussed, the variables in our regressions are first differenced and demeaned. In Model (2), we do not demean the variables. The results are almost identical. Further, throughout the paper, we estimate our regressions using quarter fixed effects. These effects effectively remove common effects across countries. We remove them to be conservative as these effects could

Table 3.7. Robustness checks

This table reports coefficient estimates of panel regressions using quarterly data from 38 countries (NYSE and Nasdaq counted separately) over the period 1995Q1-2014Q4. The dependent variable is the change in the number of equity issues (common stock IPOs and SEOs from SDC). Independent variables include lead, contemporaneous, and lagged changes in local market liquidity, local market returns, and lagged dependent variables. Model (1) reproduces the benchmark regression Model (2) of Table 2. In Model (2), we do not demean the variables. In Model (3), we exclude the quarter fixed effects. In Model (4), we exclude countries with an exchange merger (Brazil, Colombia, Indonesia, Japan, and Russia). In Model (5), we include data from 1990 (instead of 1995) until 2014. In Model (6), we exclude the countries Australia, Canada, India, and Japan, which have a large number of small issues. Variable definitions are in the Appendix. All variables are demeaned (except those in Model (2)) and standardized by country, so any coefficient can be interpreted as the effect in standard deviations on the dependent variable of a one standard deviation shock to the independent variable corresponding to that coefficient. Standard errors are clustered by country and quarter. Significance at the 1%, 5% and 10% level is indicated by ***, **, and *.

Dependent variable:	Δ ***number of issues (t)***					
	(1) full sample	(2) no demeaning	(3) no quarter FE	(4) no merged exchanges	(5) 1990-2014	(6) no AUS, CAN, IND, JPN
Δ *market liquidity (t+1)*	-0.02	-0.02	-0.02	-0.02	-0.01	-0.02
Δ *market liquidity (t)*	0.08***	0.08***	0.09***	0.09***	0.08***	0.07***
Δ *market liquidity (t-1)*	0.08**	0.08**	0.09**	0.11***	0.09***	0.08**
Δ *market liquidity (t-2)*	0.07***	0.07***	0.07***	0.08***	0.07***	0.06***
Δ *market liquidity (t-3)*	0.08***	0.07***	0.08***	0.08***	0.08***	0.08***
Δ *market liquidity (t-4)*	0.02	0.02	0.00	0.01	0.02	0.01
market returns (t+1)	0.01	0.00	-0.01	0.00	0.00	-0.01
market returns (t)	0.11***	0.10***	0.11***	0.11***	0.09***	0.10***
market returns (t-1)	0.10***	0.09***	0.13***	0.10***	0.09***	0.09***
market returns (t-2)	0.05*	0.04	0.03	0.04	0.05*	0.07**
market returns (t-3)	0.07***	0.06***	0.02	0.07***	0.07***	0.07***
market returns (t-4)	0.04	0.03	0.01	0.06*	0.05*	0.03
Δ *number of issues (t-1)*	-0.56***	-0.56***	-0.58***	-0.56***	-0.55***	-0.57***
Δ *number of issues (t-2)*	-0.37***	-0.37***	-0.34***	-0.35***	-0.36***	-0.37***
Δ *number of issues (t-3)*	-0.23***	-0.23***	-0.26***	-0.22***	-0.23***	-0.21***
Quarter fixed effects	yes	yes	no	yes	yes	yes
$N_{observations}$	2,831	2,831	2,831	2,511	3,126	2,520
$N_{countries}$	38	38	38	33	38	34
R^2_{within} (%)	26.9	26.8	31.2	26.7	26.0	26.8
R^2 (%)	37.0	36.9	31.2	37.7	36.0	37.1

be business cycle effects, for instance. However, these effects could also in part represent common liquidity shocks, so that by removing them we only have country-specific liquidity shocks. Model (3) estimates our benchmark regression without the quarter fixed effects (we therefore include an intercept but do not report its estimate in the table). We see that the sum of the liquidity coefficients is now 0.31, the same as in Model (1). Since removing the quarter fixed effects has little impact on the coefficients, a conclusion to be drawn from the comparison of Model (3) to the benchmark model is that country-specific liquidity shocks appear to be more important than common liquidity shocks across countries. It is noteworthy that removing the quarter fixed effects has more of an impact on the market return coefficients. In Model (3), the sum of the coefficients on market returns is 0.29, which is substantially lower than the sum of 0.38 in Model (1). Further, only two coefficients on market returns are significant in Model (3) in contrast to four in Model (1).

As we discussed earlier, exchanges merge. When exchanges in the countries in our sample merge during our sample period, we include in our dataset issuances from the exchanges that form the merged exchange. This choice could raise issues in that before the merger we are using a liquidity measure that is based on stocks trading on different markets that may have different trading volume definitions, potentially hampering the comparability of the Amihud liquidity measure across these markets. To examine the relevance of this concern, we eliminate the countries in which the main market was the result of a merger that took place during our sample period. As shown in Model (4), if anything, doing so strengthens our results.

We collect data from 1990 but do not use it because for some countries it is not clear that SDC collected data systematically before 1995. Nevertheless, if we use the longer sample period 1990-2014, Model (5) shows that our results hold up.

To address the issue that our results could be overly influenced by specific countries that have a large number of (tiny) equity issues (such as Australia, Canada, India, and Japan), we investigate whether removing these countries from the sample affects our results. It does not. In Model (6), we show that removing Australia, Canada, India, and Japan from the sample hardly affects the regression coefficients.

3.7 Conclusions

In this paper, we show that equity issuance across the world is strongly related to equity market liquidity. Using changes in country level liquidity as an explanatory variable for changes in equity issuance, we find that variation in equity issuance is significantly related to contemporaneous and past liquidity variation. We provide evidence that this relation between liquidity changes and equity issuance changes cannot be attributed to liquidity serving as a proxy for the general state of capital markets, aggregate economic activity, asymmetric information or market sentiment. It is also not plausible that the relation could be due to reverse-causation, since equity issuance typically represents a small fraction of existing stock outstanding at the country level. We show that issuance is more strongly related to liquidity in more financially developed markets, consistent with the view that firms are able to issue equity more rapidly in these countries. In contrast, the relation between issuance and liquidity is weaker for loss making firms, which suggests that in circumstances where issuing equity is a matter of greater urgency, liquidity considerations play a smaller role. Furthermore, we show that accounting for variation in liquidity not only improves explanatory power for issuance variation in-sample, but also enhances out-of-sample predictive power.

The economic magnitude of the relation between equity issuance changes and liquidity changes is similar to that of the relation between equity issuance changes and market returns. A one standard deviation shock to liquidity is associated with a 0.14 standard deviation cumulative shock to equity issuance over the subsequent three quarters, while a one standard deviation shock to returns is associated with a 0.13 standard deviation shock to equity issuance over the subsequent three quarters. For more financially developed markets, the economic significance of the liquidity effects is again similar to that of returns, and substantially greater than for less financially developed countries.

Overall, we interpret our findings to be supportive of the view that asset market liquidity affects the cost of equity issuance and that firms take asset market liquidity into account when deciding whether and when to issue equity.

Appendix to chapter 3: Variable definitions and data sources

Variable	Description	Source
Dependent variables		
number of issues	The quarterly number of primary common share issues (Initial Public Offerings (IPOs) and Seasoned Equity Offerings (SEOs)) on main markets. The Internet Appendix discusses the classification of main markets. Aggregation by quarter is based on the issue date. We exclude issues by utilities and financial firms, foreign issues, very small issues, and issues that were eventually postponed or cancelled. For the U.S., we include issues by firms on both Nasdaq and NYSE, but treat these markets as separate countries.	Securities Data Company (SDC)
number of IPOs	The quarterly number of primary common share issues (IPOs only) on main markets. Aggregation by quarter is based on the issue date. We exclude issues by utilities and financial firms, foreign issues, very small issues, and issues that were eventually postponed or cancelled. For the U.S., we include issues by firms on both Nasdaq and NYSE, but treat these markets as separate countries.	Securities Data Company (SDC)
number of SEOs	The quarterly number of primary common share issues (SEOs only) on main markets. Aggregation by quarter is based on the issue date. We exclude issues by utilities and financial firms, foreign issues, very small issues, and issues that were eventually postponed or cancelled. For the U.S., we include issues by firms on both Nasdaq and NYSE, but treat these markets as separate countries.	Securities Data Company (SDC)
number of issues: ROA>0	The quarterly number of primary common share issues (IPOs and SEOs) on main markets by firms that had a positive ROA in the year before the offering. Aggregation by quarter is based on the issue date. We exclude issues by utilities and financial firms, foreign issues, very small issues, and issues that were eventually postponed or cancelled. For the U.S., we include issues by firms on both Nasdaq and NYSE, but treat these markets as separate countries.	Own computations; Securities Data Company (SDC)
number of issues: ROA<0	The quarterly number of primary common share issues (IPOs and SEOs) on main markets by firms that had a positive negative ROA in the year before the offering. Aggregation by quarter is based on the issue date. We exclude issues by utilities and financial firms, foreign issues, very small issues, and issues that were eventually postponed or cancelled. For the U.S., we include issues by firms on both Nasdaq and NYSE, but treat these markets as separate countries.	Own computations; Securities Data Company (SDC)
proceeds	The quarterly proceeds of issues (IPOs and SEOs) on main markets. Aggregation by quarter is based on the issue date. We exclude issues by utilities and financial firms, foreign issues, very small issues, and issues that were eventually postponed or cancelled. For the U.S., we include issues by firms on both Nasdaq and NYSE, but treat these markets as separate countries.	Securities Data Company (SDC)

Appendix to chapter 3, continued

Variable	Description	Source
Independent variables		
market returns	The quarterly average of monthly local currency stock level market returns aggregated to the market level using value weighting.	Own computations; CRSP, Datastream
market liquidity	The quarterly average of monthly stock level liquidity aggregated to the market level using value weighting, scaled by the reciprocal of the growth in market capitalization. The monthly stock level liquidity is calculated as the average daily liquidity within the month. Daily stock level liquidity is calculated as Amihud's (2002) price impact proxy for individual stocks – computed as the absolute stock return divided by local currency trading volume. The Amihud measure is multiplied by -10,000 to obtain a measure that is increasing in liquidity.	Own computations; CRSP, Datastream
market volatility	The standard deviation of daily market returns within a quarter.	Own computations; CRSP, Datastream
market turnover	The quarterly average of monthly country level turnover. Daily stock level turnover is calculated as the deviation in the ratio of trading volume and the number of shares outstanding from its long-term moving average. Monthly country level turnover is calculated as the value weighted average of the average monthly stock level turnover.	Own computations; CRSP, Datastream
market liquidity risk	The conditional volatility of quarterly market-wide Amihud liquidity based on a GARCH(1,1) model estimated by country.	Own computations; Datastream
market-to-book ratio	The aggregate market value of equity, scaled by the aggregate book value of equity of all listed common stocks within a country.	Own computations; Datastream
price-earnings ratio	The aggregate market value of equity, scaled by the aggregate earnings of all listed common stocks within a country.	Own computations; Datastream
dividend-yield	Aggregate dividends, scaled by the aggregate market value of equity of all listed common stocks within a country.	Own computations; Datastream
GDP growth	Year-on-year % change of quarterly GDP (real, seasonally adjusted) by country.	IMF; World Bank
sales growth	Year-on-year % change of quarterly aggregate sales by country.	IMF; World Bank
LEI growth	The quarterly amplitude-adjusted composite leading economic indicator growth by country.	OECD Statistics
idiosyncratic volatility	The quarterly value-weighted average across all stocks within a country of the standard deviation of the residuals obtained from a simple market model run based on daily data within the quarter.	Own computations; Datastream
stock price synchronicity	The logistic transformation of the quarterly value-weighted average R2 across all stocks within a country from a simple market model run based on daily data within the quarter.	Own computations; Datastream

Chapter 4

Risk-taking implications of contingent convertible bonds

Joint work with Amiyatosh Purnanandam and Stefan Zeume

ABSTRACT

Contingent Convertible Bonds (CoCos) have emerged as one of the most important security design solutions to improve the capital position of banks in the aftermath of the recent financial crisis. We show that the issuance of CoCos is associated with higher risk taking activities. Specifically, after the issuance of CoCos, issuing banks' loan portfolios become significantly more risky than those of similar non-issuers. These results highlight an important cost of CoCo securities: their ability to provide equity cushion to banks in bad states of the world is partly offset by the associated increase in risks on the asset side of the balance sheet. These findings have important implications for understanding the effect of security design on the riskiness of individual banks and the banking system as a whole.

4.1 Introduction

The financial crisis of 2008-09 has reignited the debate on sound and effective management of the global banking system. The debate includes proposals to strengthen the balance sheets of banks, to actively monitor their activities, to more accurately measure and disclose risk, and to enhance coordination among policymakers. Arguably, the most contentious issue in this debate is the amount and nature of equity capital a bank should hold. In terms of the nature of equity capital, Contingent Convertible Bonds (or CoCo Bonds) have emerged as one of the most important security design solutions proposed by several academics and regulators. But this instrument has met with dramatically opposite enthusiasm across two sides of the Atlantic: no U.S. bank till date has issued CoCos, whereas European Banks issued over Euro 30 billion of CoCos only in 2014. Therefore, a clear understanding of the costs and benefits of this instruments, especially as it relates to the mitigation of risk in the banking sector, is needed both from an academic and policy-making perspective. Our paper sheds light on this issue by examining the effect of these instruments on the risk-taking behavior of banks on the asset side of their balance sheet, a topic that has escaped the attention of the empirical literature to the best of our knowledge.

Simply put, CoCo bonds are initially issued as bonds and they convert into equity (or are written off) when the issuing bank's equity value drops to a predetermined trigger point (see Flannery, 2014). Thus such bonds provide equity capital to banks in very crucial periods of financial distress, minimizing the risk of their failures. The key rationale for such security design is that by converting debt into equity or just writing it off, bank's capitalization ratio stays above the danger point, as a result both individual bank's default risk and the systemic risk come down. Thus CoCo bond investors take a haircut to ensure the bank's solvency, and the need for government bailout is minimized. Motivated by these arguments, a number of regulatory authorities in Europe have allowed, often encouraged, their banks to issue part of their capital as CoCos.

The key advantage of CoCos, that it improves capital ratio in bad states of the world, is all related to the effect of CoCos on the liability side of the balance sheet. The effect of CoCos on a bank's leverage, and thus its financial risk, is straightforward; what is less understood is its effect on the risk taking incentives of banks on the asset side. Thus the risk decreasing benefit of CoCos implicitly assumes that CoCos issuance does not endogenously affect the risk-taking behavior of the bank on the asset side. Put differently, the key advantage of CoCo bonds is grounded in the assumption of separation of investments and financing decisions as in the Modigliani and Miller world. This, however, is not obvious. CoCos can alter the manager-shareholder's preference for investment risks. One way to see this is to consider the incentive effects of CoCos in the context of classical literature on security design, specifically the incentive effects of regular convertible bonds. Green (1984) shows that convertible bonds can limit risk-taking behavior because shareholders are forced to share the gains of their risky bets with the convertible bondholders if the bet pays off. CoCos, on the other hand, mandatorily convert into equity only in the bad states of the word, i.e., when asset payoffs are low. Thus, one can think of CoCos as a “reverse” convertible bond. By engaging in high-risk activity, equity holders do not share any upside gains with the CoCo holders because the conversion only happens in low payoff states. At the same time, if the risk doses not payoff CoCos provide a guard against bankruptcy to the shareholders. In the presence of franchise value, such as rents that banks receive through subsidized deposit funding over time, concerns about bankruptcy and reorganization are likely to blunt the risk-increasing incentives. Replacing debt with CoCos minimizes this threat and thus it may lead to higher risk as compared to banks funded with pure debt, holding fixed their equity-to-asset ratio.

A more nuanced discussion of the incentive effects of CoCos on risk-taking must take into account the specifics of trigger mechanism, conversion ratios, and other features of this complex security. Indeed, recent theoretical literature that considers these complex features more carefully has come to a mixed conclusion on the effect of CoCo on risk-taking behavior of the bank. For example, CoCos can even have a positive effect on the risk-taking behavior as shown by Martinova and Perotti (2015). There are two main forces in their model: one coming from reduction in leverage after conversion and the other from the shareholder-bondholder conflicts. The mechanical reduction in leverage upon the conversion results in a risk-reduction effect, whereas the other effect leads to an increase in risk. Similarly Chen, Glasserman, Nouri, and Pelger (2013) consider a range of realistic features of the CoCos such as trigger levels and conversion mechanism, and show that CoCos can increase risk-taking incentives for a range of parameters, for example if the trigger is not set too low. Thus these theoretical models suggest that the effect of CoCos on risk-taking behavior is an empirical issues; an issue we tackle in this paper.

We consider a large sample of European banks between 1999-2015 and collect information on all CoCo issuance by these banks over this time period; all CoCos in our sample have been issued during the period 2009-2015, i.e., after the financial crisis and after Basel Committee rules allowed these instruments to be counted as Additional Tier 1 or 2 capital. Our sample covers 95 coco bonds issued by 40 distinct banks across 10 countries. Since there is limited research on the motivations behind the issuance of CoCos, in our first test we examine the drivers of the CoCo issuance decision. CoCo issuers are typically very large banks and have higher leverage as compared to non-issuers. Thus, in our tests linking CoCo issuance to risk-taking, we are especially careful in separating the size and leverage effect from the effect of CoCo issuance. More important, we find that a key driver of CoCo issuance is the tax treatment of interest expense on this instrument. There is a lot of variation in the tax deductibility of interest expense on CoCo across countries in Europe. While some countries have allowed these expenses to be tax-deductible, others have not. Within the set of countries that have allowed such deductibility, the timing of their decision has varied. Thus we are able to assess the effect of this tax ruling on the bank's decision to issue CoCo. We collect data on the precise year of legislation that allows for this deduction for every country in our sample, and find a strong positive effect of this regulation on CoCo issuance: banks issue more CoCos after the country of its domicile allows for this deduction. Further, this effect is stronger for banks that face higher tax rates, i.e., when the tax deductibility incentives are more likely to have a first order impact.

In our main tests, we use two simple but key measures of risk on the asset side: the proportion of impaired loans to total loans, and the proportion of loan loss reserves to the total loans of the bank. The first ratio directly measures the lending assets under default; the second measure is forward-looking in nature and captures the management's assessment of future default risk. We find a strong positive association between CoCo issuance and both these measures of risk-taking. In our main specification, we include both bank fixed effects and year fixed effects to isolate the effect of differences in bank's risk taking attitude and yearly changes in the macroeconomic conditions that may impact these measures. We find that in years after the issuance of CoCo bonds, banks have 1.854% higher impaired loans significant at the 1% level; the corresponding effect is relatively lower at 0.61% for loan loss reserves, but it is still statistically significant at the 1% level. Both these estimates are economically significant: the sample median of impaired loans and loan loss reserve ratios are 1.63% and 0.91%, respectively. In all these regressions, we control for the equity-asset ratio of the firm, as measured by common equity to total asset ratio of the firm. Thus our estimates can be interpreted as the risk-taking effect of CoCos as compared to similar bank that instead finances itself with regular debt.

The set of CoCo issuer banks differ significantly from the non-issuers, especially in terms of firm size. In our next test, we construct a matched sample to study the difference in risk-taking across issuers and non-issuers while holding their assets and country of origin well matched. On this sample, we find that CoCo issuers have 1.97% higher impaired loans and 0.77% higher loan reserves compared to non-issuers. These numbers are comparable to the regression estimates we obtain in the full sample. We perform a series of carefully constructed matched sample analyses as robustness checks and obtain broadly similar results.

Recent theoretical literature has focused a lot of attention on how specific features of CoCos affect risk-taking incentives. In our final test, we investigate this issue by analyzing the effect of trigger levels and the type of conversion on the main effects we document. The trigger level of CoCos determines the threshold level of firm's equity ratio at which CoCos are either converted into equity or written off. We find no meaningful association between risk-taking incentives and the level of trigger. Similarly we find no meaningful association between risk-taking and the type of CoCo: whether it is of equity conversion variety or principal write-off variety. In summary, our results show that it is the act of issuing CoCo that matters for risk-taking behavior, its specific features do not matter.

There are two, not mutually exclusive, possible interpretations of our results: a selection effect where banks with (unobserved) riskier loans are more likely to issue CoCos, or a treatment effect where the risk-taking behavior changes in response to the CoCo issuance. Our result is useful from policy perspective under either of these interpretations. It shows that CoCo issuance coincides with increases in risk-taking, and hence any policy that is aimed at increasing contingent equity capital through CoCos must take into account the concomitant increase in risk-taking. Said differently, the leverage-decreasing benefit of CoCos through the expected future increase in capitalization ratio is partly offset by a concomitant increase in asset risk.

To further isolate the effect of CoCo issuance on risk-taking behavior from the selection effect (i.e., banks with unobserved riskier loans are more likely to issue CoCos), we provide three arguments. As noted earlier, a key rationale for CoCo issuance has been the Basel regulations and tax treatment of interest on these instruments by the regulatory agencies of the country. While the Basel rulings broadly affected all countries in the sample at the same time, the timing of tax rulings – and hence the adoption of CoCos – varied considerably across countries depending on their legislative processes. It is unlikely that such tax rulings are motivated by some unobserved anticipated shocks to the riskiness of the lending portfolio of CoCo issuing banks. Hence the underlying motivation behind the issuance of CoCos is consistent with the causal interpretation of our findings. Second, we investigate the timing of losses after CoCo issuance. The effect of CoCo issuance on loan default rates comes after a gap of two years from the issuance. While possible, it is relatively less likely that banks possess private information about the default rates two years in advance, minimizing the selection effects. Third, we find that relative to the non-issuers, CoCo issuing banks earn higher interest on their loans after the CoCo issuance as compared to before the issuance. This result shows that issuing banks are lending to riskier borrowers after the issuance of CoCos, a finding consistent with the treatment effect.

Our results have immediate implications for policy designs. While we do not address the optimality of CoCo issuance from the shareholders' perspective, the implication for regulation is clear: CoCo issuance comes with higher risk-taking. Second, we also show that none of the main contract features such as trigger point or equity versus write-down CoCos mitigate this effect. Thus, purely from the perspective of risk-taking incentives, our study does not support the idea that CoCos with different features should be granted different status in the capital structure of a bank (e.g., treating them either as Additional Tier 1 or Tier 2 capital based on these features). Beyond the specific case of CoCo bonds, our study provides useful evidence for the broader security design literature. While the theoretical literature on the risk-taking incentive effects of security design is very rich, limited empirical research exists showing these interactions. One possible reason for this is the measure of investment risk itself. Measurement of risk-taking at the asset level is often hard outside of the banking industry, whereas in our setting we have two sensible measures of risk-taking at the loan level allowing us to relate the financial policy to asset risk more directly. In addition, there are very few empirical settings where a new class of security becomes popular with a number of firms in an industry, mainly due to regulatory reasons. Our setting provides such an empirical testing ground. Overall our results show that "reverse convertible bonds" come with higher risk taking incentives, and the precise contractual design feature seem to matter less.

Our paper relates to a growing literature in this area. Most closely related to our work is the paper by Vallée (2016) and Adjiev, Bolton, Jiang, Kartasheva, and Bogdanova (2015), who study the pricing implications of CoCos. They show that after the issuance of CoCos, credit spread on senior debt comes down; however, there is no effect of CoCos on equity prices. These papers provide very useful assessment of the pricing implications. Our paper, on the other hand, is tackling a related but different question: the effect of CoCos on asset risk. To the best of our knowledge, our paper is the first one to document the effect of CoCos on risk-taking incentives on the asset side. Our paper also provides inputs to a growing theoretical literature on the contractual design of CoCo bonds (see Sundaresan and Wang, 2015, Pennacchi and Tchistyi, 2016). These papers study the feasibility of different contractual features such as market or accounting based triggers for CoCo design. Our results suggest that we should also consider the possibility of endogenous changes in the riskiness of bank's assets while evaluating the efficacy of these features. The efficacy of market versus accounting based triggers is likely to be different when asset risk changes with the CoCo bond issuance as our results show. For example, if accounting ratios are slow to incorporate changes in asset risk as compared to market based ratios, then the triggers will vary in their effectiveness depending on whether they are accounting or market based. Overall, our results provide important inputs to both policy designs and future theoretical models in the area of security design in general.

4.2 Institutional setting and Data

4.2.1 Institutional setting

In the aftermath of the financial crisis of 2008-09, regulators around the world have undertaken a number of policy measures to control individual and systemic bank failures. These measures affect several aspects of regulations ranging from strengthening the balance sheets of banks (e.g., capital requirements, liquidity coverage ratios) to limits on the scope of their activities (e.g., regulations on proprietary trading). Most of these regulations have been formulated under the broad umbrella of Basel III, the provisions of which have been adopted in varying degrees across different countries.

On the capital requirements side, Basel III accords attempt to improve both the quantity and the quality of capital available with banks. They redefine what constitutes capital and give a special role to CoCos in the capital buffers. Under Basel III, a bank needs to maintain 4.5% of total risk-weighted assets in common equity tier 1 capital, which consists of equity and retained earnings. Further, banks need to keep 6% of total risk-weighted assets in tier 1 capital, which consists of both common equity tier 1 capital and additional tier 1 (AT1) capital in the form of CoCos.[1] Thus, Basel III

[1] Additionally, 8% of total risk-weighted assets needs to be maintained in total capital, which consists of both tier 1 capital and tier 2 capital. Tier 2 capital is a mix of undisclosed reserves, revaluation reserves, general loan-loss reserves, hybrid instruments such as preferred shares or CoCo's, and subordinated term debt. Finally, on top of these minimum capital requirements, a bank needs to have a capital conservation buffer of 2.5% of risk-weighted assets. If capital levels fall below the level required by the capital conservation

incentivizes the issuance of CoCos by making it an eligible security for the computation of Tier 1 capital ratio.

Details of the implementation of Basel III accord were left to the national regulators, and most developed and developing countries have adopted these measures at least in some degree. European regulators have in fact actively encouraged the issuance of CoCos by providing both broad regulatory support and fiscal incentives to issue CoCos. The fiscal incentive comes in the form of tax treatment of interest paid on CoCos before conversion. When the Basel III accords were agreed upon in 2011, some European governments already had fiscal incentives for CoCo issuance in place; others have introduced them since then. Since CoCos share some properties with equity and some with debt, there has been some ambiguity in the tax treatment of interest paid on coupon. Whether coupon payments on CoCos are tax deductible or not can have a substantial impact on the issuing bank's profits especially given the relatively high interest rates on these instruments. We collect information on whether and when a country issued definitive ruling on the tax deductibility of interest on CoCos. We provide details on this issue in the Appendix.

We obtain data for our study from various sources. Data on bank financials come from Bankscope. We take a number of steps, as described in Duprey and Lé (2015) to clean the Bankscope data. These details are provided in the Appendix. From the entire Bankscope universe, we select all data between 2000 and 2015. We start our sample in 2000 in order to have a substantial time-series dimension. We do not include 2016 as Bankscope coverage for 2016 was poor as at the time of our data collection. We remove firms that are not banks, and drop supranational institutions. We exclude banks from countries

buffer, a bank can continue to operate as usual, but is not allowed to distribute capital (Basel Committee on Banking Supervision, 2011).

other than the European Union, Switzerland and Norway, as CoCo issuance activity is concentrated in (western) Europe. We remove unconsolidated and non-relevant types of financial statements.

We obtain information on CoCo issuance from Bloomberg and select all available data up until the end of 2015. This dataset includes information on, amongst others, issue date, trigger level, trigger action, amount issued, currency, ISIN code, and firm ISIN code. We merge the full CoCo dataset with the bank financials using ISIN codes where available. The remaining unmatched CoCos we match by hand based on firm name wherever possible.

4.2.2 Descriptive statistics

Table 4.1 provides descriptive statistics on the issuance of CoCos in our sample. Panel A provides information on CoCo issuance for every country in our sample over the years. No CoCos were issued in our sample prior to 2009; subsequently there has been a steady increase in CoCo issuance with a considerable jump in the number of issues in 2012. Our analysis is at the bank level, since we are interested in the effect of CoCo issuance on bank's risk-taking on the asset side. Table B provides information on the number of first time issuers over time across countries. There has been a steady increase in this number over time. More important, there is a rich coverage of first time CoCo issuers across countries and over time. In total, we have 40 distinct issuers in our sample. In our empirical analysis, we compare the riskiness of their lending portfolio before and after the issuance of CoCo with non-issuer banks.

Panel C shows the amount of CoCo issued: our sample banks have issued over Euro 85 billion through this form of finance. Thus, this security has provided a significant amount of capital to these banks during the sample

Table 4.1. Cocos overview

This table provides summary statistics of CoCo issuances aggregated by country and year (Panels A-C) over the 2009-2015 period and by banks that issued at least one CoCo over the 2009-2015 period (Panel D). In Panel A, the variable of interest is the number of total CoCos issued by banks. In Panel B, the variable of interest is the number of banks that are first-time CoCo issuers. In Panel C, the variable of interest is the sum of CoCo issuance amounts in mn EUR. In Panel D, Number of CoCos denotes the number of CoCos issued by each CoCo-issuing bank, and CoCo amount issued EUR mn denotes the amount raised by each bank. Write-down and Equity conversion denote CoCos that are written off and converted into equity when triggered, respectively. Trigger level denotes the trigger levels employed by CoCo-issuing banks. Further variable descriptions are provided in the Appendix.

Panel A: Number of CoCo issues per country									
	Before 2009	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**Total**
Austria	0	0	0	0	0	0	0	0	0
Belgium	0	0	0	0	0	0	1	0	1
Denmark	0	1	1	1	1	1	1	2	8
Germany	0	0	0	0	0	0	5	5	10
Netherlands	0	0	0	2	0	0	0	1	3
Norway	0	0	0	0	0	2	5	6	13
Spain	0	0	0	0	2	2	4	3	11
Sweden	0	0	0	0	0	0	5	5	10
Switzerland	0	0	0	1	7	4	3	7	22
United Kingdom	0	0	1	0	0	2	9	5	17
Total	**0**	**1**	**2**	**4**	**10**	**11**	**33**	**34**	**95**

Table 4.1, continued

Panel B: Number of distinct first-time CoCo issuers by country									
	Before 2009	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**Total**
Austria	0	0	0	0	0	0	0	0	0
Belgium	0	0	0	0	0	0	1	0	1
Denmark	0	1	1	1	1	1	0	1	6
Germany	0	0	0	0	0	0	2	1	3
Netherlands	0	0	0	1	0	0	0	0	1
Norway	0	0	0	0	0	2	5	4	11
Spain	0	0	0	0	1	1	1	0	3
Sweden	0	0	0	0	0	0	2	2	4
Switzerland	0	0	0	1	1	1	0	1	4
United Kingdom	0	0	1	0	0	1	4	1	7
Total	**0**	**1**	**2**	**3**	**3**	**6**	**15**	**10**	**40**

Table 4.1, continued

Panel C: CoCo Issuance Amounts by country (in mn EUR)									
	Before 2009	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**Total**
Austria	0	0	0	0	0	0	0	0	0
Belgium	0	0	0	0	0	0	1948	0	1948
Denmark	0	32	2	5	1	1	2	9	53
Germany	0	0	0	0	0	0	6232	805	7036
Netherlands	0	0	0	2936	0	0	0	1708	4643
Norway	0	0	0	0	0	4	13	6	23
Spain	0	0	0	0	1782	1826	7183	4151	14942
Sweden	0	0	0	0	0	0	3217	2280	5497
Switzerland	0	0	0	1449	12041	3997	4000	5419	26906
UK	0	0	172	0	0	2865	11685	9260	23982
Total	0	32	174	4389	13824	8693	34280	23637	85030

Table 4.1, continued

Panel D: Summary statistics for cocos at the bank level								
Variable	**N**	**Mean**	**StDev**	**Min**	**P25**	**P50**	**P75**	**Max**
Number of CoCos	39	2.41	2.26	1	1	1	3	12
CoCo Amount (mn EUR)	39	2,180	3,890	0	1	544	3,310	20,500
thereof Equity Conversion CoCos	39	1,320	2,970	0	0	0	660	13,300
Relative CoCo Size (%)	39	0.48	0.51	0.03	0.17	0.35	0.55	1.98
Trigger Level	39	5.8	1.16	3.73	5.13	5.13	7	10.28

period. Finally, in Panel D we provide some key information on the nature of CoCo issued by banks in our sample. Average (median) bank issued 2.41 (1) CoCos, raising Euro 2.1 billion (Euro 544 million) in proceeds. Out of this, on average 38% of CoCos are of the Equity Conversion type, whereas the remaining ones are either pure write-down CoCos or a mix of the two. Average trigger level, i.e., the level of capital ratio, is 5.8% as measured by the book value of Tier 1 capital ratio.

Table 4.2. Summary statistics

This table provides summary statistics of sample banks over the 1999-2015 period. All variables are defined in the Appendix. All continuous variables are winsorized at the 1% and 99% levels. Variable descriptions are provided in the Appendix.

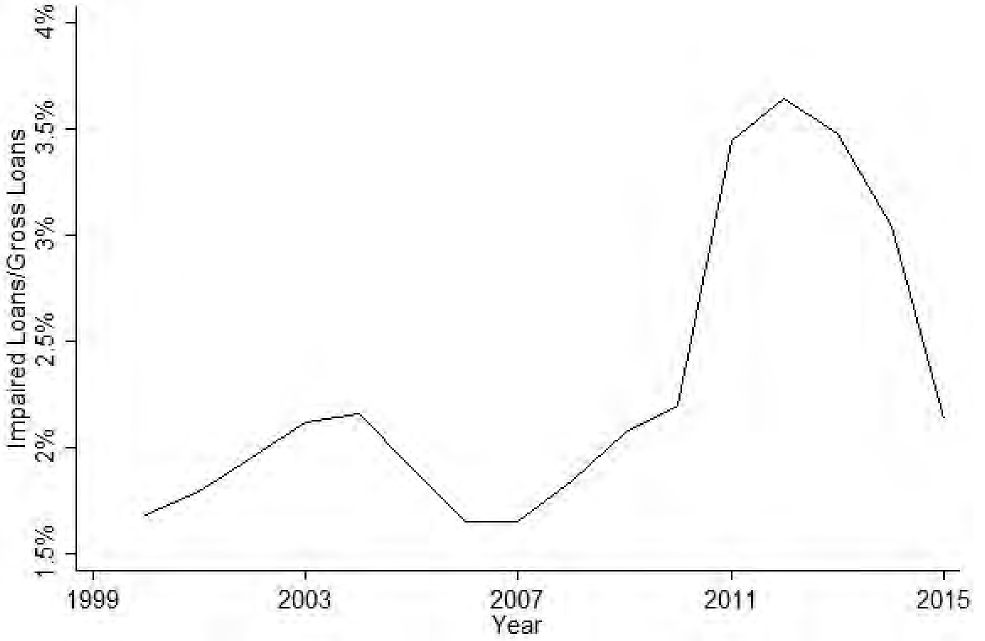
Variable	Mean	StDev	Min	P25	Median	P75	Max	N
CoCo Dummy	0.01	0.10	0	0	0	0	1	9,880
Number of Cocos Issued	0.01	0.15	0	0	0	0	6	9,880
CoCo Amount (mn EUR)	8.6	194	0	0	0	0	11,800	9,879
Relative CoCo Size (%)	0.01	0.08	0	0	0	0	2.71	9,880
Impaired Loans / Gross Loans (%)	2.7	3.13	0.02	0.74	1.63	3.46	17.82	7,764
Loan Loss Reserves / Gross Loans (%)	1.48	1.79	0	0.33	0.91	1.91	10.44	9,880
Assets (bn EUR)	20	130	0.049	0.201	0.417	1	2,220	9,880
Leverage (%)	92.2	4.7	73.6	90.1	92.6	95.6	99.2	9,880
Net Interest Margin (%)	2.1	0.9	0.4	1.5	2	2.6	5.9	9,873

Table 4.2 provides information on relevant financial numbers of all banks in our sample, including the non-issuers. Based on the issuance dataset we collect, we create an indicator variable, CoCo Dummy, that takes a value of one for banks that have issued a CoCo at a given point in time. As expected, only a small percentage of sample banks have issued CoCo: about 1% of bank-year observations in the full sample comes from the issuers as reflected by the sample average of 0.99% for the CoCoDummy variable. Reflecting that very few banks have issued CoCos, the mean CoCo size, measured by amount issued divided by total assets, is very small—the bank with the largest CoCo amount issued has 2.7% in CoCos outstanding.

Figure 4.1. Key measures of risk taking over time

This figure shows average measures of bank risk taking over the sample period. Measures of bank risk taking are Impaired Loans/Gross Loans (Panel A) and Loan Loss Reserves/Gross Loans (Panel B). All variable definitions are in the appendix.

Panel A: Impaired loans / gross loans

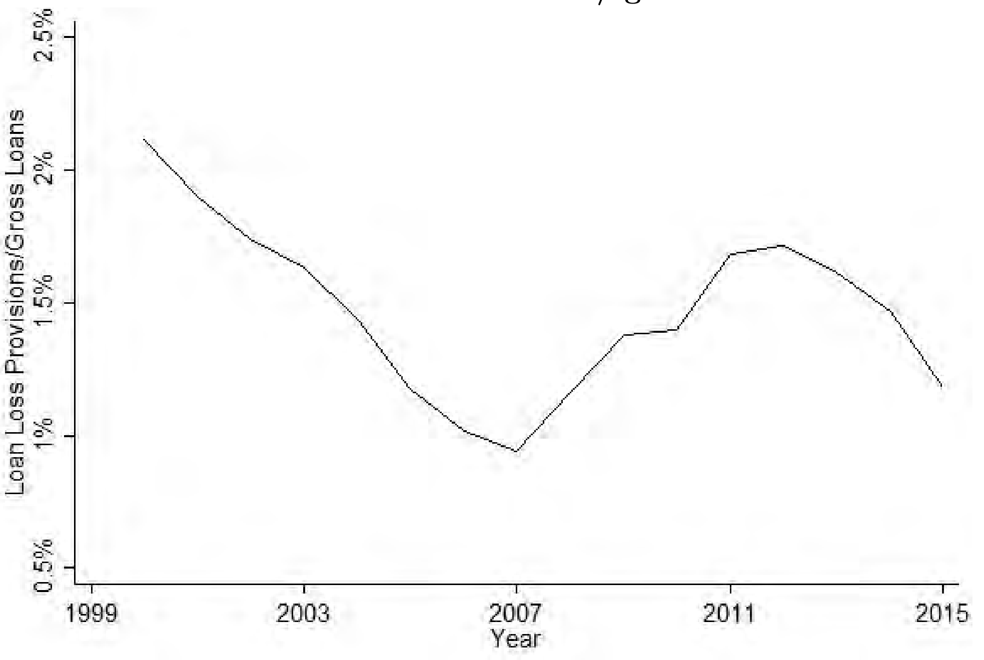


We use two measures of risk-taking for our analysis: the percentage of impaired loans in the total lending portfolio of the bank, and the percentage of loan loss reserves. Impaired loans measure loans that are already in distress, and they are defined as impaired loans divided by total gross loans. Loan loss reserves is a relatively forward looking measure of default, as anticipated by bank managers. It is defined as loan loss reserves divided by total gross loans. The average value of these ratios are 2.7% and 1.48% for impaired loans and loan reserves, respectively.

In Figure 4.1, we plot the yearly average of these variables. As can be

Figure 4.1, continued

Panel B: Loan loss reserves / gross loans



seen from this figure, there is substantial time series variation in these numbers. In our empirical analysis, we are careful in separating out the yearly variation with the inclusion of year fixed effects in empirical models. The Table provides information on the asset size, leverage ratio (defined as one minus equity-to-asset ratio) and net interest margin of the bank (a proxy for bank's profitability). We use these variables as controls in our key regression specification to separate out the effect of common equity capitalization, profitability, and bank size on risk taking from the effect of CoCo issuance.

4.3 Main results

4.3.1 Determinants of CoCo Issuance

We begin our analysis by analyzing the key drivers of CoCo issuance decisions. Clearly, these decisions are not random, and hence a better understanding of this decision allows us to interpret our main results – linking CoCos with risk-taking behavior – in proper context. In Table 4.3 we estimate a linear regression model with the number of CoCo issued during the year as the dependent variable. Our results are similar if we model this decision as a Poisson regression model, or when we replace the dependent variable by the amount of CoCos issued or by a binary variable that indicates whether a bank has issued a CoCo in a year or not.

In Model 1, we find that bank's size (as measured by log of assets) is a key driver of this decision: larger banks issue more CoCos. There is no reliable pattern in terms of difference in profitability and leverage ratio of the issuers and the non-issuers. In Model 2, we include an additional variable, called 'Fiscal Treatment Dummy', that equals one for bank-year observations after which the bank's country of domicile allows tax-deductibility of interest on CoCos, and zero otherwise. This variable has a strong explanatory power: banks issue significantly more CoCos after receiving favorable tax treatment on interest paid on these securities.

In Models 3 and 4, we progressively include bank and year fixed effects, and a clear pattern emerges from these estimation results: A key driver of CoCo issuance decision is the tax rulings of the country of domicile. With firm fixed effects, the effect of size on issuance decision disappears, which is not surprising given that relative size of a bank's asset base has not changed remarkably over the sample period. Bank's profitability from core operations,

Table 4.3. Determinants of CoCo issuance

This table provides the results of a panel analysis of CoCo issuance over the 1999 to 2015 period. The dependent variable is # CoCo Issues, the number of CoCos issued in a particular year. All controls are lagged by one year and defined in the Appendix. Fixed effects are included as indicated. All continuous variables are winsorized at the 1% and 99% levels. Standard errors are clustered at the year level. t-statistics are in parentheses; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	**(2)**	**(3)**	**(4)**	**(5)**
LN(1+Assets) (t-1)	0.017**	0.018**	0.028**	-0.030**	0.017**
	(2.16)	(2.22)	(2.61)	(-2.37)	(2.28)
Leverage (D/A) (t-1)	-0.000	-0.000	-0.001	-0.000	-0.000
	(-0.31)	(-0.18)	(-1.66)	(-0.46)	(-0.79)
Net interest margin (t-1)	-0.001	0.001	0.005	0.004	0.001
	(-1.07)	(0.78)	(0.96)	(0.78)	(0.54)
Fiscal treatment dummy		0.022**	0.114**	0.082**	
		(2.28)	(2.73)	(2.37)	
Fiscal treatment dummy x Tax rate (t-1)					0.025***
					(3.49)
N	8244	8244	8244	8244	8172
R^2	0.038	0.042	0.179	0.190	0.053
#Firm FE			1447	1447	
Firm FE	No	No	Yes	Yes	No
Year FE	No	No	No	Yes	No

as measured by its net interest margin, does not play an important role in this decision, and a bit surprisingly, the bank's leverage ratio is only weakly related to this decision. For some specification we find that banks with higher leverage are less likely to issue CoCo, but the results are not consistent across model specifications.

In Model 5, we interact the 'Fiscal Treatment Dummy', with the tax rate of the bank during the previous year. This variable measures the likely impact of tax deductibility on the bank's incentive to issue CoCos at a bank-by-bank level. Banks with higher tax rates are more likely to benefit from the tax ruling that allows the tax deductibility of CoCo. Our results provide strong support for this conjecture. The interaction variable is one of the key variables that explains the issuance decision.

These results show that the most reliable determinant of CoCo issuance is the tax rulings and its likely impact on the bank. Large banks are more likely to issue CoCo, but profitability and leverage do not play big roles. We document these results for the first time in the literature to the best of our knowledge, and they are of independent interest. More important, they provide some interesting context to our main results linking CoCo to loan portfolio risk. To the extent that tax related incentives are not systematically related to an individual issuing bank's unobserved risk-taking incentives, our results are likely to be causal. It is likely to be the case because the tax rulings are passed at the country level, often after lengthy socio-political negotiations. This provides some justification to the claim that the issuance of CoCo was not simply driven by changes in unobserved investment opportunity set of these banks.

4.3.2 Univariate analysis

We provide univariate results in Table 4.4. Panel A breaks all bank-year observations into two groups: CoCo=1 indicates bank-year observations for issuers after the issuance year; CoCo=0 are the remaining observations, i.e., they pool all observations for non-issuers and pre-issuance observations for issuers. Post-issuance issuing banks have 4.75% impaired loans compared to 2.68% for the remaining group. The difference of 2.07% across the two group is economically large, and statistically significant at 1%. A similar pattern emerges for loan reserves ratio: 2.60% for the issuers post-issuance compared to 1.47% for the other group.

Table 4.4. Univariate splits

This table compares characteristics of banks with and without outstanding CoCo(s) at the bank-year level over the 1999-2015 period. The first three columns present results for the full sample of banks, splitting by a Dummy variable that is equal to one if a bank has issued a CoCo. The last three columns present summary statistics for the set of banks that have issued at least one CoCo over the sample period, splitting such observations into those before and after the first CoCo issuance. All variables are defined in the Appendix. All continuous variables are winsorized at the 1% and 99% levels. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Sample: All Banks			Sample: CoCo Issuers		
Variable	**CoCo=1**	**CoCo=0**	**Diff**	**Before**	**After**	**Diff**
Impaired Loans / Gross Loans (%)	4.75	2.68	2.07***	2.48	4.75	2.27***
Loan Loss Reserves / Gross Loans (%)	2.60	1.47	1.13***	1.66	2.60	0.95***
Assets (bn EUR)	324	17	307***	320	324	4.27
Leverage (%)	93.0	92.2	0.8*	94.2	93.0	-1.1***
Net Interest Margin (%)	2.0	2.1	-0.2**	1.9	2.0	0.1

The table also shows that there is a big difference in the average size of banks that issue CoCos compared to banks that do not, a result that we established in the previous section as well. To address this issue in a simple univariate setting, we split our sample into two parts, namely before and after the issuance of CoCo only for banks that eventually issued CoCo. On average, before the issuance CoCo issuing banks had impaired loans of 2.48%, which increased to 4.75% after the issuance. The difference of 2.27% is both economically and statistically significant. Similar pattern holds for loan loss reserves.

4.3.3 Regression analysis

Table 4.5 provides formal regression estimation results, with impaired loans (Panel A) or loan loss reserves (Panel B) as the dependent variable. We provide estimation results for six models for both Panels: these models differ in terms of the variables used in the model, inclusion of fixed effects, and the computation of standard errors. We focus on Columns (3) and (6) that include both year and firm fixed effects in the model, and compute standard errors clustered at the year level (Column 3) and bank level (Column 6). The key variable of interest is the variable 'CoCo Dummy' that equals one for bank-years after the bank has issued CoCo, and zero otherwise. A clear theme emerges from this table: after the CoCo issuance, bank's loan portfolio becomes riskier. Impaired loans increase by about 1.9%, whereas loan loss reserves go up by about 0.61%. These effects are statistically significant for all models, with slight differences in the level of significance depending on the modeling choice. Compared to the sample median of 1.63% for impaired loans and 0.91% for loan loss reserves, these estimates are large in economic terms as well. Thus, the analysis suggests an increase in risky lending after the issuance of CoCo. The use of firm fixed effect ensures that we are estimating the within-bank changes in these variables, whereas the inclusion of year fixed effects remove concern about yearly variation in aggregate economy and loan defaults.

In our next test, we analyze whether the amount of CoCo issuance matters

Table 4.5. CoCo issuance and risk-taking

This table provides the results of a panel analysis of measures of risk of banks over the 1999 to 2015 period. The dependent variable is Impaired Loans/Gross Loans in Panel A and Loan Loss Reserves/Gross Loans in Panel B. The control variable of interest is CoCo Dummy, a dummy variable set equal to one if a bank has issued at least one CoCo in a given year. Other controls are defined in the Appendix and included, along with fixed effects, as indicated. All continuous variables are winsorized at the 1% and 99% levels. Standard errors are clustered at the year level (Columns (1)-(3)) and bank level (Columns (4)-(6)), respectively. t-statistics are in parentheses; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Impaired Loans/Gross Loans						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
CoCo Dummy	2.069***	2.446***	1.897***	2.069**	2.446***	1.897**
	(3.83)	(5.11)	(3.94)	(2.16)	(2.82)	(2.08)
LN(1+Assets)		-0.374	-1.866***		-0.374	-1.866***
		(-1.69)	(-4.02)		(-1.61)	(-4.01)
Leverage (D/A)		0.002***	0.003***		0.206***	0.276***
		(5.24)	(8.07)		(3.18)	(3.80)
Net Interest Margin		-0.007**	-0.003		-0.739***	-0.327
		(-2.66)	(-1.27)		(-2.60)	(-1.22)
N	7764	7764	7764	7764	7764	7764
$R^2_{adj.}$	0.005	0.688	0.703	0.005	0.688	0.703
#Firm FE	-	1319	1319	-	1319	1319
Cluster	Year	Year	Year	Bank	Bank	Bank
Firm FE	No	Yes	Yes	No	Yes	Yes
Year FE	No	No	Yes	No	No	Yes

Table 4.5, continued

Panel B: Loan Loss Reserves/Gross Loans						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
CoCo Dummy	1.135***	0.706***	0.610***	1.135**	0.706**	0.610*
	(3.00)	(4.12)	(4.77)	(2.06)	(2.07)	(1.74)
LN(1+Assets)		-0.316***	-0.561***		-0.316***	-0.561***
		(-6.81)	(-3.39)		(-3.51)	(-3.19)
Leverage (D/A)		0.007	0.010		0.007	0.010
		(0.94)	(1.33)		(0.79)	(1.01)
Net Interest Margin		0.054	0.037		0.054	0.037
		(0.62)	(0.44)		(0.64)	(0.42)
N	9880	9873	9873	9880	9873	9873
$R^2_{adj.}$	0.004	0.726	0.734	0.004	0.726	0.734
#Firm FE	-	1448	1448	-	1448	1448
Cluster	Year	Year	Year	Bank	Bank	Bank
Firm FE	No	Yes	Yes	No	Yes	Yes
Year FE	No	No	Yes	No	No	Yes

for risk-taking conditional on the issuance of the CoCo. We conduct this test within the sample of CoCo issuers; if our previous results are driven by some inherent differences across the CoCo issuers and non-issuers in terms of their risk-taking decisions, then the estimation based solely on the issuer sub-sample should be able to address this concern. We now use the size of CoCo issuance (as a ratio of the bank's asset value) as the key explanatory variable, and estimate the regression model using both measures of risk-taking. Results are provided in Table 4.6, Panel A based on impaired loans as the measure of risk-taking, and Panel B based on loan loss reserves.

We first provide the estimation result with CoCo dummy variable as the explanatory variable in this sample. Thus the estimated coefficient measures the effect of CoCo issuance on bank's risk-taking using pre-issue years as the control observation. Thus, the effect of CoCo issuance in this model comes

Table 4.6. CoCo issuance and risk-taking: Sample of CoCo issuers

This table replicates Table 4.5 for the subset of sample firms that have issued a CoCo at least once over the 1999-2015 period. The dependent variable is Impaired Loans/Gross Loans in Panel A and Loan Loss Reserves/Gross Loans in Panel B. The independent variable of interest in Columns (1)-(3) is CoCo Dummy, a dummy variable set equal to one if a bank has issued at least one CoCo in a given year. The independent variable of interest in Columns (4)-(6) is Relative CoCo Size, the relative CoCo size (100*EUR issued/EUR assets). All variables are defined in the Appendix. All continuous variables are winsorized at the 1% and 99% levels. t-statistics are in parentheses; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Impaired Loans/Gross Loans						
	(1) CoCo Dummy	**(2)** CoCo Dummy	**(3)** CoCo Dummy	**(4)** Relative CoCo Size	**(5)** Relative CoCo Size	**(6)** Relative CoCo Size
CoCo Variable	2.270***	2.437***	1.333**	1.402***	2.108***	0.962**
	(5.26)	(6.51)	(2.47)	(2.85)	(4.98)	(2.17)
LN(1+Assets)		0.176	-1.335*		0.804*	-1.360*
		(0.36)	(-1.79)		(1.67)	(-1.83)
Leverage (D/A)		0.772***	0.913***		0.737***	0.958***
		(5.91)	(6.92)		(5.52)	(7.30)
Net Interest Margin		-1.624***	-2.739***		-1.415***	-2.707***
		(-3.94)	(-6.49)		(-3.38)	(-6.42)
N	416	416	416	416	416	416
$R^2_{adj.}$	0.060	0.523	0.584	0.017	0.502	0.583
#Firm FE		37	37		37	37
Firm FE	No	Yes	Yes	No	Yes	Yes
Year FE	No	No	Yes	No	No	Yes

Table 4.6, continued

Panel B: Loan Loss Reserves/Gross Loans	**(1)** CoCo Dummy	**(2)** CoCo Dummy	**(3)** CoCo Dummy	**(4)** Relative CoCo Size	**(5)** Relative CoCo Size	**(6)** Relative CoCo Size
CoCo Variable	0.946***	0.840***	0.181	0.294	0.826***	0.363**
	(4.04)	(6.27)	(0.94)	(1.05)	(5.24)	(2.21)
LN(1+Assets)		-0.399**	-0.654**		-0.190	-0.632**
		(-2.28)	(-2.53)		(-1.14)	(-2.45)
Leverage (D/A)		0.313***	0.372***		0.316***	0.380***
		(7.29)	(8.68)		(7.23)	(9.01)
Net Interest Margin		-0.051	-0.367**		0.018	-0.373***
		(-0.35)	(-2.54)		(0.12)	(-2.60)
N	473	473	473	473	473	473
$R^2_{adj.}$	0.031	0.787	0.816	0.000	0.781	0.817
#Firm FE		39	39		39	39
Firm FE	No	Yes	Yes	No	Yes	Yes
Year FE	No	No	Yes	No	No	Yes

entirely from variation generated by the issuer sample, alleviating several sample selection issues that one may be concerned with when we compare issuer banks to the entire sample of banks.[2] Columns (1) – (3) provide the results, and show that CoCo issuance indeed is associated with higher risk-taking. Results are economically strong for both measures of risk-taking, and statistically strong for all models based on impaired loan losses. Results are strong for loan loss provisions as well, but the coefficient loses its significance when we use both year and firm fixed effects in the model. As we discuss below, once we exploit the variation in the extent of issuance, these results become significant as well. Overall, the results paint a clear picture: even within the sample of issuers, risk-taking goes up by significant amount after

[2]This estimated strategy is analogous to the popular econometric approach that estimates the effect of some treatment by considering only the subjects that eventually get treated.

the CoCo issuance.

Columns (4) – (6) of both panels provide the main result of this table, linking the extent of CoCo issuance to risk taking. As the amount of CoCo increases, we observe significantly riskier loans. We focus on Column (6) – the most stringent model – for discussions here. Based on impaired loans, we obtain an estimate of 0.962, which is significant at 5% level. In economic terms, the estimate suggests that one standard deviation increase in the amount of CoCo issuance results in 0.5 percentage points higher impaired loans. When we focus on loan loss reserves, we obtain a similar pattern. One standard deviation increase in CoCo amount is associated with an increase of 0.2 percentage points in loan loss reserves. The result is significant at 5% level.

Among the control variables, we also obtain some interesting results. Banks with higher leverage have riskier loan portfolios, and banks with higher net interest margins have lower risk. The first result is consistent with risk-taking incentives generated by leverage; the second result is consistent with the view that banks take higher risk as their profitability goes down. We cannot make precise conclusions on the relationship between profitability and risk-taking based on our study because we are unable to directly link the interest rates charged on loan portfolios for which we observe defaults. Further, our sample period witnessed some extraordinary measures on the monetary policy front in Europe that affected the net interest margin of different banks differently. We leave these investigations for future research.

Overall our results show that CoCo issuance coincides with higher risk taking and the higher the amount of CoCo issuance the higher is the risk-taking.

4.3.4 Matched sample evidence

We extend our analysis by conducting a matched sample test. The matched sample analysis complements the findings of regression analysis presented above, but it alleviates concerns that issuers and non-issuers are fundamentally different on observable dimensions such as bank size and country of domicile.

In the first matched sample exercise, for every issuing bank we find a non-issuing bank of similar size in the same country as the issuing bank. Thus we create a sample of bank-year observations where issuers and non-issuers are well matched on size and country dimensions. We estimate the regression model on this sub-sample, and present the results in Table 4.7. Our results remain similar. In the second matched sample analysis, we find a matched bank of similar size in a different country, and report the results on this subsample in Table 4.7 as well. Issuing banks have significantly higher risks in their loan portfolio as compared to the non-issuers in this sample as well. It is interesting to note that when we match banks in the same country, our estimates are lower in values compared to when we match them in different country. This is sensible as we expect some country level differences in risk-taking across banks.

Figure 4.2 presents our main results visually. We plot the difference in risk-taking of firms that issued a CoCo and matched firms around CoCo issuance. We find that risk taking measured by Impaired Loans (Panel A) and Loan Loss Reserves (Panel B) increases slightly in the year of CoCo issuance and the year thereafter, and increases considerably in year 2 after issuance.

Overall we find a consistent pattern with a series of tests in this paper: CoCo issuance and the amount of CoCo issued are associated with higher

Table 4.7. Robustness

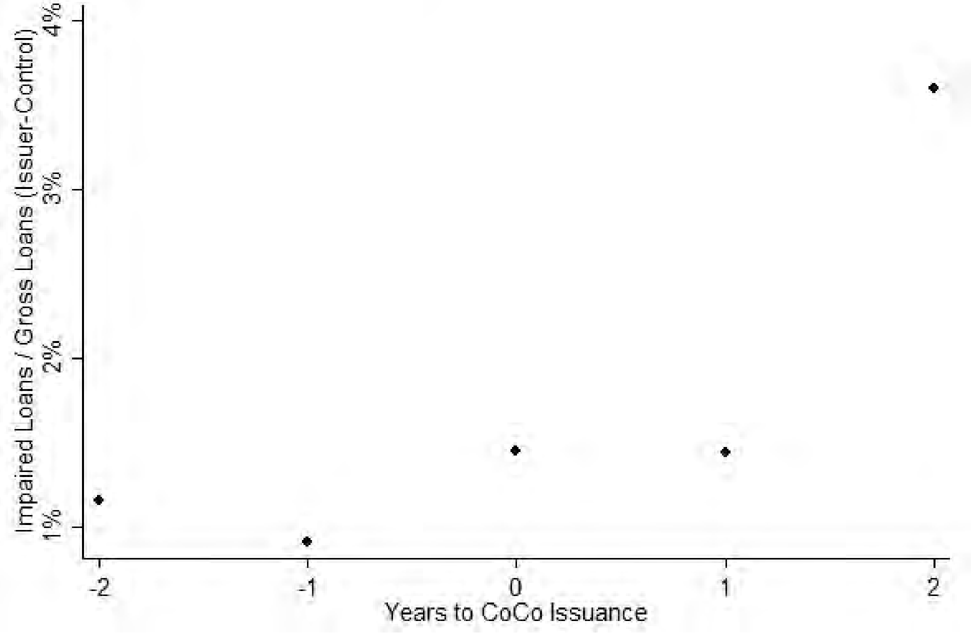
This table provides the results of robustness tests for a panel analysis of measures of risk of banks over the 1999 to 2015 period. The dependent variable is Impaired Loans/Gross Loans in Columns (1)-(2) and Loan Loss Reserves/Gross Loans in Columns (3)-(4). In Columns (1) and (3), the sample is restricted to banks that have issued a CoCo over the sample period and banks that have never issued a CoCo that are matched to CoCo issuers by same headquarter country and by size a year before CoCo issuance. In Columns (2) and (4), the sample is restricted to banks that have issued a CoCo over the sample period and banks that have never issued a CoCo and that are matched as before except that control firms are restricted to banks from different headquarter countries. The independent variable of interest is CoCo Dummy, a dummy variable set equal to one if a bank has issued at least one CoCo in a given year. Other controls are defined in the Appendix and included as indicated. All continuous variables are winsorized at the 1% and 99% levels. Standard errors are clustered at the year level. t-statistics are in parentheses; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	**(2)**	**(3)**	**(4)**
LHS	**Impaired Loans/ Gross Loans**	**Impaired Loans/ Gross Loans**	**Loan Loss Reserve/ Gross Loans**	**Loan Loss Reserve/ Gross Loans**
Sample	**Matched Same Country**	**Matched Different Country**	**Matched Same Country**	**Matched Different Country**
CoCo Dummy	1.718***	3.031***	0.859***	1.439***
	(3.32)	(7.99)	(3.38)	(7.30)
LN(1+Assets)	0.206***	0.146***	0.227***	0.169***
	(6.67)	(3.65)	(12.72)	(13.74)
Leverage(D/A)	0.001	-0.000	-0.001***	-0.001***
	(1.14)	(-0.80)	(-4.62)	(-4.31)
Net interest margin	0.011**	0.008**	0.012***	0.009***
	(2.32)	(2.38)	(7.51)	(8.49)
N	769	680	910	806
$R^2_{adj.}$	0.074	0.066	0.381	0.214
Firm FE	No	No	No	No
Year FE	No	No	No	No

Figure 4.2. Key measures of risk taking around CoCo issuance

This figure shows average measures of bank risk taking around CoCo issuance for treated and control firms. Measures of bank risk taking are Impaired Loans/Gross Loans (Panel A) and Loan Loss Reserves/Gross Loans (Panel B). The graph shows the difference between risk taking of banks that have issued a CoCo over the sample period and those that have not. All variable definitions are in the appendix.

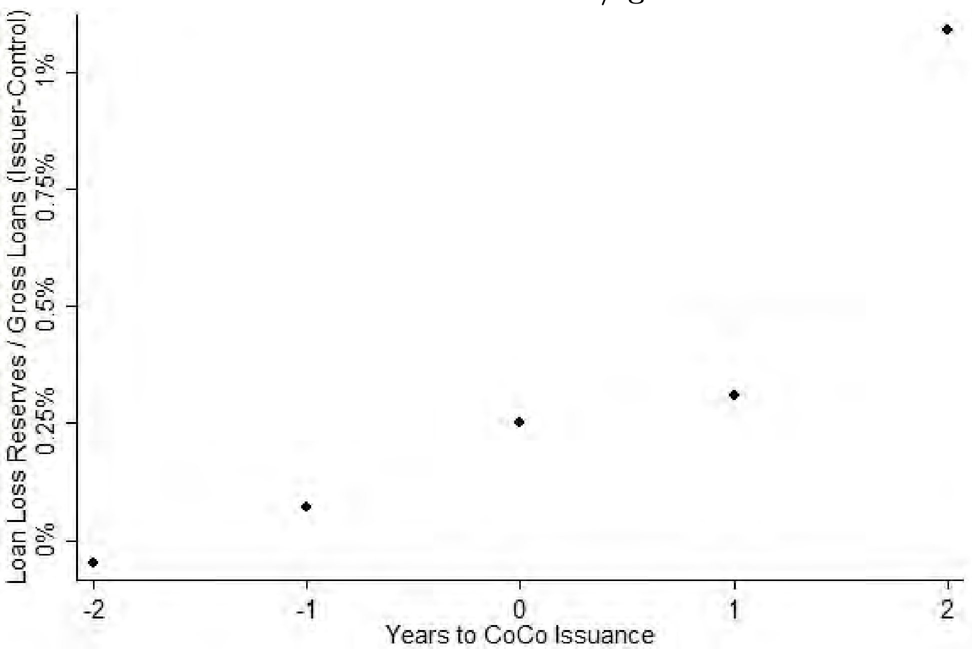
Panel A: Impaired loans / gross loans



risk-taking on the lending side. Our results cannot be explained away by differences in size, equity-to-asset ratio, profitability, unobserved bank specific fixed effects, and yearly changes in default rates. Thus our results can be causal as long as any omitted variable of concern is captured by these control variables. More important, as we showed earlier, a key motivation for CoCo issuance is the regulation on tax treatment of coupon payments on these securities. It is reasonable to assume that these laws were not designed in response to some unobserved risk-taking incentives of the banks. Thus, given

Figure 4.2, continued

Panel B: Loan loss reserves / gross loans



this underlying motivation, it is reasonable that our results are causal in nature, namely CoCo issuance affecting risk-taking.

Needless to say, our research design does not allow us to claim causality. If the results simply indicate a correlation, it is still an important and useful result to document. Under this interpretation, banks are issuing CoCo at the time when there are some unobserved changes in their risk-taking incentives. This suggests that policy designs that ignore concomitant increase in risk-taking can be problematic. In addition, theoretical models that study the design features of CoCo under the assumption of separation of investment and financing decisions can be limited. Thus, our results have important implications even without a clearly established causal link.

4.3.5 Cross-sectional evidence

We now investigate the impact of differences in CoCo design features on risk-taking incentives. A number of recent studies have argued that risk-taking incentives change depending on these features: we evaluate these claims empirically in this part of the paper. We focus on two main features of the instrument: the trigger level and whether the CoCo converts into equity or is written off upon the trigger event. Based on the sample median of trigger value, we create a dummy variable, ‘High Trigger’, that equals one if the bank’s CoCos are issued above the median, and zero otherwise. Using this variable as an additional explanatory variable, we estimate our baseline model for different specifications using impaired loans and loss reserves as dependent variables. Results are provided in Table 4.8, Panel A. Columns (1) and (2) use the entire sample, Columns (3) and (4) are based on matched sample, and Columns (5) and (6) are estimated with the sample of issuers only. Across the model specification, there is a consistent theme: though banks with lower trigger have riskier loan portfolios as evident by the negative sign of estimated coefficient on ‘High Trigger’ variable, the result is statistically insignificant.

In the next test, we break CoCo dummy into three groups: Only Equity Conversion, Only Write Down and Mixed CoCos and include these variables separately into the regression model. We fail to find any discernable pattern in risk-taking behavior across the type of CoCo issued. In other words, the effect of CoCo on risk taking behavior does not change by much in our sample.

Overall, the results show that it is the act of issuing CoCo and the amount of CoCo issued by the bank that is associated with riskier loan portfolios; the precise nature of the instrument does not seem to matter. This is an important result, as it shows that mere fine-tuning of the design of this security is unlikely

Table 4.8. CoCo characteristics

This table provides the results of a panel analysis of measures of bank risk taking over the 1999 to 2015 period. The set-up follows exactly that of Table 4.5 (Columns (1) and (5)), as well as the robustness tests provided in Table 4.6 and 4.7. In Panel A, the CoCo Dummy is additionally interacted with High Trigger, a Dummy variable that is set equal to one if a bank's CoCos are issued with above-median trigger level on average. In Panel B, the CoCo Dummy is split into banks that only ever issued Equity Conversion CoCos, banks that only ever issued Write Down CoCos, and banks that issued at least one CoCo of each type. Other controls are defined in the Appendix and included as indicated. All continuous variables are winsorized at the 1% and 99% levels. Standard errors are clustered at the year level. t-statistics are in parentheses; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A.1: Trigger levels – Impaired loans						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Sample	**All**	**All**	**Matched Same Country**	**Matched Different Country**	**CoCo Issuers**	**CoCo Issuers**
CoCo Dummy	2.364*	2.459**	2.859**	2.547*	3.056***	1.786***
	(1.89)	(2.16)	(2.24)	(1.97)	(5.23)	(2.77)
High Trigger	-1.354	-0.884	-1.403	-1.449	-0.942	-0.738
	(-0.80)	(-0.59)	(-0.81)	(-0.82)	(-1.27)	(-1.28)
LN(1+Assets)	0.179***	-1.868***	0.194***	0.155***	-0.003	-1.376*
	(3.04)	(-4.02)	(6.37)	(3.78)	(-0.04)	(-1.85)
Leverage (D/A)	-0.034	0.275***	0.057	-0.007	0.314***	0.892***
	(-1.38)	(8.23)	(1.08)	(-0.17)	(2.67)	(6.72)
Net Interest Margin	1.044**	-0.332	1.013**	0.731**	1.577***	-2.797***
	(2.77)	(-1.29)	(2.41)	(2.33)	(7.10)	(-6.60)
N	7764	7764	769	680	416	416
$R^2_{adj.}$	0.101	0.703	0.103	0.059	0.172	0.585
# Firm FE		1319				37
Firm FE	No	Yes	No	No	No	Yes
Year FE	No	Yes	No	No	No	Yes

Table 4.8, continued

Panel A.2: Trigger levels – Loan loss reserves						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Sample	**All**	**All**	**Matched Same Country**	**Matched Different Country**	**CoCo Issuers**	**CoCo Issuers**
CoCo Dummy	1.124*	0.736*	1.067*	1.053*	1.282***	0.208
	(1.97)	(2.06)	(2.04)	(1.92)	(5.16)	(0.94)
High Trigger	-1.018	-0.211	-0.773	-0.892	-0.575*	-0.051
	(-1.60)	(-0.42)	(-1.32)	(-1.46)	(-1.80)	(-0.25)
LN(1+Assets)	0.186***	-0.562***	0.227***	0.174***	0.085**	-0.656**
	(9.68)	(-3.38)	(12.77)	(14.25)	(2.55)	(-2.53)
Leverage (D/A)	-0.042***	0.010	-0.129***	-0.054***	0.112**	0.371***
	(-8.25)	(1.33)	(-4.63)	(-3.65)	(2.36)	(8.57)
Net Interest Margin	0.728***	0.036	1.210***	0.924***	1.575***	-0.370**
	(11.70)	(0.43)	(7.86)	(8.73)	(15.84)	(-2.55)
N	9873	9873	910	806	473	473
$R^2_{adj.}$	0.208	0.734	0.387	0.205	0.446	0.815
# Firm FE		1448				39
Firm FE	No	Yes	No	No	No	Yes
Year FE	No	Yes	No	No	No	Yes

Table 4.8, continued

Panel B.1: Equity conversion versus write-down CoCos – Impaired loans						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Sample	**All**	**All**	**Matched Same Country**	**Matched Different Country**	**CoCo Issuers**	**CoCo Issuers**
Only Equity Conversion CoCo	1.919***	2.939***	2.309***	2.010***	2.966***	2.172***
	(3.02)	(4.82)	(3.67)	(3.19)	(4.27)	(3.09)
Only Write Down CoCo	1.533**	1.504***	2.045***	1.642**	2.417***	0.346
	(2.36)	(3.00)	(3.03)	(2.40)	(4.47)	(0.54)
Mixed CoCos	1.231**	1.066	1.702***	1.479**	2.116**	2.361**
	(2.29)	(1.31)	(3.41)	(2.86)	(2.29)	(2.45)
LN(1+Assets)	0.177***	-1.891***	0.181***	0.145***	-0.020	-1.621**
	(3.02)	(-4.03)	(6.18)	(3.56)	(-0.26)	(-2.15)
Leverage (D/A)	-0.000	0.003***	0.001	-0.000	0.334***	1.013***
	(-1.36)	(8.10)	(1.24)	(-0.09)	(2.85)	(7.48)
Net Interest Margin	0.010**	-0.003	0.010**	0.007**	1.610***	-2.838***
	(2.77)	(-1.26)	(2.40)	(2.31)	(7.24)	(-6.73)
N	7764	7764	769	680	416	416
$R^2_{adj.}$	0.100	0.704	0.098	0.053	0.168	0.591
# Firm FE		1319				37
Firm FE	No	Yes	No	No	No	Yes
Year FE	No	Yes	No	No	No	Yes

Table 4.8, continued

Panel B.2: Equity conversion versus write-down CoCos – Loan loss reserves						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Sample	**All**	**All**	**Matched Same Country**	**Matched Different Country**	**CoCo Issuers**	**CoCo Issuers**
Only Equity Conversion CoCo	0.071	1.070***	0.288	0.146	0.689**	0.815***
	(0.28)	(4.82)	(1.04)	(0.58)	(2.15)	(3.23)
Only Write Down CoCo	0.956*	0.587***	0.996**	0.925*	1.313***	-0.111
	(1.90)	(3.17)	(2.29)	(1.98)	(5.76)	(-0.50)
Mixed CoCos	-0.017	-0.418	-0.093	-0.066	0.191	-0.160
	(-0.10)	(-1.43)	(-0.62)	(-0.46)	(0.45)	(-0.45)
LN(1+Assets)	0.187***	-0.567***	0.231***	0.178***	0.091***	-0.817***
	(9.68)	(-3.44)	(13.71)	(12.00)	(2.72)	(-3.16)
Leverage (D/A)	-0.000***	0.000	-0.001***	-0.001***	0.122**	0.395***
	(-8.15)	(1.32)	(-4.71)	(-3.30)	(2.58)	(9.10)
Net Interest Margin	0.007***	0.000	0.012***	0.009***	1.616***	-0.391***
	(11.61)	(0.46)	(7.61)	(8.26)	(16.23)	(-2.73)
N	9873	9873	910	806	473	473
$R^2_{adj.}$	0.208	0.735	0.387	0.203	0.449	0.821
# Firm FE		1448				39
Firm FE	No	Yes	No	No	No	Yes
Year FE	No	Yes	No	No	No	Yes

to mitigate risk-taking effects of the instrument. The risk-taking effect is a first order implication of this security that transcends all forms of CoCo.

4.4 Conclusion

We document a positive link between CoCo issuance and the riskiness of a bank's loan portfolios. CoCos have become a very important security for raising equity capital in Europe. The key benefits of CoCos – that they provide equity in bad states of the world – is based on a crucial assumption of the separation of financing and investment decision. Our paper shows that not to be the case: CoCo issuance and the amount of capital raised through CoCo issuance is associated with riskier investment decisions. Hence, at least partly, the leverage decreasing benefits of CoCos are offset by increased risk on the asset side of the banks' balance sheet. Regulators around the world are still thinking about the costs and benefits of this security design. Our results provide important inputs to these policy debates.

Our study goes beyond the specifics of CoCo as a financing instrument; using this security design as an empirical setting we show that financing and investment decisions are intrinsically linked. Hence theoretical models that study the pricing of these instruments or study the optimality of such security design must seriously take into account the fact that asset risk is changing concomitantly with financing vehicles.

Finally, our study does not address whether the increase in risk at the bank level was optimal from the bank's shareholders' or manager's perspective. Our focus is simply on the risk taking aspect: an issue that bank regulators care about even if the increase in risk benefits the shareholders. Whether these instruments, and the increased risk-taking that come with them, are value enhancing for the shareholders of the firm has been left for future research work.

Appendix to chapter 4: Tax treatment of CoCos by country

Country	**Position on tax deductibility**	Date of **clarification**	**Notes**	**Source**
Austria	None	-	As of 1 Jan 2017, there has not been a general/official communication by the Austrian Ministry on the tax treatment of CoCo's, other than that securities need to be scrutinized on a case by case basis.	Correspondence Austrian Ministry of Finance
Belgium	In favor	10/2013	There has been a (favourable) ruling on the tax deductibility of CoCos.	Correspondence Belgium Ministry of Finance, Voorafgaande beslissing nr. 2013.456 dd. 22.10.2013
Denmark	In favor	1/2004	A 2002 law allows for the counting of CoCos towards capital requirements. A 2004 law makes CoCos tax deductible.	Correspondence Danish Ministry of Finance
Germany	In favor	4/2014	A letter from the ministry of finance clarifies the (favourable) tax treatment of CoCos.	Crédit Agricole, Bankenverband, Bankenverband
Netherlands	In favor	6/2014	Draft legislation making coupon payments on CoCos tax deductible is circulated in June 2014; the law is passed in October.	Correspondence Dutch Ministry of Finance, NRC Handelsblad

Appendix to chapter 4: Tax treatment of CoCos by country, continued

Country	Position on tax deductibility	Date of clarification	Notes	Source
Norway	In favor	-	Currently CoCo bonds are tax deductible in Norway, and within the ministry of finance they do not know of any law or ruling affecting the tax deductibility of CoCos	Correspondence Norwegian Central Bank and Norwegian Ministry of Finance
Spain	In favor	1985	Tax treatment follows accounting principles (Spanish GAAP), in which CoCos qualify as debt and coupons are tax deductible.	Correspondence Spanish Ministry of Finance and Civil Service, Reg Cap Analytics, Allen & Overy
Sweden	In favor (until 1/2017)	-	CoCos qualified as debt under local accounting principles, and tax rules followed accounting rules. However, legislation has been passed that has removed the tax deductibility of CoCos per Jan 2017.	Correspondence Swedish Ministry of Finance
Switzerland	In favor	-	CoCo's are considered debt capital, and interest payments are deductible.	Correspondence Swiss Federal Department of Finance
United Kingdom	In favor	7/2013	Draft legislation making coupon payments on CoCos tax deductible is circulated in July 2013; the law is passed in January 2014.	Sullivan & Cromwell, HM Revenue & Customs

Appendix to chapter 4: Variable definitions and data sources

Variable name	Description	Source
Impaired Loans / Gross Loans	Impaired loans divided by total gross loans.	Bankscope, SNL
Loan Loss Reserves / Gross Loans	Loan loss reserves divided by total gross loans.	Bankscope, SNL
CoCo Dummy	A dummy set equal to one if a firm has issued at least one CoCos in that year or in previous years.	Bloomberg
CoCo Amount	The amount of capital raised through CoCo issuance in a given year.	Bloomberg
Relative CoCo Size	Coco Amount Issued / Assets in %	Bloomberg
High Trigger	A dummy set equal to one if a bank has issued CoCos with above-median trigger on average.	Bloomberg
Only Equity Conversion CoCo	A dummy set equal to one if a bank has issued only CoCos that are converted to equity when triggered.	Bloomberg
Only Write Down CoCo	A dummy set equal to one if a bank has issued only CoCos that are written down when triggered.	Bloomberg
Mixed CoCos	A dummy set equal to one if a bank has issued CoCos of both equity conversion and write-off type.	Bloomberg
Assets	Total assets (in EUR). Regressions use the logarithm of one plus total assets (in EUR).	Bankscope, SNL
Leverage	One minus total equity divided by total assets.	Bankscope, SNL
Net Interest Margin	(Interest Income-Interest Expense)/Interest Income	Bankscope, SNL
Fiscal Treatment Dummy	A dummy set equal to one if coupon payments on CoCos can be deducted from taxable income in the country in which a bank is domiciled.	See Appx. 1

Chapter 5

Summary

This thesis aims to foster a greater understanding of primary market functioning. It aims to be of use as an input in the continuous debate on how we can best shape our financial markets to provide greater affluence for society. It contains three essays, included as separate chapters, that each focus on a separate question related to raising capital via primary markets.

Chapter 2 deals with the market for initial public stock offerings. It shows that stereotypes about industry performance are related to the opening performance of newly issued stocks. It provides evidence that boundedly rational demand side factors play a role in the market for new stocks, suggesting there are inefficiencies in the way capital gets allocated. Better information provision may allow investors to form better expectations and to better determine their demand, yielding a more optimal allocation of capital.

Chapter 3 deals with the general market for new equity. It shows that firms issue more new stocks when markets become more liquid; i.e., when it becomes easier to buy or sell large quantities of stocks without having to make adjustments in the price. It uncovers one mechanism through which liquidity on financial markets can affect firm financing decisions and with that can have real economic consequences.

Chapter 4 deals with the market for new hybrid capital. It shows that banks make riskier decisions after issuing Contingent Convertible bonds (CoCos). CoCos were introduced after the financial crisis, to make the financial system safer for the taxpayers. A CoCo is a financial instrument that is a bond when a bank is functioning normally, but is written off or converted to equity when a bank becomes financially distressed. The results raise the question whether there is a net overall benefit from issuing CoCos in terms making the financial system safer.

Together these chapters provide greater understanding of primary market functioning, and describe mechanisms that can be used as input in the continuous debate on how we can best shape our financial markets.

Chapter 6

Nederlandse samenvatting

Deze dissertatie heeft als doel het begrip van het functioneren van primaire financiële markten te vergroten. De bevindingen kunnen gebruikt worden als input in het voortdurende debat over hoe we het best onze financiële markten kunnen (her)vormen ten behoeve van het vergroten van de welvaart in de samenleving. Het bevat 3 verhandelingen, ingevoegd als aparte hoofdstukken, die elk gefocust zijn op een aparte vraag gerelateerd aan het ophalen van kapitaal op de primaire financiële markten.

Hoofdstuk 2 behandelt de markt voor beursintroducties van aandelen. Het laat zien dat een stereotypisch beeld rondom prestaties van industrieën gerelateerd is aan de prestaties op de eerste handelsdag van nieuw uitgegeven aandelen. Het levert aanwijzingen op dat irrationele factoren aan de vraagzijde een rol spelen in de markt voor beursintroducties, en suggereert dat er inefficiënties zijn in de wijze waarop kapitaal wordt gealloceerd. Verbeterde informatieverstrekking zou investeerders in staat kunnen stellen om betere verwachtingen te ontwikkelen met betrekking tot aandelenprestaties. Daarmee zouden ze beter in staat kunnen zijn om hun vraag vast te stellen, met als resultaat een meer optimale allocatie van kapitaal.

Hoofdstuk 3 behandelt de algemene markt voor nieuw aandelenkapitaal. Het laat zien dat bedrijven meer aandelen uitgeven wanneer markten meer liquide worden; i.e., wanneer het makkelijker wordt om grote hoeveelheden aandelen te kopen of te verkopen zonder prijsconcessies te hoeven doen. Het onthult een van de mechanismen waardoor liquiditeit op financiële markten de financieringsbeslissingen van bedrijven kan beïnvloeden, en daarmee reële economische consequenties kan hebben.

Hoofdstuk 4 behandelt de markt voor nieuw hybride kapitaal. Het laat zien dat banken risicovollere beslissingen nemen na het uitgeven van Contingent Convertible bonds (CoCos). CoCos zijn geintroduceerd na de financiële crisis om het financiële systeem veiliger te maken voor belastingbetalers. Een CoCo is een financieel instrument dat een obligatie is wanneer een bank normaal functioneert, maar afgeschreven wordt of geconverteerd wordt naar eigen vermogen wanneer een bank in de financiële problemen komt. De bevindingen van dit hoofdstuk doen de vraag rijzen of het uitgeven van CoCos het financiële systeem daadwerkelijk veiliger maakt.

Gezamelijk geven deze hoofdstukken additioneel inzicht in het functioneren van primaire financiële markten, en brengen ze mechanismen aan het licht waar op ingehaakt kan worden in het continue debat over het (her)vormen van onze financiële markten.

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	B.Sc. in Liberal Arts and Sciences *Honors* University College Maastricht Maastricht University	Sep. 2007 - Aug. 2011
	Semester abroad University of California San Diego	Sep. 2009 - Dec. 2009

Research interests Empirical corporate finance, equity issuance, capital markets, capital raising

Publications **Do firms issue more equity when markets become more liquid?**
October 2017, forthcoming in the Journal of Financial Economics (JFE)
[with: René M. Stulz, Mathijs A. van Dijk]
Abstract: Using quarterly data on IPOs and SEOs for 37 countries from 1995 to 2014, we show that changes in equity issuance are positively related to lagged changes in aggregate local stock market liquidity. This relation is as economically significant as the well-known relation between equity issuance and lagged stock returns. It survives the inclusion of proxies for market timing, capital market conditions, growth prospects, asymmetric information, and investor sentiment. Changes in liquidity are less relevant for issuance by firms with greater financial pressures, and by firms in less financially developed countries.

Working papers **Stereotypical IPO underpricing**, December 2016

Abstract: I investigate the extent to which IPO underpricing in the U.S. can be explained by stereotypes formed by investors based on past industry underpricing. I apply the theory of stereotype formation put forward by Bordalo, Coffman, Gennaioli, and Shleifer (2016) for the construction of stereotypes. I find that IPO underpricing, as well as IPO demand as proxied by first-day turnover and IPO price revisions, are positively and significantly related to stereotypical industry underpricing. The effect of stereotypical industry underpricing is stronger for IPOs with more retail ownership. It is not significantly affected when controlling for other explanations. Price changes due to stereotypical industry underpricing are negatively related to post-IPO stock performance. These findings challenge the view that underpricing is fully a result of rational deliberations and support the view that underpricing is partly driven by boundedly rational demand side factors.

Presented at the FMA European Meeting 2016 Doctoral Consortium, Hanken School of Economics, Helsinki; PhD Seminar, Rotterdam School of Management, Erasmus University Rotterdam.

Risk-taking implications of contingent convertible bonds, December 2017
[with: Amiyatosh Purnanandam, Stefan Zeume]
Abstract: Contingent Convertible Bonds (CoCos) have emerged as one of the most important security design solutions to improve the capital position of banks in the aftermath of the recent financial crisis. We show that the issuance of CoCos is associated with higher risk taking activities. Specifically, after the issuance of CoCos, issuing banks' loan portfolios become significantly more risky than those of similar non-issuers. These results highlight an important cost of CoCo securities: their ability to provide equity cushion to banks in bad states of the world is partly offset by the associated increase in risks on the asset side of the balance sheet. These findings have important implications for understanding the effect of security design on the riskiness of individual banks and the banking system as a whole.

Work in progress

Capital allocation in action: evidence from IPOs, July 2015
[with: Mathijs van Dijk]
Abstract: Efficient capital allocation is arguably the most important function of financial markets. We propose a new way to measure the degree to which stock markets fulfill this function by focusing on initial public offerings (IPOs), which are key events when markets actually determine the flow of capital to firms. We develop three capital allocation efficiency measures based on the intuition that firms with better growth prospects should be valued higher and be able to raise more capital at the IPO.

Abstract (continued): Using data on almost 16,000 IPOs in 41 countries over the period 1990-2013, we present evidence that, although in almost all countries IPO firms with better growth prospects are valued higher and raise more capital, there is considerable variation in the degree of capital allocation efficiency across countries and over time. Remarkably, our initial results indicate that capital allocation is more efficient in countries with smaller stock markets relative to GDP. At the same time, more developed banking sectors are associated with greater values for our capital allocation efficiency measures, suggesting that financial institutions play an important role in the efficient pricing of IPOs.

Presented at the Workshop Research Design for Causal Inference 2015, Northwestern, Chicago; The Paul Woolley Centre Conference 2014, UTS, Sydney.

Workshops

- Research Design for Causal Inference 2015, Northwestern, Chicago, instructors: Bernard Black, Donald Rubin, Stephan Morgan, and Jens Hainmueller.

Honors and awards

- Vereniging Trustfonds, Travel Grant — July 2016
- American Finance Association, Doctoral Student Travel Grant — Jan. 2016
- The Paul Woolley Centre, Travel Grant — Oct. 2014
- Erasmus Research Institute of Management, PhD Stipend — Aug. 2013

Teaching experience

Master thesis: Supervision — 2017
Erasmus University Rotterdam

University Library Data team: Member — 2014 - 2017
Erasmus University Rotterdam
• Helping students and staff gather data for research
• Designing and providing workshops on gathering data for research
• Writing manuals on gathering data for research
• Writing tools for gathering data for research

Corporate Finance (BKB0023): Workshops — 2014 - 2016
Erasmus University Rotterdam
• Hosting 300-400 students per workshop

Bachelor thesis (BKBBTH): Supervision — 2015 - 2016
Erasmus University Rotterdam

Computer Skills

Languages & Software: Matlab, R, Latex, Python, Django, HTML, CSS, Javascript, Java, PHP, SQL, Microsoft Office

Languages

Dutch: native; English: fluent; French, German, and Italian: working knowledge.

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Raising capital: on pricing, liquidity, and incentives

This thesis aims to foster a greater understanding of primary market functioning. It aims to be of use as an input in the continuous debate on how we can best shape our financial markets to provide greater affluence for society. It contains three essays, included as separate chapters, that each focus on a separate question related to raising capital via primary markets.

Chapter 2 deals with the market for initial public stock offerings. It shows that stereotypes about industry performance are related to the opening performance of newly issued stocks. Chapter 3 deals with the general market for new equity. It shows that firms issue more new stocks when markets become more liquid; i.e., when it becomes easier to buy or sell large quantities of stocks without having to make adjustments in the price. Chapter 4 deals with the market for new hybrid capital. It shows that banks make riskier decisions after issuing Contingent Convertible bonds.

About the author

Rogier Hanselaar is currently working for Aegon N.V in the analytics and pricing team. During his PhD he presented his work at international conferences, such as the FMA doctoral consortium and the Annual Conference of the Paul Woolley Centre for the Study of Capital Market Dysfunctionality, was a visiting scholar at the Ross School of Business at the University of Michigan, and published in the Journal of Financial Economics.

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