Stock Liquidity and Default Risk around the World

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Abstract

We investigate the effect of stock liquidity on default risk using a large dataset of 4,381 non-financial firms across 46 countries for 2004–2015. We find a negative effect of stock liquidity on default risk, even in various natural-experimental settings with an exogenous negative (i.e., the Global Financial Crisis) and positive (i.e., removal of broker identifiers in Australia and non-tradable share reform in China) shocks to liquidity. Further, we find that the negative effect of stock liquidity on default risk is conditional on the extent of regulatory settings. Specifically, the effect is more pronounced in countries with greater creditor protection, higher levels of information sharing, a common-law tradition and efficient judicial systems.

Keywords: stock liquidity, default risk, creditor protection, information sharing, legal origin, the judicial system, global markets.

JEL Classification: G12, G15, G18, G32, G33, G34, K40

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1 Introduction

Corporate defaults around the world remain high: in some parts of the world, they are higher now than they were during the global financial crisis (GFC).[1] The devastating effects of a corporate default on the stakeholders (i.e., creditors, shareholders, customers, employees, and regulators) are well known;[2] it is, therefore, imperative to explore the key drivers of the corporate defaults. In general, a firm typically defaults when shareholders are unable to make contractual payments to debt holders (Valta, 2016). To pay off debt obligations, a firm primarily depends on internally available funds (e.g., cash on hand); more importantly, if internal funds are not sufficient, a firm has to rely on external funding that is affected by stock liquidity (i.e., the ease to trade without unduly affecting prices) (Duan & Zou, 2014). Therefore, stock liquidity is a key factor in determining a firm's survivability and thus default risk.[3]

The empirical understanding of the importance of stock liquidity in predicting default risk, however, remains limited, particularly in the international setting. To the best of our knowledge, more recent study establishing a negative impact of stock liquidity on default risk for non-financial US firms is that of Brogaard et al. (2017), which uses the Securities and Exchange Commission decimalization regulation as a shock to stock liquidity. They find that enhanced liquidity decreases default risk through improving stock price informational efficiency and

[1] For instance, Western European countries recorded 174,891 failure cases in 2015, compared to 155,581 cases in 2008. As of 2015/16, the number of corporate insolvencies reported increased in the following countries (percent)—Bulgaria (5), France (0.9), Portugal (7.6), Russia (0.8), Serbia (0.5), and Switzerland (3.9), whereas other countries recorded decreases (percent)—Belgium (9.1), Denmark (0.5), the UK (9.7), and the US (13.6), compared to the previous year (The Creditreform Economic Research Unit, 2015).

[2] For example, defaults can disrupt productivity through supply chain interruptions; destroy some or all of the value of investment the shareholders have made; lead to a loss of customers, creditors and suppliers; and harm employee well-being, including loss of jobs, reputation, income and non-pecuniary benefits (e.g., Brogaard, Li, & Xia, 2017; Clayman, Fridson, & Troughton, 2012; Verwijmeren & Derwall, 2010; Xu & Zhang, 2009).

[3] Prior literature offers competing views as to whether higher stock liquidity results in either higher or lower default risk. On the one hand, stock liquidity may increase default risk when it worsens noise trading. Consequently, a firm experiences greater mispricing and higher volatility (e.g., Baker, Stein, & Wurgler, 2003; Goldstein & Guembel, 2008; Ozdenoren & Yuan, 2008; Polk & Sapienza, 2008). On the other hand, higher stock liquidity reduces default risk because it improves stock price informational efficiency as well as facilitates corporate governance by block-holders (Brogaard et al., 2017).

facilitating corporate governance by block-holders.

The existing evidence on the relationship between stock liquidity and default risk centers exclusively on US firms. Hence, generalizing the findings of Brogaard et al. (2017) to all countries is risky for at least two reasons. Firstly, compared to the US stock market, the capital markets in other economies are less developed (e.g., Thailand) and information asymmetry is more severe (i.e., less stock liquidity) (Udomsirikul, Jumreornvong, & Jiraporn, 2011). Thus, our study extends Brogaard et al. (2017) in the global context by providing the first empirical evidence on the effect of stock liquidity on default risk at the firm level. Secondly, stock liquidity can be altered by a country's macro-level regulatory settings. Therefore, our study examines whether the firm level impact of stock liquidity on default risk is conditional on the degree of a country's regulatory settings, as opposed to prior research that explores two channels through which stock liquidity reduces default risk at the firm level. Regulatory settings serve as the effective external control mechanisms in modern corporations (Jensen, 1993) and provide macro-level benefits without extra costs to the firms when settings are strong (Gao & Zhu, 2015). More specifically, countries with strong regulatory settings have more liquid stock markets (e.g., Brockman & Chung, 2003; Chung, 2006; Eleswarapu & Venkataraman, 2006) and in turn, strengthen the effect of higher liquidity on lowering default risk.

To address our empirical predictions, we find strong support on the effect of stock liquidity on default risk at the firm level, using a large number of countries from 46 economies, resulting in 41,684 firm-year observations for 4,381 non-financial firms during 2004–2015. Unlike Brogaard et al. (2017), to capture default risk, we use the Altman Z-score (Z-score) and the Merton distance to default (D2D), which are inversely related to default risk. To measure stock liquidity, we use the Amihud illiquidity estimate (Amihud), the quoted spread (QS) and the turnover-adjusted zero daily volumes (TAZD). Our study, using fixed effects (FE), documents a negative effect of stock liquidity on default risk at firm level even across sampled countries, suggesting that firms with highly liquid stocks significantly reduce default risk. The effect is economically meaningful: one standard deviation increase in liquidity measured by Amihud, QS, and TAZD increases D2D by 17.19%, 0.31%, and 2.13%, respectively, suggesting a reduction in default risk. Since the effect of industries is a crucial predictor of default risk (Chava & Jarrow, 2004), we discover the stronger negative impact of stock liquidity on default risk in terms of significance and magnitude, by adding industry effect across the specifications.

To establish causality, we first make use of a negative exogenous shock to stock liquidity generated by the recent GFC surrounding 2008–2009. Using a difference-in-differences (DiD) approach, we find that firms with a larger reduction in liquidity due to the GFC (i.e., firms experiencing a negative change in liquidity) exhibit greater increase on default risk after the GFC than those with liquid firms (i.e., firms experiencing positive change in liquidity). Second, we use a positive exogenous shock to stock liquidity that occurred in Australia (i.e., removal of broker identifiers on the Australian Stock Exchange in 2005) and China (i.e., non-tradable share reform in 2005). By regressing the change in firm default risk surrounding these positive exogenous shocks against the change in liquidity from the financial year prior to the shock (i.e., 2004) and to the financial year after the shock (i.e., 2006), we find an increase in liquidity surrounding these events leading to a decrease in default risk. Overall, our identification tests that stock liquidity has a negative causal effect on default risk.

Having established the causality running from stock liquidity to default risk, we show that the firm-level impact of stock liquidity on default risk is conditional on the degree of country-level settings: creditor protection, information sharing, legal origins and judicial systems.[4] By adding cross-level interaction terms between the measures of certain regulatory settings and

[4] To measure regulatory settings, we use the creditor rights index for creditor protection, the credit information index for information sharing, the common vs civil law system for legal origins and the rule of law index for judicial systems, respectively (Djankov, McLiesh, & Shleifer, 2007; La Porta, Lopez-de-Silanes, Shleifer, & Vishny, 1997; Pistor, Raiser, & Gelfer, 2000).

three proxies for stock liquidity, our evidence discovers that the negative effect of stock liquidity on default risk is not homogenous across countries, implying that there is a significant role for regulatory settings in driving such an effect. Specifically, we show that stock liquidity significantly decreases default risk in countries with greater creditor protection, higher levels of information sharing, a common-law tradition and efficient judicial systems. The findings retain their significance in various sensitivity tests (e.g., alternative sample excluding Japan and the US firms, omitted variables concern and the weighted regressions).

The primary contribution of our study is to shed light on whether the firm level impact of stock liquidity on default risk depends on a country's macro-level institutions, referred to as regulatory settings. Prior research by aiming at a single secondary market (i.e., the US) examines how stock liquidity reduces default risk using firm-level environments (Brogaard et al., 2017). Another stream of research focuses on the effect of macro-level factors on the trading cost of liquidity (Eleswarapu & Venkataraman, 2006) and firm liquidity (e.g., Brockman & Chung, 2003; Chung, 2006). As opposed to other studies, our study, by conducting a cross-country analysis for 46 countries, offers new empirical evidence that the negative effect of stock liquidity on default risk at the firm level is not applicable to the countries where regulatory settings are weak. These findings provide a new insight and implications on the secondary markets by showing that regulatory settings interact with firm stock liquidity to have a stronger negative effect on default risk. Also, regulators are particularly interested in these findings, since stock liquidity can be altered by financial market regulations (Fang, Tian, & Tice, 2014). Overall, to the best of our knowledge, our study for the first time brings together the literature of market microstructure (i.e., firm stock liquidity), asset pricing (i.e. firm default risk), and law and finance (i.e., macro-level regulatory settings) in a single study.

The remainder of the study proceeds as follows. Section 2 provides an overview of the theoretical background and hypotheses. Section 3 describes the data and methodology we use in the study. Section 4 presents the main results on stock liquidity and default risk at the firm level and the role of regulatory settings at firm and country-level along with several robustness tests, including causality tests, while Section 5 concludes the study.

2 Hypothesis development

2.1 Stock liquidity and default risk at the firm level

The likelihood of default faced by a firm depends on whether the future cash flows of the firm are sufficient to cover both its debt service costs (interest payments) and its principal amount. In other words, a firm typically defaults when shareholders are unable to make contractual payments to debt holders (Valta, 2016). Thus, it seems appropriate to assume that such a firm, with debts in its capital structure, faces deteriorating funding liquidity (availability of internal cash) and requires financial resources for repayment. In such a situation, stock liquidity can mitigate default risk by increasing the ability of a firm to raise external finance in repaying the debt at the time of need.[5] In other words, when a firm needs external funds to repay debt, stock market liquidity is a critical factor in determining the firm's survivability (Duan & Zou, 2014). Consistent with these arguments, Frino, Jones, and Wong (2007) show that the bid-ask spread (a measure of stock liquidity) of defaulted firms widens substantially up to seven months prior to failure, indicating the likelihood of significant information asymmetries across market participants (greater illiquidity) in the defaulted firms. Likewise, Brogaard et al. (2017) find that default risk decreases with an increase in stock liquidity in the US. Given this evidence, a negative relationship between stock liquidity and default risk is plausible, suggesting that firms with more liquid stocks reduce default risk. Thus, our baseline hypothesis is:

H1: Firms with high stock liquidity experience low default risk across countries.

[5] Market microstructure literature provides ample evidence on the importance of stock liquidity in raising equity finance (e.g., Amihud & Mendelson, 1986; Butler, Grullon, & Weston, 2005; Stoll & Whaley, 1983) because liquidity provides investors with an ability to trade a significant quantity of stock at a low cost in a short time.

2.2 Role of regulatory settings on stock liquidity and default risk

Regulatory settings represent the legal and political institutions or environments in which firms operate (Clayman et al., 2012; Eleswarapu & Venkataraman, 2006). In this section, we hypothesize that the effect of stock liquidity on default risk is conditional on the degree of regulatory settings including on creditor protection, information sharing, legal origins, and judicial systems. Prior research building on the relationship between stock liquidity and default risk uses firm-level environments and centers on a single country study for a developed financial market (Brogaard et al., 2017). Unlike the prior work, our main interest is on the interaction between country-level (i.e., the measures of regulatory settings) and firm-level (i.e., firm stock liquidity) environments on firm default risk.

Regulatory settings are substantially different from one country to another and the differences in governing frameworks lead to different firm behaviour across capital markets (e.g., Djankov, La Porta, Lopez-de-Silanes, & Shleifer, 2008; Fan, Titman, & Twite, 2012; Gao & Zhu, 2015; La Porta, Lopez-de-Silanes, Shleifer, & Vishny, 1998; La Porta et al., 1997; Rajan & Zingales, 1995). They also serve as one of the effective external control mechanisms to solve agency problems in modern corporations (Jensen, 1993). Thus, firms take the advantage of macro-level investor protection and external control without extra costs from strong regulatory settings (Gao & Zhu, 2015). Given the differences in regulatory settings and thus, macro-level benefits to the individual firms, it is plausible to expect different impacts of stock liquidity on default risk. Specifically, in the presence of strong regulatory settings, the inverse effect of stock liquidity on default risk is expected to be stronger compared to weak regulatory settings.

The creditor rights have been crucial in influencing the development of financial systems and in affecting firm corporate governance and financial patterns (Claessens & Klapper, 2005). In settings where creditors are better protected, stock liquidity is expected to have a greater influence on default risk. This is because, better creditor protection is associated with lower stock price volatility (Hale, Razin, & Tong, 2014). Specifically, the stock prices under the investment-constrained regime increase with better creditor protection. Therefore, the effect of stock liquidity on default risk should be stronger for firms operating in such an environment. Similar to the power of creditors, information sharing matters for lending or external funding and helps credit markets to function effectively (Djankov et al., 2007). In countries where information sharing is established, we expect the inverse effect of stock liquidity on default risk to be stronger because of low asymmetric information. Credit markets and lenders often exchange borrowers' black (i.e., past defaults) and white (i.e., overall debt exposure, family and job history, criminal records) information either directly or indirectly, via information-sharing agencies such as central banks and credit bureaus (Padilla & Pagano, 2000). Specifically, the presence of such information sharing agencies improves the level of disclosure on borrowers' data. Consequently, lenders are able to know more about borrowers, including their credit history and viable projects, and this does not induce adverse selection problems. These suggest relatively low information risk in securities markets and, thus, low trading costs (Djankov et al., 2007; Eleswarapu & Venkataraman, 2006; Jappelli & Pagano, 2002). These views are related to the information theories of credit pioneered by Jaffee and Russell (1976) and Stiglitz and Weiss (1981). Based on these two views of creditor power and information theories, we propose our second and third hypotheses regarding the moderating effects of creditor protection and information sharing on stock liquidity–default risk relationship as follows:

H2a. Greater creditor protection is significantly associated with the inverse effect of liquidity on default risk.

H2b. A higher level of information sharing is significantly associated with the inverse effect of liquidity on default risk.

Legal rules protecting investors differ greatly and systematically across countries (La Porta et al., 1997). In particular, these rules vary systematically by legal origin either English law (i.e., common-law tradition) or French law (i.e., civil-law tradition). These origins, which differ in their ability to adjust to changing commercial circumstances (Beck, Demirguc-Kunt, & Levine, 2003), influence stock liquidity. Specifically, in countries where legal rules originate in the common-law tradition protect both shareholders and creditors the most against expropriation by insiders (i.e., managers), relative to the civil-law tradition (Clayman et al., 2012; La Porta et al., 1998; La Porta et al., 1997). Since better investor protection in the common-law countries leads to limited expropriation by insiders, and thus lower information asymmetric costs. Consequently, investors are motivated to trade more stocks in the securities markets. Brockman and Chung (2003) show that firms listed on the Stock Exchange of Hong Kong (a common-law country) have higher firm stock liquidity than the stocks of China-related firms (a civil-law country). In addition to varying legal traditions, there is a need for an efficient judicial system for ensuring quality enforcement of laws. In settings where the judicial systems are efficient, we assume stock liquidity to have a greater impact on default risk because of the level of investor participation. La Porta et al. (1998) and La Porta et al. (1997) argue that legal rules shape small investors' willingness to participate in equity markets. Markedly, the investor participation depends on the confidence of the law enforcement, in addition to the laws (Eleswarapu & Venkataraman, 2006). Therefore, countries with efficient judicial systems would have more investor participation and less concentrated inside ownership (i.e., more float), leading to more depth and a lower cost of liquidity. Eleswarapu and Venkataraman (2006) find that trading costs are significantly lower for countries with efficient judicial systems. Similarly, Chung (2006), using 'American depository receipt (ADR) data on various countries, shows that higher quality law enforcement levels have lower asymmetric information costs and higher firm liquidity. These arguments suggest our fourth and fifth hypotheses regarding the moderating effects of legal origins and efficient judicial systems on stock liquidity–default risk relationship as follows:

H2c. A common-law tradition is significantly associated with the inverse effect of liquidity on default risk.

H2d. An efficient judicial system is significantly associated with the inverse effect of liquidity on default risk.

3 Data, sample, variable, method and summary statistics

3.1 Data sources and sample

We collect firm- and country-level data from several sources. For the firm-specific variable, we primarily use the Bloomberg database, the Osiris database and the Credit Research Initiative (CRI) database. Bloomberg receives real-time bid-ask quotes and transaction data for stocks traded on global markets through a live feed directly from the exchanges (Brockman, Chung, & Pérignon, 2009). We obtain raw data for stock liquidity on a daily basis (e.g., ask price, bid price, volume, open price, last price, high price and low price) and estimate them into the annual frequency for analysis, as all other firm-specific measures retrieved on yearly basis. The data for the date of firms' incorporation is obtained from the Osiris database, which consists 53,000 publicly listed firms worldwide. We collect the market-based proxy for default risk from the CRI database managed by the Risk Management Institute (RMI) at the National University of Singapore. As the RMI-CRI database provides the historical time series of individual distance to default on a monthly frequency at the firm level, this requires an adjustment to annual frequency, to be consistent with the other variables. For the country-specific variable, we rely on three other data sources: the World Development Indicators (WDI), the Doing Business, and the Global Financial Development database (GFDD). We also use databases compiled by La Porta et al. (1998), Djankov et al. (2007), Djankov, Hart, McLiesh, and Shleifer (2008) and Kaufmann, Kraay, and Mastruzzi (2012). They all provide cross-country data on creditor protection, the judicial system, information-sharing agencies, legal origin, and bankruptcy-related costs.

Our final sample is an unbalanced panel consisting of 41,684 firm-year observations across 46 countries on 4,381 non-financial firms spanning the period 2004–2015, based on certain filters. First, the choice of countries in the sample depends on the availability of firm-specific data in the Bloomberg database: we select firms from countries that disclose a unique stock market index (e.g., TOPIX 1000, SSE 380 Index, FTSE 350 Index, S&P/ASX 300, among others) during the sample period. Second, for countries that do not disclose unique stock market index in the Bloomberg, we choose firms based on the MSCI index, a leading index provider (Jacobs, 2016). These two requirements exclude countries (e.g., Sri Lanka, Jordan, Ireland, among others) that do not provide data based on either a unique stock market index or the MSCI index.[6] Finally, we omit financial firms from the analysis in line with prior studies (e.g., Chang, Chou, & Huang, 2014), as such firms have unique financial characteristics and operating regulations.

3.2 Variable Measurement

3.2.1 Measures of stock liquidity

To measure stock liquidity, we use three proxies by adopting the three key dimensions, the price impact of trade, trading cost, and immediacy. The first proxy is the Amihud illiquidity estimate (Amihud) (Amihud, 2002), a reliable measure of price impact (Goyenko, Holden, & Trzcinka, 2009; Hasbrouck, 2009). This proxy is defined as the daily ratio of absolute stock return to trading volume in the currencies of the sampled countries, averaged over a number of trading days in the financial year: the higher the illiquidity estimate, the lower the stock liquidity. Our second proxy the quoted spread (QS), an average of the daily ratio between the closing bid-ask spread and the mid-point price in a financial year (Aitken & Frino, 1996; Chai,

[6] As reported in Table 2, the number of firm-years available for analysis differs greatly across countries. Indeed, no single country accounts for more than 8% of our sample observations except for Japan and the US. Of the sample distribution, the four countries with the largest number of observations are Japan with 23%, the US with 18%, India and China with 7% approximately each. The remaining countries in our sample have less than 6% of sample observations.

Faff, & Gharghori, 2010). The higher the quoted spread means the lower the stock liquidity. Our third proxy is the turnover-adjusted zero daily volumes (TAZD), a measure of liquidity for individual securities (Liu, 2006). This measure, which captures multiple dimensions of liquidity, places particular emphasis on trading speed. The higher value of this measure indicates lower stock liquidity. As the measures of stock liquidity move in an opposite direction to liquidity, we use the inverse of those proxies when running regression(s). For brevity, we continue to use similar acronyms (i.e., Amihud, QS, and TAZD) in the remainder of the paper (refer to Appendix A for an estimation of proxies for stock liquidity).

[Insert Table 1 here]

3.2.2 Measures of default risk

Default prediction has a long history, with the literature going back to Beaver (1968) and Altman (1968). We primarily measure default risk using two proxies: one from an accounting-based measure and another from a market-based measure. The accounting-based measure of a firm's default risk, the Altman's Z-score (Z-score), which measures the distance, from insolvency, has been widely used in the literature (e.g., Hicks, 1962; Houston, Lin, Lin, & Ma, 2010; Laeven & Levine, 2009). The higher the value of the Z-score, the lower the probability of bankruptcy: firms are more stable. Following Laeven and Levine (2009) and Houston et al. (2010), we use the natural logarithm of the Z-score to measure risk since it is highly skewed.[7] The market-based measure of a firm's default risk, the distance to default (D2D), a popular measure for gauging how far a limited-liability firm is away from default, has been widely adopted in the finance research (e.g., Duan, Sun, & Wang, 2012; Duan & Wang, 2012). Distance to default, a concept originating from the structural credit risk model of Merton (1974), is produced by the Credit Research Initiative (CRI) database using its corporate default

[7] For brevity, we use the acronym Z-score to refer the log of Z-score in the remainder of the paper.

prediction model. The higher the value of the distance to default, the lower the default risk, i.e., more firm stability. For methodological details on estimating the distance to default see, for example, Ali, Liu, and Su (2014) and Duan et al. (2012).

3.2.3 Measures of regulatory settings and other controls

To examine the moderating effect of stock liquidity and default risk, we include four regulatory measures: creditor protection, information sharing, legal origins of a country and judicial systems. We use the credit rights index of Djankov et al. (2007), who update the original index constructed by La Porta et al. (1998) to measure the protection of creditors. To measure information sharing among lenders, we include an index (Credit information index) measuring rules and practices affecting the coverage, scope, and accessibility of credit information available through either a credit bureau or a credit registry (Djankov et al., 2007; Houston et al., 2010). The credit bureau and registry collect information on the creditworthiness of borrowers in the financial system and facilitate the exchange of credit information among banks and financial institutions (Houston et al., 2010). To proxy for the integrity of a judicial system, we use an index of rule of law (Rule of law), as reported for most countries by La Porta et al. (1998) and for transition countries by Pistor et al. (2000). The credit bureau and registry collect information on the creditworthiness of borrowers in the financial system and facilitate the exchange of credit information among banks and financial institutions (Houston et al., 2010). Finally, in line with La Porta et al. (1998) and Djankov et al. (2007), we classify countries as common-law or civil-law by assigning a value of one if the country's legal origin is based on common-law and zero otherwise.

In addition, we include the following firm-level controls: stock return volatility (RTNVOLATY); profitability (ROA); cost of equity (CoE); firm size (Size); growth (MTB); asset liquidity (CACL); firm age (Age); tangibility (NFATA); research and development (RDTA); and R&D missing, a dummy variable set to zero if they are not reported. These variables are consistent with Brogaard et al. (2017), Bharath and Shumway (2008) and Switzer, Wang, and Tu (2015). To minimize the effect of outliers, we mitigate the outliers of all firm-specific variables, including explanatory and dependent variables, at their first and ninety-ninth percentiles.

3.3 Summary Statistics

Table 2 presents sample averages for default risk, stock liquidity and regulatory measures by each country and for the overall sample. The sample firms show 1.15 and 4.42 as averages of Z-score and D2D, respectively. However, mean values of Z-score and D2D vary greatly around the world. For example, 14 (around 30%) of the countries in our sample, including Denmark, Switzerland and the US, exhibit the Z-score on average in excess of 1.15. Similarly, some economies, such as Japan, Argentina, Russia, Poland and Croatia post a lower D2D compared with the mean D2D. On average, stocks from 35% of the countries are the most liquid, in that their mean values of Amihud, QS, and TAZD in excess of (-16.52), 2.65 and 249.5, respectively. The regulatory settings also vary significantly across countries. Creditor rights are not homogenous across countries with similar Rule of Law indexes and a common-law system. For example, Australia, New Zealand, the US and Canada are all common-law countries with a higher judicial efficiency, but the US and Canada have a lower creditor rights index, with the score of one. Information sharing among lenders has a mean of 4, suggesting the availability of more credit information from either a public registry or a private bureau to facilitate lending decisions. We observe that at least 45% of the countries offer protection to outside investors, compared to the countries with the civil-law system. Finally, the worst mean rating for the efficiency of the judicial system is 2.73 for the Philippines, while 26% of the countries (including the US, Canada, and Australia) tied with a perfect score of 10.

[Insert Table 2 here]

4 Empirical Results

4.1 Main results

4.1.1 Effect of stock liquidity on default risk at the firm level (H1)

To test our first hypothesis (H1) that higher stock liquidity results in lower default risk across countries, we specify our baseline empirical model as follows:

$$Default\ risk_{i,j,c,t} = \alpha + \beta_1 Stock\ liquidity_{i,j,c,t} + \sum \gamma_k\ Control_{i.j,c,t} + \theta' Firm + \psi' Year + u_{i,j,c,t} \quad (1)$$

Where Eq. (1) measures default risk by Z-score or D2D, and stock liquidity by Amihud, QS, or TAZD for firm i of industry j of country c in year t. Control is a vector of firm-level characteristics, as defined in Section 3. The baseline estimation for Eq. (1) is fixed effects (FE), where we add firm and year fixed effects in all specifications. To reflect industry effects in line with Chava and Jarrow (2004), we estimate Eq. (1) using pooled ordinary least squares (OLS).

Table 3 presents the regression results of FE in Panel A and of pooled OLS in Panel B. Panel A of Table 3 shows that for all three measures of liquidity, the coefficients on Amihud, QS, and TAZD are positive and significant in most cases.[8] As predicted, firms with high stock liquidity exhibit a higher level of Z-score and D2D, indicating a negative relationship between stock liquidity and default risk. Though the coefficients on Amihud, QS, and TAZD hold similar signs and statistical significance across two different proxies of default risk, the magnitude for market-based proxy (Models 2, 4 and 6) is significantly larger than that for the accounting-based measure (Models 1, 3 and 5).

[Insert Table 3 here]

We apply a method similar to that of Brogaard et al. (2017) to explore the economic significance of the relationship between stock liquidity and default risk. For instance, a one-

[8] As noted, the higher inverse of liquidity proxies (i.e., Amihud, QS and TAZD) indicates a higher stock liquidity. Similarly, a higher value of Altman's Z-score (Z-score) or distance to default (D2D) signifies a lower default risk.

standard-deviation increase in Amihud, QS, and TAZD is associated with an increase in the Z-score of about 15.69%, 0.40%, and 1.17%, respectively, where the mean of the Z-score is 1.15. Similarly, the expected increase in D2D caused by a one-standard-deviation increase in liquidity proxies (i.e., Amihud, QS, and TAZD) is about 17.19%, 0.31%, and 2.13%, respectively where the mean of D2D is 4.42. Therefore, stock liquidity not only has a significant statistical impact but also has a significant economic impact on default risk; such a relationship is much stronger when a market-based model is used.

More predominantly, Chava and Jarrow (2004) argue that adding industry effects can significantly improve default risk prediction. Consistent with this notion, our models control for industry effects in all specifications as in Panel B of Table 3. Relative to the FE method, the results retain similar signs across all specifications; the coefficients on Amihud, QS, and TAZD are large in magnitude (in five of the six cases). The level of statistical significance for QS improves from 5% (Column 3, Panel A) to 1% (Column 9, Panel B) and from insignificant (Column 4, Panel A) to significant (Column 10, Panel B), respectively.

As Panel B of Table 3, the results indicate that default risk (irrespective of default risk proxies) is lower for firms that are more profitable (ROA), that enjoy high growth (MTB) and that own more current assets (CACL). In contrast, default risk (irrespective of default risk proxies) is higher in firms that have more volatility in stock returns (RTNVOLATY), more cost of equity issuance (CoE) and are older (Age). The notion that larger firms (Size) are expected to reduce default risk is not supported by our study. Lastly, firms that have a higher proportion of fixed assets (NFATA) and that spend more on research and development expenses (RDTA) reduce default risk.

In summary, we provide evidence on a negative relationship between stock liquidity and default risk even after accounting for industry effects and find strong empirical support for H1. Our results not only confirm those of the US study but also provide additional evidence on the role of industry effects in improving default risk across countries. Therefore, our study expands the existing literature on market microstructure and asset pricing in the international setting.

4.1.2 Role of regulatory settings on stock liquidity and default risk (H2a–H2d)

Whereas Table 3 provides support for H1, that stock liquidity reduces the likelihood of default at firm-level among sampled countries, this section examines whether the firm-level impact of stock liquidity on default risk depends on regulatory settings. We add cross-level interaction terms between the measures of certain regulatory settings (i.e., creditor protection, information sharing, legal origins and judicial systems) and our three proxies for stock liquidity to Eq. (1) and report the results in Table 4.

[Insert Table 4 here]

Panel A of Table 4 shows that the coefficients on *Creditor rights* × *Amihud, Creditor rights* × *QS, and Creditor rights* × *TAZD* carry significantly positive signs at the 1% level across all model specifications. Consistent with our hypothesis H2a, this evidence suggests that the negative effect of stock liquidity on default risk is strengthened in countries where creditors are better protected. Similarly, from Panel B of Table 4, we find the coefficients on *Credit information index* × *Amihud, Credit information index* × *QS, and Credit information index* × *TAZD* to be positive and significant at the 1% level. This result indicates that stock liquidity has a greater influence on default risk in countries where information sharing about borrowers is established, lending support to our hypothesis H2b. In Panel C of Table 4, our study finds a significant negative relationship (i.e., positive coefficients on *Common-law* × *Amihud, Common-law* × *QS, and Common-law* × *TAZD*) that exists between stock liquidity and default risk in common-law countries, relative to civil-law countries. This result supports the views that better investor protection motivates investors to trade more stocks in the stock markets and provides strong support for our hypothesis H2c. Finally, the estimated coefficients on *Rule of law* × *Amihud, Rule of law* × *QS, and Rule of law* × *TAZD* correlate positively and significantly at the 1% level (five of the six cases) with default risk proxies for countries with efficient judicial systems. This evidence implies that the efficient judicial systems induce stock liquidity via more investor participation and less concentrated ownership and thus, greatly influence on the negative effect of stock liquidity on default risk, in line with the hypothesis H2d.[9]

Overall, the results in Table 4 support the argument that creditor protection, information sharing, legal origins and judicial systems moderate the role of stock liquidity in default risk across the sampled countries. Specifically, the countries with greater creditor rights, higher levels of information sharing, a common-law tradition and higher judicial efficiency strengthen the effect of higher liquidity on lowering default risk. Thus, we conclude that the firm-level effect of stock liquidity on default risk is conditional across varying regulatory settings.

4.2 Robustness tests: stock liquidity and default risk at the firm level (H1)

4.2.1 Causality identification strategy (H1)

Establishing a causal effect between stock liquidity and default risk is a potential concern because stock liquidity is likely to be endogenous, i.e., either stock liquidity causes default risk or default risk causes stock liquidity. This may be consistent with the notion that market makers demand higher returns for making markets in riskier assets by quoting wider spreads (Brogaard et al., 2017; Copeland & Galai, 1983). As a result, fewer buyers might be interested to hold stocks with high default risk. To address this possible endogeneity arising from reverse causality, we first employ a DiD approach with the GFC as an exogenous shock to liquidity. Second, we use an OLS regression to identify a causal effect of stock liquidity on default risk triggered by the exogenous change in liquidity, particularly, in Australia and China.

[9] We also add the measures of regulatory settings, the interaction terms between the measures of regulatory settings and various stock liquidity proxies to Eq. (1) and an unreported table presents qualitatively similar results in the most cases.

4.2.1.1 *The financial crisis as a natural experiment*

The most recent research uses tick price decimalization as an exogenous shock to liquidity when studying the effect of stock liquidity on firm value (Fang, Noe, & Tice, 2009), innovation (Fang et al., 2014), governance (Edmans, Fang, & Zur, 2013) and default risk (Brogaard et al., 2017). This event closely relates to the major US stock exchanges, the New York Stock Exchange (NYSE), the National Association of Securities Dealers Automated Quotation (NASDAQ) and the American Stock Exchange (Amex). Though the exogenous shock of decimalization is a positive change to stock market liquidity (Brogaard et al., 2017), few US studies identify the largest declines for the most actively traded stocks following the decimalization (e.g., Bessembinder, 2003; Furfine, 2003).

Contrasting to the exogenous positive shock of decimalization, we use the recent GFC as an exogenous negative shock to stock liquidity on the secondary market. Markedly, the drying-up of market liquidity during the financial crisis is a well-documented phenomenon (Rösch & Kaserer, 2013), although the crisis is a broad-based shock (Chen, Harford, & Kamara, 2017). For example, using the samples from the NYSE (1947–2008) and the Oslo Stock Exchange (1980–2008), Naes, Skjeltorp, and Ödegaard (2011) show that stock market liquidity tends to dry up during economic downturns. Similarly, by analyzing 23 emerging markets over the period 1993–2000, Lesmond (2005) shows that bid-ask spreads, as well as several other liquidity measures sharply, increase during the Asian and Russian crisis. The basis for using the crisis is that it increases the liquidity costs, resulting in lower stock liquidity among the world financial markets.[10] Yeyati, Schmukler, and Horen (2008) use a sample of 52 stocks from seven different countries over the period April 1994–June 2004 and demonstrate crisis periods to have an association with higher liquidity costs. In addition, investors' expectations during

[10] Many prior studies take advantage of the recent GFC to conduct a natural experiment (e.g., Campello, Graham, & Harvey, 2010; Chen et al., 2017; Duchin, Ozbas, & Sensoy, 2010).

the crisis period can partially explain a decline in the stock prices. For example, a drop in investor's expectation about this liquidity leads to a decline of the stock prices because of stock liquidity is priced in the stock market (e.g., Amihud & Mendelson, 1986). Based on these arguments, we believe that the GFC appears to be a good candidate to generate exogenous variations in liquidity since it directly affects liquidity costs, which in turns leads to lower stock liquidity. Therefore, the investigation of the change in default risk following the change in liquidity offers a natural-experiment setting for our study.

[Insert Table 5 here]

Following prior literature (e.g., Brogaard et al., 2017; Fang et al., 2014), we construct a treatment and a control group using propensity score matching. Specifically, we measure the change in liquidity proxies and sort sample firms into three terciles. As we use the inverse of liquidity proxies, we retain only the first tercile experiencing a negative change in the liquidity proxies and the third tercile experiencing positive change in the liquidity proxies. When running propensity score matching, we first estimate a logit model based on the sample firms in the first and the third terciles. The dependent variable of interest is equal to one for firms in the first tercile (i.e., treatment group) and zero for firms in the third tercile (i.e., control group. The logit regression with similar control variables captures significant coefficients in the most cases, as reported in Panel A of Table 5 (Columns 1–3). In addition, the overall model produces a pseudo-*R*-squared of 0.154, 0.126 and 0.159 with the p-value from the chi-square test below 0.01, suggesting a significant amount of variation in the choice of variable. Second, using predicated probabilities from Columns 1–3, we match each firm in the first tercile with a firm in the third tercile. Our matching procedure ends up with 415, 377 and 594 treatment-control pairs with the closest propensity scores.

Since the validity of the DiD estimates critically depends on the parallel trends assumption, we conduct two diagnostic tests to verify that the firms in the treatment and control groups are indistinguishable in terms of observable characteristics. In the first test, we re-estimate the logit model restricted to the matched sample. Columns 4–6 from Panel A of Table 5 shows none of the coefficients from the logit estimates to be statistically significant. This implies that no observable different trends exist in default risk between the two groups. In addition, the pseudo-R^2 drops substantially from 15.4% to 0.005%, 12.6% to 0.002%, and 15.9% to 0.004% with insignificant p-values for all post-matched samples. In the second test, we examine the difference in the propensity scores of the treatment and control firms. The maximum (minimum) distance between the propensity scores for both groups is less than 0.003 (-0.001) (Panel B of Table 5). Overall, the diagnostic tests suggest that propensity score matching removes all observable differences other than the difference in the change in liquidity surrounding the GFC.

Finally, to test the effect of a change in stock liquidity on default risk, we undertake a DiD analysis by focusing on the firms from one year before (year –1) and after the GFC (year +1) as in Eq. (2):

$$Default\ risk_{i,j,c,t} = \alpha + ß_1(Treatment_i * Post_t) + \sum \gamma_k\ Control_{i.j,c,t} + \phi Industry + u_{i,j,c,t} \quad (2)$$

The dependent variable in Eq. (2) is either Z-score or D2D. *Treatment* is a dummy variable equal to one (zero) if a stock is part of the treatment (control) group. Similarly, *Post* is a dummy variable equal to one for the year 2010 (post-GFC period) and zero for the year 2007 (pre-GFC period).[11] *Treatment*Post* is an independent variable specifying the difference-in-difference estimate of the effect of the GFC.

Panel C of Table 5 presents DiD results along with the same controls. As reported, we find that the coefficient estimates on *Treatment * Post* for all liquidity measures are negative and statistically significant (five of the six cases). These suggest that each firm in the treatment

[11] We assign the period 2008–2009 to the GFC.

group (i.e., illiquid firms) exhibits greater increase on default risk by (-13.8%), (-41%), (-2.5%), (-17.6), (-2.1%), and (-31.2%) after the GFC, relative to the control firms (i.e., liquid firms). The results of the natural-experiment further support the main finding of the negative impact of stock liquidity on default risk, providing further support for our hypothesis H1.

4.2.1.2 An exogenous change in stock liquidity: the case in Australia and China

To further rule out the causal effect from stock liquidity to default risk, we identify a few economies, such as Australia and China that adopt a once-off regulatory change on the stock market trading during our sample period.

On November 28, 2005, the Australian Stock Exchange (ASX) removed the real-time display of broker identifiers from its trading screens (Comerton-Forde & Tang, 2009). From 1987 until that, brokers had been able to identify the broker associated with every order in the consolidated order book. After that date, brokers can no longer observe the ID of other brokers submitting orders in the ASX (Nguyen, Duong, & Singh, 2016). This switch to broker anonymity implemented by the ASX improves stock liquidity in the Australian stock market (Comerton-Forde & Tang, 2009). Therefore, the change in liquidity caused by the removal of broker identifiers from the central limit order book of the ASX provides a natural setting to identify the causal effect of liquidity on default risk.

Prior to the non-tradable share reform in China, the shares were divided into tradable and non-tradable (Yeh, Shu, Lee, & Su, 2009). Of the shares, non-tradable shareholders represent the government and hold roughly a two-thirds majority. The lack of market trading (due to government prohibition) of government-controlled shares severely restricted the market liquidity in the Chinese stock market (Hung, Chen, & Fang, 2015; Yeh et al., 2009). To remove such a trading restriction on non-tradable shares, which is a major hurdle for domestic financial development, the Chinese government declared the non-tradable share (NTS) reform in 2005, aiming to make all non-tradable shares to tradable. As a result, the NTS reform increases the supply of tradable shares in the stock market, resulting in higher liquidity (e.g., Amihud, 2002; Beltratti, Bortolotti, & Caccavaio, 2012). Hence, the change in stock liquidity caused by the introduction of the NTS reform helps address the causal effect of liquidity on default risk.

We apply a method similar to that of Fang et al. (2009) to mitigate the reverse causality issue for a sample of Australian and Chinese firms. More specifically, the change in firm default risk surrounding the exogenous positive shock is regressed on the change in liquidity from the financial year prior to the shock (i.e., 2004) and to the financial year after the shock (i.e., 2006) as in Eq. (3):

$$\Delta\ (Default\ risk)_{i,j,c,04\ to\ 06} = \alpha_0 + \alpha_1\ \Delta\ (Stock\ liquidity)_{i,j,c,04\ to\ 06} + \sum \gamma_k\ \Delta (Control)_{i.j,c,04\ to\ 06} + \phi Industry + u_{i,j,c,04\ to\ 06} \qquad (3)$$

We estimate Eq. (3) using OLS procedures and report the regression results in Panels D and E of Table 5. Panel D shows similar results across all liquidity proxies for Australian firms. In particular, the coefficients on the change in liquidity proxies (Δ Amihud, Δ QS, and Δ TAZD) remain positive and significant in the regressions for Δ Z-score and Δ DTD. The significant level varies with the Δ DTD regressions (Column 2, 4 and 6), while it is significant at the 1% level in the Δ Z-score regressions. Similarly, for a sample of Chinese firms, the coefficients on Δ Amihud, Δ QS, and Δ TAZD are all positive and significant at the 5% level in the most cases as shown in Panel E. Overall, the results reinforce the baseline findings and confirm the causality running from liquidity to default risk.

4.2.2 Alternative estimation method (H1)

As a robustness check, we repeat our analysis using industry-adjusted firm-fixed effects where all variables except the dummy variable (e.g., R&D missing) are industry-adjusted, a method similar to Fang et al. (2009). This estimation is useful to test a causal relationship between variables using their time-series covariation (Chung, Elder, & Kim, 2010). As in Panel

A of Table 6, an increase in industry-adjusted Amihud, QS, and TAZD leads to an increase either in the industry-adjusted Z-score or D2D, suggesting a decrease in default risk. Consistent with the earlier findings, the results are robust to the inclusion of an alternative estimation method.

[Insert Table 6 here]

4.2.3 Alternative measures of default risk (H1)

To examine whether the negative effect of stock liquidity on default risk persists across countries, we use the score of Zmijewski (1984) and the credit default swap spreads (CDS).[12] The first measure, a bankruptcy model used to predict a firm's bankruptcy in two years, is an alternative to Altman's Z-score.[13] The second measure, an annual average of credit default spread from the RMI-CRI database, is an alternative to the distance to default (D2D). From Panel B of Table 6, we find that the coefficients on Amihud, QS, and TAZD are constantly significant at the 1% level and are positive across all accounting-based models (Columns 1, 3 and 5). For the market-based models (Columns 2, 4 and 6), the coefficients enter negatively and significantly at the 1% level. However, the findings from both models remain similar, suggesting a negative effect on default risk.[14]

4.2.4 Cross-industry estimation (H1)

To check any potential impact of the industry classifications on the relationship between

[12] The higher value of the Zmijewski score and the lower value of the CDS indicate more firm stability (i.e., a low default risk).

[13] Zmijewski score= $[-4.3 - 4.5\ (X_1) + 5.7\ (X_2) + 0.004\ (X_3)]$ where X_1= net income/total assets; X_2= total liabilities/total assets; and X_3= current assets/current liabilities.

[14] Additionally, we re-estimate similar regressions using the zero return measure (ZRM); the liquidity ratio (LR); and the trading volume ratio (TVR) as alternative proxies for explanatory variable (i.e., stock liquidity) and find that the main results are robust to the choice of liquidity proxies. On running specifications, we do not use te inverse measures of the LR and the TVR as both proxies move with the direction of stock liquidity (i.e., the higher the values of LR and TVR, the higher the stock liquidity).

stock liquidity and default risk, we classify samples into GICS industry groups (the Global Industry Classification Standard) and estimate the default risk regression separately for each of the industries excluding financial firms.[15] Since industry clustering could differ across sample countries (e.g., sectors like industrials and consumer discretionary dominate in the sample), these estimations may ensure that the negative effect of stock liquidity on default risk is not driven by the uneven distribution of observations across the industries. The results, as reported in Panel C of Table 6, consistently show positive and statistically significant coefficients on Amihud, QS, and TAZD across default risk proxies with a few exceptions.

4.3 Robustness tests: the role of regulatory settings on stock liquidity and default risk (H2a–H2d)

4.3.1 Alternative sample excluding Japan and the US (H2a–H2d)

Since our sample includes almost 40% of the public firms listed on the stock exchanges of Japan and the US, such dominated firms may heavily influence the moderating effect of regulatory settings on the stock liquidity–default risk relationship. To lessen this concern, we re-estimate our analysis using an alternative subsample that excludes Japanese and the US firms. As shown in Panel A of Table 7, we find all the estimated coefficients on interaction terms between the measures of regulatory settings and various proxies for stock liquidity to be positive and highly significant with a few exceptions.

[Insert Table 7 here]

To further tease out, we perform a subsample test only for the above countries by splitting countries into strong (weak) based on their scores being above (below) the sample medians of creditor rights index, credit information index and rule of law. To proxy legal origins, we use a

[15] An untabulated table narrates that sectors such as industrials (23%), consumer discretionary (19%), materials (14%) and information technology (12%) dominate in the sample distribution.

dummy variable coded one for common-law countries and zero for civil-law countries. Our findings remain significant in strong settings (Panel B of Table 7), compared to the weak settings (Panel C of Table 7). Importantly, we conclude that the negative influence of stock liquidity on default risk with conditional effect by regulatory settings largely remain, but not affected by the exclusion of such firms.

4.3.2 Omitted variables (H2a–H2d)

The omitted variable is likely to be a concern and such an issue may drive the moderating role of regulatory settings on the relationship between stock liquidity and default risk. As a robustness check for our analysis, we account for 12 country-level variables as additional controls. As motivated by Cho, El Ghoul, Guedhami, and Suh (2014) and Djankov, Hart, et al. (2008), we include three time-invariant variables related to bankruptcy costs, the length of time it takes to resolve the insolvency process (Time); the estimated cost of insolvency proceeding (Cost); and (3) a dummy variable for whether the insolvency outcome is efficient (Efficient insolvency outcome).

[Insert Table 8 here]

To control for time-varying country-specific conditions, we first account for the growth rate GDP (GDP) and the annual inflation rate (Inflation) (e.g., Claessens & Klapper, 2005; Houston et al., 2010). Second, to control for different dimensions of governance of a country, we include the six components of the world governance indicators (i.e., rule of law, voice and accountability, political stability, government effectiveness, regulatory quality and control of corruption) constructed by Kaufmann et al. (2012). As these components are highly correlated with each other, we use an overall index (WGI) averaged through the period from 2004 to 2015. Additionally, we add the ratio of the value of the liquid assets (easily converted to cash) to the short-term funding and the total deposits to control for global financial development.[16]

From Panel A of Table 8, we find that the estimated coefficients on the interaction terms continue to be positive and significant at the 1% level in the most cases. Similarly, by running a subsample analysis for strong regulatory settings, we find the coefficients on Amihud, QS, and TAZD to be positive and significant at the 1% level as in Panel B of Table 8. In contrast, a subsample analysis of weak regulatory settings shows either an insignificant or less a significant relationship between stock liquidity and default risk with a few exceptions (Panel C of Table 8). In summary, these findings reinforce the view that the negative effect of stock liquidity on default risk is conditional across varying settings.

4.3.3 Weighted regressions (H2a–H2d)

A great variation is likely to be possible in firm default risk among some of the countries because of a large number of countries in the sample. This might lead to a high degree of heteroscedasticity, resulting in bias estimates (Chen, Dou, Rhee, Truong, & Veeraraghavan, 2015). As a way to handle this issue, we re-run the weighted least squares (WLS) using pooled OLS by assigning a weight that can minimize the sum of the weighted squared residuals and in turn, heteroscedasticity is replaced. Prior studies use the reciprocal of the number of observations for that country (Cho et al., 2014) and the inverse of the within-country variance of the dependent variable (Chen et al., 2015) as a country's weight. As opposed to these studies, we treat the inverse of the total assets by firms as a country's weight, consistent with Houston et al. (2010). From Panel A of Table 9, we find that all estimated coefficients on interaction terms retain their signs and statistical significance (i.e., at the 1% level in the most cases). Similarly, in strong settings ((Panel B of Table 9), we find a highly significant negative

[16] World Bank database "Global Financial Development" defines liquid assets as cash and due from banks, trading securities and at fair value through income, loans and advances to banks, reverse repos and cash collaterals. Deposits and short-term funding includes total customer deposits (current, savings and term) and short-term borrowing (money market instruments, CDs and other deposits).

relationship between stock liquidity and default risk exists in strong regulatory settings. Moreover, in weak regulatory settings, we continue to find either insignificant or less significant relationship between stock liquidity and default risk with a few exceptions. Overall, our findings provide convincing evidence that our key conclusion on the moderating role of regulatory settings does not suffer from the high heteroscedasticity problem.

[Insert Table 9 here]

5 Summary and concluding remarks

In this study, we examine the effect of stock liquidity on default risk, as measured by Altman's Z-score and the Merton distance to default, using a cross-country sample. The increased number of corporate insolvencies after the GFC and the differences in regulatory settings across emerging and developed economies motivate our study in the global context.

We first document a strong negative relationship between stock liquidity and default risk around the globe, using a sample of 46 countries representing 4,381 non-financial firms with 41,684 firm-year observations for 2004–2015. Our results support the argument that industry effects are important in predicting default risk. Moreover, these results are further robust to the alternative estimation method (e.g., industry-adjusted firm-fixed effects), to alternative specifications of stock liquidity (e.g., the zero-return measure, the liquidity ratio and the trading volume ratio), to alternative measures of default risk (e.g., the Zmijewski score and the credit default swap spreads), and to the cross-industry estimation. To establish causality, we make use of both the exogenous negative (i.e., the effect of the GFC) and positive (i.e., removal of broker identifiers on the ASX and non-tradable share reform in China) shocks to liquidity. Overall, our results confirm that the causality runs from stock liquidity to default risk.

Additionally, we claim that the effect of stock liquidity on default risk depends on the extent of a country's regulatory settings. Specifically, we show the inverse effect of stock liquidity on default risk to be heterogeneous across varying regulatory settings around the globe.

By adding cross-level interaction terms, we document a new contribution that default risk is significantly lower for stocks from countries with greater creditor protection, higher levels of information sharing, a common-law tradition and efficient judicial systems. These findings imply that a country's regulatory settings can alter firm stock liquidity on secondary markets and have profound implications for the regulators and investors, including shareholders and creditors.

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Table 1
Variables, definitions and sources

Variable	Predicted sign with default risk	Definition	Sources
Amihud illiquidity estimate (Amihud)	–	The natural log of the daily ratio of absolute stock return to trading volume in currencies of sampled countries averaged over the number of trading days in a financial year, computed over the period from 2004 to 2015.	Bloomberg and Authors' calculation
Quoted spread (QS)	–	The daily ratio of the closing bid-ask spread divided by the mid-point spread averaged over the number of trading days in a financial year, computed over the period from 2004 to 2015.	Bloomberg and Authors' calculation
Turnover-adjusted zero daily volumes (TAZD)	–	The turnover-adjusted zero daily volumes, computed over the period from 2004 to 2015.	Bloomberg and Authors' calculation
Altman's Z-score (Z-score)	Not applicable	This variable equals the natural log of 1.2 * (Working Capital / Tangible Assets) + 1.4 * (Retained Earnings / Tangible Assets) + 3.3 * (EBIT / Tangible Assets) + 0.6 * (Market Value of Equity / Total Liabilities) + (Sales / Tangible Assets), computed over the period from 2004 to 2015.	Bloomberg
Distance to default (D2D)	Not applicable	The annual average of distance to default for gauging how far a limited-liability firm is away from default, computed over the period from 2004 to 2015.	RMI-CRI database
Stock return volatility (RTNVOLATY)	+	The annualized stock return volatility, computed over the period from 2004 to 2015.	Bloomberg database
Profitability (ROA)	–	The earnings before interest and tax to total assets computed over the period from 2004 to 2015.	Bloomberg database
Cost of equity (COE)	+	The risk-free rate + (beta * country risk premium), over the period from 2004 to 2015.	Bloomberg database
Firm size (Size)	–	The natural log of total assets, computed over the period from 2004 to 2015.	Bloomberg database
Growth opportunities (MTB)	–	The market to book value, computed over the period from 2004 to 2015.	Bloomberg database
Asset liquidity (CACL)	–	The ratio of current assets to current liabilities computed over the period from 2004 to 2015.	Bloomberg database
Firm age (Age)	+	The natural log of a number of years since the firm's listing computed over the period from 2004 to 2015.	Osiris database
Tangibility (NFATA)	–	The ratio of net property, plant, and equipment to total assets, computed over the period from 2004 to 2015.	Bloomberg database
Research and development (RDTA)	?	The ratio of research and development expenses to total assets, computed over the period from 2004 to 2015.	Bloomberg database
R&D missing	?	This variable equals one if research and development expenses are not reported, and zero otherwise.	Bloomberg database
Creditor rights index	–	An index that ranges from zero (weak creditor rights) to four (strong creditor rights), aggregating four different creditor rights such as no automatic stay, secured creditor paid first, restrictions on reorganization and no management stay.	Djankov et al. (2007), La Porta et al. (1998)
The depth of credit information Index (Credit Information Index)	–	An index measures rules and practices affecting the coverage, scope, and accessibility of credit information available through either a credit bureau or a credit registry.	World Bank "Doing Business" database, Djankov et al. (2007)
Legal origins (Common vs. civil law)	–	This variable equals one for countries with a common-law system and zero for countries with a civil-law system.	Djankov et al. (2007), La Porta et al. (1998)
Index of rule of law (Rule of law)	–	An index, ranging from zero (weak judicial system) to ten (efficient judicial system), is the assessment of the law and order tradition in the country as defined by La Porta et al. (1998).	La Porta et al. (1998), Pistor et al. (2000)
Time	?	The estimated duration, in years, of the time to resolve the insolvency case of Mirage under the factual and procedural assumptions provided. Time measures the duration from the moment of Mirage's default to the point at which the fate of Mirage is determined: i.e., when Mirage is either sold as a going concern, sold piecemeal, or successfully reorganized.	Djankov, Hart, et al. (2008)

Cost	?	The estimated cost of the insolvency proceeding for Mirage reported as a percentage of the value of the insolvency estate, borne by all parties. Costs include court/bankruptcy authority costs, attorney fees, bankruptcy administrator fees, accountant fees, notification and publication fees, assessor or inspector fees, asset storage and preservation costs, auctioneer fees, government levies and other associated insolvency costs.	Djankov, Hart, et al. (2008)
Efficient insolvency outcome	?	Equals one if the efficient insolvency outcome is achieved in the case of Mirage, zero otherwise. In version A, the efficient outcome applies if Mirage continues operating as a going concern both throughout and upon completion of the insolvency process. In version B, the efficient outcome applies if Mirage discontinues operations and is sold piecemeal.	Djankov, Hart, et al. (2008)
World Governance Indicators (WGI)	–	The average of all six Kaufmann et al. (2012) world governance indicators: rule of law, voice, and accountability, political stability, government effectiveness, regulatory quality and control of corruption, over the period from 2004 to 2015.	Kaufmann et al. (2012)
Liquid assets	–	The ratio of the value of liquid assets (easily converted to cash) to short-term funding plus total deposits to control	World Bank “Global Financial Development”
GDP growth rate (GDP)	–	The natural log of the growth rate of GDP, over the period from 2004 to 2015.	World Development Indicators (WDI)
Annual inflation rate (Inflation)	+	The percentage of the annual inflation rate, over the period from 2004 to 2015.	World Development Indicators (WDI)

Table 2

Summary statistics by country: This table presents the individual and overall mean value for proxies of stock liquidity and default risk (i.e., Amihud, QS, TAZD, Z-score, and D2D) including firm-year observations. In addition, measures for regulatory settings (i.e., creditor rights, credit information index, common-law vs. civil-law and rule of law) are reported for each country in our sample. A detailed description of all variables including sources of data is provided in Table 1.

Country	Obs.	Z-score	D2D	Amihud	QS	TAZD	CR Index	Credit Information Index	Law System	Rule of Law
Argentina	159	0.729	2.970	-21.694	1.410	236.11	1.000	6.000	Civil-law	5.350
Australia	1918	1.197	5.094	-19.782	1.388	243.68	3.000	5.000	Common-Law	10.00
Austria	287	0.833	4.744	-20.557	1.904	237.45	3.000	5.000	Civil-law	10.00
Belgium	115	1.036	6.543	-17.464	2.990	251.42	2.000	4.000	Civil-law	10.00
Brazil	354	0.928	4.342	-16.648	2.688	249.95	1.000	3.315	Civil-law	6.317
Bulgaria	87	1.089	4.055	-25.654	1.021	222.79	2.000	4.526	Civil-law	5.900
Canada	1592	1.040	5.716	-18.327	2.546	250.30	1.000	6.000	Common-Law	10.00
China	2921	1.092	3.864	-16.557	3.694	251.42	2.000	2.100	Civil-law	-
Croatia	155	0.546	3.535	-22.638	0.629	227.36	3.000	3.664	Civil-law	7.000
Czech Republic	53	1.324	5.721	-15.829	2.625	250.95	3.000	4.909	Civil-law	8.300
Denmark	156	1.590	6.624	-15.185	3.026	249.04	3.000	4.000	Civil-law	10.00
Egypt	173	0.993	3.975	-20.698	0.251	242.28	2.000	4.318	Civil-law	4.167
Finland	220	1.142	5.030	-17.330	3.055	250.01	1.000	4.000	Civil-law	10.00
France	2442	0.958	4.666	-20.683	2.376	250.17	0.000	4.000	Civil-law	8.983
Germany	428	0.953	5.368	-16.227	2.770	251.26	3.000	5.716	Civil-law	9.233
Hong Kong	20	1.012	4.305	-16.171	2.726	251.09	4.000	5.000	Common-Law	8.217
Hungary	117	0.963	4.174	-17.268	0.558	245.70	1.000	3.969	Civil-law	8.700
India	3059	1.184	4.274	-16.825	2.812	250.51	2.000	2.362	Common-Law	4.167
Indonesia	346	1.389	4.736	-10.980	2.049	245.25	2.000	3.070	Civil-law	3.983
Israel	427	0.689	4.419	-14.970	2.398	243.91	3.000	4.978	Common-Law	4.817
Japan	9679	1.060	2.840	-13.758	2.992	251.37	1.000	3.830	Civil-law	8.983
Malaysia	211	1.310	7.835	-17.263	2.680	251.14	3.000	5.400	Common-Law	6.783
Mexico	76	1.249	6.128	-19.378	1.166	218.76	0.000	5.154	Civil-law	5.350
Netherlands	190	1.061	5.667	-16.457	3.191	251.48	3.000	5.000	Civil-law	10.00
New Zealand	285	1.114	7.088	-20.072	2.262	243.49	4.000	5.000	Common-Law	10.00
Norway	145	1.130	4.463	-15.720	2.745	250.65	2.000	4.000	Civil-law	10.00
Oman	78	1.140	4.736	-21.833	1.615	230.71	0.000	3.052	Civil-law	-
Pakistan	636	1.113	3.740	-19.111	2.858	228.35	1.000	0.884	Common-Law	3.033
Philippines	244	0.906	4.564	-16.866	2.044	237.73	1.000	1.662	Civil-law	2.733
Poland	520	1.105	3.474	-22.871	1.771	247.82	1.000	5.522	Civil-law	8.700
Portugal	152	0.429	4.216	-19.332	2.686	250.36	1.000	5.000	Civil-law	8.683
Russia	239	1.164	3.455	-15.396	3.005	248.35	2.000	2.761	Civil-law	3.700
Serbia	21	1.519	4.907	-21.586	0.148	179.92	2.000	5.000	Civil-law	-
Singapore	232	0.976	6.593	-17.191	2.691	249.25	3.000	3.556	Common-Law	8.567
South Africa	182	1.371	5.951	-10.542	2.859	251.48	3.000	5.755	Common-Law	4.417
South Korea	1522	0.968	3.958	-11.391	2.606	251.29	3.000	5.658	Civil-law	5.350
Spain	248	0.700	5.628	-16.158	2.830	251.49	2.000	5.000	Civil-law	7.800
Sweden	370	1.305	5.436	-17.555	2.623	247.93	1.000	4.000	Civil-law	10.00
Switzerland	298	1.571	7.488	-16.027	3.159	250.90	1.000	5.000	Civil-law	10.00
Taiwan	47	1.144	5.463	-13.366	3.419	251.49	2.000	5.000	Civil-law	8.517
Thailand	655	1.025	4.684	-16.067	2.457	250.76	2.000	4.838	Common-Law	6.250
Turkey	828	1.075	3.920	-18.728	2.757	251.47	2.000	4.830	Civil-law	5.183
UAE	58	1.025	4.818	-17.774	2.383	249.12	2.000	3.600	Common-Law	-
UK	1900	1.240	5.812	-13.700	2.905	250.91	4.000	6.000	Common-Law	8.567
US	7694	1.464	5.421	-17.900	2.386	251.33	1.000	3.866	Common-Law	10.00
Vietnam	145	1.033	4.355	-11.148	3.511	251.33	1.000	3.416	Civil-law	-
Overall mean		1.150	4.421	-16.516	2.653	249.56	1.693	4.007	0.453	8.264

Table 3

Stock liquidity and default risk (H1): This table presents the results of stock liquidity on default risk in Panels A (fixed effects) and B (pooled OLS). The explanatory and dependent variables of interest are stock liquidity (Amihud, QS, and TAZD) and default risk (Z-score and D2D), respectively. Standard errors are adjusted for heteroscedasticity and t-statistics are presented in parentheses. Estimates followed by the symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables, including sources of data, is provided in Table 1.

	Panel A. *Fixed Effects*						Panel B. *Pooled OLS*					
	Z-score	D2D	Z-score	D2D	Z-score	D2D	Z-score	D2D	Z-score	D2D	Z-score	D2D
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Amihud	0.052***	0.219***					0.028***	0.245***				
	(19.91)	(18.67)					(25.76)	(49.66)				
QS			0.003**	0.009					0.008***	0.037***		
			(2.38)	(1.57)					(5.70)	(5.05)		
TAZD					0.001***	0.007***					0.002***	0.017***
					(3.53)	(5.10)					(8.16)	(22.94)
RTNVOLATY	0.001***	-0.005***	0.002***	0.000	0.002***	-0.002***	0.000***	-0.002***	0.001***	-0.000	0.001***	-0.000
	(7.46)	(-6.09)	(10.37)	(0.49)	(10.22)	(-3.26)	(7.28)	(-9.06)	(13.43)	(-0.19)	(13.07)	(-0.49)
ROA	0.032***	0.053***	0.033***	0.018***	0.033***	0.060***	0.047***	0.099***	0.048***	0.104***	0.048***	0.105***
	(49.03)	(21.93)	(50.11)	(11.88)	(49.99)	(24.11)	(82.63)	(42.13)	(83.80)	(42.49)	(83.93)	(42.76)
CoE	-0.003***	-0.069***	-0.001	-0.012***	-0.001	-0.064***	-0.011***	-0.114***	-0.007***	-0.082***	-0.008***	-0.088***
	(-2.98)	(-17.53)	(-1.36)	(-3.69)	(-1.53)	(-16.16)	(-13.06)	(-27.62)	(-8.60)	(-19.71)	(-9.27)	(-21.41)
Size	-0.168***	-0.273***	-0.109***	0.026	-0.111***	-0.040	-0.050***	-0.414***	-0.025***	-0.190***	-0.025***	-0.194***
	(-15.16)	(-7.13)	(-10.03)	(1.44)	(-10.17)	(-1.09)	(-33.42)	(-56.37)	(-23.25)	(-31.25)	(-23.27)	(-32.55)
MTB	0.077***	0.133***	0.086***	0.005	0.086***	0.171***	0.064***	0.146***	0.073***	0.228***	0.073***	0.225***
	(26.48)	(13.58)	(29.47)	(0.82)	(29.47)	(17.19)	(34.59)	(18.00)	(40.94)	(27.56)	(41.29)	(27.18)
CACL	0.168***	0.289***	0.175***	0.078***	0.175***	0.319***	0.217***	0.376***	0.221***	0.408***	0.221***	0.409***
	(29.58)	(14.83)	(30.23)	(7.00)	(30.23)	(16.24)	(83.52)	(29.92)	(85.32)	(31.68)	(85.37)	(31.80)
Age	-0.004*	0.007	-0.002	-0.013*	-0.002	0.013	0.000	0.015***	0.000*	0.016***	0.000**	0.016***
	(-1.65)	(0.52)	(-1.12)	(-1.87)	(-1.05)	(0.95)	(1.59)	(39.63)	(1.93)	(38.77)	(2.09)	(39.61)
NFATA	-0.323***	0.401**	-0.316***	0.151*	-0.315***	0.432***	-0.407***	1.276***	-0.405***	1.303***	-0.400***	1.347***
	(-6.49)	(2.53)	(-6.27)	(1.86)	(-6.25)	(2.63)	(-32.50)	(22.50)	(-31.96)	(22.19)	(-31.67)	(23.11)
RDTA	-0.149	0.168	-0.169	-0.036	-0.171	0.079	-0.345*	2.292**	-0.336*	2.370*	-0.334*	2.397*
	(-1.10)	(0.60)	(-1.21)	(-0.37)	(-1.22)	(0.29)	(-1.69)	(1.98)	(-1.78)	(1.80)	(-1.81)	(1.78)
R&D missing	0.003	0.090**	0.007	-0.273***	0.008	0.111***	0.001	0.323***	-0.007	0.257***	-0.005	0.277***
	(0.38)	(2.49)	(0.78)	(-6.23)	(0.96)	(3.04)	(0.10)	(6.43)	(-0.82)	(4.62)	(-0.63)	(4.91)
Intercept	3.044***	9.640***	1.500***	0.918***	1.263***	1.531**	1.508***	10.058***	0.719***	3.229***	0.356***	-0.958***
	(21.90)	(14.75)	(12.69)	(3.17)	(9.14)	(2.42)	(40.26)	(56.28)	(37.30)	(30.02)	(7.17)	(-4.50)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Industry FE	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	41684	41684	41684	41684	41684	41684	41684	41684	41684	41684	41684	41684
Adj. R^2	0.479	0.018	0.496	0.343	0.480	0.329	0.646	0.302	0.653	0.335	0.647	0.309

Table 4

Stock liquidity, regulatory settings and default risk (H2a–H2d): This table presents the interaction effects between the measures of four regulatory settings (i.e., creditor protection in Panel A, information sharing in Panel B, legal origins in Panel C and judicial systems in Panel D) and three proxies of stock liquidity. The explanatory and dependent variables of interest are interaction terms and default risk (Z-score and D2D), respectively. Standard errors are adjusted for heteroscedasticity and t-statistics are presented in parentheses. Estimates followed by the symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables, including sources of data, is provided in Table 1.

	Panel A. *Role of creditor protection*						Panel B. *Role of information sharing*					
	Z-score	D2D	Z-score	D2D	Z-score	D2D	Z-score	D2D	Z-score	D2D	Z-score	D2D
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Creditor rights × Amihud	0.003***	0.015***										
	(3.54)	(3.84)										
Creditor rights × QS			0.419***	2.247***								
			(3.97)	(4.60)								
Creditor rights × TAZD					0.000***	0.003***						
					(4.41)	(3.45)						
Credit information index × Amihud							0.002***	0.003***				
							(9.72)	(3.17)				
Credit information index × QS									0.096***	0.364***		
									(14.55)	(13.40)		
Credit information index × TAZD											0.000**	0.000***
											(2.45)	(8.13)
Amihud	0.055***	0.203***					0.002***	0.011***				
	(18.33)	(19.75)					(6.90)	(11.95)				
QS			0.329**	0.026***					0.005***	0.014*		
			(2.04)	(3.39)					(3.24)	(1.83)		
TAZD					0.023***	0.006***					0.001***	0.002***
					(11.06)	(2.69)					(5.48)	(4.45)
RTNVOLATY	0.001***	-0.003***	0.001***	-0.002***	0.001***	-0.002***	0.001***	-0.002***	0.001***	-0.003***	0.001***	-0.002***
	(14.96)	(-6.16)	(17.55)	(-4.00)	(11.25)	(-4.07)	(16.32)	(-3.51)	(14.62)	(-4.54)	(15.79)	(-3.57)
ROA	0.046***	0.092***	0.049***	0.100***	0.047***	0.099***	0.048***	0.097***	0.048***	0.097***	0.049***	0.018***
	(74.69)	(41.28)	(74.21)	(44.42)	(77.84)	(45.71)	(74.27)	(42.84)	(74.38)	(42.87)	(74.94)	(12.50)
CoE	-0.012***	-0.136***	-0.009***	-0.122***	-0.011***	-0.129***	-0.014***	-0.141***	-0.014***	-0.143***	-0.013***	-0.012***
	(-13.68)	(-32.13)	(-10.35)	(-28.63)	(-12.23)	(-31.56)	(-14.79)	(-33.25)	(-15.37)	(-33.72)	(-14.25)	(-2.86)
Size	-0.122***	0.011	-0.061***	0.271***	-0.068***	0.268***	-0.074***	0.248***	-0.070***	0.249***	-0.063***	0.137***
	(-36.06)	(0.86)	(-29.76)	(27.46)	(-33.68)	(29.03)	(-34.27)	(25.11)	(-34.75)	(27.18)	(-32.32)	(16.92)
MTB	0.055***	0.168***	0.069***	0.221***	0.066***	0.205***	0.073***	0.213***	0.072***	0.210***	0.075***	0.044***
	(27.43)	(21.78)	(33.68)	(28.93)	(34.19)	(28.30)	(34.62)	(27.68)	(34.50)	(27.26)	(35.67)	(8.53)
CACL	0.190***	0.470***	0.191***	0.503***	0.196***	0.506***	0.197***	0.514***	0.197***	0.515***	0.199***	0.141***
	(68.37)	(36.66)	(65.19)	(38.97)	(70.56)	(41.56)	(64.35)	(40.07)	(64.56)	(40.30)	(65.14)	(14.93)
Age	0.000***	0.018***	0.000***	0.018***	0.000**	0.018***	0.001***	0.015***	0.001***	0.016***	0.001***	0.012***
	(3.14)	(40.52)	(2.65)	(39.98)	(2.43)	(42.13)	(7.16)	(35.50)	(7.30)	(35.74)	(7.37)	(29.00)
NFATA	-0.456***	1.216***	-0.469***	1.255***	-0.443***	1.237***	-0.534***	1.089***	-0.522***	1.126***	-0.525***	0.333***
	(-35.52)	(20.85)	(-34.10)	(21.15)	(-34.09)	(21.77)	(-39.16)	(20.41)	(-38.37)	(21.10)	(-38.41)	(6.66)
RDTA	-0.408	0.680	-0.398	0.640	-0.390	0.668	-0.354	1.073*	-0.354	1.039	-0.355	0.183
	(-1.57)	(1.55)	(-1.51)	(1.31)	(-1.60)	(1.35)	(-1.62)	(1.70)	(-1.59)	(1.63)	(-1.63)	(1.13)
R&D missing	0.054***	-0.324***	0.048***	-0.346***	0.048***	-0.302***	0.023**	-0.340***	0.013	-0.371***	0.016	-0.359***
	(5.05)	(-9.30)	(4.45)	(-9.66)	(4.73)	(-8.73)	(2.19)	(-8.65)	(1.21)	(-9.38)	(1.53)	(-11.01)
Intercept	1.582***	6.834***	0.907***	-0.389**	0.855***	-2.934***	1.008***	-0.277	0.765***	-0.138	0.513***	-1.766***
	(30.91)	(21.05)	(23.39)	(-1.99)	(18.79)	(-7.87)	(16.76)	(-1.07)	(17.71)	(-0.72)	(7.48)	(-12.40)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	41684	41684	41684	41684	41684	41684	41684	41684	41684	41684	41684	41684

Adj. R^2	0.681	0.466	0.678	0.454	0.674	0.439	0.636	0.444	0.637	0.445	0.635	0.256

Table 4 *(continued)*

	Panel C. *Role of legal origins*						Panel D. *Role of judicial systems*					
	Z-score	D2D	Z-score	D2D	Z-score	D2D	Z-score	D2D	Z-score	D2D	Z-score	D2D
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Common-law × Amihud	0.000	0.002										
	(0.45)	(0.19)										
Common-law × QS			0.007***	0.190***								
			(4.94)	(25.71)								
Common-law × TAZD					0.000***	0.004***						
					(9.57)	(41.61)						
Rule of law × Amihud							0.003*	0.015***				
							(0.001)	(0.002)				
Rule of law × QS									0.005***	0.008***		
									(0.001)	(0.001)		
Rule of law × TAZD											0.000***	0.000***
											(0.000)	(0.000)
Amihud	0.028***	0.228***					0.170***	0.100***				
	(25.70)	(27.93)					(0.015)	(0.016)				
QS			-0.001	1.156***					0.543***	2.611***		
			(-0.68)	(8.78)					(0.114)	(0.140)		
TAZD					0.001***	0.013***					0.033***	0.013***
					(6.27)	(17.41)					(0.006)	(0.001)
RTNVOLATY	0.000***	-0.003***	0.000***	-0.006***	0.000***	-0.004***	0.005***	-0.003***	0.004***	-0.000	0.003***	0.000
	(7.20)	(-6.26)	(3.91)	(-24.09)	(5.68)	(-18.29)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
ROA	0.047***	0.093***	0.048***	0.090***	0.048***	0.088***	0.157***	0.091***	0.163***	0.100***	0.168***	0.106***
	(81.86)	(45.09)	(118.14)	(41.19)	(84.91)	(35.12)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)
CoE	-0.011***	-0.146***	-0.008***	-0.116***	-0.009***	-0.126***	-0.020***	-0.153***	-0.014***	-0.103***	-0.014***	-0.094***
	(-12.95)	(-36.43)	(-10.61)	(-27.41)	(-11.25)	(-31.97)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)
Size	-0.051***	-0.003	-0.008***	0.092***	-0.008***	0.086***	-0.423***	0.007	-0.108***	-0.201***	-0.099***	-0.167***
	(-32.33)	(-0.24)	(-14.42)	(30.97)	(-16.71)	(25.07)	(0.013)	(0.013)	(0.004)	(0.006)	(0.005)	(0.006)
MTB	0.064***	0.145***	0.079***	0.242***	0.078***	0.232***	0.378***	0.161***	0.422***	0.243***	0.425***	0.259***
	(34.62)	(20.29)	(59.47)	(33.94)	(44.33)	(28.13)	(0.009)	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)
CACL	0.217***	0.468***	0.224***	0.486***	0.223***	0.458***	0.902***	0.454***	1.003***	0.370***	0.998***	0.376***
	(83.60)	(39.50)	(113.66)	(45.95)	(86.16)	(35.81)	(0.013)	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)
Age	0.000	0.016***	-0.000***	0.013***	-0.000***	0.015***	-0.000	0.016***	-0.001***	0.014***	-0.002***	0.014***
	(1.54)	(40.66)	(-5.56)	(32.76)	(-4.92)	(38.32)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
NFATA	-0.407***	1.177***	-0.432***	1.094***	-0.434***	1.056***	-1.046***	1.098***	-0.839***	1.309***	-0.810***	1.349***
	(-32.15)	(21.55)	(-39.58)	(18.65)	(-33.89)	(18.28)	(0.051)	(0.058)	(0.050)	(0.061)	(0.050)	(0.061)
RDTA	-0.345*	0.631*	-0.221***	2.777***	-0.234	2.415*	-0.721	0.599	-0.746	2.174*	-0.731	2.167*
	(-1.69)	(1.73)	(-4.41)	(10.31)	(-1.58)	(1.75)	(0.488)	(0.392)	(0.466)	(1.245)	(0.493)	(1.207)
R&D missing	0.001	-0.244***	0.040***	0.224***	0.039***	0.156***	0.230***	-0.237***	0.031	0.330***	0.086***	0.359***
	(0.12)	(-7.74)	(7.15)	(7.50)	(5.60)	(2.77)	(0.028)	(0.033)	(0.026)	(0.054)	(0.026)	(0.053)
Intercept	1.511***	6.663***	0.556***	0.639***	0.268***	-2.137***	4.246***	5.564***	1.196***	2.178***	0.614***	-1.131***
	(39.91)	(21.87)	(37.12)	(6.67)	(5.53)	(-10.46)	(0.238)	(0.313)	(0.086)	(0.119)	(0.090)	(0.209)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	41684	41684	41684	41684	41684	41684	41684	41684	41684	41684	41684	41684
Adj. R^2	0.653	0.446	0.643	0.319	0.644	0.338	0.665	0.453	0.644	0.314	0.647	0.317

Table 5

Reverse causality on the effect of stock liquidity on default risk: This table presents the regression estimates on the causal effect of stock liquidity on default risk around the GFC, the removal of broker identifiers implemented by the ASX and the non-tradable share reform in China. Panel A (Columns 1–3) reports the results of a logit model based on the pre-matched sample in the treatment and control groups. The dependent variable of interest for the logit model equals one if the firm belongs to the treatment group and zero otherwise. Panel A (4–6) reports the results of the same logit model based on the post-matched sample in the treatment and control groups. Panel B reports the statistical distributions of the propensity scores of the treatment and control groups with the differences. Panel C reports the results for the DiD estimator based on the matched sample. *Treatment*Post* is an independent variable specifying the difference-in-difference estimate of the effect of the GFC. Panel D reports the results on the change in firm default risk caused by the exogenous shock of the broker ID removal to liquidity in Australia. Panel E reports the results of the change in firm default risk caused by the exogenous shock of the non-tradable share reform to liquidity in China. Δ denotes the change in each variable due to the exogenous shock to liquidity in Australia and China. Estimates followed by the symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables, including sources of data, is provided in Table 1.

Panel A. *Propensity score regression*	Pre-matched samples			Post-matched samples		
	Pre-match (1)	Pre-match (2)	Pre-match (3)	Post-match (4)	Post-match (5)	Post-match (6)
RTNVOLATY	-0.003***	-0.005***	-0.001	-0.000	-0.000	0.001
	(-3.39)	(-5.82)	(-1.28)	(-0.21)	(-0.29)	(1.05)
ROA	-0.034***	-0.009	-0.030***	-0.007	0.007	-0.021
	(-5.21)	(-1.48)	(-4.24)	(-0.68)	(0.78)	(-1.82)
CoE	0.049***	-0.046***	0.032***	-0.013	-0.002	-0.010
	(4.56)	(-4.75)	(3.08)	(-0.70)	(-0.18)	(-0.56)
Size	-0.050***	0.063***	0.144***	0.000	-0.005	-0.019
	(-2.89)	(3.99)	(8.44)	(0.02)	(-0.21)	(-0.66)
MTB	-0.283***	-0.038**	-0.168***	0.006	-0.021	0.012
	(-13.55)	(-2.01)	(-7.70)	(0.17)	(-0.81)	(0.32)
CACL	-0.066**	-0.101***	0.017	0.064	0.027	-0.020
	(-1.98)	(-3.31)	(0.51)	(1.11)	(0.62)	(-0.37)
Age	0.012***	0.003**	0.013***	-0.003	0.001	0.001
	(8.62)	(2.09)	(9.46)	(-1.08)	(0.63)	(0.30)
NFATA	-0.486***	-0.141	-0.651***	0.140	0.203	0.081
	(-2.70)	(-0.83)	(-3.48)	(0.46)	(0.95)	(0.28)
RDTA	2.139*	-2.580**	3.601***	-1.081	-1.909	0.110
	(1.93)	(-2.10)	(2.93)	(-0.63)	(-0.93)	(0.07)
R&D missing	-0.550***	-0.013	-0.435***	-0.168	-0.130	0.085
	(-5.78)	(-0.15)	(-4.89)	(-1.03)	(-1.05)	(0.57)
Intercept	1.639***	0.315	-0.955***	0.196	0.047	0.290
	(4.88)	(1.31)	(-2.40)	(0.43)	(0.15)	(0.65)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	4360	4416	4440	830	754	1188
p-value of X^2	0.000	0.000	0.000	0.984	0.910	0.836
Pseudo R^2	0.154	0.126	0.159	0.005	0.002	0.004

Panel B. *Propensity scores distribution*	Group	N	Mean	Standard deviation	Minimum	Maximum
Amihud	Treatment	415	0.475	0.191	0.112	0.872
	Control	415	0.474	0.191	0.111	0.899
	Difference	-	0.001	0.000	0.001	-0.027
QS	Treatment	377	0.500	0.190	0.135	0.899
	Control	377	0.499	0.190	0.136	0.896
	Difference	-	0.001	0.000	-0.001	0.003
TAZD	Treatment	594	0.488	0.190	0.067	0.899
	Control	594	0.488	0.190	0.067	0.899
	Difference	-	0.000	0.000	0.000	0.000

Panel C. *Difference-in-differences regression*	Z-score (1)	D2D (2)	Z-score (3)	D2D (4)	Z-score (5)	D2D (6)
Treatment × Post_Amihud	-0.138***	-0.410**				
	(-0.85)	(-2.06)				
Treatment × Post_QS			-0.025	-0.176**		
			(-0.68)	(-0.95)		
Treatment × Post_TAZD					-0.021**	-0.312**
					(-0.17)	(-2.06)
RTNVOLATY	0.003**	0.003*	0.000	0.000	0.002	0.004***
	(1.98)	(1.72)	(0.67)	(0.31)	(1.62)	(3.02)
ROA	0.143***	0.081***	0.041***	0.097***	0.151***	0.026**
	(11.65)	(5.32)	(13.78)	(6.43)	(14.87)	(2.08)
CoE	-0.008	-0.048*	-0.011**	-0.068***	-0.031*	-0.038*
	(-0.36)	(-1.80)	(-2.24)	(-2.67)	(-1.86)	(-1.87)
Size	-0.150***	-0.216***	-0.029***	-0.146***	-0.093***	-0.197***
	(-4.78)	(-5.58)	(-3.83)	(-3.82)	(-3.73)	(-6.53)

MTB	0.405***	0.241***	0.077***	0.235***	0.409***	0.113***
	(10.20)	(4.90)	(7.56)	(4.57)	(12.55)	(2.84)
CACL	1.094***	0.386***	0.216***	0.613***	1.099***	0.157***
	(18.24)	(5.20)	(14.81)	(8.32)	(22.89)	(2.68)
Age	-0.005**	0.015***	-0.001*	0.018***	-0.004**	0.009***
	(-2.07)	(4.56)	(-1.78)	(5.49)	(-2.10)	(3.73)
NFATA	-0.473	0.560	-0.507***	1.127***	-0.539*	0.291
	(-1.33)	(1.28)	(-5.88)	(2.59)	(-1.93)	(0.86)
RDTA	-9.370***	0.321	-2.296***	-0.357	-6.916***	0.044
	(-6.01)	(0.17)	(-5.85)	(-0.18)	(-5.16)	(0.03)
R&D missing	-0.165	0.366*	-0.014	0.094	-0.248*	0.283*
	(-0.98)	(1.76)	(-0.36)	(0.47)	(-1.86)	(1.75)
Intercept	2.188***	3.598***	0.977***	2.514***	1.903***	1.452***
	(4.22)	(5.61)	(7.64)	(3.90)	(4.61)	(2.90)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	830	754	1188	830	754	1188
Adj. R^2	0.602	0.217	0.612	0.268	0.613	0.101

Panel D. *The causal effect triggered by the removal of broker identifiers in Australia*	Δ Z-score (1)	Δ DTD (2)	Δ Z-score (3)	Δ DTD (4)	Δ Z-score (5)	Δ DTD (6)
Δ Amihud	0.479***	0.053*				
	(3.40)	(1.75)				
Δ QS			0.586***	0.370**		
			(3.16)	(2.41)		
Δ TAZD					0.056***	0.117**
					(4.59)	(2.11)
Intercept	0.236	0.276*	0.248	-0.503	0.333	0.081
	(0.35)	(1.90)	(0.37)	(-0.90)	(0.51)	(0.67)
Δ Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	204	204	204	204	204	204
Adj. R^2	0.175	0.172	0.168	0.198	0.214	0.187

Panel E. *The causal effect triggered by the non-tradable share reform in China*	Δ Z-score (1)	Δ DTD (2)	Δ Z-score (3)	Δ DTD (4)	Δ Z-score (5)	Δ DTD (6)
Δ Amihud	0.064	0.230**				
	(1.13)	(2.10)				
Δ QS			0.081**	0.029**		
			(2.26)	(1.99)		
Δ TAZD					0.058**	0.007
					(2.57)	(0.26)
Intercept	-0.066	-0.655***	0.098**	-0.015	-0.020	-0.644***
	(-0.68)	(-3.48)	(2.01)	(-0.75)	(-1.00)	(-3.38)
Δ Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	430	430	430	430	430	430
Adj. R^2	0.506	0.051	0.503	0.491	0.495	0.041

Table 6

Robustness tests on stock liquidity and default risk (H1): This table presents the results of industry-adjusted firm-fixed effects (except for dummy variable) in Panel A and of pooled-OLS estimation in Panel B using alternative proxies of default risk. Panel C presents the regression coefficients of three stock liquidity proxies using a cross-industry estimation of stock liquidity on default risk. The explanatory and dependent variables of interest are stock liquidity (industry-adjusted Amihud, QS and TAZD for Panel A; Amihud, QS and TAZD for Panels B and C) and default risk (industry-adjusted Z-score and D2D for Panel A; Zmijewski and CDS for Panel B; Z-score and D2D for Panel C), respectively. The coefficients of firm-level controls are not reported in the interests of brevity. Standard errors adjusted for heteroscedasticity and t-statistics are presented in parentheses. Estimates followed by the symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables, including sources of data, is provided in Table 1.

Panel A. *Firm-fixed effects*	Ind_Z-score (1)	Ind_D2D (2)	Ind_Z-score (3)	Ind_D2D (4)	Ind_Z-score (5)	Ind_D2D (6)
Industry-adjusted Amihud	0.048*** (35.09)	0.306*** (40.60)				
Industry-adjusted QS			0.002** (2.21)	0.016*** (2.90)		
Industry-adjusted TAZD					0.001*** (7.10)	0.010*** (11.92)
Intercept	0.003 (0.62)	-0.225*** (-9.78)	-0.000 (-0.03)	-0.251*** (-10.67)	-0.001 (-0.18)	-0.246*** (-10.50)
Industry-adjusted controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	No
N	41684	41684	41684	41684	41684	41684
Adj. R^2	0.433	0.130	0.415	0.091	0.416	0.095

Panel B. *Alternative proxies for default risk*	Zmijewski (1)	CDS (2)	Zmijewski (3)	CDS (4)	Zmijewski (5)	CDS (6)
Amihud	0.055*** (32.85)	-0.872*** (-20.53)				
QS			0.013*** (5.91)	-0.017*** (-6.12)		
TAZD					0.001*** (3.13)	-0.033*** (-4.61)
Intercept	0.111* (1.93)	0.788 (0.53)	-1.453*** (-42.88)	3.230*** (87.53)	-1.639*** (-20.67)	33.055*** (16.88)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	41684	41684	41684	41684	41684	41684
Adj. R^2	0.551	0.250	0.538	0.334	0.538	0.243

Panel C. *Cross-industry estimation*	Z-score			D2D		
	Amihud (1)	QS (2)	TAZD (3)	Amihud (4)	QS (5)	TAZD (6)
Consumer Discretionary	0.034*** (14.11)	0.017*** (5.27)	0.003*** (6.39)	0.210*** (20.77)	0.039** (2.34)	0.016*** (10.96)
Consumer Staples	0.027*** (9.61)	0.016*** (3.92)	0.001*** (2.88)	0.247*** (15.56)	0.075*** (2.60)	0.013*** (6.86)
Energy	-0.016*** (-3.02)	-0.028*** (-3.94)	-0.001 (-1.36)	0.141*** (5.30)	0.062** (2.11)	0.020** (2.50)
Health Care	0.040*** (8.48)	0.019*** (3.05)	0.003* (1.94)	0.303*** (14.93)	0.078*** (2.60)	0.009*** (2.58)
Industrials	0.031*** (14.61)	0.010*** (4.06)	0.002*** (5.04)	0.229*** (22.36)	0.043*** (3.03)	0.019*** (11.87)
Information Technology	0.044*** (12.03)	0.022*** (4.72)	0.004** (2.46)	0.308*** (18.92)	0.089*** (3.36)	0.021*** (6.05)
Materials	0.021*** (7.53)	0.001 (0.27)	0.000 (0.15)	0.225*** (18.37)	0.051*** (2.92)	0.014*** (9.76)
Real Estate	0.046*** (9.15)	0.029*** (3.45)	0.003*** (6.43)	0.297*** (12.14)	0.268*** (7.43)	0.018*** (7.94)
Telecommunication Services	0.010 (0.96)	-0.030* (-1.70)	0.334*** (7.28)	0.004*** (3.27)	0.241** (2.41)	0.029*** (4.32)
Utilities	-0.000 (-0.05)	-0.004 (-0.62)	-0.005** (-2.24)	0.355*** (15.19)	-0.030 (-0.88)	0.017** (2.16)

Table 7

Robustness test on sample excluding the US and Japan (H2a–H2d): This table presents the results based on interaction effects (Panel A), countries with strong regulatory settings (Panel B) and countries with weak regulatory settings (Panel C) for the sample excluding the US and Japanese firms. We control industry and year fixed effects in all regressions but report the coefficients of the explanatory variable only in the interests of brevity. Standard errors are adjusted for heteroscedasticity. t-statistics are presented in parentheses. Estimates followed by the symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables, including sources of data, is provided in Table 1.

Panel A. *Interaction effects*	Z-score	D2D	Z-score	D2D	Z-score	D2D	Z-score	D2D
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Coefficient. of creditor rights × Amihud	0.016***	0.073***						
	(4.98)	(15.73)						
Coefficient. of creditor rights × QS	0.480***	3.675***						
	(4.00)	(7.44)						
Coefficient. of creditor rights × TAZD	0.000***	0.003***						
	(3.76)	(4.04)						
Coefficient. of credit information index × Amihud			0.002***	0.010***				
			(7.01)	(10.95)				
Coefficient. of credit information index × QS			0.070***	0.234***				
			(9.17)	(8.10)				
Coefficient. of credit information index × TAZD			-0.000*	0.000***				
			(-1.73)	(4.53)				
Coefficient. of common-law × Amihud					0.001*	0.030***		
					(1.75)	(3.34)		
Coefficient. of common-law × QS					0.056***	0.085***		
					(18.41)	(10.53)		
Coefficient. of common-law × TAZD					0.001***	0.001***		
					(23.48)	(11.39)		
Coefficient. of rule of law × Amihud							0.002***	0.024***
							(0.001)	(0.002)
Coefficient. of rule of law × QS							0.012***	0.068***
							(0.001)	(0.002)
Coefficient. of rule of law × TAZD							0.000***	0.001***
							(0.000)	(0.000)

Panel B. *Subsample test with strong regulatory settings*	Creditor protection		Information sharing		Legal origins		Judicial systems	
	Z-score	D2D	Z-score	D2D	Z-score	D2D	Z-score	D2D
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Coefficient. of Amihud	0.018***	0.202***	0.016***	0.216***	0.012***	0.232***	0.051***	0.212***
	(13.71)	(35.82)	(11.51)	(37.56)	(6.91)	(34.29)	(13.90)	(14.50)
Coefficient. of QS	0.180***	0.089***	0.015***	0.278***	0.011***	0.155***	0.029***	0.024***
	(4.95)	(8.50)	(4.59)	(20.81)	(3.45)	(11.28)	(5.83)	(4.06)
Coefficient. of TAZD	0.001***	0.016***	0.001***	0.018***	0.001***	0.018***	0.002***	0.017***
	(4.15)	(17.99)	(3.69)	(19.61)	(3.10)	(17.27)	(6.08)	(13.50)

Panel C. *Subsample test with weak regulatory settings*	Creditor protection		Information sharing		Legal origins		Judicial systems	
	Z-score	D2D	Z-score	D2D	Z-score	D2D	Z-score	D2D
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Coefficient. of Amihud	-0.000	-0.000	0.000	-0.000	-0.009	0.014	-0.008	-0.004
	(-1.29)	(-1.17)	(0.71)	(-0.01)	(-1.11)	(1.46)	(-0.87)	(-1.23)

Coefficient. of QS	0.455**	0.061**	0.004	-0.019	0.010**	-0.007	0.001	-0.003
	(2.13)	(8.61)	(1.57)	(-1.52)	(2.03)	(-0.33)	(0.52)	(-0.77)
Coefficient. of TAZD	0.000	0.000**	-0.003	0.002	0.000	0.031*	0.000	0.015
	(0.86)	(2.70)	(-0.55)	(0.09)	(0.69)	(3.11)	(1.46)	(1.41)

Table 8

Robustness test on additional country-level variables (H2a–H2d): This table presents the results based on interaction effects (Panel A), countries with strong regulatory settings (Panel B) and countries with weak regulatory settings (Panel C) for additional country-level control variables. We control industry and year fixed effects in all regressions but report the coefficients of the explanatory variable only in the interests of brevity. Standard errors are adjusted for heteroscedasticity. t-statistics are presented in parentheses. Estimates followed by the symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables, including sources of data, is provided in Table 1.

Panel A. *Interaction effects*	Z-score (1)	D2D (2)	Z-score (3)	D2D (4)	Z-score (5)	D2D (6)	Z-score (7)	D2D (8)
Coefficient of creditor rights × Amihud	0.003***	0.020***						
	(2.94)	(4.47)						
Coefficient of creditor rights × QS	0.615***	3.717***						
	(4.85)	(6.14)						
Coefficient of creditor rights × TAZD	0.001***	0.001						
	(5.32)	(-0.66)						
Coefficient of credit information index × Amihud			0.003***	0.005***				
			(11.75)	(4.81)				
Coefficient. of credit information index × QS			0.110***	0.379***				
			(14.81)	(12.71)				
Coefficient of credit information index × TAZD			0.000*	0.000***				
			(1.73)	(7.28)				
Coefficient. of common-law × Amihud					0.003***	0.039***		
					(6.53)	(4.03)		
Coefficient. of common-law × QS					0.009***	0.308***		
					(4.36)	(31.88)		
Coefficient. of common-law × TAZD					0.000***	0.007***		
					(8.85)	(48.40)		
Coefficient. of rule of law × Amihud							0.008***	0.014***
							(0.002)	(0.003)
Coefficient. of rule of law × QS							0.002***	0.004***
							(0.001)	(0.001)
Coefficient. of rule of law × TAZD							0.000***	0.000***

Panel B. *Subsample test with strong regulatory settings*	Creditor protection		Information sharing		Legal origins		Judicial systems	
	Z-score (1)	D2D (2)	Z-score (3)	D2D (4)	Z-score (5)	D2D (6)	Z-score (7)	D2D (8)
Coefficient. of Amihud	0.018***	0.188***	0.023***	0.233***	0.052***	0.246***	0.086***	0.407***
	(10.75)	(26.04)	(14.78)	(34.40)	(16.02)	(21.10)	(23.53)	(30.25)
Coefficient. of QS	0.206***	0.251***	0.014***	0.167***	0.022***	0.071***	0.018***	0.041***
	(4.83)	(17.79)	(6.45)	(13.83)	(6.76)	(5.76)	(5.97)	(3.43)
Coefficient. of TAZD	0.001***	0.017***	0.002***	0.018***	0.003***	0.016***	0.003***	0.017***
	(4.68)	(17.51)	(5.52)	(19.03)	(5.67)	(10.74)	(8.04)	(14.44)

Panel C. *Subsample test with weak regulatory settings*	Creditor protection		Information sharing		Legal origins		Judicial systems	
	Z-score (1)	D2D (2)	Z-score (3)	D2D (4)	Z-score (5)	D2D (6)	Z-score (7)	D2D (8)
Coefficient. of Amihud	-0.000***	-0.018	0.020**	0.000	-0.003	0.204**	-0.015	0.013**
	(-3.19)	(-0.62)	(2.12)	(1.39)	(-0.37)	(2.38)	(-1.11)	(2.51)
Coefficient. of QS	0.061	0.014	0.007**	-0.023	-0.009	0.008	0.011***	0.099**
	(0.27)	(1.09)	(2.56)	(-1.57)	(-0.91)	(0.10)	(2.60)	(2.48)
Coefficient. of TAZD	0.001*	0.000	-0.001	-0.006	0.000	0.000***	-0.002*	0.000
	(1.74)	(0.85)	(-0.09)	(-0.12)	(1.01)	(11.23)	(-1.80)	(0.62)

Table 9

Robustness test on weighted regression for all countries (H2a–H2d): This table presents the results for the weighted regressions for all countries where the inverse of total assets by firms is treated as a country's weight, based on interaction effects (Panel A), countries with strong regulatory settings (Panel B) and countries with weak regulatory settings (Panel C). We control industry and year fixed effects in all regressions but report the coefficients of the explanatory variable only in the interests of brevity. Standard errors are adjusted for heteroscedasticity. t-statistics are presented in parentheses. Estimates followed by the symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables, including sources of data, is provided in Table 1.

Panel A. *Interaction effects*	Z-score (1)	D2D (2)	Z-score (3)	D2D (4)	Z-score (5)	D2D (6)	Z-score (7)	D2D (8)
Coefficient. of creditor rights × Amihud	0.029*** (4.67)	0.048*** (3.06)						
Coefficient. of creditor rights × QS	2.377** (2.31)	8.645*** (4.69)						
Coefficient. of creditor rights × TAZD	0.001*** (2.71)	0.002*** (3.56)						
Coefficient. of credit information index × Amihud			0.002*** (7.01)	0.010*** (10.95)				
Coefficient. of credit information index × QS			0.130** (2.51)	0.311** (2.38)				
Coefficient. of credit information index × TAZD			0.000** (2.36)	0.001*** (3.77)				
Coefficient. of common-law × Amihud					0.071*** (4.57)	0.058* (1.88)		
Coefficient. of common-law × QS					0.020*** (6.48)	0.177*** (23.73)		
Coefficient. of common-law × TAZD					0.002* (1.68)	0.003*** (5.46)		
Coefficient. of rule of law × Amihud							0.026*** (0.005)	0.025** (0.010)
Coefficient. of rule of law × QS							0.019*** (0.006)	0.035*** (0.004)
Coefficient. of rule of law × TAZD							0.001** (0.000)	0.001*** (0.000)

Panel B. *Subsample test with strong regulatory settings*	Creditor protection		Information sharing		Legal origins		Judicial systems	
	Z-score (1)	D2D (2)	Z-score (3)	D2D (4)	Z-score (5)	D2D (6)	Z-score (7)	D2D (8)
Coefficient. of Amihud	0.047*** (5.46)	0.263*** (13.40)	0.052*** (6.16)	0.273*** (15.87)	0.063*** (5.55)	0.267*** (11.92)	0.077*** (4.86)	0.311*** (9.80)
Coefficient. of QS	0.802*** (4.21)	0.226*** (3.58)	0.064** (2.44)	0.323*** (4.63)	0.075*** (4.74)	0.327*** (10.47)	0.868*** (3.94)	0.134** (2.37)
Coefficient. of TAZD	0.003*** (2.90)	0.007*** (3.77)	0.003*** (3.10)	0.009*** (5.06)	0.004*** (3.29)	0.009*** (4.72)	0.003** (2.43)	0.006*** (3.17)

Panel C. *Subsample test with weak regulatory settings*	Creditor protection		Information sharing		Legal origins		Judicial systems	
	Z-score (1)	D2D (2)	Z-score (3)	D2D (4)	Z-score (5)	D2D (6)	Z-score (7)	D2D (8)
Coefficient. of Amihud	0.003**	0.000	0.027**	-0.000	0.008	0.156	0.017	0.000

	(1.99)	(1.47)	(2.25)	(-1.28)	(0.53)	(0.91)	(0.59)	(0.73)
Coefficient. of QS	0.025**	0.063**	-0.003	0.047	-0.001	-0.244	-0.020	-0.102
	(2.11)	(7.69)	(-0.21)	(1.01)	(-0.08)	(-0.83)	(-0.76)	(-1.63)
Coefficient. of TAZD	0.001	-0.000	0.000	0.005	0.000	0.027**	-0.000	-0.003
	(0.28)	(-0.65)	(0.33)	(1.64)	(0.15)	(2.19)	(-0.66)	(-1.02)

Appendix A. Measures of stock liquidity

1. **Amihud illiquidity estimate (Amihud)**

The first measure of liquidity, based on price impact of trade developed by Amihud (2002), is the Amihud illiquidity estimate. Consistent with Amihud (2002), we define the Amihud illiquidity estimate (Amihud) as follows:

$$Amihud_{i,j,c,t} = \frac{1}{D_{i,j,t}} \frac{\sum_{d=1}^{D_{i,j,c,t}} |R_{i,j,c,t,d}|}{VOLD_{i,j,c,t,d}} \qquad \text{(A1)}$$

Where $R_{i,j,c,t,d}$ is the absolute stock return of firm i of industry j of country c on day d of year t. $VOLD_{i,j,c,t,d}$ is the trading volume of firm i of industry j of country c on day d of year t and $D_{i,j,c,t}$ is the number of days with available data for firm i of industry j of country c in year t.

2. **Quoted spread (QS)**

The second measure of liquidity, based on trading cost, is the quoted spread, which is an average of the daily ratio between the closing bid-ask spread and the mid-point price in a financial year (Aitken & Frino, 1996; Chai et al., 2010). We calculate the quoted spread (QS) as follows:

$$QS_{i,j,c,t} = \frac{1}{D_{i,j,c,t}} \sum_{d=1}^{D_{i,j,c,t}} \frac{BidAskSpread_{i,j,c,t,d}}{MidPointPrice_{i,j,c,t,d}} \qquad (A2)$$

Where subscripts i, j, c and t represent firm, industry, country and time, respectively. $BidAskSpread_{i,j,c,t,d}$ is the closing bid–ask spread of firm i of industry j of country c on day d of year t. $MidPointPrice_{i,j,c,t,d}$ is the mid-point price of firm i of industry j of country c on day d of year t and $D_{i,j,c,t}$ is the number of days with available data for firm i of industry j of country c in year t.

3. **Turnover-adjusted zero daily volumes (TAZD)**

Based on immediacy, the third measure of liquidity is the turnover-adjusted zero daily volumes (TAZD), measured as follows:

$$TAZD_{i,j,c,t} = \left[NoZV_{i,j,c,t} + \frac{1/(turnover_{i,j,c,t})}{Deflator}\right] X \ \frac{252}{NoTD_t} \quad \text{(A3)}$$

Where $NoZV_{i,j,c,t}$ is the number of zero daily trading volumes for firm i industry j of country c in year t. $Turnover_{i,j,c,t}$ is the stock turnover for firm i industry j of country c in year t obtained from the sum of daily shares traded per year to the number of shares outstanding. $NoTD_t$ is the total number of trading days in year t and the deflator is set to 480,000. Multiplication by the factor $\frac{252}{NoTD_t}$ standardizes the number of trading days in a year as 252.

Appendix B. Role of mechanisms on stock liquidity and default risk

Prior research advocates a channel between stock liquidity and default risk (Brogaard et al., 2017). Notably, stock liquidity may drive default risk for four reasons. A highly liquid firm uses relatively more equity financing, due to a lower flotation cost, and hence has less debt in its capital structure (Lipson & Mortal, 2009), resulting in a lower default risk. Second, higher stock liquidity could result in lower default risk, as liquidity is associated with increased firm value through, for example, higher operating profitability (Fang et al., 2009), which, in turn, causes a drop in default risk. Third, higher stock liquidity, through a firm's stock added into the stock market, enhances information transparency, resulting in more analysts following the firm (Kot, Leung, & Tang, 2015). Subsequently, by serving as monitors, analysts reduce agency-related costs (Jensen & Meckling, 1976), which may increase a firm's expected cash flows (Chung & Jo, 1996), diminishing a firm's default probabilities. Additionally, stock liquidity makes exit easier for large investors (such as institutional), so large shareholders serve as an effective governance mechanism to engage managers in value-enhancing investments (Edmans, 2009; Maug, 1998), potentially leading to lower chances of default (Brogaard et al., 2017). In line with prior research (e.g., Brogaard et al., 2017; Fang et al., 2009; Kot et al., 2015; Lipson & Mortal, 2009), we examine whether the effect of liquidity on default risk is magnified for firms with low leverage, high firm value, more analyst coverage and enhanced governance using following two empirical models:

$$\begin{aligned} Mechanisms_{i,j,c,t} &= \alpha + \theta_1 Stock\ liquidity_{i,j,c,t} + \sum \gamma_k\ Control_{i.j,c,t} + \Psi Country + \phi Industry + \psi' Year \\ &+ u_{i,j,c,t} \end{aligned} \quad (B4)$$

$$\begin{aligned} Default\ risk_{i,j,c,t} &= \alpha + \zeta_1\ Leverage_{i,j,c,t} + \zeta_2\ Firm\ value_{i,j,c,t} + \zeta_3\ Analyst\ coverage_{i,j,c,t} \\ &+ \zeta_4\ Corporate\ governance_{i,j,c,t} + \zeta_5\ Stock\ liquidity_{i,j,c,t} + \sum \gamma_k\ Controls_{i.j,c,t} \\ &+ \Psi Country + \phi Industry + \psi' Year + u_{i,j,c,t} \end{aligned} \quad (B5)$$

Eq. (B4) estimates how stock liquidity affects each mechanism, while Eq. (B5) describes how the mechanisms determine default risk across countries. We use the ratio of total debt to market value of assets for leverage (ML), Tobin's Q for firm value (TQ), a natural logarithm of the total number of analysts making recommendations for the security for analyst coverage (RFA), and institutional ownership for corporate governance (Pshares).[18] Other variables remain same as described before.

Table B1 reports simultaneously estimated results for the direct effect of stock liquidity on each mechanism and, subsequently, the effect of these mechanisms on default risk using seemingly unrelated regression (SUR). As in Panel A of Table B1, stock liquidity retains a negative and significant (1% level) relationship with leverage (ML; Models 1, 5 and 9). This is consistent with the findings of Lipson and Mortal (2009), Udomsirikul et al. (2011) and Gao and Zhu (2015). Similarly, Models 2–4, 6–8 and 10–12 show a positive and significant relationship (1% level) with firm value (TQ), analyst coverage (RFA) and corporate governance (Pshares). These results

[18] See, for example, Fang et al. (2009), Cheung, Chung, and Fung (2015) and Lipson and Mortal (2009) for definition of leverage, firm value, analyst coverage and corporate governance.

confirm the findings of Fang et al. (2009), Nguyen et al. (2016), Kot et al. (2015), Maug (1998), Edmans and Manso (2011) and Brogaard et al. (2017). Panel B of Table B1 reports that leverage (ML), as predicted, associates positively and significantly with default risk (i.e., the lower the Z-score and D2D), while firm value (TQ), analyst coverage (RFA) and corporate governance (Pshares) correlate negatively and significantly with default risk (i.e., the higher the Z-score and D2D). These findings are consistent with those of Harris and Raviv (1991), Harris and Raviv (1990), Chung and Jo (1996) and Chiang, Chung, and Huang (2015). Columns 1–6 also find a negative and significant (1% level) relationship between stock liquidity and default risk across all specifications irrespective of measures.

[Insert Table B1 here]

Panels A and B of Table B2 presents the results of the specific and total indirect effects of stock liquidity on default risk from four mechanisms using the multivariate delta method. As in Part 1 from Panel A of Table B2, the specific indirect effect through leverage (ML) is negative (i.e., positive sign) across both the accounting and market-based models, suggesting that leverage is likely to be an important mechanism that transmits the effect of liquidity on default risk. This finding is in line with the argument, that firms with highly liquid stocks have low default risk via low leverage because high liquid firms use relatively more equity financing due to a lower flotation cost. Likewise, Parts 2–4 display that specific indirect effects through firm value (TQ), analyst coverage (RFA; significant in four of the six cases) and corporate governance are negative (i.e., positive sign) and statistically significant at the 1% and 10% levels across all models. These findings suggest that the negative effect of liquidity on default risk appears by improving firm value, attracting more analysts and enhancing corporate governance. Hence, firm value, analyst coverage and corporate governance also mediate the negative transmission effect on default risk.

From Panel B of Table B2, we find that the point estimate of the total indirect effect of liquidity is positive (i.e., negative effect) and statistically significant at the 1% level across all specifications. This implies that the combined negative effect on default risk is magnified for liquid stocks with low leverage, with high firm value, with more analysts to cover firms and with enhanced corporate governance.

[Insert Table B2 here]

To summarize, we find that stocks with high liquidity have low default risk through either low leverage, or high firm value, or more analyst coverage or enhanced corporate governance. The findings are similar across both specific and total indirect effects. However, it is unclear which mechanism is more important in predicting default risk. To compare the relative importance of the mechanisms, we focus on the Amihud and calculate the marginal effect of an increase in the Amihud from the 25th to 75th percentile, which corresponds to an increase in stock liquidity, a method similar to that of Chung et al. (2010). Multiplying the change in the Amihud by the point estimate of the Amihud obtained from the specific indirect effects yields a change in default risk. As in Panel C of Table B2, an increase in Amihud through the specific indirect effect of leverage can lead to about 13.44% and 31.04% increase in default risk proxies, suggesting a reduction in default risk. The economic significance of this effect is much stronger than the effects of other mechanisms. Therefore, the findings highlight the relative importance of the leverage mechanism, which has been unexplored in the earlier US study.

Table B1

Direct effects: stock liquidity and mechanisms, mechanisms and default risk: Panel A of this table presents the results of the direct effect of stock liquidity on each mechanism (i.e., ML, TQ, RFA and Pshares) where the dependent variable is either ML, TQ, RFA or Pshares. Panel B presents the results on the effect of mechanisms (i.e., ML, TQ, RFA, and Pshares) on default risk where the dependent variable is either Z-score or D2D. The coefficients of controls are not reported in the interests of brevity. The country, industry and year fixed effects (FE) are controlled in all regressions. t-statistics are presented in parentheses. Estimates followed by the symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables, including sources of data, is provided in Table 1

Panel A. *Effect of stock liquidity on mechanisms*	ML (1)	TQ (2)	RFA (3)	Pshares (4)	ML (5)	TQ (6)
Amihud	-0.029***	0.041***	0.269***	2.047***		
	(-32.29)	(22.63)	(69.94)	(15.70)		
QS					-0.011***	0.008***
					(-8.52)	(3.35)
Intercept	-0.972***	2.104***	5.081***	62.981***	(6.95)	0.731***
	(-27.03)	(29.11)	(33.28)	(12.19)	0.001	(18.46)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	41684	41684	41684	19646	41684	41684
Adj. R^2	0.533	0.869	0.671	0.598	0.509	0.866

Panel A *(Continued)*	RFA (7)	Pshares (8)	ML (9)	TQ (10)	RFA (11)	Pshares (12)
QS	0.040***	0.501***				
	(6.83)	(2.79)				
TAZD			-0.001***	0.000*	0.005***	0.055***
			(-5.92)	(1.72)	(8.97)	(3.47)
Intercept	-3.886***	-5.107*	0.156***	0.647***	-4.932***	-19.909***
	(-41.99)	(-1.82)	(4.91)	(9.99)	(-33.48)	(-4.41)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	41684	19646	41684	41684	41684	19646
Adj. R^2	0.587	0.593	0.509	0.866	0.587	0.593

Panel B. *Effect of mechanisms on default risk*	Z-score (1)	D2D (2)	Z-score (3)	D2D (4)	Z-score (5)	D2D (6)
ML	-1.078***	-2.494***	-1.088***	-2.654***	-1.088***	-2.697***
	(-66.82)	(-25.58)	(-68.29)	(-27.50)	(-69.15)	(-28.29)
TQ	0.414***	0.886***	0.418***	0.946***	0.414***	0.949***
	(51.66)	(18.28)	(52.39)	(19.58)	(53.91)	(20.36)
RFA	0.018***	0.006	0.029***	0.098***	0.028***	-0.012
	(4.93)	(0.25)	(8.14)	(4.78)	(8.18)	(-0.56)
Pshares	0.000***	0.003***	0.000***	0.003***	0.000***	0.004***
	(3.99)	(4.66)	(3.97)	(4.97)	(4.06)	(5.82)
Amihud	0.012***	0.151***				
	(5.38)	(10.88)				
QS			0.012***	0.086***		
			(5.18)	(5.17)		
TAZD					0.001***	0.015***
					(4.19)	(9.98)
Intercept	1.241***	3.364***	0.877***	-1.327***	0.628***	-5.001***
	(14.71)	(6.60)	(19.30)	(-4.83)	(8.84)	(-11.62)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	19646	19646	19646	19646	19646	19646
Adj.R^2	0.782	0.497	0.782	0.494	0.782	0.494

Table B2

Specific and total indirect effects: stock liquidity and default risk: Panel A of this table presents the specific indirect effect of stock liquidity on default risk through four mediators (i.e., ML, TQ, RFA, and Pshares) using a multivariate delta method where point estimate indicates the coefficients of specific indirect effect. Panel B presents the total indirect effect of stock liquidity on default risk by aggregating four mediators (i.e., ML, TQ, RFA, and Pshares) where point estimate indicates the coefficient of total indirect effect (i.e., the sum of the specific indirect effects). Both standard errors and z-values are presented in parentheses. Panel C presents the relative importance of mechanisms on the relationship between stock liquidity and default risk. Estimates followed by the symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables, including sources of data, is provided in Table 1.

Panel A. *Specific indirect effect*		Amihud		QS		TAZD	
		Z-score (1)	D2D (2)	Z-score (3)	D2D (4)	Z-score (5)	D2D (6)
(1) Specific indirect effect via ML	point estimate	0.0316***	0.0730***	0.0118***	0.0288***	0.0007***	0.0018***
	std. error	(0.0011)	(0.0036)	(0.0014)	(0.0035)	(0.0001)	(0.0003)
	z-value	(29.08)	(20.05)	(8.46)	(8.14)	(5.90)	(5.80)
(2) Specific indirect effect via TQ	point estimate	0.0171***	0.0366***	0.0035***	0.0080***	0.0002*	0.0004*
	std. error	(0.0008)	(0.0026)	(0.0011)	(0.0024)	(0.0001)	(0.0002)
	z-value	(20.73)	(14.22)	(3.35)	(3.31)	(1.72)	(1.71)
(3) Specific indirect effect via RFA	point estimate	0.0050***	0.0015	0.0012***	0.0040***	0.0001***	0.0001
	std. error	(0.0010)	(0.0061)	(0.0002)	(0.0010)	(0.0000)	(0.0001)
	z-value	(4.92)	(0.25)	(5.23)	(3.91)	(6.05)	(0.56)
(4) Specific indirect effect via Pshares	point estimate	0.0009***	0.0065***	0.0002**	0.0017**	0.0000***	0.0002***
	std. error	(0.0002)	(0.0015)	(0.0001)	(0.0007)	(0.0000)	(0.0001)
	z-value	(3.86)	(4.47)	(2.28)	(2.43)	(2.64)	(2.98)

Panel B. *Total indirect effect*		Amihud		QS		TAZD	
		Z-score (1)	D2D (2)	Z-score (3)	D2D (4)	Z-score (5)	D2D (6)
Total indirect effect via ML TQ, RFA and Pshares	point estimate	0.0545***	0.1176***	0.0167***	0.0424***	0.0010***	0.0023***
	std. error	(0.0017)	(0.0073)	(0.0019)	(0.0048)	(0.0002)	(0.0004)
	z-value	(31.87)	(16.03)	(8.80)	(8.91)	(6.16)	(5.60)

Panel C. *Relative importance of mechanisms*		75th Percentile of Amihud (1)	25th Percentile of Amihud (2)	ΔAmihud (1 – 2 = 3)	Point Estimate of Amihud (4)	(3 * 4 = 5)	Economic Significance (5 * 100)
ML	Z-score	-14.1958	-18.4479	4.2521	0.0316	0.1344	13.44
	D2D	-14.1958	-18.4479	4.2521	0.0730	0.3104	31.04
TQ	Z-score	-14.1958	-18.4479	4.2521	0.0171	0.0727	07.27
	D2D	-14.1958	-18.4479	4.2521	0.0366	0.1556	15.56
RFA	Z-score	-14.1958	-18.4479	4.2521	0.0050	0.0213	02.13
	D2D	-14.1958	-18.4479	4.2521	0.0015	0.0064	00.64
Pshares	Z-score	-14.1958	-18.4479	4.2521	0.0009	0.0038	00.38
	D2D	-14.1958	-18.4479	4.2521	0.0065	0.0276	02.76