Stock Market Liquidity, Bank Diversification and Bank Stability

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Abstract

Motivated by the liberalisation of financial systems across the world, this paper is the first to explore the spillover effects of aggregate stock market liquidity on bank diversification and bank stability. Using a sample of 7131 banks operating in 39 countries for the period 1999-2014, I find that enhancement in aggregate stock market liquidity is associated with greater reliance of banks on diversified revenue and assets and also with increased bank stability. These spillover effects vary as per the level of development of the financial markets in which the banks operate and as per the level of investor protection provided to market participants. These results have important policy and practical implications and are robust to several tests.

Keywords: Stock market liquidity, bank stability, bank diversification, financial institution interaction, developed and emerging financial markets, legal origin

JEL classifications: *G15, G18, G21*

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1 Introduction

Banks and stock markets are major constituents of the financial system. In this paper, I analyse the potential spillover effects across these two financial institutions. Specifically, I analyse if enhancement in aggregate stock market liquidity has important spillover effects on the banking sector, by focusing on bank diversification and bank stability. Moreover, I further analyse the determinants of such spillover effects by assessing if such effects vary as per the level of development of the financial markets in which the banks operate and further as per the level of legal protection provided to market participants.

There is a large literature showing that sophisticated, liquid stock markets can substitute for bank's traditional sources of business, including the supply of deposits and loans (Douglas W Diamond, 1997; Haubrich & King, 1990; Jacklin, 1987; Wallace, 1988). Liquid stock markets can provide investors with higher long term returns and further, protection from liquidity risk, resulting in investors shifting the demand for deposits to stock market investments. Reduced demand for deposits drives down bank's lending capacity and hence, reduces bank business from loan contracts. Therefore, I expect that development in aggregate stock market liquidity can induce the banking sector to shift from traditional intermediary functions to rely more on diversified revenue and assets, to mitigate the loss of business from traditional banking operations.

Policy considerations and practical implications of examining the possibility of stock market liquidity to have important spillover effects on the banking sector, extending beyond traditionally assumed boundaries motivate this research. On the one hand, if enhancement in aggregate stock market liquidity induces the banking sector to expand into non-traditional sources of business to reduce the impact of loss of business from traditional sources, it is important for the policy makers and regulators to strengthen the infrastructure necessary for the banks to expand into such business activities. On the other hand, exploring the determinants of bank stability is important for an array of stakeholders including regulators, bank managers, bank borrowers, lenders and shareholders. For instance, knowledge of such determinants is crucial for regulatory authorities, whose primary focus is to sustain

the stability of the financial system. Such policy and practical implications are elaborated in the discussion section of this paper.

Previous research which provide empirical evidence on the spillover effects of aggregate stock market liquidity on the banking sector is scarce (Samarasinghe & Uylangco, 2021). Accordingly, this paper is the first to provide direct empirical evidence and the associated determinants of the effect of stock market liquidity on bank diversification and bank stability. Analysing such spillovers is important to shed more light into literature that focus on the co-evolution of financial markets and banking systems, with relevant to theories put forward by Song and Thakor (2010). Specifically, findings of this paper provide useful insights on the long-debated substitutability vs complementarity between banks and stock markets by providing evidence on the channels through which stock market developments affect the banking sector.

Two major factors motivate the hypothesis that enhancement in aggregate stock market liquidity will impact the level of bank diversification. First, much of the traditional literature in this field suggest that developed stock markets 'cannibalise' the business from the banking sector[1]. Studies also present theoretical models demonstrating how investor's reliance on bank demand deposits retains only until the banking sector and capital markets are segmented (Allen, Carletti, & Marquez, 2015; Hellwig, 1994; Von Thadden, 1998). Once this segmentation is relaxed, as in the case of current globalised environment, sophisticated stock markets can attract investors by offering both long term returns and liquidity. This reduces the traditional business of banks. A decline in demand for deposits limits bank's lending capacity since searching for alternative funding sources can require considerable costs and efforts. Moreover, it has been suggested that firms tend to take advantage of favourable conditions during stock markets boom and increase their equity issues (Baker & Stein, 2004; Baker, Stein, & Wurgler, 2003; Hanselaar, Stulz, & van Dijk, 2019). This results in a decline in demand for loans provided by the banking sector hence, creating further negative impact on bank business. Lin (2020), in a recent paper provides evidence to this phenomenon. The author finds that the deposit growth

[1] See, for example, (Allen & Gale, 1997; Jacklin, 1987)

and the lending growth in the banking sector in the US significantly declines during stock market booms. Furthermore, when I regress the aggregate debt to equity ratio of 27 OECD countries in the sample with the aggregate stock market liquidity, I find a statistically significant negative relationship between the level of aggregate stock market liquidity and firm's debt to equity ratio. This confirms that the firm's reliance on debt funding tends to decrease with enhancement in aggregate stock market liquidity. The loss of business from the traditional intermediary functions of bank deposits and loans can induce the banking sector to increase the level of diversification.

Second, development in stock markets improves the opportunity for the banking sector to expand their non-traditional sources of business. Importantly, highly liquid capital markets provide banks with enhanced investor participation as they attempt to securitize high quality credit (Song & Thakor, 2010). Hence, developed stock markets provide a sophisticated platform for the banking sector to trade securitised instruments (Song & Thakor, 2010) which is at present, a major source of non-traditional business. Other non-traditional income generating businesses which is facilitated by liquid stock markets includes brokering securities, organising potential mergers and acquisitions and trading income. Gilje, Loutskina, and Strahan (2016) show that the banking sector's increased reliance on securitised credit and sophisticated financial instruments for bank funding can explain how banks have supplemented deposits in order to continue to provide loans. Therefore, development in stock markets can help banks to expand to non-traditional sources of business to mitigate losses from the decline in banks' business from traditional intermediary functions.

Stock market liquidity is also expected to have spillover effects on bank stability, again, for several reasons which will impact in different ways. First, such spillover effects may be driven by the increased levels of bank income diversification resulting from enhancement in stock market liquidity. Baele, De Jonghe, and Vander Vennet (2007) examine 255 banks operating in 17 European countries for the period 1989-2004, arguing that bank diversification reduces operating costs and improves loan origination and credit risk management owing to economies of scope and information. Hence, increased income diversity reduces a bank's idiosyncratic risk and total risk. Theoretical and empirical studies also provide evidence that diversification enables banks to strengthen their role as screeners and

monitors, hence reducing credit risk (Douglas W. Diamond, 1984; Doumpos, Gaganis, & Pasiouras, 2016). Furthermore, Demirgüç-Kunt and Martinez Peria (2010) argue that activities that generate non-interest income can improve bank performance and help diffuse risk. Edirisuriya, Gunasekarage, and Dempsey (2015) find that stock markets in South Asia positively respond to bank diversification, increasing market-to-book ratios and bank solvency. On the other hand, several studies including DeYoung and Roland (2001) and Kim, Batten, and Ryu (2020) suggest that excessive levels of bank diversification significantly increases financial risk, ultimately leading to financial crises and hence necessitating policies to regulate excess levels of diversification.

Secondly, stock market liquidity can influence bank risk through improved risk management practises and information signalling. For instance, Biagio and Jong-Kun (2004) provide theoretical evidence that access to sophisticated capital markets provide banks with more effective instruments of risk management thereby reducing bank risk as well as the cost of risk management practises. In addition, reputation signalling will allow banks to access equity finance required to efficiently manage risks related to higher production levels.

These reasons motivate the hypothesis that aggregate stock market liquidity to have important spillover effects on bank diversification and bank stability. To test this hypothesis, I use a cross-country sample of 7131 banks operating in 39 countries. This allows me to draw broader implications on how the impact of stock market liquidity on bank diversification and bank stability varies among countries which substantially differ in terms of their market characteristics. Moreover, empirical literature analysing bank diversification has predominantly been conducted in the US banking industry with studies conducted in a global context being very limited (Kim et al., 2020). This paper helps to fill this gap in the literature. The measure of aggregate stock market (il)liquidity that I focus on is the Amihud illiquidity measure. I use both the Herfindahl–Hirschman Index (HHI) measure and the measure of diversification introduced by Laeven and Levine (2007) to quantify bank diversification. I construct a time varying Z-score to quantify bank stability (bank risk)[2].

[2] Throughout this paper, stability and risk are used interchangeably; higher bank stability is equivalent to lower bank risk and vice versa.

The key findings are as follows; first, enhancement in aggregate stock market liquidity results in an increase in both the level of revenue and asset diversification in the banking sector. Second, stock market liquidity further has positive spillover effects on bank stability. Results are both statistically and economically significant. With regard to bank diversification, a one standard deviation increase in the Amihud illiquidity measure, which corresponds to a decline in stock market liquidity, is associated with a decline in the level of income diversification and asset diversification of 0.012 and 0.019 respectively. With sample means of income diversity and asset diversity being equal to 0.1 and 0.25 respectively, the economic effects are clearly significant. Similarly, a one standard deviation increase in the Amihud illiquidity measure (hence, a decline in stock market liquidity) result in a decline in Z-score (which represents a decline in bank stability) by 0.26. The economic significance is substantial, compared with the mean value of Z-score being 2.13. These findings survive a number of robustness tests, including controlling for endogeneity. Third, I find that the positive effect of aggregate stock market liquidity on bank diversification and bank stability is more pronounced in banks operating in countries with developed financial markets. Fourth, the results suggest that the spillover effects of stock market liquidity on both the bank diversification and bank stability are stronger when a high level of legal protection is provided to market participants. To further explore the channels through which stock market liquidity affects the banking sector, I allow for the joint determination of bank stability and bank diversification and find that aggregate stock market liquidity has important spillover effects on bank stability independent of its effect on bank diversification.

The paper is organised as follows; Section 2 presents the data and methodology. Section 3 presents the results and the discussion of results. Section 4 presents the robustness tests. Section 5 concludes.

2 Data and methodology

2.1 Sample data

Data permitting, the sample of this paper includes 39 countries[3] which constitutes 21 countries with developed markets and 18 countries with emerging and frontier markets based on country classifications provided by FTSE Russell. Sample data is from 1999 to 2014. Choosing a cross-country sample allows to generalise the results of potential spillover effects of stock markets on the banking sector beyond the United States to other countries which are characterised by different levels of regulatory policies and financial development.

I use the Amihud illiquidity measure to quantify aggregate stock market (il)liquidity. The reasons for choosing the Amihud measure are outlined in Section 2.2.3. Stock price and trading volume data required to compute the Amihud measure for the US are from the Centre for Research in Security Prices (CRSP). Such data for all other countries in the sample are from Thomson Reuters Datastream. Several filters are applied to ensure that only commons stocks are included. For data collected from CRSP, I only include stocks with share code 10 or 11 which are identified as common stocks. Similarly, for data collected from Datastream, shares which are classified as equities and are registered as primary quote in each of the exchanges are included. Further, securities identified as non-common stocks, including depositary receipts, exchange traded commodities, exchange-traded funds, preference shares and warrants[4] are excluded.

Data is collected for one major stock exchange in each country in the sample except for Japan, China, and South Korea. I include data for both the Tokyo and Osaka exchanges in Japan, both the Shenzhen and Shanghai exchanges in China, and both the KOSDAQ and Korea exchanges in South

[3] The selection of countries predominantly depends on the availability of detailed data.

[4] Since Datastream does not provide any code for identifying non common shares, several other filters are applied manually to ensure that only common stocks are considered in the analysis. Following Lee (2011), I exclude the following types of non-common stocks manually for each country. For Belgium, shares of the type 'AFV' and 'VVPR' are excluded since they have preferential tax or dividend incentives. For Canada, shares containing the name 'INC.FD' are excluded which fall under income trusts. For France, shares of the type 'ADP' and 'CIP' are excluded since they have preferential dividend rights and do not have voting rights. Similarly, for Italy, shares of the type 'RSP' are excluded since they do not carry voting rights.

Korea since majority of the stocks are listed in only one of the two main exchanges in these countries. Stocks listed in both the exchanges are excluded. For the US market, I only include the securities listed in the NYSE and AMEX since volume definitions for the NASDAQ are substantially different and hence, not comparable (Amihud, 2002).

I apply several filters following existing literature (Amihud, 2002; Kang & Zhang, 2014; Samarasinghe & Uylangco, 2021) to clean the data collected from Datastream. For instance, in the calculation of the Amihud measure, I include both active stocks and dead stocks which were terminated during the sample period and I only include stocks traded in local currency, including Euros for stocks listed in the Euro Zone. Ince and Porter (2006) and Lee (2011) ascertain that extremely high daily stock returns reported in Datastream are often due to data errors and thus should be eliminated. Hence, I set the daily return of a stock to be missing if the reported returns are higher than 200% in a particular day if any daily return of 100% or above is reversed the day after[5]. Further filters include setting non-trading days to be missing and excluding daily volume data if lower the hundred US dollars. Daily stock return data needed to compute the Amihud measure are obtained by taking the change in Return Index (RI) reported in Datastream. Datastream calculates daily RI values controlled for dividend and stock splits rounding off to the nearest hundredths. Hence, when computing daily stock returns based on the values of changes in RI, this could lead to rounding errors since small figures could be rounded to zero values. To prevent this issue from distorting the results, I set the daily returns to be missing if RI figures from Datastream are less than US$ 0.01.

Data on net interest income, individual components of non-interest income, bank loan classifications, individual components of bank earning assets required to compute the income and asset diversity measurements, data used to compute the Z-Score measure and all other data on bank-level controls are from Fitch Connect. Apart from the data filters discussed in Section 2.2.1 , similar to Laeven and Levine (2007) and Mercieca, Schaeck, and Wolfe (2007) , I excluded extreme outliers with regard to the data used in the calculation of the diversity measures. With regard to industry-specific and macro-

[5] A comparison of extreme returns reported by Datastream and daily returns reported in CRSP is outlined in Ince and Porter (2006).

economic controls, data on deposit rates and lending rates are from EIU country data. Data on regulatory restrictions and the level of institutional quality are from World Bank surveys on bank regulation by Barth, Caprio Jr, and Levine (2013) and data on GDP and inflation are from Global Financial Development Database published by the World Bank.

2.2 Methodology

2.2.1 Measurement of bank diversification

To quantify the level of diversification, granular data on individual non-traditional sources of income and asset base (for instance, data on securitisation, income from brokerage services etc) for each bank would be ideal (Laeven & Levine, 2007). However, since such data is not available, diversification indices which, to a certain extent, reflect the individual components of non-interest income and non-traditional sources of the asset base are adopted. Hence, in this paper, I use two main diversification indices; Herfindhal-Hirshman (HHI) type diversification indices and the diversity measures introduced by Laeven and Levine (2007) (LL). These measures have been extensively used in the literature to quantify the level of bank diversification (Baele et al., 2007; Doumpos et al., 2016; Elsas, Hackethal, & Holzhäuser, 2010; Mercieca et al., 2007; Schmid & Walter, 2009). The income diversity measure introduced by Laeven and Levine (2007) (LL) is used to quantify the level of income diversification of the banks. For the asset diversity measure, I use the Herfindhal-Hirshman index[6]. These measures are able to reflect the level of diversification of the banking sector, with regard to the composition of income, assets, and balance sheet figures (Doumpos et al., 2016). I present further robustness tests by quantifying the level of diversification using alternative measures of diversification in Section 4 .

Equation (1) shows the construction of income diversity measure and Equation (2) shows the construction of the asset diversity measure.

[6] The income diversification measured by HHI requires data on individual components of non-interest income. However, the data availability is relatively low for countries with emerging and frontier markets. Similarly, the component of "other earning assets" required to compute the asset base measure for LL is limited for emerging markets. Hence, I do not use those measures as the main measures of income and asset diversification. However, in the robustness tests, I show that the results are still significant when income diversification is measured using the HHI and the asset diversification is measured using LL.

$$LL_{INCOME} = 1 - \left[\frac{(Net\ interest\ income - Other\ operating\ income)}{Total\ operating\ income}\right] \quad (1)$$

Where $Net\ interest\ income$ is the difference between the interest income and interest expense and $Other\ operating\ income$ consists of net commission and fee income, net trading income and net insurance income. $Total\ operating\ income$ is the combination of net interest income and other operating income. The resulting value is subtracted from one such that an increase in LL_{INCOME} represents increased diversification. The resulting values will vary between zero and one where higher values represent higher income diversification.

$$HHI_{LOAN} = 1 - \left(\left(\frac{MTG}{TOTAL}\right)^2 + \left(\frac{COMM}{TOTAL}\right)^2 + \left(\frac{C\&O}{TOTAL}\right)^2\right) \quad (2)$$

Where *MTG*, *COMM*, *C&O* refer to mortgage loans, corporate and commercial loans and consumer and other loans respectively. *TOTAL* is the combination of *MTG*, *COMM*, and *C&O*. As with the income diversity measure, the resulting figure is subtracted from unity such that an increase in diversification results in a higher HHI_{LOAN} value. The values of this measure typically varies between zero and 0.67 where higher values of HHI_{LOAN} represent higher levels of asset diversification or lower concentration on a specific type of loan.

The following alternative measures of diversification are used in the robustness tests discussed in Section 4 .

Income based HHI

$$HHI_{INCOME} = 1 - \left(\left(\frac{INT}{TOI}\right)^2 + \left(\frac{FEE}{TOI}\right)^2 + \left(\frac{T\&I}{TOI}\right)^2 + \left(\frac{OTH}{TOI}\right)^2\right) \quad (3)$$

Where *INT*, *FEE*, *T&I* and *OTH* refer to gross interest revenue, net commission and fee income, trading and insurance income and all other net revenue respectively. *TOI* is the summation of *INT*, *FEE*, *T&I* and *OTH*. Higher values of HHI_{INCOME} represent higher levels of income diversification or lower concentration on individual categories of income.

Asset based LL

$$1 - \left|\frac{(Gross\ loans - Other\ earning\ assets)}{Total\ earning\ assets}\right| \quad (4)$$

Where *Other earning assets* include securities, insurance assets, investments in property and all other earning assets and *Total earning assets* is the combination of *Gross loans* and *Other earning assets*. Similar to all other measures, higher values represent higher levels of LL_{LOAN} represent higher levels of asset diversification.

Lastly, I also use an alternative asset-based measure (LTA) to quantify the level of diversification used by Baele et al. (2007), which is defined as follows.

LTA = 1 – Proportion of gross loans to total assets

where higher values represent lower specialisation in loans and a highly diversified asset base.

2.2.2 Measurement of Bank Stability

Bank risk (financial stability) is measured using the Z-score as is commonly used in existing literature (Berglund & Mäkinen, 2019; Demirgüç-Kunt & Huizinga, 2010; Laeven & Levine, 2009). The measure represents, for a particular bank, the number of standard deviations below the mean by which profits would have to fall before depleting its capital. Hence, the Z-score is equivalent to the inverse of the probability of insolvency. It is an objective measure which can be used by any bank since all banks are exposed to the same risk of insolvency when capital is exhausted.

Different approaches have been used to construct time varying Z-scores required in panel studies. For instance, studies including Laeven and Levine (2009) use the standard deviation of returns over the full sample period and combine this with the mean value of returns and the current capital ratio to calculate time varying Z-scores. Other studies, including Delis, Tran, and Tsionas (2012) and Beck, De Jonghe, and Schepens (2013), use a rolling moment approaches rather than the full sample period

to calculate the standard deviation of returns[7]. I follow the methodology of Berglund and Mäkinen (2019), Fiordelisi and Mare (2014) and Lepetit and Strobel (2013) who utilise mean and standard deviation estimates of the return calculated over the full sample period, combined with the current value of the capital ratio for two reasons. Firstly, using this approach eliminates the need to exclude initial observations as is necessary for rolling moment approaches. Second, as shown in Lepetit and Strobel (2013), Z-score measures calculated using this approach minimise the "spurious" volatility in the calculation of time varying bank insolvency measures. As such, the calculation of Z-score in this paper is as follows;

$$Z - score_{i,t} = \frac{\mu(ROAA_{c,t}) + CAR_{i,t}}{\sigma(ROAA_{c,t})} \quad (5)$$

Where $\mu(ROAA_{c,t})$is the mean of ROAA within country *c* in year *t*, $CAR_{i,t}$ is the capital asset ratio for bank *i* in year *t* and $\sigma(ROAA_{c,t})$ is the standard deviation of ROAA within country *c* in year *t*. A higher Z score corresponds to a lower probability of insolvency risk; hence a higher Z score implies higher bank stability (lower risk) and vice versa. Following Fiordelisi and Mare (2014) and Laeven and Levine (2009), I take the natural logarithm of the computed Z-score to smooth out the effect of extreme values of the Z distribution.

2.2.3 Measurement of stock market liquidity

Aggregate stock market (il)liquidity is quantified by the Amihud (2002) illiquidity measure. It is computed as the daily ratio of the average absolute return over the trading volume. As such, this measure reflects the daily price response of a stock to its corresponding order flow and hence captures the capacity of a particular stock market to absorb transactions without substantial variation in prices. Accordingly, higher values of the Amihud illiquidity measure represents high stock market illiquidity (low stock market liquidity) and vice versa.

[7] Lepetit and Strobel (2013) elaborate on such approaches used in existing literature.

The Amihud measure is used as the measure of aggregate stock market (il)liquidity in this paper due to several reasons. For instance, since it measures the ability of a stock market to absorb transactions without significant price impact, it adequately represents the breadth and the depth of stock markets (Galariotis, Krokida, & Spyrou, 2016). Moreover, the Amihud measure is proved to be an adequate proxy for high frequency measures of liquidity in existing literature. Goyenko, Holden, and Trzcinka (2009) prove this using US data and Fong, Holden, and Trzcinka (2017) show that such adequacy also holds when applied to global data. Furthermore, existing studies also find a high correlation between the Amihud illiquidity measure and other measures of liquidity. Examples include Kang and Zhang (2014) and Lesmond (2005) who find a high correlation between the Amihud measure and the Effective spread in actively traded markets and emerging markets respectively. Due to these associated benefits, the Amihud ratio is frequently utilised in existing literature to quantify aggregate stock market (il)liquidity (Amihud, Hameed, Kang, & Zhang, 2015; Jain, 2005; Lesmond, 2005; Ma, Anderson, & Marshall, 2018; Næs, Skjeltorp, & Ødegaard, 2011). The Amihud ratio is calculated following Hanselaar et al. (2019) as follows;

$$Amihud_{i,d} = 10000 * \ln\left(1 + \frac{|r_{i,d}|}{vol_{i,d}}\right) \quad (6)$$

where $|r_{i,d}|$ refers to the absolute return for stock *i* on day *d* and $vol_{i,d}$ represents the trading volume in US dollars for stock *i* on day *d*, calculated by multiplying the number of shares traded by the closing price. All filters discussed in Section 2.2.3 are applied when computing the Amihud ratio and in addition, to decrease the impact from outliers, I add a constant and use the natural logarithm of the standard Amihud ratio. The resulting measure is multiplied by 10000 to avoid very minor values and thus, deliver a common representation among variables. The daily stock level (il)liquidity is then averaged across all stocks in a specific country by weighting the individual stocks by their corresponding market capitalisation to compute the country-level (il)liquidity measures. To further reduce the impact of extreme outliers, the computed annual country-level liquidity values are winsorized at the 1st and 99th percentile.

2.2.4 Empirical Models

The following empirical model is used to investigate the spillover effects of stock market liquidity on bank diversification.

$$Diversification_{ict} = \beta_0 + \beta_1 Illiquidity_{ct} + \beta_2 Industry\ \&\ Macro\ EconomicControls_{ct} + \beta_3 Bank\ Controls_{ict} + \beta_4 X_{ct} + \theta_b + \theta_t + \varepsilon_{ict} \quad (7)$$

where the subscripts *i,c,t* refer to the bank, country and year respectively. The dependent variable is bank income and asset diversification, measured by the LL_{INCOME} and HHI_{LOAN} measures respectively. Industry & Macro Economic Controls include the deposit rate, lending rate, regulatory restrictions, the level of institutional quality and GDP. Bank Controls include additional bank characteristics such as bank size, capital adequacy, and liquidity. θ_t and θ_b represent year and bank fixed effects respectively. Standard errors are clustered at the bank-level[8]

The following empirical model is used to investigate the spillover effects of stock market liquidity on bank stability.

$$Bank\ Stability_{ict} = \beta_0 + \beta_1 Illiquidity_{ct} + \beta_2 Bank\ Controls_{ct} + \beta_3 Other\ Controls_{ict} + \theta_b + \theta_t + \varepsilon_{ict} \quad (8)$$

Where the subscripts *i,c,t* refer to the bank, country and year respectively. The dependent variable is the bank stability and the key independent variable $Illiquidity$, represents the Amihud illiquidity measure. $Other\ Controls$ control for GDP, inflation and financial crisis and *Bank Controls* include deposit growth, share of interest income, loan loss provisions, funding costs, bank size, capital adequacy and liquidity[9]. Measurement of control variables, regarding both bank diversification and

[8] The Amihud illiquidity measure remains negative and statistically significant when the standard errors are clustered at the country-level.

[9] I control for annual deposit growth since it is a good proxy for the financial structure of a bank which can impact bank risk. I also control for the share of interest income which represents a bank's business model (Dietrich & Wanzenried, 2011) which should influence bank stability. Higher loan loss provisions typically imply higher credit risk (Bouzgarrou, Jouida, & Louhichi, 2018; Dietrich & Wanzenried, 2011). Hence, I include it as a control variable. Higher funding costs may imply inefficient management which could lead to financial distress (Berger & DeYoung, 1997; Moutsianas & Kosmidou, 2016). Hence, I

bank stability is outlined in Appendix A. θ_t and θ_b represent year and bank fixed effects, respectively. Standard errors are clustered at the bank level[10]. Annual country-level liquidity variable and control variables are winsorized at the 1st and 99th percentile while extreme outlier clusters are excluded. The main panel regressions are re-estimated for subsamples based on the level of development in capital markets and further based on the legal origin of each country included in the sample.

Table 1 displays summary statistics of the key variables used in the analysis. While the average level of income diversity is 0.1 (where the maximum value is 1, which represents perfect diversification between interest and non-interest income), the average level of asset diversity is 0.25 (where the maximum value is 0.67). The mean value of Z score is 2.13. This indicates that, on average, profits would need to fall approximately 8.4 times their standard deviation to fully deplete bank equity. The mean value of the Amihud illiquidity measure is 0.24, with substantial variation across countries. The level of supervisory power indicates the level of authority of regulatory body where higher values represent higher levels of authority. The corresponding value ranges from 4 to 16 in the countries included in my sample with an average value of 12.89. The mean value of the economic freedom index is 75.71 which represents, on average a higher level of institutional quality[11]. Interest income, on average, accounts for 81% of the total operating income of the banks in the sample with the 75th percentile at 89%. Loan loss provisions as a percentage of average assets, which represents the quality of the credit portfolio, has a mean value of 1.09%. The average capital ratio is 11% and bank size (logarithm of total assets in million dollars) has an average value of 19.37. Finally, on average, the amount of liquid assets of banks in my sample accounts for 13% of total assets.

[Insert Table 1 Here]

control for funding costs. Risk attitudes of bank may change with business cycle (Giovanni & Robert, 2006). Hence, I control for GDP and inflation. Periods of crisis are often associated with higher firm credit risk (Martins, Serra, & Stevenson, 2019) which could affect bank's overall risk. A plethora of literature associate bank size as a significant determinant of bank stability (Berglund & Mäkinen, 2019; Micco, Panizza, & Yañez, 2007; Pasiouras & Kosmidou, 2007), though a consensus has not been reached thus far regarding the direction of the relationship. Similarly, the level of capital adequacy of banks is often associated to be a determinant of bank risk (John, Phil, & John, 2004; Pasiouras & Kosmidou, 2007).

[10] The Amihud measure remains negative and statistically significant when the standard errors are clustered at the country level.

11 See Table A1 for further definition.

3 Results and Discussion

3.1 Stock market liquidity and bank diversification

Model denoted by equation (7) is estimated with bank-specific fixed effects and time fixed effects to directly measure the impact of aggregate stock market liquidity on the level of bank income and asset diversification. The results are presented in Table 2. The coefficients of the Amihud measure regarding both the income diversity measure and asset diversity measure are negative and statistically significant. This indicates that lower stock market illiquidity (higher stock market liquidity) is associated with a higher level of both bank income and asset diversification. With regard to the economic significance of this liquidity effect the coefficients can be interpreted as a one standard deviation increase in the Amihud illiquidity measure, which corresponds to a decline in stock market liquidity, is associated with a decline in the level of income diversification and asset diversification of 0.012 (=0.00841*1.52) and 0.019 (=0.0125*1.52) respectively[12]. With a sample mean of income diversity equal to 0.1, the economic effect is clearly significant, since such effect corresponds to 13% (0.012/0.1) of its mean value. With regard to asset diversity, the associated effect corresponds to 8% (0.019/.25) of its mean value. Hence, the effect of aggregate stock market liquidity on bank income and asset diversity is both statistically significant and economically meaningful.

Importantly, the statistical significant positive relationship between aggregate stock market liquidity and bank diversification remains after controlling for the effect of industry-level, macro-economic and bank-specific factors, as is evident in column (2) and column (4) of Table 2. These findings confirm the importance of the spillover effects of aggregate stock market liquidity on the level of income and asset diversification in the banking sector.

As elaborated in Section 1, both theoretical (Haubrich & King, 1990; Jacklin, 1987) and empirical studies (Lin, 2020) emphasise how liquid stock markets are able to attract investors by offering higher long-term returns, which can result in a decline in demand for bank deposits. On the

[12] The economic effect (0.012 for income diversity and 0.019 for asset diversity) is calculated as the coefficient of Amihud illiquidity (0.0084 for income diversity and 0.0125 for asset diversity) multiplied by the standard deviation of Amihud illiquidity (1.52).

other hand, several studies emphasise how enhancement in aggregate stock market liquidity can induce firms to rely more on equity issues (Hanselaar et al., 2019), hence driving down the demand for bank loans. Thus, the significant positive relationship between aggregate stock market liquidity and bank diversification can be attributed to three key factors. Firstly, as deposits decline, banks may attempt to borrow funds from diverse sources to continue supplying loans to customers. Second, as the demand for loans also declines, banks need to diversify their source of assets. Third, as the decline in traditional business collectively continues, banks attempt to innovate by diversifying their income sources to remain competitive.

Thus, with a reduction in traditional bank business, banks may rely more on non-traditional sources of revenue to compensate for the loss of interest income. In addition, banks can be motivated to seek more diversification in terms of both revenue sources and assets due to the distinct advantages on which the banking sector can capitalise from enhancement in aggregate stock market liquidity including enhanced access to trade securitised instruments in a highly liquid, sophisticated market.

Of the control variables, the coefficient for the level of net interest income (calculated as net interest income divided by total assets) is negative and statistically significant for both the level of revenue and asset diversification. This implies that an increase in net interest income from traditional sources of bank business reduces the level of bank diversification. This provides strong evidence that one of the major reasons for banks deciding to diversify their revenue stream and expand their asset portfolio is to compensate for the loss of income from traditional sources of bank business, which is compatible with the "interest replacement theory". Shifting to non-traditional sources of income may not result in a full recovery of the loss of net interest income, however, it can at least partially compensate for the loss. Several studies find evidence to support the interest replacement theory including (Lepetit, Nys, Rous, & Tarazi, 2008; Williams, 2007). While the impact of deposit rate on bank diversification is negative and statistically significant, the impact of lending rate on bank diversification is positive and significant. While higher deposit rates can increase demand for deposits by potential investors, reducing the need for banks to diversify, higher lending rates are likely to result in a decline in demand for loans by investors and borrowing firms and hence could lead to a loss of

interest income. This can induce banks to seek alternative revenue streams. Similarly, banks with a highly concentrated loan portfolio will be more affected by the reduced demand for loans and hence are required to diversify their asset base.

The level of GDP has a significantly negative coefficient for both income diversification and asset diversification which suggests that during economic booms, bank business from traditional sources of income increases and banks do not need to diversify into non-traditional income and asset sources. This finding is consistent with Nguyen, Skully, and Perera (2012). In addition, during the Global Financial Crisis banks engage in a higher level of diversification, as a diversified revenue stream and asset base allows banks to absorb shocks to traditional sources of bank business during the crisis period (Elsas et al., 2010).

Bank size is positively related to the level of revenue and negatively related to asset diversification. Larger banks diversify their revenue base more than smaller banks, which is compatible with the findings of DeYoung and Rice (2004) and Mercieca et al. (2007). In contrast, negative and significant coefficient for banks size related to asset diversity measure suggests that larger banks are less diversified in their asset base, compared to smaller banks[13].

[Insert Table 2 Here]

[13] It is also important to note here that the correlation between the income diversity measure and the asset diversity measure used in this paper has a weak negative correlation of -0.0224. The negative correlation between asset and income diversity measure is acknowledged in existing studies (Elsas et al., 2010; Laeven & Levine, 2007). Laeven and Levine (2007) suggests that the reasons for such a low correlation may be due to potential measurement problems associated with the income diversity measure. For instance, the income diversity measure could overstate income from non-interest activities since fee income could be derived from loans. However, in Fitch Connect, the fee income is defined as "net fees and commission income and expenses, which are not related to loans or insurance". Hence, this justification is not applicable in this paper. Moreover, Laeven and Levine (2007) suggest that, using net non-interest revenue figures may also lead to measurement errors, and consequently, a low correlation between the income diversity and asset diversity measures. While using gross non-interest income figures to calculate the income diversity measure would be ideal, such data are not available for most banks. However, Elsas et al. (2010) note that using net non-interest revenue figures to calculate income diversity should not have a material impact on the results. Section 4 shows that the results are robust to using alternative measurements of income diversification.

3.2 Stock market liquidity and bank stability

The results of the panel regressions of aggregate stock market liquidity on bank stability are shown in Table 3. The Amihud measure maintains the statistically significant negative relationship with bank stability, measured using the Z-score. Lower values of the Amihud measure represents low stock market illiquidity or high stock market liquidity and vice versa and higher Z-score values indicate higher bank stability or lower bank risk. Hence, the negative coefficient relating the Amihud illiquidity measure with the bank Z-score implies that lower (higher) stock market illiquidity (liquidity) is associated with higher bank stability or lower bank risk. The coefficient for the Amihud measure is statistically significant at the 1% level, as shown in column (1) of Table 3 and the statistical significance remains after including the control variables, as shown in column (2) of Table 3. In terms of the economic significance, a one standard deviation increase in the Amihud measure is associated with a decline in the Z-score measure by 0.26 (=0.172*1.52)[14]. With a sample mean of Z-score equal to 2.13, the effect is clearly significant, corresponding to 12% of its mean value.

[Insert Table 3 Here]

The results presented previously confirm that enhancement in aggregate stock market liquidity is related to an increase in the level of both income and asset diversification for banks. The decrease in risk is likely due to the corresponding increase in the level of diversification as stock markets become more liquid. Increased diversification is associated with enhanced bank stability for several reasons. For instance, the economies of scope and increased informativeness associated with increased diversification strengthens bank credit risk management procedures which reduces bank risk (Baele et al., 2007; Doumpos et al., 2016). Information collected through non-traditional sources of business such as insurance underwriting, securities underwriting and brokerage services, assist banks to more accurately evaluate a potential borrower's credit risk profile. This results in better rate adjustments for loans to better reflect the creditworthiness of customers (Shim, 2019). Rossi, Schwaiger, and Winkler (2009) also find that a diversified asset base reduces the cost of provisioning for non-performing loans.

[14] The economic effect of 0.26 is calculated as the coefficient of Amihud illiquidity (0.172) multiplied by the standard deviation of Amihud illiquidity (1.52).

In addition to the impact of diversification, the positive effect of enhancement in stock market liquidity on bank risk is explained by Biagio and Jong-Kun (2004) who provide theoretical evidence that access to sophisticated capital markets reduces bank costs by providing banks with more efficient instruments of risk management and reputation signalling. These instruments enable banks to economise on the financial capital required to maintain higher production levels. In contrast, enhancement in aggregate stock market liquidity reduces the cost of equity capital for banks (Song & Thakor, 2010), increasing their tendency to provide riskier loans, hence increasing bank risk.

These findings have important practical implications. Given the ability for banks to benefit from enhancement in stock market liquidity, they should strengthen risk management capabilities and information extracting capacity to capitalise on these potential profits. Regulators can facilitate such capitalisation by easing market and transaction regulations and providing adequate infrastructure. Maintaining bank stability is particularly important for regulators given that bank stability is a crucial component of overall financial stability.

Regarding the control variables, the share of interest income, representing the extent of bank reliance on traditional intermediary functions, has a negative and statistically significant coefficient. This implies that banks which rely more on traditional sources of income face lower stability and higher bank risk. This finding confirms the phenomenon that increased income diversification contributes to a decline in bank risk and an increase in financial stability. The loans loss provision variable also has a negative and statistically significant relationship with bank stability. This is expected, as higher loan loss provisions often imply higher credit risk. The statistically significant negative coefficient for GDP with bank stability (implying a positive relationship between GDP and bank risk) may be due to the relationship between economic prosperity and an increase in risk taking within banks (Giovanni & Robert, 2006). Such findings are consistent with existing literature (Berger, Kick, & Schaeck, 2014; Haq & Heaney, 2012). As expected, bank risk significantly increases during the times of crisis as evidenced by the statistically significant negative coefficient for the financial crisis. The impact of capital adequacy is statistically significant and positive for bank stability is in line with intuition; maintaining higher levels of capital reduces the likelihood of financial distress (Haq & Heaney, 2012).

3.3 Differential impacts of the relationship between stock market liquidity, bank diversification and bank stability

In tables 4,5,6, and 7, I show the differential impacts of the relationship between aggregate stock market liquidity, bank diversification and bank stability by re-estimating the main panel regressions (Table 2 and Table 3) for sub-samples categorised by the level of development in financial markets and the legal origin of the countries. Banks operating in developed and sophisticated financial markets may have greater opportunities to diversify their business. Moreover, such sophisticated markets can provide banks with important information signals regarding borrowing firms' credit quality, hence strengthening bank's risk management procedures, leading to increased stability. Financial market sophistication rises with higher investor participation, induced by higher levels of protection provided to investors. It is well-established in literature that countries with common law origin offer comparatively higher levels of protection to market participants, in comparison to countries with civil law origin (La Porta, Lopez De Silanes, Shleifer, & Vishny, 1997). Thus, I hypothesise that the spillover effects of stock market liquidity on bank diversification and bank stability to be different by the level of development of the financial markets and the legal origin of the countries. The sample includes a total of 39 countries; 21 countries with developed financial markets and 18 countries with emerging and frontier capital markets. Please refer Table A2 for the list of countries in the sample categorised as per the level of financial market development and the legal origin. As evident from the results presented in Table 4 , enhancement in aggregate stock market liquidity increases the level of income and asset diversification for banks operating in both developed market countries (-0.117 and -0.0611, respectively) and emerging and frontier market countries (-0.00801 and -0.0122, respectively), with coefficients statistically significant at the 1% level. The results remain pertinent when industry-level, macro-economic and bank-specific control variables are controlled for, as evident in the results in columns (2), (4), (6) and (8) of Table 4. However, the level of significance and the magnitude of the coefficients of the Amihud measure in countries with developed markets is comparatively higher than

the countries with emerging and frontier markets[15]. Hence, the impact of enhancement in aggregate stock market liquidity on bank diversification is more pronounced in countries with developed markets.

[Insert Table 4 Here]

Such findings can be attributed to the fact that the banks operating in emerging and frontier markets may face limitations to expand to non-traditional sources of business due to different factors, such as limited opportunities to diversify, limited financial infrastructure to facilitate expansion of operations and limited financial expertise. However, for banks operating in developed market countries, highly developed markets may assist banks to better identify growth opportunities in non-traditional activities, allowing banks to capitalise on enhanced aggregate stock market liquidity. For instance, developed stock markets provide a sophisticated platform to trade securitised instruments (Song & Thakor, 2010) which is one of the main non-traditional sources of income relied upon by banks. Developed stock markets enable the banking sector to effectively expand their revenue stream and asset base to compensate the loss of income from traditional banking activities.

Regarding the relationship between stock market liquidity and bank stability, as shown in the results in Table 5 , The Amihud illiquidity measure is negative and statistically significant for bank risk, measured by the Z-score, for banks operating in countries with both developed markets (-0.463) and countries with emerging markets (-0.15). Hence, enhancement in aggregate stock market liquidity strengthens financial stability (lowering risk) in the banking sector in both developed market countries and emerging market countries alike. However, the coefficient for the Amihud measure for banks operating in countries with developed markets is higher than the corresponding coefficient for banks operating in countries with emerging and frontier markets[16]. This implies that the spillover effects of aggregate stock market liquidity on bank risk is more prominent in banks operating in countries with developed markets.

[Insert Table 5 Here]

[15] The difference in the coefficient for the Amihud illiquidity measure between banks operating in developed market countries and emerging market countries is statistically significant at 1% level.
[16] The difference in the coefficient for the Amihud illiquidity measure between banks operating in developed market countries and emerging market countries is statistically significant at 5% level.

There are several reasons for the spillover effects of stock market liquidity to be stronger in countries with developed markets. For instance, as discussed previously, the increase in bank diversification following enhancement in stock market liquidity is more prominent in countries with developed stock markets. As enhanced diversification is positively related to bank stability, I expect the spillover effects of stock market liquidity on bank stability to be more prominent in developed market countries. Moreover, banks operating in developed markets typically have more expertise in capitalising on the cost advantages from efficient risk management instruments and reputation signalling resulting from sophisticated financial markets.

With regard to the control variables, the increased risk preference of banks during periods of economic expansion is most relevant to banks operating in developed markets as evidenced by the negative relationship between the level of GDP and bank stability. This is also likely due to better access to sophisticated financial instruments in developed markets.

While larger banks have greater stability in emerging market countries, the reverse is applicable in developed market countries (i.e. larger banks are riskier in developed market countries). With regard to banks operating in developed markets, regulatory fortification may give rise to large banks becoming "too big to fail" (De Haan & Poghosyan, 2012; Haq & Heaney, 2012) which can induce risk taking behaviours[17].

Table 6 and Table 7 show the results when the main panel regressions (Table 2 and Table 3) are re-estimated on sub-samples categorised as per the legal origin of the countries in which the banks operate. The sample includes 15 countries with common law origin and 24 countries with civil law origin. Regarding the level of diversification, as per the results depicted in column (1), column (3), column (5) and column (7) of Table 6 , the negative coefficient of the Amihud illiquidity measure relating to income diversification is statistically significant only for banks operating in countries with common law origin. The Amihud illiquidity measure relating to asset diversification has a negative and

[17] The coefficients for GDP and bank size between developed market countries and emerging market countries is statistically different from each other at 5% level.

statistically significant coefficient for countries with both common law and civil law origin. However, when additional controls are introduced, the Amihud measure for banks operating in countries with civil law origin becomes insignificant. Hence, it is clear that the spillover effects of aggregate stock market liquidity on the level of bank diversification is more pronounced in countries which offer a higher level of protection to market participants (countries with common law origin). This demonstrates that countries that implement regulations which protect the interests of market participants are likely to attract more investors, hence creating more sophisticated stock markets with greater investor participation. This increases the opportunity for banks to seek more non-traditional sources of income and to diversify their asset base following enhancement in aggregate stock market liquidity.

[Insert Table 6 Here]

The corresponding results related to bank stability are shown in Table 7. As evidenced by the results, the positive impact of stock market liquidity on bank stability is significant only in countries with common law origin which offer higher levels of investor protection. As shown previously, the positive spillover effects of aggregate stock market liquidity on bank diversification is significant only in countries with common law origin which provide higher levels of investor protection. As such, since increased diversification positively affects bank stability (as discussed earlier), this explains the positive impact of stock market liquidity on bank stability being more prominent in banks operating in countries with common law origin. In addition, as mentioned earlier, countries with common law origin typically enjoy higher investor participation, better facilitating banks to extract quality information signals from stock markets to improve the screening and monitoring functions, hence explaining the positive spillover effects of stock market liquidity on bank stability being more pronounced in banks operating in countries with common law origin.

These findings further re-iterate the importance of policy makers to ensure continuing development of legal and institutional infrastructure and procedures which enable higher protection to market participants. Such continuing development of facilitating infrastructure enhances investor's knowledge on available investment opportunities and hence facilitates the banking sector to secure non-

traditional sources of funding. Enhanced investor participation further results in better quality information signals, hence, assisting risk management procedures of the banking sector.

[Insert Table 7 Here]

4 Robustness Tests

Several tests are performed to ensure the robustness of the results. First, I re-estimate the main regression models for bank diversification and bank stability by excluding observations from the US since approximately 75% of sample observations are from banks operating in the US. This ensures that the results are not unduly affected by the US observations and the results reflect the global situation. The corresponding results relating to bank diversification are shown in Table 8 and results relating to bank stability are shown in Table 9. As evidenced in column (1) and (3) of Table 8 and column (1) of Table 9, the Amihud illiquidity measure remains negative and statistically significant with both bank diversification and bank stability even after excluding observations from the US. The results remain consistent following the introduction of the control variables.

[Insert Table 8 and Table 9 Here]

Table 10 presents the results when alternative measurements of income diversification and asset diversification are used in the analysis. Even with a reduced number of observations, the HHI index provides a robust measure of the level of revenue diversification and the results are shown in column (1) and column (2) of Table 10. As evident from the results, the coefficient of the Amihud measure remains negative and statistically significant, providing further evidence of the robust (negative) positive relationship between aggregate stock market (il)liquidity and the level of bank income diversification. Column (3), column (4), column (5) and column (6) of Table 10 present the results when the level of asset diversification is measured using the methodology introduced by Laeven and Levine (2007) (LL_{LOAN}) and the ratio of *1 – Proportion of gross loans to total assets* (LTA) which represents the level of specialisation in bank loans. The significant positive relationship between the level of aggregate stock market liquidity (evidenced by the negative coefficient of the Amihud illiquidity

measure) and bank asset diversification remain robust even when the alternative measurements of asset diversification is used.

[Insert Table 10 Here]

Furthermore, to address concerns that the results of this paper could be excessively influenced by countries with a large number of small banks (such as China, Brazil, Indonesia, Austria, Italy, Japan and Switzerland), I re-estimate the main regression models by excluding these countries. Table 11 presents the results relating to bank diversification and Table 12 presents the results relating to bank stability. As evident in Table 11 and Table 12, the results remain largely the same, where excluding these countries does not alter the statistically significant impact of aggregate stock market liquidity on bank diversification and bank stability.

[Insert Table 11 and Table 12 Here]

4.1 Endogeneity

I have employed different measures in this paper to address potential concerns of endogeneity. First, I include several industry-level, macro-economic and bank-specific control variables in all the regressions to mitigate the potential omitted variable bias. Moreover, I control for bank and year fixed effects in all the panel regressions to account for unobserved heterogeneity across banks. In addition to these measures, I also conduct additional robustness tests to control for endogeneity. First, I regress both the level of bank diversification and bank stability on the lagged level of stock market illiquidity. As shown in Table 13 and Table 14, the results remain largely unchanged with a significant negative coefficient for the lagged Amihud illiquidity measure, implying that low stock market illiquidity (high stock market liquidity) is associated with a positive impact on bank diversification[18] and bank stability over the subsequent year. This re-iterates the findings of this paper that aggregate stock market liquidity has important spillover effects on the diversification of bank's revenue stream and asset base and the overall bank stability.

[18] To further address concerns of endogeneity, a further regression was run using 1-year lagged bank-specific controls rather than contemporaneous controls. Results remain significant and similar.

[Insert Table 13 and Table 14 Here]

As a further robustness test, I perform instrumental variable regressions using a two-stage least square framework, to explicitly control for potential endogeneity resulting from simultaneity bias. I use the lagged Amihud measures as the instrumental variable for the current level of aggregate market (il)liquidity since the lagged values of the endogenous independent variable have proven to be effective instruments (Reed, 2015) and have been employed in existing literature (Elsas et al., 2010). The relevancy of the lagged value of the Amihud illiquidity measure as an instrument is evidenced by the Kleibergen-Paap rk LM statistics of 73.2 and 82.4 for bank diversification and bank stability respectively, with a Chi-square(1) p value of 0.000.

The results related to bank diversification are presented in Table 15 and the results relating to bank stability are shown in Table 16 As evident from the results, the coefficients and the statistical significance of the Amihud illiquidity variable remain largely the same; re-iterating the findings of this paper that enhancement in aggregate stock market liquidity has important spillover effects on bank diversification and bank stability, even after controlling for endogeneity.

[Insert Table 15 and Table 16 Here]

In the next robustness test, I control for the endogenous determination of bank stability (bank risk) and bank diversification and test whether an association exists between bank stability and stock market liquidity independent of bank diversification. Table 17 presents the results of the two-stage least square regression model which allows for the joint determination of bank risk with bank diversification. Stock market liquidity may influence bank risk only by affecting bank diversification. Since enhancement in aggregate stock market liquidity is proved to result in an increase in bank diversification, this can impact bank stability due to the reasons elaborated in Section 1 and Section 3.2.

To test this association, a two-stage least squares regression is performed. In the second stage of the two-stage least squared framework, bank Z-score is modelled as in Table 3 , except that the level of income diversification is also included. In the first stage, bank income diversification is modelled both as a function of the bank level and country level control variables used in the main model related to bank stability (Equation 8) and the chosen instrumental variable for income diversification. I use the

level of income diversification of other banks, following Shim (2019) as the instrumental variable for diversification of bank i, with the assumption that the level of diversification of other banks explain cross-bank differences in bank stability (bank risk) only through its impact on the level of diversification of bank i.

Table 17 presents the complete first stage and second stage results. The instrumental variable is a strong instrument as evidenced by the Kleibergen-Paap rk LM statistic. It reports a Chi-sq(1) p value of 0.000, which shows that the diversification of other banks is a relevant instrument for the level of diversification of bank i. Column (1) of Table 17 confirms the main finding that an increase in stock market liquidity results in improved bank stability while controlling for the endogenous determination of income diversification as the coefficient for the Amihud illiquidity measure remains negative and statistically significant. This shows that the impact of stock market liquidity on bank stability (bank risk) is not limited to the effect of stock market liquidity on bank diversification. The results also hold when simply including income diversification in the panel regressions in Table 3.

[Insert Table 17 Here]

5 Conclusions

In this paper, I conduct the first empirical assessment of the spillover effects of aggregate stock market liquidity on bank diversification and bank stability. Existing literature suggest that liquid, sophisticated stock markets are substitutes to the banking sector and hence, further developments in stock markets can create an adverse impact on bank's traditional intermediary business. Thus, I hypothesise that banks increase their reliance on non-traditional sources of business following enhancement in aggregate stock market liquidity to compensate for the loss of business from traditional intermediary functions. Such increase in diversification together with the complementarities coming from liquid stock markets can create important spillover effects on overall bank stability.

I find that enhancement in aggregate stock market liquidity positively affects both bank diversification and bank stability. A closer examination shows that such impact is more pronounced for banks operating in countries with developed markets and further for banks operating in countries with

common law origin which offer higher levels of investor protection. Exploring the mechanisms through which stock market liquidity affects bank stability reveals that an association exists between stock market liquidity and bank stability independent of bank diversification.

Findings of this paper have important implications for policy makers and regulators. Given that development in stock markets induces banks to engage in non-traditional sources of business, regulators need to simultaneously develop the infrastructure necessary for banks to expand their operations. This allows banks to offset losses from traditional sources of income and to capitalise on opportunities provided by liquid stock markets. Strengthening such infrastructure particularly benefits banks operating in countries with emerging and frontier markets which are heavily dependent on traditional business activities, allowing them to expand their revenue and asset base. Moreover, the relevant authorities need to further ensure that when banks increase their diversification to offset the loss of traditional business, that such diversification does not significantly increase the bank's risk level. Banks will need to comply with precautionary regulations since in some instances, excessive diversification could lead to bank instability with implications for overall stability in the financial sector. Practical implications for banks include the opportunity to understand how competitors offset losses from traditional sources of bank business. Similarly, analysis of the determinants of bank stability is important from a policy perspective since bank stability has been found to affect overall economic growth, fluctuations in business cycles and the economic stability of a country. As enhancement in stock market liquidity has positive spillover effects on bank stability, regulators can encourage banks to access capital markets by developing appropriate infrastructure.

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Table 1 Summary Statistics

Variable	Mean	SD	P25	Median	P75
Bank level					
Income diversity	0.1	0.21	0	0.05	0.07
Asset diversity	0.25	0.145	0.148	0.25	0.36
Z-Score (log)	2.13	0.56	1.94	2.19	2.41
Amihud illiquidity measure	0.24	1.52	0.0002	0.0006	0.0001
Interest income to total operating income	0.81	3.58	0.75	0.84	0.89
Loan loss provisions (%)	1.09	2.03	0.58	0.83	1.16
Funding costs	0.09	5.31	0.01	0.02	0.03
Deposit Growth	0.26	11.18	0.00	0.06	0.14
Net interest income to total assets	0.034	0.02	0.028	0.034	0.04
Bank size	19.37	1.94	18.1	18.93	20.12
Capital adequacy	0.11	0.07	0.082	0.10	0.123
Liquidity	0.13	0.15	0.05	0.08	0.16
Country level					
Supervisory power	12.89	1.61	13	13	13
Economic freedom (institutional quality)	75.71	6.85	75.5	78	79.9
Deposit rate (%)	2.79	3.15	0.43	1.73	4.78
Lending rate (%)	5.96	5.52	3.25	4.67	7.96
GDP	1.09e+13	5.54e+12	9.70e+12	1.20e+13	1.50e+13
Inflation (%)	2.55	2.28	1.62	2.68	3.23

Notes: This table reports summary statistics of variables used in the analysis. The sample contains 39 countries, with 21 developed market countries and 18 emerging and frontier market countries over the period 1999-2014. See Table A1 for definitions of all variables.

Table 2 Panel Regressions of Stock Market Liquidity on Bank Income and Asset Diversification

	(1)	(2)	(3)	(4)
	Income Diversification		Asset Diversification	
Amihud illiquidity	-0.00841***	-0.00750***	-0.0125***	-0.0121***
	(-3.619)	(-3.363)	(-3.958)	(-3.467)
Net interest income		-0.620***		-0.194**
		(-5.625)		(-1.990)
Deposit rate		-0.00456***		-0.00702***
		(-2.835)		(-3.071)
Lending rate		0.00299***		0.00547***
		(2.758)		(3.003)
GDP		-6.07e-15***		-1.08e-14***
		(-3.504)		(-4.785)
Financial crisis (dummy)		0.0607***		0.0816***
		(6.237)		(7.985)
Supervisory power		0.00488***		0.000312
		(3.259)		(0.163)
Economic freedom (institutional quality)		-0.00390***		0.00190**
		(-4.340)		(2.058)
Bank size		0.0102***		-0.0112***
		(3.753)		(-4.009)
Capital adequacy		0.000120		-0.000273
		(0.558)		(-1.302)
Liquidity		0.000120		0.0173
		(0.0110)		(1.573)
R^2	0.046	0.064	0.094	0.098
N	90749	86597	80551	78664
Bank fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes

Notes: This table reports coefficient estimates of panel regressions using annual data from 7131 banks over the period 1999-2014. I control for bank and year fixed effects in all regressions. See Table A1 for definitions of all variables. Standard errors are clustered at the bank level. T statistics are presented in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% respectively.

Table 3 Panel Regressions of Stock Market Liquidity on Bank Stability

	(1)	(2)
Dependent variable	Z-score	Z-score
Amihud illiquidity	-0.172***	-0.119***
	(-8.849)	(-6.523)
Deposit growth		6.80e-05
		(1.017)
Interest share		-0.000460***
		(-3.372)
Loan loss provisions		-0.0195***
		(-2.904)
Funding costs		-0.000474
		(-1.066)
GDP		-4.51e-14***
		(-7.980)
Inflation		0.468
		(0.928)
Financial crisis		-0.147***
		(-5.276)
Size		-0.0112
		(-1.576)
Capital adequacy		0.0543***
		(31.09)
Liquidity		-0.0563
		(-1.479)
R^2	0.145	0.409
N	90558	81311
Bank fixed effects	Yes	Yes
Year fixed effects	Yes	Yes

Notes: This table reports coefficient estimates of panel regressions using annual data from 7039 banks over the period 1999-2014. I control for bank and year fixed effects in all regressions. See Table A1 for definitions of all variables. Standard errors are clustered at the bank level. T statistics are presented in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% respectively.

Table 4 Panel Regressions of Stock Market Liquidity on Bank Income and Asset Diversification for Developed Market Countries and Emerging and Frontier Market Countries

	Income diversification				Asset diversification			
	Developed Market Countries		Emerging and Frontier Market Countries		Developed Market Countries		Emerging and Frontier Market Countries	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Amihud illiquidity	-0.117***	-0.104**	-0.00801***	-0.00544**	-0.0611***	-0.0530***	-0.0122***	-0.00869**
	(-3.253)	(-2.393)	(-3.271)	(-2.445)	(-3.785)	(-2.737)	(-3.552)	(-2.164)
Net interest income		-0.407***		-0.798***		-0.180**		-0.391**
		(-3.095)		(-4.230)		(-2.010)		(-2.142)
Deposit rate		0.00921**		-9.69e-05		-0.00903**		-0.00102
		(2.133)		(-0.0467)		(-2.047)		(-0.433)
Lending rate		-0.0115***		-0.00211		0.00320		0.000414
		(-2.669)		(-1.568)		(0.706)		(0.225)
GDP		-4.31e-15**		-1.19e-13***		-9.21e-15***		-2.11e-13***
		(-2.358)		(-5.132)		(-3.673)		(-4.582)
Financial crisis (dummy)		0.0361***		0.0782***		0.0632***		0.0735*
		(2.718)		(2.714)		(4.568)		(1.944)
Supervisory power		0.00546***		0.00562		0.00192		-0.00857
		(3.353)		(1.456)		(1.138)		(-1.119)
Economic freedom		-0.00158		-0.00393**		0.000107		0.00282
(institutional quality)		(-1.216)		(-2.326)		(0.0802)		(1.472)
Bank size		0.0131***		0.0208*		-0.0130***		0.0201
		(4.683)		(1.673)		(-4.626)		(1.145)
Capital adequacy		0.000541**		-0.00154**		-0.000419**		0.00183*
		(2.443)		(-2.183)		(-2.019)		(1.691)
Liquidity		0.000798		-0.0106		0.0249**		-0.0421
		(0.0708)		(-0.296)		(2.290)		(-0.672)
R^2	0.057	0.072	0.038	0.105	0.093	0.096	0.148	0.211
N	84400	81716	6349	4881	77726	76701	2825	1963
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports coefficient estimates of panel regressions when the main sample is split into developed and emerging and frontier market countries, using annual data from 6260 banks operating in developed market countries and 871 banks operating in emerging and frontier market countries over the period 1999-2014. I control for bank and year fixed effects in all regressions. See Table A1 for definitions of all variables. See Table A2 for the country classifications. Standard errors are clustered at the bank level. T statistics are presented in parentheses. *, **, and *** indicate statistical significance at the 10%, 5% and 1% respectively.

Table 5 Panel Regressions of Stock Market Liquidity on Bank Stability for Developed and Emerging and Frontier Market Countries

	Z-score		Z-score	
	Developed market countries		Emerging market countries	
	(1)	(2)	(3)	(4)
Amihud illiquidity	-0.463***	-0.404***	-0.150***	-0.128***
	(-3.599)	(-3.199)	(-7.288)	(-6.052)
Deposit growth		0.000106*		-0.0148
		(1.647)		(-1.469)
Interest share		-0.000426***		-0.0134
		(-3.037)		(-0.859)
Loan loss provisions		-0.0340***		-0.00908
		(-9.065)		(-1.401)
Funding costs		-0.000414		-0.000530
		(-0.494)		(-1.382)
GDP		-4.27e-14***		-7.12e-15
		(-7.422)		(-0.464)
Inflation		5.479***		-0.207
		(5.128)		(-0.509)
Financial crisis		-0.185***		0.0848
		(-6.521)		(0.843)
Size		-0.0226***		0.0915**
		(-3.332)		(2.054)
Capital adequacy		0.0552***		0.0481***
		(27.71)		(12.01)
Liquidity		-0.0521		-0.0865
		(-1.444)		(-0.573)
R^2	0.185	0.484	0.141	0.233
N	85106	77064	5452	4247
Bank fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes

Notes: This table reports coefficient estimates of panel regressions when the main sample is split into developed and emerging and frontier market countries, using annual data from 6237 banks operating in developed market countries and 802 banks operating in emerging and frontier market countries over the period 1999-2014. I control for bank and year fixed effects in all regressions. See Table A1 for definitions of all variables. See Table A2 for the country classifications. Standard errors are clustered at the bank level. T statistics are presented in parentheses. *, **, and *** indicate statistical significance at the 10%, 5% and 1% respectively.

Table 6 Panel Regressions of Stock Market Liquidity on Bank Income and Asset Diversification for Countries with Common Law and Civil Law Origin

	Income diversification				Asset diversification			
	Common law origin		Civil law origin		Common law origin		Civil law origin	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Amihud illiquidity	-0.00873***	-0.00667***	-0.00146	-0.000261	-0.013***	-0.0131***	-0.0130**	-0.00486
	(-3.610)	(-3.296)	(-0.241)	(-0.0412)	(-3.706)	(-3.246)	(-2.211)	(-0.776)
Net interest income		-0.443***		-0.725***		-0.144		-0.321*
		(-3.461)		(-4.048)		(-1.550)		(-1.778)
Deposit rate		-0.0348***		-0.000578		0.00787		-0.00883***
		(-6.078)		(-0.294)		(1.200)		(-3.812)
Lending rate		0.0330***		0.000529		0.00435		0.00564***
		(5.873)		(0.446)		(0.690)		(3.027)
GDP		-2.28e-14***		2.04e-15		-3.03e-15		-6.95e-14***
		(-3.987)		(0.140)		(-0.589)		(-3.029)
Financial crisis (dummy)		0.113***		0.0250*		0.113***		0.0775***
		(3.838)		(1.777)		(3.307)		(4.688)
Supervisory power		0.00361		0.00331*		-0.00199		0.00647**
		(1.047)		(1.875)		(-0.688)		(2.070)
Economic freedom (institutional quality)		0.000311		-0.00427***		0.00288		0.000701
		(0.0895)		(-3.749)		(0.884)		(0.610)
Bank size		0.0107***		0.00612		-0.0125***		0.00807
		(3.891)		(0.756)		(-4.302)		(0.798)
Capital adequacy		0.000532**		-0.00109**		-0.000373*		0.000331
		(2.288)		(-2.124)		(-1.667)		(0.568)
Liquidity		0.0184		-0.0412**		0.0341***		-0.0870***
		(1.482)		(-1.980)		(2.933)		(-2.975)
R^2	0.074	0.104	0.021	0.036	0.098	0.102	0.072	0.100
N	75936	75135	14813	11462	74250	73999	6301	4665
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports coefficient estimates of panel regressions when full sample is split into countries with common law and civil law origin, using annual data of 5230 banks operating in common law countries and 1901 banks operating in civil law countries over the period 1999-2014. I control for bank and year fixed effects in all regressions. See Table A1 for definitions of all variables. Standard errors are clustered at the bank level. T statistics are presented in parenthesis. *,**, and *** indicates statistical significance at the 10%, 5% and 1% respectively.

Table 7 Panel Regressions of Stock Market Liquidity on Bank Stability for Countries with Common Law and Civil Law Origin

Dependent variable	Z-score	Z-score	Z-score	Z-score
	Common law origin		Civil law origin	
	(1)	(2)	(3)	(4)
Amihud illiquidity	-0.221***	-0.179***	-0.0508	-0.00568
	(-10.56)	(-9.186)	(-1.433)	(-0.177)
Deposit growth		3.03e-05		7.86e-05
		(0.474)		(0.785)
Interest share		-0.000367		-0.000650***
		(-0.872)		(-10.23)
Loan loss provisions		-0.0105*		-0.0225**
		(-1.868)		(-2.426)
Funding costs		0.000516		-0.000597
		(0.752)		(-0.984)
GDP		-5.09e-14***		7.09e-14***
		(-2.956)		(4.875)
Inflation		0.385		0.698
		(0.632)		(1.006)
Financial crisis		-0.124		-0.0853**
		(-1.456)		(-2.068)
Size		-0.00401		-0.118***
		(-0.700)		(-4.819)
Capital adequacy		0.0564***		0.0463***
		(23.50)		(19.22)
Liquidity		-0.0776**		-0.0334
		(-2.316)		(-0.395)
R^2	0.292	0.637	0.047	0.203
N	75969	69753	14589	11558
Bank fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes

Notes: This table reports coefficient estimates of panel regressions when the full sample is split into countries with common law and civil law origin, using annual data of 5240 banks operating in common law countries and 1799 banks operating in civil law countries over the period 1999-2014. I control for bank and year fixed effects in all regressions. See Table A1 for definitions of all variables. See Table A2 for the country classifications. Standard errors are clustered at the bank level. T statistics are presented in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% respectively.

Table 8 Panel Regressions of Stock Market Liquidity on Bank Income and Asset Diversity Excluding US Banks

	Income diversification		Asset diversification	
	(1)	(2)	(3)	(4)
Amihud illiquidity	-0.00685***	-0.00651***	-0.0110***	-0.00937***
	(-2.982)	(-2.972)	(-3.441)	(-2.623)
Net interest income		-0.812***		-0.251
		(-4.498)		(-1.405)
Deposit rate		-0.00214		-0.00659***
		(-1.154)		(-2.906)
Lending rate		0.000883		0.00508***
		(0.753)		(2.791)
GDP		-4.36e-14***		-6.01e-14***
		(-3.027)		(-3.813)
Financial crisis (dummy)		0.0786***		0.0609***
		(5.458)		(3.863)
Supervisory power		0.00598***		-0.000737
		(3.433)		(-0.262)
Economic freedom (institutional quality)		-0.00213*		0.00154
		(-1.672)		(1.430)
Bank size		0.00878		0.0161*
		(1.147)		(1.847)
Capital adequacy		-0.000810		0.000728
		(-1.586)		(1.278)
Liquidity		-0.0139		-0.0609**
		(-0.680)		(-2.353)
R^2	0.029	0.047	0.113	0.126
N	18985	14833	8229	6342
Bank fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes

Notes: This table reports coefficient estimates of panel regressions when the banks operating in the US are excluded. The results are derived using annual data from 2380 banks over the period 1999-2014. I control for bank and year fixed effects in all regressions. See Table A1 for definitions of all variables. Standard errors are clustered at the bank level. T statistics are presented in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% respectively.

Table 9 Panel Regressions of Stock Market Liquidity on Bank Stability Excluding US Banks

Dependent variable	Z-score	Z-score
	(1)	(2)
Amihud illiquidity	-0.150***	-0.136***
	(-7.685)	(-6.998)
Deposit growth		9.84e-05
		(0.949)
Interest share		-0.000751***
		(-4.752)
Loan loss provisions		-0.0204***
		(-2.885)
Funding costs		-0.000481
		(-0.577)
GDP		6.61e-14***
		(4.860)
Inflation		0.314
		(0.628)
Financial crisis		0.0822**
		(2.052)
Size		-0.154***
		(-6.284)
Capital adequacy		0.0413***
		(17.68)
Liquidity		-0.0496
		(-0.662)
R^2	0.044	0.183
N	18247	14452
Bank fixed effects	Yes	Yes
Year fixed effects	Yes	Yes

Notes: This table reports coefficient estimates of panel regressions when the banks operating in the US are excluded. The results are derived using annual data from 2288 banks over the period 1999-2014. I control for bank and year fixed effects in all regressions. See Table A1 for definitions of all variables. Standard errors are clustered at the bank level. T statistics are presented in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% respectively.

Table 10 Panel Regressions of Stock Market Liquidity on Bank Income and Asset Diversification Using Alternative Measurements of Diversification

	Income diversity measured by HHI		Asset diversity measure by Laeven and Levine (2007)		Ratio of 1-Gross loans/total assets	
	(1)	(2)	(3)	(4)	(5)	(6)
Amihud illiquidity	-0.00181*	-0.00319***	-0.00413***	-0.00400***	-0.00182**	-0.00456***
	(-1.891)	(-3.543)	(-3.220)	(-2.737)	(-2.068)	(-6.423)
Net interest income		-0.324***		-1.436***		-1.820***
		(-2.675)		(-3.117)		(-8.217)
Deposit rate		-0.00586***		-0.00371*		-0.00223*
		(-5.783)		(-1.869)		(-1.896)
Lending rate		0.00230***		0.00466***		0.00260***
		(3.628)		(2.989)		(3.036)
GDP		5.57e-15***		-1.19e-15		4.73e-16
		(4.205)		(-0.539)		(0.452)
Financial crisis (dummy)		0.0619***		-0.0296**		-0.0191***
		(10.15)		(-2.539)		(-3.107)
Supervisory power		-0.00119		-0.00648***		-0.00316***
		(-1.463)		(-3.565)		(-4.234)
Economic freedom (institutional quality)		-0.00272***		-0.00358***		-0.00213***
		(-5.318)		(-3.816)		(-4.616)
Bank size		-0.0177***		-0.0190***		-0.00676***
		(-5.757)		(-4.281)		(-2.724)
Capital adequacy		-0.000232		0.00229***		0.00218***
		(-0.954)		(6.118)		(9.783)
Liquidity		0.00688		-0.0594***		0.539***
		(0.743)		(-2.886)		(50.55)
R^2	0.057	0.074	0.034	0.055	0.050	0.285
N	48864	44568	75540	72109	83699	80071
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports coefficient estimates of panel regressions when the level of income and asset diversification are measured by alternative measurements of diversification. I control for bank and year fixed effects in all regressions. See Table A1 for definitions of all variables. Standard errors are clustered at the bank level. T statistics are presented in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% respectively.

Table 11 Panel Regressions of Stock Market Liquidity on Bank Income and Asset Diversification when Observations from Countries with a Larger Number of Small Banks Are Excluded

	Income diversification		Asset diversification	
	(1)	(2)	(3)	(4)
Amihud illiquidity	-0.00865***	-0.00747***	-0.0130***	-0.0111***
	(-3.658)	(-3.345)	(-4.123)	(-3.187)
Net interest income		-0.686***		-0.262**
		(-4.259)		(-2.546)
Deposit rate		-0.00841**		-0.00382
		(-2.556)		(-1.421)
Lending rate		0.00578**		0.00256
		(2.204)		(1.235)
GDP		-7.79e-15***		-1.42e-14***
		(-2.758)		(-5.076)
Financial crisis (dummy)		0.0666***		0.0942***
		(4.934)		(7.709)
Supervisory power		0.00253		-0.00223
		(0.977)		(-0.910)
Economic freedom (institutional quality)		-0.00367***		0.00312***
		(-2.827)		(2.981)
Bank size		0.0106***		-0.0113***
		(3.784)		(-3.965)
Capital adequacy		0.000336		-0.000305
		(1.445)		(-1.391)
Liquidity		0.0105		0.0219*
		(0.858)		(1.936)
R^2	0.052	0.070	0.096	0.101
N	82199	80050	77934	76745
Bank fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes

Notes: This table reports coefficient estimates of panel regressions using annual data from 6048 banks over the period 1999-2014. I control for bank and year fixed effects in all regressions. See Table A1 for definitions of all variables. Standard errors are clustered at the bank level. T statistics are presented in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% respectively.

Table 12 Panel Regressions of Stock Market Liquidity on Bank Stability when Observations from Countries with a Larger Number of Small Banks Are Excluded

Dependent variable	Z-score	Z-score
	(1)	(2)
Amihud illiquidity	-0.167***	-0.143***
	(-7.422)	(-6.473)
Deposit growth		-4.21e-05
		(-0.466)
Interest share		-0.000450
		(-0.930)
Loan loss provisions		-0.0205***
		(-4.404)
Funding costs		-0.000159
		(-0.167)
GDP		-1.32e-14
		(-1.584)
Inflation		-0.897*
		(-1.952)
Financial crisis		-0.300***
		(-7.212)
Size		0.00765
		(1.071)
Capital adequacy		0.0566***
		(26.81)
Liquidity		-0.130***
		(-3.331)
R^2	0.188	0.479
N	82448	74790
Bank fixed effects	Yes	Yes
Year fixed effects	Yes	Yes

Notes: This table reports coefficient estimates of panel regressions using annual data from 6035 banks over the period 1999-2014. I control for bank and year fixed effects in all regressions. See Table A1 for definitions of all variables. Standard errors are clustered at the bank level. T statistics are presented in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% respectively.

Table 13 Panel Regressions of Lagged Stock Market Liquidity on Bank Income and Asset Diversification

	Income diversity (Levine)		Asset diversity (HHI)	
	(1)	(2)	(3)	(4)
Amihud illiquidity (Lagged)	-0.00921***	-0.0071***	-0.0110***	-0.00987***
	(-3.88)	(-3.25)	(-4.714)	(-3.919)
Net interest income		-0.700***		-0.172*
		(-5.14)		(-1.719)
Deposit rate		-0.0048**		-0.00579**
		(-2.49)		(-2.174)
Lending rate		0.0025*		0.00436**
		(1.79)		(2.022)
GDP		-5.20e-15***		-8.93e-15***
		(-2.77)		(-3.640)
Financial crisis (dummy)		0.0474***		0.0681***
		(4.43)		(6.215)
Supervisory power		0.0043***		0.00112
		(2.85)		(0.556)
Economic freedom (institutional quality)		-0.00423*** (-4.27)		0.00134 (1.278)
Bank size		0.0088***		-0.00759**
		(2.88)		(-2.530)
Capital adequacy		0.000652*		-0.000775**
		(1.89)		(-2.553)
Liquidity		0.00317		-0.00113
		(0.26)		(-0.0951)
R^2	0.049	0.063	0.103	0.105
N	82907	79436	74429	72943
Bank fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes

Notes: This table reports coefficient estimates of panel regressions using annual data from 6955 banks over the period 1999-2014. I control for bank and year fixed effects in all regressions. See Table A1 for definitions of all variables. Standard errors are clustered at the bank level. Z statistics are presented in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% respectively.

Table 14 Panel Regressions of Lagged Stock Market Liquidity on Bank Stability

Dependent variable	Z-score	Z-score
	(1)	(2)
Amihud illiquidity (Lagged)	-0.045***	-0.0218**
	(-4.595)	(-2.445)
Deposit growth		8.32e-05
		(1.234)
Interest share		-0.000465***
		(-3.398)
Loan loss provisions		-0.0198***
		(-2.848)
Funding costs		-0.000468
		(-1.236)
GDP		-4.93e-14***
		(-8.614)
Inflation		0.271
		(0.560)
Financial crisis		-0.132***
		(-4.686)
Size		-0.00612
		(-0.858)
Capital adequacy		0.0549***
		(30.96)
Liquidity		-0.0436
		(-1.133)
R^2	0.174	0.405
N	82804	81279
Bank fixed effects	Yes	Yes
Year fixed effects	Yes	Yes

Notes: This table reports coefficient estimates of panel regressions using annual data from 7039 banks over the period 1999-2014. I control for bank and year fixed effects in all regressions. See Table A1 for definitions of all variables. Standard errors are clustered at the bank level. T statistics are presented in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% respectively.

Table 15 Panel Regressions of Stock Market Liquidity on Bank Income and Asset Diversification Controlling for Endogeneity

	Income diversification		Asset diversification	
	(1)	(2)	(3)	(4)
Amihud illiquidity (Instrumented)	-0.0138***	-0.0111***	-0.0162***	-0.0148***
	(-3.94)	(-3.34)	(-5.005)	(-4.150)
Net interest income		-0.698***		-0.152
		(-5.12)		(-1.531)
Deposit rate		-0.0044**		-0.00548**
		(-2.33)		(-2.066)
Lending rate		0.0027*		0.00475**
		(1.94)		(2.219)
GDP		-4.53e-15**		-7.78e-15***
		(-2.41)		(-3.139)
Financial crisis (dummy)		0.0472***		0.0674***
		(4.42)		(6.286)
Supervisory power		0.00445***		0.00137
		(2.94)		(0.681)
Economic freedom		-0.0041***		0.00131
(institutional quality)		(-4.11)		(1.245)
Bank size		0.00878***		-0.00777***
		(2.87)		(-2.593)
Capital adequacy		0.000624*		-0.000807***
		(1.83)		(-2.726)
Liquidity		0.00411		0.00102
		(0.34)		(0.0862)
R^2	0.045	0.060	0.102	0.104
N	82907	79436	74429	72943
Bank fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes

Notes: This table reports coefficient estimates of panel regressions controlling for possible endogeneity as a further robustness test, using annual data from 6955 banks over the period 1999-2014. I control for bank and year fixed effects in all regressions. See Table A1 for definitions of all variables. Standard errors are clustered at the bank level. Z statistics are presented in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% respectively.

Table 16 Panel Regressions of Stock Market Liquidity on Bank Stability Controlling for Endogeneity

Dependent variable	Z-score	Z-score
	(1)	(2)
Amihud illiquidity (Instrumented)	-0.129***	-0.0647***
	(-5.094)	(-2.598)
Deposit growth		8.27e-05
		(1.226)
Interest share		-0.000465***
		(-3.377)
Loan loss provisions		-0.0194***
		(-2.806)
Funding costs		-0.000467
		(-1.148)
GDP		-4.79e-14***
		(-8.173)
Inflation		0.413
		(0.832)
Financial crisis		-0.490***
		(-27.84)
Size		-0.00794
		(-1.106)
Capital adequacy		0.0548***
		(30.88)
Liquidity		-0.0487
		(-1.268)
R^2	0.179	0.408
N	82571	81053
Bank fixed effects	Yes	Yes
Year fixed effects	Yes	Yes

Notes: This table reports coefficient estimates of panel regressions controlling for possible endogeneity as a further robustness test, using annual data from 6640 banks over the period 1999-2014. I control for bank and year fixed effects in all regressions. See Table A1 for definitions of all variables. Standard errors are clustered at the bank level. Z statistics are presented in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% respectively.

Table 17 Simultaneous Determination of Bank Stability and Bank Diversification

	(1)
Second stage – Z score	
Income diversity	0.711***
	(4.162)
Amihud illiquidity	-0.0967***
	(-5.365)
Deposit growth	6.29e-05
	(1.008)
Interest share	-0.00423
	(-0.843)
Loan loss provisions	-0.0235***
	(-4.197)
Funding cost	-0.000659
	(-0.477)
GDP	-4.18e-14***
	(-7.001)
Inflation	0.398
	(0.725)
Financial crisis	-0.456***
	(-21.74)
Bank size	-0.0193**
	(-2.558)
Capital adequacy	0.0545***
	(29.40)
Liquidity	-0.0636
	(-1.624)
First stage – Income diversity	
Amihud illiquidity	-0.0081**
	(-1.99)
Deposit growth	0.00000721
	(0.31)
Interest share	-0.00414
	(-1.25)
Loan loss provisions	-0.0235***
	(-4.20)
Funding cost	0.000243
	(0.22)
GDP	-2.71e-15*
	(-1.90)
Inflation	0.0587
	(0.58)
Financial crisis	-0.00463
	(-1.00)
Bank size	0.0119***
	(4.01)
Capital adequacy	0.000311
	(0.92)
Liquidity	0.0151
	(-1.31)
Income diversity of other banks	0.760***
	(18.97)
R^2	0.397
N	79800
Bank fixed effects	Yes
Year fixed effects	Yes

Notes: This table reports the results of panel regressions when allowing for the joint determination of bank risk and bank diversification. I control for bank and year fixed effects in all regressions. See Table A1 for definitions of all variables. Standard errors are clustered at the bank level. Z statistics are presented in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% respectively.

Appendix A

Table A1: Variable Definitions and Data Sources

Variable	Description	Source
Dependent Variables		
Income diversification	Measured using income diversity measured introduced by Laeven and Levine (2007). Higher values represent higher income diversity	Computations using data from Fitch Connect
Asset diversification	Measured using Herfindhal-Hirshman (HHI) asset diversity index. Higher values indicate higher asset diversity	Computations using data from Fitch Connect
Z-score (log)	Bank stability quantified by a time-varying Z-score. Higher values represent higher bank stability or lower bank risk	Computations using data from Fitch Connect
Explanatory and Control Variables		
Amihud illiquidity measure	The Amihud measure demonstrates the ability of a market to absorb a number of transactions without any significant price variations. It is calculated as the average ratio of the absolute daily return (r) to daily trading volume (Dvol) in one day over all available trading days (Dt) of a particular stock in a given year. A higher Amihud measure represents higher market illiquidity (lower market liquidity)	Computations using data from Thomson Reuters DataStream and CRSP
GDP	GDP	World Bank: The Global Financial Development Database

Economic freedom index (Institutional Quality)	This index is an aggregate indicator which represents the quality of the institutional environment in a particular country. It is calculated using the average indicators for ten factors: the extent to which private property rights are protected by the government, government integrity, tax burden, government spending, business freedom, labour freedom, monetary freedom, trade freedom, investment freedom and financial freedom. Higher values indicate higher institutional quality	Heritage Foundation Database
Supervisory power	Reflects the level of authority of supervisory authorities to take required actions to prevent and correct issues. Higher values represent higher supervisory power	World Bank surveys on bank regulation
Deposit rate	Deposit rate	EIU Country data
Lending rate	Lending rate	EIU Country data
Inflation	Inflation rate	World Bank: The Global Financial Development Database
Financial crisis (dummy)	A dummy variable that takes the value of 1 for crisis years (2007-2009) and the value of 0 otherwise	
Net interest income	The ratio of net-interest income to total assets	Computations using data from Fitch Connect
Deposit growth	Annual growth in deposits	Computations using data from Fitch Connect
Interest income share	The ratio of interest income to total operating income	Computations using data from Fitch Connect

Loan loss provisions	Loan loss provisions as a percentage of average assets	Computations using data from Fitch Connect
Funding costs	The ratio of interest expenses over bank deposits	Computations using data from Fitch Connect
Bank size	Bank size measured by logarithm of total assets	Computations using data from Fitch Connect
Capital adequacy	The ratio of total equity to total assets	Computations using data from Fitch Connect
Liquidity	The ratio of liquid assets to total assets	Computations using data from Fitch Connect

Appendix B

Table A2: List of Countries in the sample categorised as per the level of financial market development and the legal origin

Countries with developed markets	Countries with emerging and frontier markets	Countries with common law origin	Countries with civil law origin
Australia	Argentina	Australia	Argentina
Austria	Bangladesh	Bangladesh	Austria
Belgium	Brazil	Canada	Belgium
Canada	China	Cyprus	Brazil
Denmark	Cyprus	Hong Kong	China
France	Czech	India	Czech
Hong Kong	Greece	Israel	Denmark
Israel	Hungary	Kenya	France
Italy	India	New Zealand	Greece
Japan	Indonesia	Pakistan	Hungary
Korea	Kenya	South Africa	Indonesia
Netherlands	Pakistan	Sri Lanka	Italy
New Zealand	Peru	Thailand	Japan
Norway	Philippines	UK	Korea
Poland	South Africa	USA	Netherlands
Portugal	Sri Lanka		Norway
Spain	Thailand		Peru
Sweden	Turkey		Philippines
Switzerland			Poland
UK			Portugal
USA			Spain
			Sweden
			Switzerland
			Turkey