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# Financial Development and Banking Sector Stability

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In this paper, we examine the effects of financial development in terms of financial depth, financial access, and financial efficiency on the four aspects of banking sector stability, including (1) the level of credit risk in a country's banking system, (2) the level of liquidity risk in a country's banking system, (3) the probability of default of a country's banking system, and (4) the occurrence of a banking crisis. We find that not all dimensions of financial development promote banking sector stability. Financial development in terms of quality (i.e. financial efficiency) is more important to banking sector stability. Financial efficiency evidently provides stability for the banking sector both in developed and developing countries subsamples. Additionally, the impact of individual dimensions of financial development on banking sector stability is not homogeneous across countries with different levels of income.

Keywords    financial development, banking sector stability, credit risk, liquidity risk

## 1 Introduction

Financial development could promote the stability of the financial system. The financial sector with both financial liquidity and depth allows firms and households to diversify risk and increases their ability to absorb the impact of shocks (Bernanke, Gertler, and Gilchrist, 1999; Sahay et al., 2015). Banking crises in the 1980s and 1990s have raised the concern that reckless and rapid financial development could increase risk and leverage levels of economic units and consequently increase the probability of crisis occurrence (Naceur, Candelon, and Lajaunie,

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2019). Recent studies (Arcand, Berkes, and Panizza, 2012; Dabla-Norris and Srivisal, 2013) have shown that financial development promotes financial stability only to a certain extent. Too much finance could be detrimental to the economy and the financial system because it exacerbates shock and increases economic and financial volatility (Arcand et al., 2012; Dabla-Norris and Srivisal, 2013; Cecchetti and Kharroubi, 2015; Sahay et al., 2015). Rapid growth of the financial sector could potentially encourage credit expansion, thereby lowering lending standards and excessive risk taking by commercial banks. This, as a consequence, could increase fragility and instability in the banking system (Sahay et al., 2015).

Extant literature on financial development and stability has focused on financial depth (i.e. the size of the financial sector) (Arcand et al., 2012; Dabla-Norris and Srivisal, 2013; Beck, Degryse, and Kneer, 2014). Demirgüç-Kunt and Detragiache (2005) find that financial deepening, as measured by the credit-to-GDP ratio and credit growth rate, has a positive effect on the occurrence of a banking crisis. Nonetheless, Sahay et al. (2015) find that rapid financial deepening increases instability of the financial system, particularly in the countries with weak supervisory and regulatory frameworks. Some recent studies (e.g., Mothonnat and Minea, 2018; Naceur et al., 2019) have attempted to examine other dimensions of financial development and find that only some certain dimensions of financial development are associated with banking crisis occurrence. In this study, our objective is to put together different dimensions and investigate their effects on financial stability. By investigating financial development in these three dimensions, we will be able to assess the differential relations between financial development and banking sector stability, which can eventually lead to more prudential measures for financial development.

Previous studies (Čihák, Demirgüç-Kunt, Feyen, and Levine, 2013; Sahay et al., 2015) have measured banking sector stability primarily by bank Z-score. In this study, however, we will measure banking sector stability by four proxies, namely a percentage of bank non-performing loans to gross loans as an indicator of the level of credit risk in a country's banking system, a percentage of bank credit to bank deposits as an indicator of the level of liquidity risk in a country's banking system, bank Z-score as an indicator of the probability of default of a country's banking system, and a banking crisis dummy variable as an indicator of banking crisis occurrence. This will provide us with a more comprehensive understanding of the relations between financial development and banking sector stability. By examining financial development in terms of quantity (i.e. financial depth) and quality (i.e. financial access and financial efficiency), we can further improve our understanding of the relations between financial develop-

ment and banking sector stability.

## 2 Related literature on financial development and banking sector stability

Most studies on the relationship between financial development and banking sector stability have focused on financial depth, as measured primarily by the ratio of private credit to GDP. Examining 77 banking crises in 94 countries during 1980–2002, Demirgüç-Kunt and Detragiache (2005), for instance, find that the level of private credit to GDP and the growth of domestic credit to the private sector have significant and positive effects on the occurrence of a banking crisis. Sahay et al. (2015), in their study of 176 countries between 1980 to 2013, find that rapid growth of poorly regulated financial sectors is likely to encourage financial institutions to take excessive risk and use more leverage, potentially leading to increasing instability of the banking system. Existing literature also noted that financial stability, as measured by bank Z-score, tends to deteriorate with financial institution depth, as measured in their study by the composite index of private sector credit, pension fund assets, mutual fund assets, and insurance premiums. The increase in financial depth is associated with the misallocation of resources, greater economic volatility, and an increase in the probability of crisis occurrence. Some studies, however, show a contradictory result by indicating that financial deepening is not a determinant of banking crises (Von Hogen and Ho, 2007; Davis and Karim, 2008; Rose and Spiegel, 2011; Hahm, Shin, and Shin, 2013).

Apart from financial depth, other dimensions of financial development have also been studied in extant literature. In Mathonnat and Minea's (2018) study of 113 banking crises in 112 countries from 1980–2009, for instance, it is found that by using aggregated financial development indexes, the level of banking sector activity and the growth of banking sector size are positively associated with the probability of banking crises. Moreover, it is also found that increases in banking sector size, as measured by the growth of liquid liabilities (M3)/GDP, and banking sector activity, as measured by the ratio of credits to the private sector by banks to bank deposits, are associated with an increase in the occurrence of banking crises. Naceur et al. (2019) assess the effects of financial development in terms of financial access, financial depth and financial efficiency on the occurrence of banking crises in 98 countries from 1980 to 2016. They find that financial institution development and, to a lesser extent, financial market development increases financial instability within a one- to two-year horizon. More precisely, both financial institution depth and financial institution access are leading indicators for future banking crises in advanced economies, whereas only financial institution depth is a determinant of banking cri-

ses in emerging markets and less developed economies. Financial access also appears to promote financial stability in emerging and low-income countries.

In terms of the quality aspect of financial development, financial access is usually adopted and is measured by how easy the households and companies can gain access to financial services. On the one hand, lending to a broader range of households and firms would allow banks to better diversify their loan portfolio, reduce the degree of banks' dependence on big loans, lessen volatility in banks' income, and consequently increase banking sector stability (Hannig and Jansen, 2010; Čihák, Mare, and Melecký, 2016). Greater financial access also helps facilitate the transmission of monetary policy to a broader range of households and firms, contributing to a more effective monetary policy and financial stability (Morgan and Pontines, 2014). On the other hand, rapid expansion of credits to a broader range of borrowers could impair financial stability (Čihák et al., 2016). Excessive expansion of credits could induce financial institutions to reduce their lending standards (Morgan and Pontines, 2014). Since not all of the borrowers can handle credit responsibly, providing access to financial services to a broad range of borrowers, particularly to low-income households and SMEs, could result in higher non-performing loans, which could finally lead to a banking crisis.

To date, empirical studies on the relationship between financial access and financial stability have revealed inconclusive results. Using panel data of countries from 2005–2011, Morgan and Pontines (2014) find that an increase in SMEs access to financial services, as measured by the share of lending to SMEs to total lending, promotes financial stability through the means of decreasing non-performing loans and reducing the probability of financial institutions' default. Testing the relationship between various measurements of financial access and financial stability, Čihák et al. (2016) find that, on average, financial access and financial stability are negatively correlated. More specifically, increases in account ownership and credit card penetration seem to be associated with a decrease in financial stability, as measured by bank capital to total assets and bank credit to bank deposit.

With regard to financial efficiency, previous studies have also shown mixed findings between the relation between financial efficiency and financial stability. The efficiency of the financial sector can have either positive or negative impacts on financial stability. On the one hand, financial efficiency could promote innovation in the financial sector, foster a more efficient banking system, and lead to more stability in the financial system (Ongena, Smith, and Michalsen, 2003; Beck, Demirgüç-Kunt, and Levine, 2006). Financial efficiency could increase profits of banks, reduce incentives for financial institutions to take excessive risk, and provide a buffer

against bank fragility (Beck, 2008). Countries with efficient financial systems are less prone to banking crises (Ongena et al., 2003; Beck et al., 2006; Blejer, 2006). On the other hand, the attempt of financial institutions to increase efficiency may intensify competition in the financial sector. More intense competition could erode banks' profits, encourage excessive risk-taking by banks, and adversely affect bank stability (Beck, 2008). Prior studies find that a higher level of competition in the banking industry increases bank risk-taking (Levy-Yeyati and Micco, (2007) for Latin American countries, Turk-Ariss (2010) for developing countries, and Agoraki, Delis, and Pasiouras (2011) for central and eastern European countries). More pressure to increase profits induces financial institutions to lower lending standards and loosens the criteria for screening the creditworthiness of borrowers, resulting in higher non-performing loans and increasing bank fragility (Beck, 2008).

Based on the literature review, we propose the following hypotheses for empirical testing:

*Hypothesis 1: Financial depth is positively associated with banking sector stability.*

*Hypothesis 2: Financial access is positively associated with banking sector stability.*

*Hypothesis 3: Financial efficiency is positively associated with banking sector stability.*

### 3 Data and Methodology

We retrieve financial development data and annual macroeconomic data for 206 countries from 1990–2016, from the Global Financial Development database and the World Development Indicators of the World Bank. To minimize the effects of outliers and recording errors, we winsorize all variables at the 1<sup>st</sup> and 99<sup>th</sup> percentiles. We follow the same procedures of the dynamic two-step panel generalized method of moments (GMM) estimation to address the endogeneity and reverse causality concerns (Rioja and Valev, 2004; Baltagi, Demetriades, and Law, 2009; Sahay et al., 2015; Naceur, Blotevogel, Fischer, and Shi, 2017). To test our hypotheses, we estimate a series of dynamic GMM regressions of financial development on the stability of the banking sector and a set of control variables. Our regression model could be written as follows:

$$STABILITY_{i,t} = a_0 + a_1 STABILITY_{i,t-1} + a_2 FD_{i,t-1} + \delta CON_{t-1} + \varepsilon_{i,t},$$

where  $i$  and  $t$  represent the index country and year, respectively.  $STABILITY_{i,t}$  denotes the indicator of the banking sector stability of country  $i$  at time  $t$ . We measure banking sector stability by four proxies, including (i) a percentage of bank non-performing loans to gross loans, which reflects the level of credit risk in a country's banking system, (ii) a percentage of bank

credit to bank deposits, which reflects the level of liquidity risk in a country's banking system, (iii) bank *Z*-score, which indicates the probability of default of a country's banking system, and (iv) banking crisis dummy, which indicates a banking crisis occurrence.  $FD_{i,t-1}$  denotes the indicator of the financial development of country  $i$  at time  $t-1$ . Financial development is measured in terms of (i) *financial depth* using a percentage of domestic credit to the private sector to GDP, (ii) *financial access* using the logarithm of the number of commercial bank branches per 100,000 adults, and (iii) *financial efficiency* using a percentage of bank's non-interest income to total income as proxies. The aggregate impact of financial development ( $FD$ ) is the value of the multiplicative terms of financial depth, financial access, and financial efficiency indicators.

We select indicators of financial depth, financial access, and financial efficiency based on prior studies (Herwartz and Walle, 2014; Almarzoqi, Naceur, and Kotak, 2015; Sahay et al., 2015; Čihák et al., 2016; Naceur et al., 2017; Trabelsi and Cherif, 2017), data availability, and the results of the correlation matrix. We check the robustness of our main results by performing additional tests for financial depth using the ratio of private credit by domestic money banks as a percentage of GDP, the ratio of mutual fund assets to GDP, and the ratio of pension fund assets to GDP. For financial access, we conduct robustness tests using a percentage of firms with a loan or line of credit from a financial institution, a percentage of respondents who get loan from a financial institution, and the logarithm of the number of ATMs per 100,000 adults. Finally, the robustness test for financial efficiency is performed using bank net interest margin, bank lending-deposit spread, and banks return on assets. To conserve space, we do not tabulate the results, but we discuss our findings in Section 4.

In our regression analysis,  $CON_{t-1}$  denotes country-level control variables at time  $t-1$ . Consistent with earlier studies in this line of research (Eichengreen, Gullapalli, and Panizza, 2011; Herwartz and Walle, 2014; Almarzoqi et al., 2015; Sahay et al., 2015; Naceur et al., 2017; Trabelsi and Cherif, 2017; Naceur et al., 2019), we include a set of control variables in our estimation, namely trade openness ( $TRADE$ ) as measured by total trade as a percentage to GDP, financial openness ( $FINOPEN$ ) as measured by the Chinn-Ito financial openness index, inflation ( $INFLATION$ ) as measured by the annual growth rate of the GDP implicit deflator, GDP growth ( $GDPGROWTH$ ) as measured by the annual percentage growth rate of GDP, and the degree of competition in the banking sector ( $COMPET$ ) as measured by assets of the five largest banks as a share of the total commercial banking assets (i.e. 5-bank asset concentration). We use the one-period lagged values of the dependent variable as an explanatory variable to control for possible persistence in banking sector stability. The first differences of the two-



Table 1: Summary statistics for key variables

	Mean	Median	S.D.	Min.	Max.	N
	Full sample					
<i>Financial depth</i>	37.92	26.21	35.76	1.69	312.03	7,861
<i>Financial access</i>	19.23	12.61	26.54	0.51	287.24	2,247
<i>Financial efficiency</i>	38.93	36.71	14.91	8.74	93.70	3,309
<i>TRADE</i>	77.76	67.89	52.24	10.96	860.80	8,316
<i>FINOPEN</i>	0.45	0.42	0.36	0.00	1.00	6,977
<i>INFLATION</i>	36.61	4.45	484.72	-11.84	26,766	5,340
<i>GDPGROWTH</i>	3.99	3.88	6.01	-13.13	149.97	9,047
<i>COMPET</i>	80.67	83.43	16.17	36.15	100.00	2,636
	Developed countries subsample					
<i>Financial depth</i>	50.93	39.79	39.59	4.32	312.03	4,697
<i>Financial access</i>	27.07	20.66	30.97	3.05	287.24	1,345
<i>Financial efficiency</i>	38.00	35.48	14.37	10.20	93.70	2,054
<i>TRADE</i>	86.79	77.39	60.09	10.96	860.80	5,007
<i>FINOPEN</i>	0.56	0.45	0.37	0.00	1.00	4,040
<i>INFLATION</i>	11.86	3.34	44.18	-31.57	395.33	3,258
<i>GDPGROWTH</i>	4.00	3.66	6.31	-12.12	149.97	5,513
<i>COMPET</i>	80.64	82.91	15.83	36.88	100.00	1,792
	Developing countries subsample					
<i>Financial depth</i>	18.62	14.73	15.03	1.06	123.82	3,164
<i>Financial access</i>	7.56	4.13	9.83	0.37	71.61	902
<i>Financial efficiency</i>	40.43	39.63	15.65	6.53	93.70	1,255
<i>TRADE</i>	64.10	57.14	32.95	10.95	311.35	3,309
<i>FINOPEN</i>	0.30	0.17	0.29	0.00	1.00	2,937
<i>INFLATION</i>	58.23	6.90	738.95	-7.52	26,766	2,082
<i>GDPGROWTH</i>	3.97	4.30	5.54	-14.84	64.07	3,534
<i>COMPET</i>	80.73	83.99	16.89	35.07	100.00	844

period lagged values of the same explanatory variables are used as instruments. For all estimations, standard errors are robust to heteroskedasticity and serial correlation, and are clustered at the country level.

Table 1 reports descriptive statistics for key variables. In this study, our full sample mostly consists of data from developed countries. Since extant literature has found differential effects of financial development for countries with different income levels (Sahay et al., 2015; Naceur et al., 2017; Trabelsi and Cherif, 2017), we test our hypotheses for developed and developing countries.

#### 4 The effects of financial development on banking sector stability

Tables 2 and 3 report empirical results of the impact of individual dimensions of financial development on four aspects of banking sector stability. Overall, financial depth seems to have detrimental effects on banking sector stability. The growth of the financial sector, as measured by domestic credit to the private sector as a percentage of GDP, is associated with increases in

the level of bank risk; more precisely, the level of bank credit risk as measured by the ratio of bank non-performing loans, and the level of bank liquidity risk as measured by the ratio of bank credit to bank deposits. Development in terms of the size of the financial sector is also positively associated with banking crisis occurrence. Here, the increase in financial depth lowers the probability of default of a country's banking system as measured by bank Z-score, but the result is statistically significant only at the 10% level. The beneficial effect of financial deepening on bank Z-score is more pronounced when we use the ratio of private credit by domestic banks as a percentage of GDP as a proxy for financial depth. Note that a large value of the bank Z-score indicates a low probability of default of a country's banking system, and thus, high banking sector stability. Because of the insufficient number of observations, in most cases we cannot estimate coefficients for other proxies of financial depth. As a result, we only find some evidence that increasing financial depth in terms of a larger size of mutual fund business promotes banking sector stability, as indicated by the lower ratio of bank non-performing loans. Our findings are generally in line with prior studies. For instance, Sahay et al. (2015) find that financial depth is associated with a greater risk of crisis and macroeconomic instability. Rapid development of the financial sector may encourage financial institutions to use high leverage and take more risks, consequently increasing systemic risk of the entire financial system. Demirgüç-Kunt and De-tragiache (2005) find that financial development in terms of the size of the financial sector is positively associated with the banking crisis occurrence.

In terms of financial access, we find that generally, financial access negatively affects the banking sector stability as indicated by the increasing ratio of bank non-performing loans, a higher percentage of bank credit to bank deposits, and banking crisis occurrence. The results are slightly different when we use the logarithm of the number of ATMS per 100,000 adults as a proxy for financial access. Financial development in terms of more access to ATMs seems to exert beneficial effects on banking sector stability as indicated by the lower ratio of bank credit to bank deposits and the lower probability of default of a country's banking system. Because of the insufficient number of observations, we cannot estimate the coefficients for the other proxies of financial access. Overall, our findings are in line with prior studies. Morgan and Pontines (2004), for instance, find that more access of households and firms to bank depository services and loans encourages bank lending, increases the bank credit to bank deposits ratio, and as a consequence, worsens banking sector stability. However, they did find that greater access to finance by firms promotes financial stability by the means of decreasing the ratio of bank non-performing loans. Čihák et al. (2016) find that an increase in account ownership is associ-

ated with an increase in bank credit to bank deposit ratio. An increase in credit card penetration of households is also found to be associated with a decrease in bank capital to total assets (Naceur et al., 2019).

With respect to financial efficiency, it is found that efficiency is beneficial to banking sector stability. Here, we find that an increase in financial sector efficiency, as measured by a percentage of a bank's non-interest income to total income, is associated with a lower ratio of bank non-performing loans, a lower ratio of bank credit to bank deposits, a reduction in the probability of default of a country's banking system and a lower banking crisis occurrence. The effects of financial efficiency on banking sector stability are quite mixed when testing with different indicators of financial efficiency. However, an increase in financial efficiency is associated with a lower ratio of bank non-performing loans in all cases. In addition, we also find that financial efficiency, as measured by bank lending-deposit spread, adversely affects banking sector stability because it promotes bank risk taking (i.e. expanding bank credit to bank deposits ratio), and increases banking crisis occurrence. Narrowing bank lending-deposit spread as an indicator of more financial efficiency seems to be associated with the lower level of credit risk in the banking sector and the lower probability of default of a country's banking system. When we measure financial efficiency by bank return on assets and bank net interest margin, an increase in financial efficiency seems to be associated with the reduction in the ratio of bank non-performing loans, an increase in the ratio of bank credit to bank deposits, an increase in the probability of default of a country's banking system, and more banking crisis occurrence. Naceur et al. (2019) find that financial efficiency reduces the future occurrence of a banking crisis for advanced countries, but does not have stabilizing effects for emerging countries.

Taking the level of country development into account, the results for the developed countries subsample are, for the most part, in line with the results for the full sample, except that increases in efficiency in terms of bank revenue diversification can potentially have adverse effects on the level of bank credit risk and banking crisis occurrence. The results for the developing countries subsample can only be estimated for some models. For the developing countries subsample, financial efficiency is associated with a lower level of bank liquidity risk. It is found that more financial deepening and higher efficiency of the financial sector reduces the probability of default of a country's banking system in developing countries. An increase in efficiency in terms of bank revenue diversification can potentially reduce banking crisis occurrence; however, an increase in financial depth seems to be associated with banking crisis occurrence. Consistent with findings in prior studies (Herwartz and Walle, 2014; Sahay et al., 2015; Trabelsi and Cherif,

2017; Naceur et al., 2019), the effects of financial development on banking sector stability are found in our study to be different across income groups.

By looking at Tables 2 and 3, we find that trade openness is beneficial to the stability of the whole banking system, as indicated by the reduction in the probability of default of a country's banking system (i.e. bank Z-score). The effects of financial openness on banking sector stability is quite mixed. Financial openness enhances the stability of a country's banking sector because it is associated with a lower ratio of bank non-performing loans. A higher degree of financial openness can adversely affect banking sector stability by promoting banks' risk-taking (i.e. increasing the ratio of bank credit to bank deposits) and increasing the probability of default of a country's banking system. Baltagi et al. (2009) find that trade openness and financial openness are significant determinants of banking sector development. Financial openness, however, could cause more volatility and macroeconomic fluctuations. Herwartz and Walle (2014) also find that countries with a high degree of financial openness benefit less from financial development. GDP growth seems to encourage banks to expand more credits as indicated by the higher ratio of bank credit to bank deposits; however, economic growth seems to alleviate bank non-performing loans. Here, it is evident that a stable economic environment is important to promote a robust financial system. The positive effect of economic growth on financial stability is also in line with prior studies (Almarzoqi et al., 2015). More competition in the banking industry, as measured by 5-bank asset concentration, seems to be beneficial to banking sector stability as it is associated with the reduction of bank non-performing loans and the decline in banking crisis occurrence. Greater competition promotes efficiency of the financial system, which is beneficial to financial stability (Almarzoqi et al., 2015).

In summary, we find partial support to our hypotheses. Our empirical findings indicate that not every dimension of financial development is beneficial to banking sector stability. Financial efficiency, a quality aspect of financial development, promotes banking sector stability by suppressing the levels of bank credit risk and bank liquidity risk, reducing the probability of default of a country's banking system, and limiting banking crisis occurrence. The benefits of financial efficiency on banking sector stability are evident in both the developed and developing countries subsamples. As the financial sector in most developing countries is relatively small, developing countries still benefit from financial deepening (i.e. increase in the size of the financial sector).

Table 4 reports the results of dynamic panel GMM regressions for the joint effects of financial development on banking sector stability for full sample and the developed countries subsam-

Table 2: Panel dynamic GMM regressions of banking sector stability

Variable	Bank non-performing loan			Bank credit to bank deposits		
	(1) 2000-2016	(2) 2004-2016	(3) 2000-2015	(4) 1999-2016	(5) 2004-2016	(6) 1999-2015
<i>STABILITY</i> <sub><i>t</i>-1</sub>	0.651*** (0.001)	0.481*** (0.001)	0.672*** (0.001)	0.607*** (0.000)	0.736*** (0.003)	0.650*** (0.000)
<i>Financial depth</i> <sub><i>t</i>-1</sub>	0.040*** (0.000)			0.385*** (0.000)		
<i>Financial access</i> <sub><i>t</i>-1</sub>		0.244*** (0.022)			4.445*** (0.055)	
<i>Financial efficiency</i> <sub><i>t</i>-1</sub>			-0.010*** (0.000)			-0.196*** (0.000)
<i>TRADE</i> <sub><i>t</i>-1</sub>	-0.019*** (0.000)	0.030*** (0.000)	0.018*** (0.000)	-0.050*** (0.000)	-0.244*** (0.006)	0.044*** (0.000)
<i>FINOPEN</i> <sub><i>t</i>-1</sub>	-5.675*** (0.041)	-2.960*** (0.017)	-5.803*** (0.022)	9.060*** (0.005)	7.602*** (0.287)	18.903*** (0.014)
<i>INFLATION</i> <sub><i>t</i>-1</sub>	0.131*** (0.000)	0.087*** (0.000)	0.104*** (0.000)	-0.019*** (0.000)	0.161*** (0.002)	-0.021*** (0.000)
<i>GDPGROWTH</i> <sub><i>t</i>-1</sub>	-0.222*** (0.000)	-0.231*** (0.000)	-0.267*** (0.001)	0.406*** (0.000)	0.403*** (0.004)	0.259*** (0.001)
<i>COMPET</i> <sub><i>t</i>-1</sub>	0.058*** (0.000)	0.013*** (0.000)	0.059*** (0.000)	-0.238*** (0.000)	0.089*** (0.004)	-0.389*** (0.000)
Sargan Statistics	99.294	99.527	106.238	99.527	116.490	107.338
Sargan p-value	0.557	0.523	0.394	0.923	0.496	0.770
Countries included	108	108	109	126	123	127
Country-year observations	1,372	903	1,313	1,841	1,076	1,729

This table reports the results of dynamic panel GMM regressions of banking sector stability (*STABILITY*) for the full sample. In columns (1) to (3), the dependent variable represents the bank non-performing loans, which is the ratio of defaulting loans to total gross loans. In columns (4) to (6), the dependent variable represents the bank credit to bank deposits, which is the ratio of credits provided to the private sector by domestic money banks to total deposits of banks. *Financial depth* is domestic credit to the private sector as a percentage of GDP. *Financial access* is the logarithm of the number of commercial bank branches per 100,000 adults. *Financial efficiency* is the bank's non-interest income as a percentage of total income. *TRADE* is the ratio of total trade to GDP. *FINOPEN* is the Chinn-Ito financial openness index. *INFLATION* is the annual growth rate of the GDP implicit deflator. *GDPGROWTH* is the annual percentage growth rate of GDP. *COMPET* is a share of assets of the five largest banks to the total commercial banking assets. Standard errors are reported in parentheses. Symbols \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3: Panel dynamic GMM regressions of banking sector stability

Variable	Bank Z-score			Banking crisis		
	(1) 1999-2016	(2) 2004-2016	(3) 1999-2015	(4) 1999-2011	(5) 2004-2011	(6) 1999-2011
<i>STABILITY</i> <sub><i>t</i>-1</sub>	0.296*** (0.001)	0.358*** (0.003)	0.318*** (0.001)	0.552*** (0.003)	0.524*** (0.003)	0.655*** (0.004)
<i>Financial depth</i> <sub><i>t</i>-1</sub>	0.001* (0.001)			0.006*** (0.000)		
<i>Financial access</i> <sub><i>t</i>-1</sub>		0.056 (0.037)			0.074*** (0.002)	
<i>Financial efficiency</i> <sub><i>t</i>-1</sub>			0.047*** (0.001)			-0.000*** (0.000)
<i>TRADE</i> <sub><i>t</i>-1</sub>	0.026*** (0.001)	0.018*** (0.001)	0.022*** (0.001)	-0.003*** (0.000)	0.001*** (0.000)	-0.001*** (0.000)
<i>FINOPEN</i> <sub><i>t</i>-1</sub>	-2.509*** (0.090)	-6.901*** (0.111)	-2.248*** (0.134)	-0.109*** (0.002)	-0.135*** (0.005)	0.076*** (0.001)
<i>INFLATION</i> <sub><i>t</i>-1</sub>	0.020*** (0.001)	0.003** (0.001)	0.018*** (0.001)	0.000*** (0.000)	0.001*** (0.000)	-0.000*** (0.000)
<i>GDPGROWTH</i> <sub><i>t</i>-1</sub>	0.001 (0.002)	-0.065*** (0.000)	-0.031*** (0.001)	0.000*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)
<i>COMPET</i> <sub><i>t</i>-1</sub>	-0.034*** (0.000)	0.040*** (0.002)	-0.046*** (0.001)	-0.001*** (0.000)	-0.004*** (0.000)	-0.003*** (0.000)
Sargan Statistics	124.253	119.136	124.148	85.121	85.094	88.995
Sargan p-value	0.401	0.582	0.530	0.476	0.247	0.306
Countries included	128	129	133	123	118	125
Country-year observations	1,885	1,118	1,813	1,312	536	1,328

This table reports the results of dynamic panel GMM regressions of banking sector stability (*STABILITY*) for the full sample. In columns (1) to (3), the dependent variable represents the bank Z-score, which is the ratio of capitalization and returns of a country's commercial banking system to the volatility of those returns. In columns (4) to (6), the dependent variable represents the banking crisis dummy, which takes a value of one for any year observation when a banking crisis occurred and zero otherwise. *Financial depth* represents the domestic credit to the private sector as a percentage of GDP. *Financial access* is the logarithm of the number of commercial bank branches per 100,000 adults. *Financial efficiency* represents the bank's non-interest income as a percentage of total income. *TRADE* is the ratio of total trade to GDP. *FINOPEN* is the Chinn-Ito financial openness index. *INFLATION* is the annual growth rate of the GDP implicit deflator. *GDPGROWTH* is the annual percentage growth rate of GDP. *COMPET* is a share of assets of the five largest banks to total commercial banking assets. Standard errors are reported in parentheses. Symbols \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4: Panel dynamic GMM regressions for the joint effects of financial development on banking sector stability

	Bank non-performing loan		Bank credit to bank deposits		Bank Z-score		Banking crisis	
	2004-2015	2004-2015	2004-2015	2004-2015	2004-2015	2004-2015	2004-2011	2004-2011
Panel A: Full sample								
<i>STABILITY<sub>t-1</sub></i>	0.520*** (0.002)	0.518*** (0.002)	0.593*** (0.001)	0.591*** (0.001)	0.410*** (0.007)	0.432*** (0.008)	0.405*** (0.004)	0.411*** (0.003)
<i>Financial depth<sub>t-1</sub></i>	0.145*** (0.001)	0.171*** (0.001)	0.246*** (0.001)	0.237*** (0.001)	0.018*** (0.003)	0.038*** (0.003)	0.009*** (0.000)	0.008*** (0.000)
<i>Financial access<sub>t-1</sub></i>	-1.836*** (0.032)	-1.589*** (0.038)	1.667*** (0.021)	1.682*** (0.066)	-0.228 (0.151)	-0.228 (0.166)	-0.078*** (0.001)	-0.084*** (0.001)
<i>Financial efficiency<sub>t-1</sub></i>	0.020*** (0.001)	0.051*** (0.001)	0.021*** (0.000)	0.012*** (0.001)	-0.010*** (0.002)	0.008*** (0.002)	-0.001*** (0.000)	-0.002*** (0.000)
<i>FD<sub>t-1</sub></i>		-0.026*** (0.001)		0.007*** (0.000)		-0.018*** (0.001)		0.001*** (0.000)
<i>GDPGROWTH<sub>t-1</sub></i>	-0.035*** (0.002)	-0.039*** (0.002)	0.380*** (0.002)	0.382*** (0.004)	-0.031*** (0.002)	-0.031*** (0.003)	0.000*** (0.000)	0.000*** (0.000)
Sargan p-value	115.617	118.179	163.881	164.336	125.969	124.996	98.106	96.117
Countries included	128	128	168	168	169	169	166	166
Country-year observations	942	942	1,376	1,376	1,388	1,388	779	779
Panel B: Developed countries								
<i>STABILITY<sub>t-1</sub></i>	0.615*** (0.001)	0.618*** (0.001)	0.801*** (0.002)	0.810*** (0.002)	0.412*** (0.002)	0.422*** (0.003)	0.433*** (0.020)	0.468*** (0.021)
<i>Financial depth<sub>t-1</sub></i>	0.059*** (0.000)	0.058*** (0.000)	0.023*** (0.000)	0.075*** (0.002)	0.012*** (0.001)	0.047*** (0.001)	0.006*** (0.001)	0.003*** (0.001)
<i>Financial access<sub>t-1</sub></i>	3.697*** (0.018)	3.759*** (0.028)	8.213*** (0.159)	9.080*** (0.100)	-0.878*** (0.038)	-0.132*** (0.062)	-0.045*** (0.012)	-0.128*** (0.016)
<i>Financial efficiency<sub>t-1</sub></i>	0.012*** (0.000)	0.013*** (0.000)	-0.108*** (0.002)	-0.029*** (0.001)	0.011*** (0.000)	0.073*** (0.002)	-0.002*** (0.000)	-0.003*** (0.000)
<i>FD<sub>t-1</sub></i>		-0.001*** (0.000)		-0.036*** (0.001)		-0.033*** (0.001)		0.001*** (0.000)
<i>GDPGROWTH<sub>t-1</sub></i>	-0.043*** (0.000)	-0.046*** (0.000)	0.268*** (0.001)	0.275*** (0.002)	-0.049*** (0.000)	-0.053*** (0.000)	0.002*** (0.000)	0.001*** (0.001)
Sargan p-value	80.473	79.095	93.294	94.369	95.776	98.058	47.624	31.462
Countries included	86	86	99	99	102	102	99	99
Country-year observations	671	671	838	838	850	850	478	478

The FD variable is the value of the multiplicative terms of financial depth, financial access, and financial efficiency indicators. Other variables are defined as in Tables 2 and 3. Standard errors are reported in parentheses. Symbols \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively.

ple. We find that, for the full sample and the developed countries subsample, the beneficial effects of financial access and financial efficiency on the reduction of banking crisis occurrence are strengthened by the joint effects of financial development. This finding implies that policymakers should encourage higher efficiency of the domestic financial sector and more access to financial services. By doing so, the occurrence of a banking crisis will be less likely. Due to a small number of observations, we cannot estimate panel dynamic GMM for the developing countries subsample. We find that financial depth, financial access, and financial efficiency promote liquidity risk in the banking sector, as measured by the ratio of bank credit to bank deposits, and such adverse effects are strengthened by the joint effects of financial development. Thus, policymakers should be cautious, as the larger size of the domestic financial sector, more access to financial services, and greater financial efficiency may have combined effects on increasing the level of liquidity risk of the financial sector. For the developed countries subsample, the positive effects of financial efficiency lessen the negative effects of financial depth and financial access on the level of bank liquidity risk. This finding further emphasizes the important role of financial efficiency in promoting banking sector stability.

Although the benefits of financial access on curbing the level of bank credit risk are evident in full sample, the effects are weakened by the joint effects of financial development. The adverse effects of financial depth, financial access, and financial efficiency on the level of bank credit risk are more pronounced for the developed countries subsample. Financial depth is beneficial to banking sector stability as measured by bank *Z*-score. The negative effects of financial efficiency on the probability of default of a country's banking system are weakened by the joint effects of financial development. The effect is, however, positive for the full sample. For the developed countries subsample, the adverse effects of financial access on bank *Z*-score are weakened by the joint effects of financial development when the positive effects of financial efficiency become stronger. This again emphasizes the importance of the quality aspect of financial development.

## 5 Conclusion

Using financial development and macroeconomic data of over 170 countries during 1990 to 2016, we empirically test the effects of financial development on four aspects of the banking sector stability. We find that the effects of financial development on banking sector stability are different across the dimensions of financial development, with financial efficiency exerting the most beneficial effects on banking sector stability. The benefits of financial efficiency on bank-



ing sector stability are seen in both the developed and developing countries. As the size of the financial sector in most developing countries is still small, developing countries can benefit more from financial deepening.

By examining the effects of individual dimensions of financial development on different aspects of banking sector stability, our study provides an in-depth understanding of the sources of banking sector stability, leading to the more effective development of policies for financial development. The quality aspect of financial development (i.e. financial efficiency) is crucial, and thus more emphasis should be put into promoting efficiency of the domestic financial sector. Because the impact of financial development is not homogeneous, policies for financial development should be different for developed and developing countries. Policymakers should also be more cautious about the combining effects of financial development on financial stability. For instance, larger size of the financial sector, more access to financial services, and greater financial efficiency can potentially have combining effects on increasing the level of liquidity risk of the financial sector. Concurrent development of the financial sector in terms of size, access, and efficiency could have detrimental effects on banking sector stability by increasing the level of credit risk in a country's banking system.

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