Concentration in Asia's Cross-border Banking Determinants and Impacts

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Concentration in Asia's Cross-border Banking: Determinants and Impacts

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Abstract:

Cross-border bank positions in the Asia and the Pacific region remain highly concentrated to few counterparties, exposing the region to financial risks and policy spillovers. Consequently, assessing the determinants and impacts of the region's cross-border banking concentration is relevant in designing appropriate policies to promote financial development and safeguard financial stability. To this end, we construct cross-border bank concentration measures for 47 economies in Asia and the Pacific from 2000 to 2019. The results show that higher capital account and trade openness as well as per capita income are significantly associated with lower cross-border bank concentration. Moreover, elevated cross-border bank concentration tends to lower domestic credit growth and nonperforming loans, while we find no impact on bank profitability for the region.

Keywords: *cross-border bank exposures, cross-border bank concentration, credit growth, non-performing loans, bank profitability, Asia and the Pacific*

JEL Codes: E44, F36, G21, O16

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1. Introduction

High concentration of cross-border bank claims and liabilities exposes economies to financial spillovers and risks emanating from few counterparties and can lead to less efficient cross-border financial intermediation, with implications on the domestic financial system. Few studies specifically analyze cross-border bank concentration. For instance, Barrell and Nahhas (2020) show that more concentrated or less competitive lender countries' banks engage in more cross-border lending, especially in less concentrated or more competitive borrowers' banking systems for a sample of advanced economies. Aldasoro, Huang and Kemp (2020) find that cross-border bank linkages with non-bank financial institutions' gained importance globally after the global financial crisis, with their exposures being highly concentrated. Aldasoro and Ehlers (2019) show that cross-border bank credit is dominated by a small number of very sizeable links between banks in one country and borrowers in another, whereby the largest-sized cross-border banking links are mainly between major advanced economies. They also find that concentration is higher for interbank credit than for credit with non-bank financial institutions.

Most studies, however, focus on bank concentration within the domestic banking sector. Beck, Demirguc-Kunt, and Levine (2006), empirically find that increased domestic bank concentration leads to a more stable financial market and less crises occurrence. However, they discuss that economic theory predicts ambiguous effects between domestic bank concentration and stability. Barrell and Karim (2020) concur and conclude that increasing competition in the banking sector should be accompanied by increases in capital standards. Meanwhile, Cifter (2015) finds an ambiguous relationship between domestic bank concentration and credit risk in Central and Eastern European countries. Using the Herfindahl-Hirschman Index (HHI), Schaeck, Cihak, and Wolfe 2009 show bank concentration ratios tend to exaggerate the level of competition in small economies, and these are increasingly unreliable when the number of banks is small (Bikker, 2004). Nonetheless, the use of HHI as a measure of cross-border bank concentration remains warranted as it provides a clear methodological procedure in which available cross-border data can be used to measure cross-border concentration across sample of economies. Consequently, this paper utilizes HHI to measure aggregate cross-border bank concentration exposures.

But there are gaps in the existing literature which this paper addresses. First, this paper examines cross-border bank concentration, instead of domestic concentration, which is vital in assessing domestic impact of high concentration and in understanding cross-border exposures and spillovers. Second, this paper aims to determine which factors are relevant in explaining cross-border bank concentration exposures, which previous studies have not considered. Determining which factors significantly covary with cross-border bank concentration exposures will enable policy makers to design and implement

measures that could address associated risks related to having high concentrations. Third, more importantly, this study aims to assess the impact of having high cross-border bank concentration on domestic banking sector measures such as domestic credit growth, banking sector stability, and banking sector profitability, which previous studies have not considered. Understanding the impact of high HHI on these bank measures will allow authorities mitigate the adverse effects of having high cross-border bank exposures to few counterparties, and, hence, help maintain banking sector health and stability.

This paper focuses on a sample of advanced and emerging Asia and the Pacific economies. The focus on the Asia region is warranted. First, the region's financial systems generally rely heavily on the banking sector as main source of corporate financing as well as for cross-border financial intermediation (ADB 2020). Hence, understanding and considering the determinants and impacts of cross-border bank concentration exposures will aid in assuring efficient financial intermediation of banks, while maintaining and safeguarding macroeconomic and financial stability in the region. Second, cross-border bank claims and liabilities in the Asia and the Pacific region are characterized by a high and constant level of concentration, compared to other regions. That is, the region's cross-border banking activities are concentrated to few counterparties. Such high concentration exposes the region to risks and policy spillovers that may have adverse consequences for macroeconomic for financial intermediation as well as macroeconomic and financial stability.

To this end, this study considers the determinants and impacts of cross-border bank concentration measure, Herfindahl-Hirschman Index, for 47 advanced and emerging Asia and Pacific economies for the period of 2000-19. Using the Bank for International Settlements (BIS) International Banking Statistics database to construct Herfindahl-Hirschman Indices (HHIs) of cross-border bank holdings, we estimate our HHI measures on host of potential determinants, and then use the same measure to assess its impacts on banking sector measures. Our HHI measure captures concentration of an economy's cross-border bank positions with several counterparty economies.

To preview our results, our computed HHI measure shows that Asia and Pacific region exhibits elevated cross-border concentration – exceeded only by the Americas. However, the region has considerable variations across subregions. For instance, the Pacific subregion exhibits high concentration, whereas the East Asia and Oceania subregions have low concentration. On determinants, we find that higher capital account and trade openness, financial development and per capita income are significantly associated with lower cross-border bank concentration, suggesting that less developed, less integrated and closed economies tend to be more dependent on a few cross-border bank counterparties. On impacts,

we find that bank concentration tends to decrease domestic credit and the level of nonperforming loans (NPLs), while our results on bank profitability are inconclusive.

These findings complement existing research on the implications and risks of cross-border banking exposures, amid increasing financial interconnectedness in Asia and the Pacific (ADB 2017, 2020; Dungey et al. 2019). Park and Shin (2017 and 2018) look at the liability side of cross-border interbank exposure, highlighting it as a source of contagion during the global financial crisis. Cerutti (2015) analyses drivers of cross-border banking exposures during global financial crisis and highlights the relevance of global and domestic financial conditions. Matousek (2019) examines cross-border interbank positions and risks of contagion countries in Asia and the Pacific but using network analysis.

Overall, the contributions of this study are two-folds. First, it is one of the few studies that considers the importance of *cross-border* bank concentration positions, thereby extending the literature on bank concentration in the context of cross-border exposures, risks, and spillovers. Second, it also extends the literature by assessing the determinants and potential impacts of cross-border bank concentration, which were not considered by existing studies.

The remainder of the paper is as follows: Section 2 discusses the construction of the cross-border bank concentration measure and discusses related stylized facts. Section 3 introduces the empirical specification; and followed by a discussion of the empirical findings in Section 4. Section 5 concludes and suggests policy considerations.

2. Cross-border bank concentration: construction and stylized facts

a) Construction of cross-border bank concentration

The HHI (Herfindahl, 1950; Hirschman, 1945 and 1964) is a measure of the degree of concentration of entities. For instance, it has been widely used to measure the size of a firm relative to the industry or gauge the competition in a particular sector. Following Avila et. al. (2013), we use HHI to construct a cross-border bank concentration indices for 47 economies in Asia and the Pacific from 2001 to 2019, as defined below:

$$HHI_{i,t} = \sum_{j=1}^{N}\left(s_{j,t}^{i}\right)^{2} \qquad \text{(Equation 1)}$$

where $s_{j,t}^{i}$ is the cross-border share of reporter j at time t in country i's cross-border position. The market share refers to each reporting economy's bank cross-border position as % of the total cross-border bank position of counterparty i. We construct an index for each cross-border bank position, namely cross-

border bank claims (assets), liabilities, and total (claims plus liabilities), using data from BIS Locational Banking Statistics, Table A6.2.

The HHI values range from 0 to 1. The higher the value, the higher the concentration of an economy's cross-border position. The index approaches one as the number of counterparties decreases or as the disparity in value of cross-border position increases among counterparties. For example, Timor-Leste's HHI in 2004 is 1, with the United Kingdom being its only counterparty. As a rule of thumb, values greater than 0.25 are considered to indicate high concentration, while values between 0.15 and 0.25 represent moderate levels of concentration. In contrast, values below 0.15 are considered as low concentration.

The HHI concentration measure, apart from being commonly used to quantify concentration, can capture both the number of linkages and size of linkages, which is essential when looking into the cross-border bank positions. It is therefore also used in industrial policy to examine market competitiveness when analyzing implications of mergers and acquisitions (Laderman, 1995). The Gini coefficient would be another option, but it rather captures inequality. Other prominent measures of bank concentration are the ratio of the three (or five) largest commercial banks' assets to total commercial banks assets, the Boone indicator or the Lerner index – the same indicators used by Barrell and Karim (2020). The Boone indicator is a firm competition measure, computed as the elasticity of profits to marginal cost. A higher Boone indicator indicates less competition in the industry. Meanwhile, the Lerner index measures the market power of a firm or bank, capturing the gap between the price and the marginal cost. The higher the index, the higher the market power of a firm is (World Bank GFDD 2019). While the asset concentration measures capture the size of concentration, it arbitrarily determines the number of banks (top three or top five) that would determine bank concentration. Moreover, it is more aptly used as a measure of inequality among the firms in a sector. Meanwhile both the Boone indicator and the Lerner index do not consider information on the number of linkages. For these reasons, we chose to use HHI concentration measure in this study.

b) *Stylized facts on Asia's cross-border bank concentration*

A comparison of the HHI across regions reveals that Asia has one of the highest on average globally, with an upward trend since 2013 (Figure 1a). In 2019, the average stood at 0.27, indicating a rather high degree of concentration. Since 2005, only the Americas region exhibited a higher average cross-border bank concentration. This could be because several economies in the Americas are highly

dollarized, amid a concentrated global United States dollar wholesale market. [1] However, the degree of cross-border bank concentration across subregions in Asia and the pacific varies considerably. The mean HHI in the Pacific has exhibited an increasing trend since 2006 and exceeds other subregions considerably (Figure 1b), with 0.45 as of 2019. Tonga's HHI, for instance, increased substantially from 0.40 in 2006 to 0.94 in 2019. Meanwhile, Central Asia's average HHI has been declining since 2005, with the Kyrgyz Republic and Tajikistan contributing significantly to this downward trend. East Asia and Oceania show a comparably low average cross-border bank concentration, however at an upward trend since 2017, while that of Southeast Asia reveals a downward trend in the same period.

Figures 2a and 2b show that concentration of Asia's cross-border bank linkages is similar for bank claims and liabilities and patterns of the overall HHI, with the Pacific region visibly representing the highest average cross-border bank concentration. This highlights the fact that not only lenders' concentration— e.g. in the form emerging market economies borrowing from a few advanced economies only—but also borrowers' concentration is elevated in Asia and the Pacific.

Thus, it is important to consider cross-border bank concentration shares, given that high concentration can expose the region to financial risk and policy spillovers emanating from few counterparties. Park and Shin (2017, 2018) show that advanced countries experiencing financial distress tend to withdraw cross-border lending from emerging markets during financial crises, resulting in capital outflows in emerging markets. A high cross-border bank concentration can further exacerbate this problem, with possible implications on the domestic financial system. Figure 3 shows that cross-border bank concentration is negatively correlated with economic development, financial development, and trade openness. This pattern suggests that more economically and financially developed economies tend to engage in more cross-country counterparty risk sharing, which may help increase their financial resilience to external shocks. Figures 3a and 3b further illustrate that there are countries exhibiting high economic or financial development have comparably low cross-border counterparty concentration, suggesting that it requires a certain level of economic and financial sophistication for attaining cross-border bank counterparty diversification.

As regards to indicators of the domestic banking sector, cross-border bank concentration appears to be negatively associated with levels of domestic credit (Figure 4a). This could indicate that a high counterparty concentration tends to drag on the efficiency in domestic financial intermediation through limited competition, thus resulting in lower credit levels. On the other hand, cross-border bank

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[1] Refer to Appendix 1 for full list of samples by regions.

5

concentration has a positive relationship with bank profitability (return on asset and return on equity, Figures 4b and 4c). Again, the level of competitiveness could be the underlying reason, similar to a monopoly, wherein banks can dictate more profitable terms to borrowers. This is supported by Figure 5, which examines the relationship between domestic bank concentration and competition measures. In particular, these are World Bank Global Financial Development Database (GFDD) domestic bank concentration (assets of three largest banks as share of total bank assets), and the Boone indicator (bank competition measure). Both the GFDD bank concentration and bank profitability (return on assets and return on equity), as well as the Boone indicator and bank profitability, are positively correlated and thereby offer possible explanations of the positive relationship between cross-border bank concentration and bank profitability.

Figure 4d indicates a negative relationship between cross-border bank concentration and NPLs. While this appears to be puzzling, it may be driven by outliers with very high concentration and low NPL ratios, such as Tonga and Fiji. Moreover, Cifter (2015) also finds an ambiguous relationship between domestic bank concentration and NPLs in Central and Eastern European countries.

In summary, these stylized facts reveal that Asia and the Pacific has comparatively high degree of cross-border bank concentration position, compared to other regions. In addition, there appears to be significant covariation between HHI and economic development, financial development, and trade openness; as well as between HHI and domestic bank credit levels and NPLs.

3. Empirical Specifications

To assess the determinants of cross-border bank concentration, we consider several covariates which are most likely to influence the degree of international banking sector exposures. Specifically, we estimate:

$$HHI_{i,t} = \theta' x_{i,t-1} + \varepsilon_{i,t} \qquad\qquad \text{(Equation 2)}$$

where HHI refers to either HHI total (HHI_TOT), HHL claims (HHI_CLM), or HHI liabilities (HHI_LIA) of country *i* at time *t* as discussed and presented in the previous section. HHI enters the estimation in percent, thus ranging from zero to 100. *x* is a row vector of lagged determinants with θ being a column of coefficients; and ε is the error term. Robust clustered standard errors at country levels are used. Pooled and fixed effects estimations are presented. Although country fixed effects capture unobserved heterogeneity and limit omitted variables bias, some economies have persistently strong or weak covariations between cross-border bank concentrations and regressors which may be captured by country

6

fixed-effects. Hence, pooled estimates are also presented. The regressors are lagged to reduce possible concerns regarding endogeneity.

On determinants, several variables are considered. First, capital account openness increases cross-border exposures, hence, can significantly reduce cross-border concentrations (Herrmann and Mihaljek, 2013). Trade openness is, likewise, linked to cross-border bank holdings as trade financing are mostly carried out through cross-border banking transactions or for hedging purposes (Coeurdacier, 2009; Lane and Milesi-Ferretti, 2005; and Obstfeld and Rogoff, 2000). Political stability and inflation volatility capture both risk and macroeconomic volatility as high economic risk and macroeconomic instability may lead to fewer international banks willing to provide credit. Lastly, two control variables are included. Per capita income reflects the level of economic and financial development, and financial center dummy variable captures huge cross-border transactions and holdings with large financial centers (Portes and Rey, 2005; and Portes, Rey, and Oh, 2001; and Warnock and Cleaver, 2003).[2]

To assess the impact of cross-border bank concentration measures on banking sector credit, stability, and profitability, we estimate:

$$BM_{i,t} = \beta_1 HHI_{i,t-1} + \theta' x_{i,t-1} + \varepsilon_{i,t} \qquad \text{(Equation 3)}$$

where BM refers to bank performance measures including bank credit, bank stability, and bank profitability of country *i* at time *t*. Bank credit pertains to domestic credit provided to the private sector by domestic banks. Bank stability is captured by the ratio of non-performing loans, while bank profitability includes return on assets and return on equity. Lag HHIs are bank cross-border concentration indices (HHI_TOT, HHI_CLM, HHI_LIA), and x is a row vector of lagged bank measure covariates with θ being a column of coefficients. ε is the error term. Robust clustered standard errors at country levels are used, and regressors are lagged to reduce endogeneity issues. [3] Equation 2 is estimated using both pooled and fixed-effects estimation.

Estimation on credit growth and levels include interest rate, economic growth, and inflation. Higher interest rate tends to lower bank credit growth as the cost of borrowing increases. Higher inflation also reduces bank credit growth as lenders will receive lower future debt payments. Stronger economic

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[2] Financial centers include Australia; People's Republic of China; Hong Kong, China; India; Japan; Republic of Korea; Malaysia; Singapore; and Taipei,China. These financial centers are included in China Development Institute list.

[3] We considered to address endogeneity between banking sector measures and our HHI measures by using two-stage least squares regression. However, given that the weakness of the potential instruments we tried, we opted to use lagged regressors in addressing potential endogeneity.

growth increases the provision of bank credit as demand for credit raises. The inclusion of lagged per capita income and bank credit level captures possible convergence mechanism, wherein economies with low initial credit level and per capita income might experience faster credit growth (Lane and McQuade, 2014). We expect high concentration of cross-border bank holdings will reduce credit growth as fewer cross-border counterparties provide credit.

For nonperforming loans, average economic growth captures the impact of business cycles on loan quality. Higher interest rate raises the cost of debt payments, and hence, will increase non-performing loans. Larger budget deficits, likewise, can increase NPLs as banks cut lending to the private sector and consequently debt refinancing becomes difficult (Ghosh, 2015; and Reinhart and Rogoff, 2010). In contrast, higher per capita income, which proxies for the level of economic and financial development, will lower nonperforming loans. Inflation can have ambiguous impact on NPLs as higher inflation may reduce the cost of debt servicing but may increase it as (i) interest rates rise due to higher inflation (ii) or real income declines amid sticky wages weighing on borrowers' debt servicing capacity (Nkusu 2011) . The inclusion of lagged NPL ratio captures dynamic effects of NPLs, which tend to be highly persistent (Klein 2013, and Lee and Rosenkranz 2020).

For bank profitability, economic growth, inflation, and political stability are included as determinants. Higher bank assets are expected to increase bank profitability, while financial center dummy variable captures impact of higher bank profits in the financial centers (Kohlscheen, Murcia, and Contreras, 2018). For non-performing loans and bank profitability estimations, the determinants are limited to those discussed above to avoid multicollinearity among regressors and to address the lack of data availability for most economies in the sample. The inclusion of economy fixed effects will capture those omitted variables.

Our sample includes annual values from 2000 to 2019 and includes 47 Asia and the Pacific economies, namely: Afghanistan; Armenia; Australia; Azerbaijan; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; China, People's Republic of; Fiji; Georgia; Hong Kong, China; India; Indonesia; Japan; Kazakhstan; Kiribati; Korea, Republic of; Kyrgyz Republic; Lao PDR; Malaysia; Maldives; Marshall Islands; Micronesia, Federated States of; Mongolia; Myanmar; Nauru; Nepal; New Zealand; Pakistan; Palau; Papua New Guinea; Philippines; Samoa; Singapore; Solomon Islands; Sri Lanka; Taipei,China; Tajikistan; Thailand; Timor-Leste; Tonga; Turkmenistan; Tuvalu; Uzbekistan; Vanuatu; and Viet Nam. Appendix 2 presents data definitions, notes, and sources.

4. Empirical Results

Table 1 presents the estimates for Equation (2) on the determinants of HHI. The results included HHI_TOT with economy and year fixed-effects, economy fixed-effects, year fixed-effects, pooled OLS, as well as economy fixed effects and pooled OLS for TOT_CLM and TOT_LIA. As expected, fixed effects specifications have higher R-squared, than pooled OLS estimates.

The results indicate that higher openness measures, both trade and capital account, and level of economic development tend to have lower HHI_TOT. For instance, a one percent of GDP increase in trade openness is significantly associated with lower HHI_TOT by 0.05 percentage points (column 4). These results indicate that Asia and Pacific economies that are highly open in terms of trade and finance tend to have lower cross-border concentration of bank holdings, while those that are less open tend to have higher bank concentration. This offers evidence on the importance of trade and financial openness in mitigating the adverse consequences of having large bank exposures to limited number of economies. The results also show that higher inflation volatility is significantly associated with higher HHI_TOT, while financial centers tend to have lower HHI, as expected. Interestingly, higher political stability is significantly correlated with higher HHI_TOT, perhaps because magnitude of holdings to economies with higher political stability are significantly larger as they are an attractive borrower/lender counterparty, and thus they appear to be highly concentrated. Focusing on HHI_CLM and HHI_LIA, the results are similar, as shown in columns (5) to (8).

These findings are consistent across several sensitivity tests. First, we use financial development index sourced from the IMF, instead of per capita income to directly test the impact of financial development. The results are the same (Table S1). Second, as trade and capital account openness may be correlated, such that those that are highly open to trade tends to be highly open to international finance, we remove our de jure measure of capital account openness. The key findings also hold (Table S2). Third, a measure of domestic bank concentration was included to assess the link between domestic and cross-border bank concentration. It is possible that economies with a highly concentrated domestic banking sector might be borrowing from a few cross-border counterparties only, and hence both would be related. The findings indicate that the results are similar those presented in Table 1, but inflation volatility and financial centers tend to be significant in fewer specifications, unlike in the baseline results. But the estimated coefficients for domestic bank concentration show inconclusive results (Table S3). For economy fixed-effects specifications (in columns 1 and 5), the signs are negative, indicating higher domestic banking sector concentration is significantly associated with lower cross-border bank concentrations. This result is intuitive as highly concentrated and profitable domestic banking sector may have better capacity to be exposed with more cross-border counterparties. In contrast, for time fixed-

9

effects and pooled OLS specifications (in columns 3, 4, 6, and 8), the estimated coefficients are positive i.e. higher domestic banking sector concentration is significantly associated with higher cross-border concentrations. This may suggest that the positive covariation between domestic and international bank concentration hold for subset of economies in the sample, which are subsumed by the fixed effects.

In summary, our results show that Asia and the Pacific economies with higher capital account openness, trade openness, as well as per capita income tend to lower cross-border banking concentration, while higher political stability and inflation volatility tend to increase cross-border banking concentration. Financial centers usually have lower cross-border concentration.

Table 2 presents the results on the impact of HHI on domestic credit growth. The estimates provide evidence that higher cross-border bank concentration is significantly associated with lower domestic credit growth in the Asia and Pacific region. Specifically, a one percentage point increase in HHI lowers domestic credit growth by around 0.10%. This finding is intuitive as higher concentration of cross-border bank exposures limits the availability of acquiring external loans, and hence, reduces domestic credit. The results hold for both fixed effects and pooled OLS specifications. The estimates in Table 2 also show that higher lag credit ratio tends to be significantly correlated with lower domestic credit growth, while we do not find any evidence on significance of other credit growth determinants, except for per capita income for pooled OLS specifications. Focusing on credit levels, the pooled OLS results including financial center effect also indicates that higher cross-border bank concentration is significantly associated with lower levels of domestic credit (Table 3). As lag credit level is significant, we run a sensitivity test including lag credit ratio in our fixed effects and pooled OLS specifications. The results validate the negative covariation between credit and external bank concentration (Table S4). We also run both fixed-effects and pooled OLS estimation on credit level with lag credit level to assess the persistence of credit levels. There is evidence that cross-border bank concentration is significantly associated with lower domestic credit level, specifically for pooled OLS results; while lag bank credit levels are significant with positive coefficients (Table S5).

Taken together, the results indicate that higher cross-border bank concentration in the Asia and Pacific region tends to lower domestic credit levels and growth.

Next, the covariation between HHI and nonperforming loans is assessed. Table 4 indicates that higher cross-border bank concentration of assets (claims) reduces non-performing loans. In particular, one percentage point increase in HHI claims is significantly associated with lower non-performing loans of around 0.1% in Asia and Pacific region. This new finding implies that non-performing loans are responsive to cross-border concentration of bank claims or assets and not on cross-border liabilities. One

possible interpretation of this result could be that when economic activity slows down and therefore credit risk rises, high bank concentration on cross-border claims would provide better position to hedge against their domestic losses. The estimates also show the significance of per capita income, interest rate, average growth rate, inflation, and lag NPLs. However, when lag NPLs are included in all specification, the results disappeared suggesting the importance of lag effects of NPLs (Table S6). We also run a sensitivity test by adding bank assets as one of the regressors. The results are the same (Table S7).

In summary, the estimates provide some evidence that higher bank concentration of cross-border assets tends to lower non-performing loans in Asia and the Pacific region.

For bank profitability, we find no evidence suggesting that bank profitability measures, such as return on assets and return on equity, are responsive to higher cross-border bank concentration (Table 5). Moreover, the estimated coefficients are not only statistically insignificant, but also have inconsistent signs. Several possible explanations are considered. First, bank profitability measures may be more responsive to individual banking conditions such that there are heterogeneous effects within the domestic banking sector. An aggregate level analysis may not capture such effects.[4] Second, it is also possible that bank profitability measures are unresponsive to cross-border bank concentration. There is no *a piori* evidence suggesting that profitability measures covary with cross-border concentrations, although cross-border bank exposures and bank returns inversely covary during crises and episodes of financial stress (Hale, Kaplan, and Minoiu, 2019). We also run a sensitivity test by splitting the same into two periods, e.g. 2000s versus 2010s, as cross-border banking exposures were considerably higher in the pre-global financial period. But the results indicate no significant impact of HHI on bank profitability measures.[5]

5. Concluding Remarks and Policy Considerations

This paper presents new measure of cross-border bank concentration of total holdings, claims and liabilities for 47 Asia and Pacific economies from 2000-2019. The stylized facts show that the region has one of the highest cross-border bank concentration, imply the region's vulnerability to external policy and shock transmissions. Using the cross-border bank concentration measure, computed as HHI, the results indicate that higher capital account and trade openness, as well as per capita income tend to significantly lower HHI, while higher political stability and inflation volatility are significantly associated with higher HHI. financial centers in the region tend to have lower HHI. These results hold under several sensitivity tests.

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[4] Bank-level analysis is beyond the scope of this study.
[5] The results are available upon request.

Assessing the impact of cross-border bank concentration on banking sector measures of credit growth, banking stability and profitability, we uncover several new findings on the impacts of cross-border bank exposures of Asia and Pacific economies. First, the results show that higher bank concentration is significantly associated with lower bank credit growth and bank credit level, indicating implications for domestic financial intermediation. Second, there is evidence to suggesting that higher NPLs are associated with lower cross-border bank concentration of claims or assets. This finding adds to the discussion on the nexus between bank concentration and stability, by specifically considering the cross-border dimension of bank concentration. Lastly, there is no evidence showing that HHI covaries with bank profitability measures.

These results reveal have several policy implications for Asia and the Pacific. First, to diversify cross-border bank exposures, it is important for economies to maintain trade and capital account openness as these tend to lower cross-border bank exposures. In the same vein, financial development is also vital in reducing banking sector external concentration, with their associated risks of policy and risk transmissions. Resulting external cross-border bank counterparty diversification would lead to more ample domestic credit conditions, as indicated through the significant effect of HHI on bank credit growth and levels.

Second, given the significance of HHI on bank credit growth and especially non-performing loans, there is merit in considering the concentration of banking sector external exposures in addressing concerns related to financial stability. The results also point toward some possible trade-off. On the one hand, lower HHI could facilitate domestic financial intermediation through more credit growth. On the other hand, excessive credit growth as well as increased credit risk could put reveal risks to financial stability. To swiftly address rising NPLs, effective NPL resolution mechanisms are needed.

Third, the region should continue developing long term local currency bond markets, incl. corporate bonds, to help diversity domestic financing sources. Capital market offering more stable sources of finance could address possible volatilities arising from cross-border bank flows, which are of shorter maturity and often denominated in foreign currency (from the perspective of the emerging economy). Likewise, a diversification of corporate financing channels could reduce the dependency on a few cross-border banking counterparts and associated risks.

Finally, as Asia's financial markets are more and more integrated and interconnected, both regionally and globally, a strong regional financial safety net is needed, supported by strong regulation and supervision. While potential benefits of increased financial integration are substantial, including opportunities for better risk sharing and increased allocation efficiency, it also gives rise to possible

spillovers and contagion from abroad. Hence, adequate safety net arrangements are needed to safeguard domestic and regional financial stability.

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Figure 1: Cross-border Bank Concentration

a: World
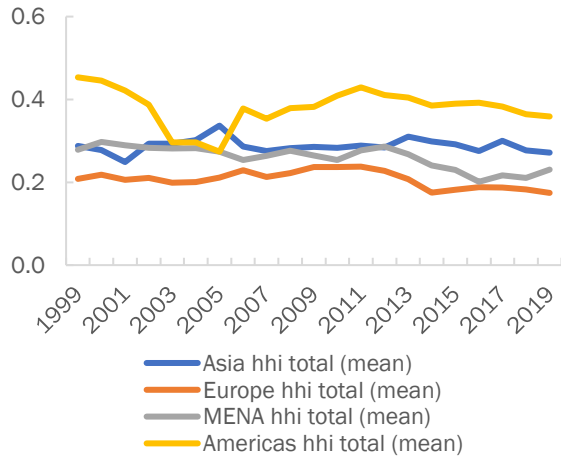
b: Asia
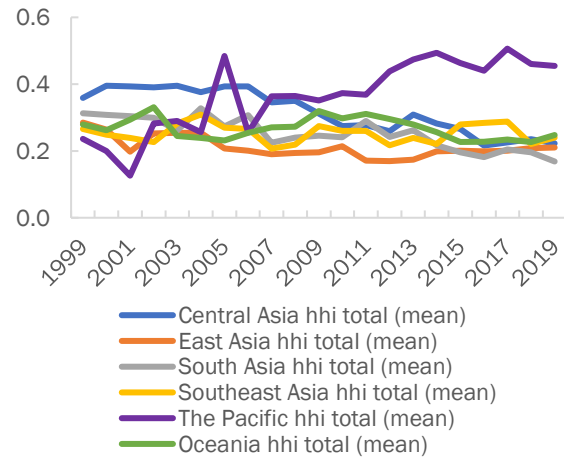
Refer to Appendix 1 for the list of regional and subregional economies and (iso codes).
Source: Authors' calculations using data from Bank for International Settlements. Locational Banking Statistics.
https://www.bis.org/statistics/bankstats.htm (accessed August 2020).

Figure 2: Cross-border Bank Concentration, Asia by cross-border position

a: Claims

b. Liabilities

Refer to Appendix 1 for the list of regional and subregional economies and (iso codes).
Source: Authors' calculations using data from Bank for International Settlements. Locational Banking Statistics.
https://www.bis.org/statistics/bankstats.htm (accessed August 2020).

16

Figure 3: Correlation HHI with Economic Development, Financial Development, and Trade Openness

a: HHI and Economic Development

b. HHI and Financial Development

c: HHI and Trade Openness
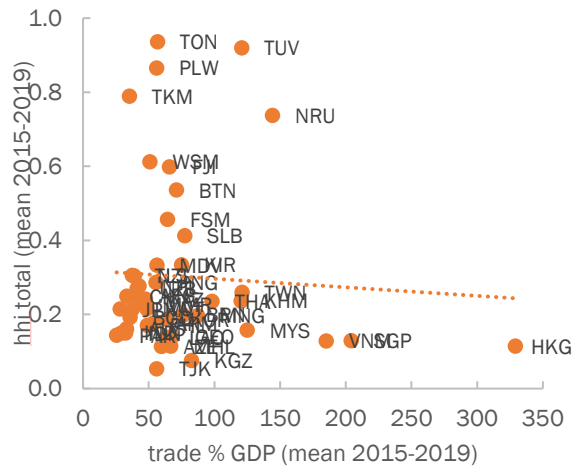
Refer to Appendix 1 for the list of regional and subregional economies and (iso codes).

Source: Authors' calculations using data from Bank for International Settlements. Locational Banking Statistics. https://www.bis.org/statistics/bankstats.htm (accessed October 2020); International Monetary Fund (IMF). Financial Development Index Database. data.imf.org/; IMF. International Financial Statistics. data.imf.org/IFS; and World Bank. World Development Indicators. http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators (all accessed December 2020).

Figure 4: HHI and Bank Credit, Stability, and Profitability

a: HHI and Bank Credit
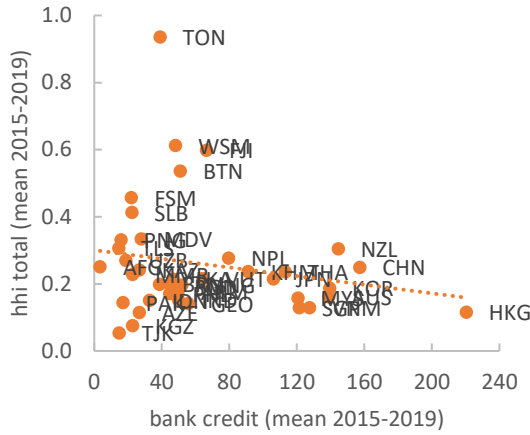
b: HHI and ROE
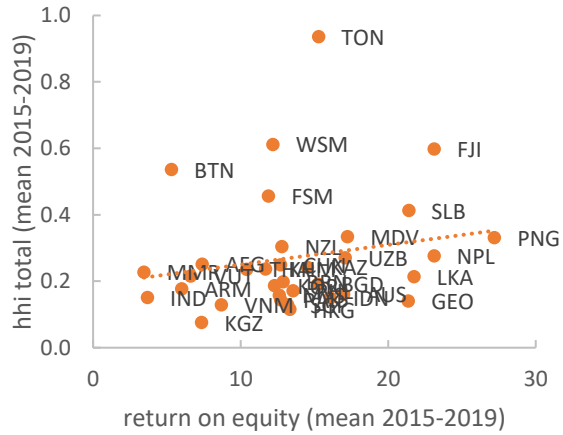
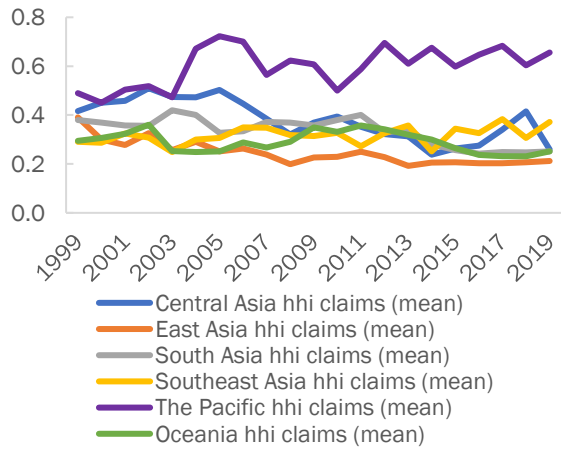C: HHI and ROA
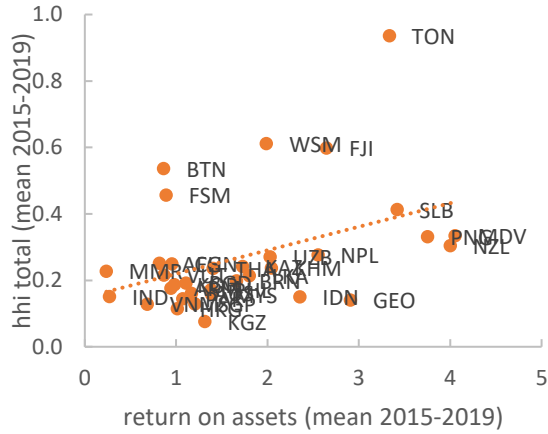
d: HHI and nonperforming loans
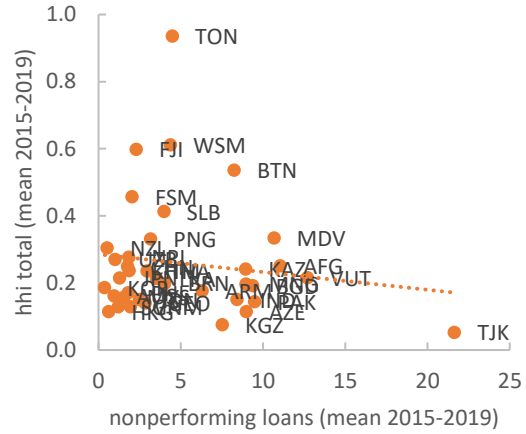
Refer to Appendix 1 for the list of regional and subregional economies and (iso codes).
Source: Authors' calculations using data from Bank for International Settlements. Locational Banking Statistics.
https://www.bis.org/statistics/bankstats.htm (accessed October 2020); International Monetary Fund (IMF). Global Financial
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data.imf.org/IFS; and World Bank. World Development Indicators.
http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators (all accessed December 2020).

Figure 5: Domestic Bank Concentration and Profitability

a: GFDD bank concentration v. ROE
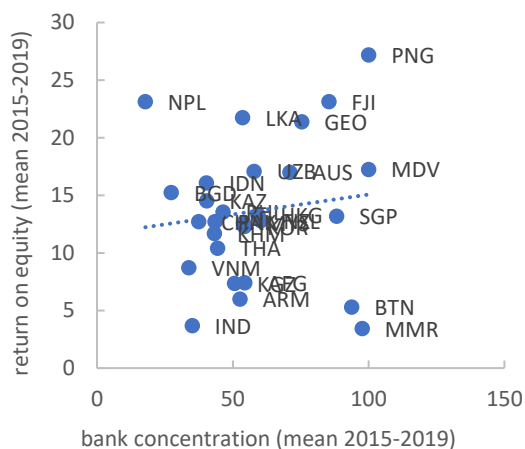
b: GFDD bank concentration v. ROA
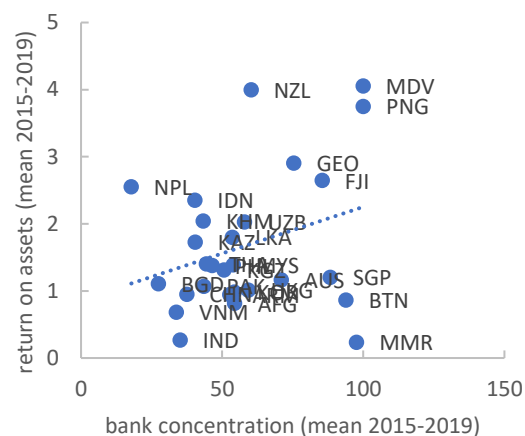
c: Boone competition index v. ROE
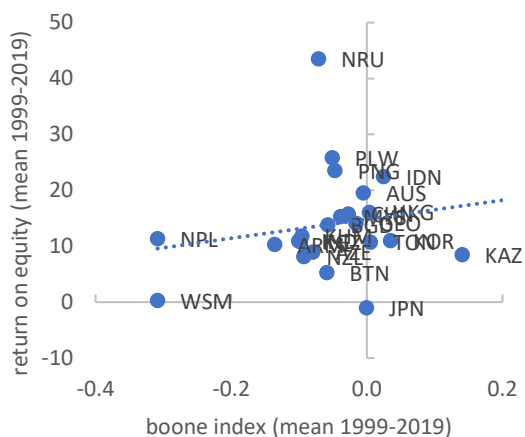
d: Boone competition index v. ROA
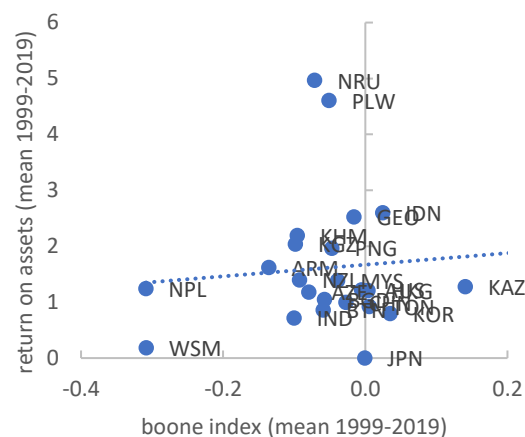
Refer to Appendix 1 for the list of regional and subregional economies and (iso codes).
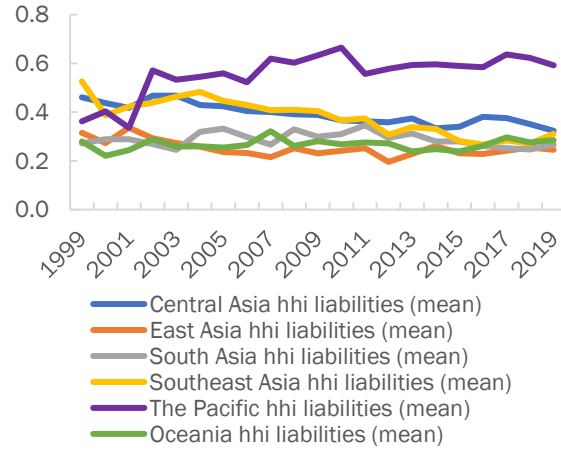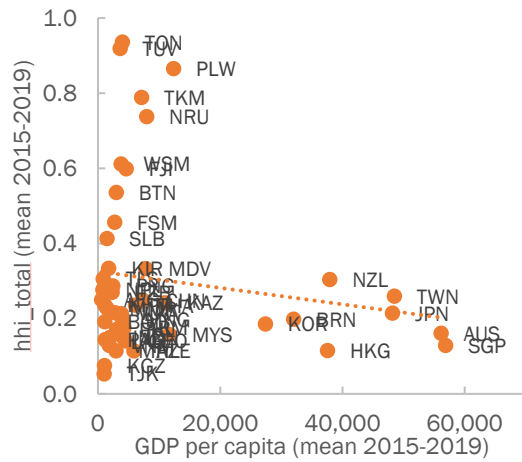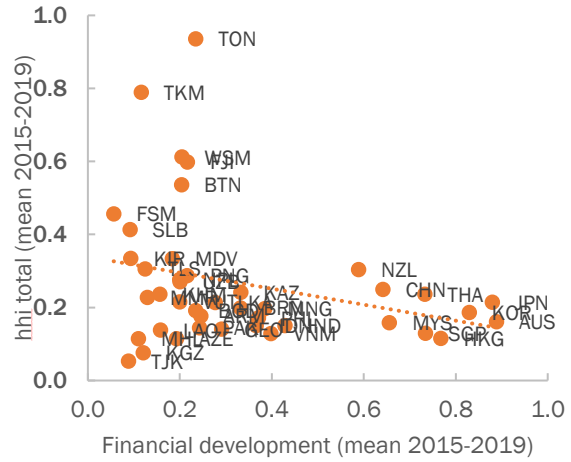Sources: Authors' calculations using data from Bank for International Settlements. Locational Banking Statistics. https://www.bis.org/statistics/bankstats.htm (accessed October 2020); and World Bank. Global Financial Development Database. https://www.worldbank.org/en/publication/gfdr/data/global-financial-development-database (accessed December 2020).

Table 1: Determinants of HHI

|	(1) HHI_TOT	(2) HHI_TOT	(3) HHI_TOT	(4) HHI_TOT	(5) HHI_CLM	(6) HHI_CLM	(7) HHI_LIA	(8) HHI_LIA
Capital Openness	2.607	2.613	-3.370**	-3.675**	-0.606	-2.860*	2.929	-1.576
	(1.747)	(1.994)	(1.526)	(1.547)	(1.564)	(1.610)	(1.916)	(1.429)
Trade Openness	0.040	0.056	-0.054***	-0.040**	-0.003	-0.032	-0.033	-0.063***
	(0.072)	(0.073)	(0.018)	(0.018)	(0.042)	(0.024)	(0.033)	(0.021)
Per Capita Income	-27.263*	-10.107*	-3.837**	-1.801	-11.829*	-5.541*	-7.689**	-7.412***
	(14.470)	(5.542)	(1.801)	(1.913)	(6.536)	(2.744)	(3.179)	(1.931)
Political Stability	0.202	0.140	0.374***	0.336***	0.003	0.462***	0.042	0.433***
	(0.128)	(0.121)	(0.118)	(0.108)	(0.128)	(0.107)	(0.079)	(0.100)
Inflation Volatility	0.893***	0.719**	1.741***	1.470**	0.217	1.350*	0.125	0.350
	(0.303)	(0.322)	(0.631)	(0.624)	(0.350)	(0.718)	(0.271)	(0.369)
Financial Centre				-7.768**		-13.688***		-6.437*
				(3.224)		(3.915)		(3.542)
Observations	689	689	689	689	689	689	689	689
R-squared	0.560	0.536	0.229	0.225	0.642	0.313	0.699	0.346
Economy FE	Yes	Yes	No	No	Yes	No	Yes	No
Year FE	Yes	No	Yes	No	No	No	No	No

Notes: Dependent variables are HHI_TOT (HHI total); HHI_CLM (HHI Claims); and HHI_LIA (HHI Liabilities). All regressors are in lagged except financial center. Per capita income in log values. Sample includes Asia and Pacific economies. Robust clustered standard errors are in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 2: Impact of HH on Bank Credit Growth

	(1)	(2)	(3)	(7)	(4)	(5)	(6)	(8)
	HHI_TOT	HHI_CLM	HHI_LIA	HHI_TOT	HHI_TOT	HHI_CLM	HHI_LIA	HHI_TOT
HHI_	-0.107**	0.015	0.019	-0.072	-0.070**	0.004	-0.012	-0.088**
	(0.050)	(0.038)	(0.070)	(0.048)	(0.032)	(0.019)	(0.033)	(0.034)
Per Capita Income	-4.960	-3.504	-3.518	4.766	-1.193**	-1.047**	-1.112**	-0.226
	(3.892)	(4.193)	(4.468)	(4.772)	(0.446)	(0.472)	(0.474)	(0.635)
Interest Rate	-0.244	-0.239	-0.245	-0.373	0.191	0.198	0.202	0.073
	(0.358)	(0.382)	(0.378)	(0.311)	(0.146)	(0.148)	(0.146)	(0.159)
Ave GDP Growth	0.166	0.055	0.038	-0.169	0.316	0.376	0.354	0.369
	(0.336)	(0.365)	(0.385)	(0.339)	(0.265)	(0.261)	(0.271)	(0.261)
Inflation	-0.314	-0.334	-0.330	-0.248	-0.321	-0.345	-0.346	-0.310
	(0.281)	(0.294)	(0.287)	(0.265)	(0.228)	(0.238)	(0.238)	(0.230)
Bank Credit Level (L)				-0.264***				-0.054**
				(0.060)				(0.022)
Observations	721	721	721	721	721	721	721	721
R-squared	0.137	0.127	0.127	0.181	0.052	0.043	0.043	0.064
Estimation	F.E.	F.E.	F.E.	F.E.	Pooled	Pooled	Pooled	Pooled

Notes: Dependent variable is bank credit growth (%). HHI_ refers to HHI_TOT (HHI total); HHI_CLM (HHI Claims); and HHI_LIA (HHI Liabilities). All regressors are in lagged. Fixed effects refer to country fixed effects. Per capita income in log values. Sample includes Asia and Pacific economies. Robust clustered standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: Impact of HHI on Bank Credit Level and Growth

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Bank Credit Growth				Bank Credit Levels		
	HHI_TOT	HHI_CLM	HHI_LIA	HHI_TOT	HHI_TOT	HHI_CLM	HHI_LIA	HHI_TOT
HHI_	-0.078**	-0.000	-0.017	-0.088**	-0.208**	-0.159*	-0.425***	-0.020*
	(0.033)	(0.020)	(0.035)	(0.035)	(0.102)	(0.094)	(0.138)	(0.011)
Per Capital Income	-0.852*	-0.857	-0.899*	-0.237	11.152**	11.013**	10.083**	-0.141
	(0.492)	(0.528)	(0.523)	(0.655)	(4.560)	(4.605)	(4.311)	(0.309)
Interest Rate	0.165	0.185	0.186	0.073	-1.703***	-1.608***	-1.616***	-0.035
	(0.148)	(0.150)	(0.149)	(0.159)	(0.545)	(0.516)	(0.491)	(0.038)
Ave GDP Growth	0.361	0.397	0.380	0.367	0.267	0.154	-0.063	0.190**
	(0.269)	(0.270)	(0.277)	(0.266)	(0.800)	(0.752)	(0.750)	(0.072)
Inflation	-0.319	-0.345	-0.347	-0.310	0.144	0.098	0.033	-0.024
	(0.229)	(0.238)	(0.240)	(0.230)	(0.156)	(0.138)	(0.159)	(0.025)
Financial Centre	-2.210	-1.277	-1.481	0.184	42.807***	42.743***	40.256***	-0.225
	(1.434)	(1.477)	(1.482)	(1.682)	(15.321)	(15.688)	(14.848)	(1.035)
Bank Credit Level (L)				-0.055**				1.000***
				(0.023)				(0.018)
Observations	721	721	721	721	723	723	723	721
R-squared	0.055	0.044	0.044	0.064	0.673	0.671	0.693	0.985
Estimation	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled

Notes: Dependent variables are bank credit levels and growth (%). HHI_ refers to HHI_TOT (HHI total); HHI_CLM (HHI Claims); and HHI_LIA (HHI Liabilities). All regressors are in lagged, except financial center. Per capita income in log values. Sample includes Asia and Pacific economies. Robust standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Impact of HHI on Nonperforming Loans

	(1) HHI_TOT	(2) HHI_CLM	(3) HHI_LIA	(4) HHI_CLM	(5) HHI_TOT	(6) HHI_CLM	(6) HHI_LIA	(7) HHI_CLM
HHI	-0.039	-0.100*	-0.005	-0.052	-0.016	-0.044**	-0.017	-0.008
	(0.054)	(0.059)	(0.045)	(0.040)	(0.021)	(0.018)	(0.024)	(0.009)
Per Capita Income	-9.296***	-10.156***	-8.926***	-2.646*	-1.743***	-1.841***	-1.777***	-0.280
	(2.267)	(2.083)	(2.554)	(1.495)	(0.504)	(0.512)	(0.502)	(0.224)
Interest Rate	0.269	0.271	0.268	-0.016	0.195**	0.228***	0.200**	-0.013
	(0.213)	(0.185)	(0.220)	(0.120)	(0.075)	(0.082)	(0.078)	(0.050)
Ave GDP Growth	-0.498***	-0.521***	-0.486***	-0.207	-0.324**	-0.383**	-0.320**	-0.071
	(0.181)	(0.168)	(0.178)	(0.134)	(0.154)	(0.150)	(0.150)	(0.089)
Inflation	-0.028	-0.053	-0.032	0.155***	-0.093	-0.113	-0.095	0.147**
	(0.123)	(0.110)	(0.121)	(0.047)	(0.151)	(0.148)	(0.150)	(0.055)
Ave Budget Balance	0.075	0.088	0.052	0.093	0.015	0.034	0.015	-0.002
	(0.152)	(0.136)	(0.147)	(0.068)	(0.126)	(0.128)	(0.127)	(0.033)
NPL (L)				0.570***				0.673***
				(0.117)				(0.083)
Observations	576	576	576	558	576	576	576	558
R-squared	0.491	0.513	0.487	0.734	0.197	0.212	0.197	0.693
Estimation	F.E.	F.E.	F.E.	F.E.	Pooled	Pooled	Pooled	Pooled

Notes: Dependent variable is nonperforming loans (%). HHI_ refers to HHI_TOT (HHI total); HHI_CLM (HHI Claims); and HHI_LIA (HHI Liabilities). All regressors are in lagged. Fixed effects (F.E.) refer to country fixed effects. Per capita income in log values. Sample includes Asia and Pacific economies. Robust clustered standard errors are in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 5: Impact of HHI on Bank Profitability

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Return on Assets						Return on Equity					
	HHI_TOT	HHI_CLM	HHI_LIA	HHI_TOT	HHI_CLM	HHI_LIA	HHI_TOT	HHI_CLM	HHI_LIA	HHI_TOT	HHI_CLM	HHI_LIA
HHI	-0.013	0.002	-0.007	0.004	0.004	0.011	-0.119	0.036	-0.137	-0.041	-0.031	0.006
	(0.012)	(0.006)	(0.011)	(0.013)	(0.009)	(0.014)	(0.172)	(0.076)	(0.179)	(0.164)	(0.087)	(0.165)
GDP Growth	-0.101	-0.103	-0.101	-0.076	-0.076	-0.072	-2.184	-2.208	-2.184	-1.884	-1.885	-1.870
	(0.100)	(0.102)	(0.101)	(0.088)	(0.086)	(0.089)	(2.012)	(2.048)	(2.012)	(1.722)	(1.707)	(1.739)
Inflation	0.068	0.068	0.068	0.050	0.051	0.051	1.103	1.106	1.113	1.246	1.244	1.251
	(0.076)	(0.075)	(0.076)	(0.082)	(0.082)	(0.082)	(1.386)	(1.385)	(1.397)	(1.482)	(1.489)	(1.487)
Political Stability	0.005	0.005	0.004	0.006	0.006	0.005	0.078	0.077	0.077	0.019	0.017	0.005
	(0.015)	(0.015)	(0.015)	(0.008)	(0.007)	(0.007)	(0.161)	(0.159)	(0.161)	(0.090)	(0.068)	(0.079)
Bank Assets	-0.011**	-0.011**	-0.011**	-0.000	-0.000	0.001	-0.176**	-0.172**	-0.179**	0.011	0.012	0.018
	(0.005)	(0.004)	(0.005)	(0.003)	(0.003)	(0.003)	(0.084)	(0.082)	(0.088)	(0.032)	(0.040)	(0.033)
Financial Centre				-0.786**	-0.765**	-0.770**				2.094	1.996	2.444
				(0.328)	(0.349)	(0.323)				(2.491)	(2.783)	(2.690)
Observations	463	463	463	463	463	463	461	461	461	461	461	461
R-squared	0.430	0.426	0.427	0.083	0.083	0.091	0.302	0.300	0.302	0.073	0.072	0.072
Estimation	F.E.	F.E.	F.E.	Pooled	Pooled	Pooled	F.E.	F.E.	F.E.	Pooled	Pooled	Pooled

Notes: Dependent variables are return on assets and return on equity (%). HHI_ refers to HHI_TOT (HHI total); HHI_CLM (HHI Claims); and HHI_LIA (HHI Liabilities). All regressors are in lagged except financial center. Per capita income in log values. Fixed effects (F.E.) refer to country fixed effects. Sample includes Asia and Pacific economies. Robust clustered standard errors are in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table S1: Sensitivity Test - Determinants of HHI (Using Financial Development)

	(1) HHI_TOT	(2) HHI_TOT	(3) HHI_TOT	(4) HHI_TOT	(5) HHI_CLM	(6) HHI_CLM	(7) HHI_LIA	(8) HHI_LIA
Capital Openness	2.120	1.825	-3.759**	-3.699**	-1.349	-3.275**	2.439	-2.403
	(1.876)	(1.953)	(1.472)	(1.494)	(1.356)	(1.417)	(1.913)	(1.433)
Trade Openness	0.038	0.055	-0.042***	-0.038**	-0.003	-0.025	-0.033	-0.055***
	(0.076)	(0.078)	(0.015)	(0.016)	(0.048)	(0.021)	(0.035)	(0.015)
Financial Development	0.016	-0.082	-0.224***	-0.215***	-0.260	-0.487***	-0.163	-0.511***
	(0.283)	(0.152)	(0.056)	(0.075)	(0.225)	(0.154)	(0.125)	(0.089)
Political Stability	0.131	0.101	0.330***	0.320***	-0.047	0.398***	0.010	0.336***
	(0.115)	(0.115)	(0.097)	(0.096)	(0.127)	(0.083)	(0.083)	(0.083)
Inflation Volatility	1.157**	1.038**	1.540**	1.354**	0.548	1.180	0.342	0.274
	(0.441)	(0.434)	(0.663)	(0.643)	(0.481)	(0.711)	(0.259)	(0.337)
Financial Centre				-1.053		-0.314		5.604
				(3.906)		(7.663)		(4.641)
Observations	689	689	689	689	689	689	689	689
R-squared	0.528	0.521	0.255	0.241	0.629	0.361	0.691	0.395
Economy FE	Yes	Yes	No	No	Yes	No	Yes	No
Year FE	Yes	No	Yes	No	No	No	No	No

Notes: Dependent variables are HHI_TOT (HHI total); HHI_CLM (HHI Claims); and HHI_LIA (HHI Liabilities). All regressors are in lagged except financial center. Per capita income in log values. Robust clustered standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

Table S2: Sensitivity Test - Determinants of HHI (Removing Capital Openness)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	HHI_TOT	HHI_TOT	HHI_TOT	HHI_TOT	HHI_CLM	HHI_CLM	HHI_LIA	HHI_LIA
Trade Openness	0.061	0.067	-0.067***	-0.053***	-0.003	-0.050**	-0.021	-0.072***
	(0.075)	(0.074)	(0.019)	(0.019)	(0.041)	(0.025)	(0.035)	(0.021)
Per Capita Income	-18.892	-8.175	-4.415**	-2.833	-12.330*	-7.441***	-6.366*	-7.049***
	(14.381)	(5.323)	(2.042)	(2.074)	(6.300)	(2.378)	(3.178)	(2.186)
Political Stability	0.132	0.100	0.306**	0.271**	-0.079	0.483***	0.016	0.395***
	(0.128)	(0.112)	(0.115)	(0.110)	(0.128)	(0.097)	(0.081)	(0.095)
Inflation Volatility	0.917**	0.737**	1.524**	1.231*	0.106	1.191*	0.254	0.321
	(0.353)	(0.362)	(0.663)	(0.659)	(0.351)	(0.702)	(0.251)	(0.347)
Financial Centre				-7.993***		-14.101***		-8.404**
				(2.889)		(3.887)		(3.698)
Observations	765	765	765	765	765	765	765	765
R-squared	0.481	0.469	0.152	0.152	0.644	0.299	0.648	0.294
Economy FE	Yes	Yes	No	No	Yes	No	Yes	No
Year FE	Yes	No	Yes	No	No	No	No	No

Notes: Dependent variables are HHI_TOT (HHI total); HHI_CLM (HHI Claims); and HHI_LIA (HHI Liabilities). All regressors are in lagged except financial center. Per capita income in log values. Robust clustered standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Table S3: Sensitivity Test - Determinants of HHI (Adding Domestic Bank Concentration)

	(1) HHI_TOT	(2) HHI_TOT	(3) HHI_TOT	(4) HHI_TOT	(5) HHI_CLM	(6) HHI_CLM	(7) HHI_LIA	(8) HHI_LIA
Capital Openness	0.350	0.582	-2.810*	-2.852*	-0.884	-2.196	0.525	-0.401
	(1.217)	(1.228)	(1.442)	(1.418)	(1.289)	(1.372)	(1.015)	(1.462)
Trade Openness	0.007	0.013	-0.055***	-0.051***	-0.007	-0.040*	-0.025	-0.062***
	(0.046)	(0.052)	(0.018)	(0.018)	(0.029)	(0.023)	(0.028)	(0.015)
Per Capita Income	-8.915	-15.753**	-2.204	-1.936	-19.777***	-4.261*	-6.206**	-5.439***
	(10.548)	(5.789)	(2.002)	(1.878)	(6.317)	(2.304)	(2.682)	(1.451)
Political Stability	0.037	0.063	0.229*	0.227*	-0.022	0.276**	0.088	0.181
	(0.116)	(0.098)	(0.134)	(0.131)	(0.124)	(0.127)	(0.077)	(0.132)
Inflation Volatility	0.838	0.713	1.507	1.450*	0.345	1.311	-0.257	-0.402
	(0.519)	(0.447)	(0.916)	(0.853)	(0.405)	(0.900)	(0.191)	(0.483)
Bank Concentration	-0.104*	-0.067	0.200**	0.212**	-0.138*	0.307***	0.024	0.226**
	(0.061)	(0.061)	(0.086)	(0.080)	(0.069)	(0.085)	(0.072)	(0.088)
Financial Centre				-2.175		-6.955*		-0.721
				(2.741)		(3.582)		(2.327)
Observations	579	579	579	579	579	579	579	579
R-squared	0.724	0.717	0.333	0.324	0.744	0.407	0.724	0.345
Economy FE	Yes	Yes	No	No	Yes	No	Yes	No
Year FE	Yes	No	Yes	No	No	No	No	No

Notes: Dependent variables are HHI_TOT (HHI total); HHI_CLM (HHI Claims); and HHI_LIA (HHI Liabilities). All regressors are in lagged except financial center. Per capita income in log values. Sample includes Asia and Pacific economies. Robust clustered standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

Table S4 Sensitivity Test: Impact of HHI on Bank Credit Growth (with Lagged Bank Credit Level)

	(1)	(2)	(3)	(4)	(5)	(6)
	HHI_TOT	HHI_CLM	HHI_LIA	HHI_TOT	HHI_CLM	HHI_LIA
HHI_	-0.072	0.031	0.026	-0.088**	-0.009	-0.039
	(0.048)	(0.034)	(0.064)	(0.034)	(0.020)	(0.038)
Per Capital Income	4.766	6.537	6.301	-0.226	-0.306	-0.321
	(4.772)	(4.913)	(4.995)	(0.635)	(0.675)	(0.669)
Interest Rate	-0.373	-0.375	-0.383	0.073	0.112	0.102
	(0.311)	(0.324)	(0.321)	(0.159)	(0.160)	(0.164)
Ave GDP Growth	-0.169	-0.258	-0.280	0.369	0.406	0.379
	(0.339)	(0.354)	(0.379)	(0.261)	(0.263)	(0.267)
Inflation	-0.248	-0.259	-0.253	-0.310	-0.339	-0.344
	(0.265)	(0.275)	(0.266)	(0.230)	(0.238)	(0.244)
Bank Credit Level	-0.264***	-0.279***	-0.277***	-0.054**	-0.043*	-0.049**
	(0.060)	(0.063)	(0.061)	(0.022)	(0.022)	(0.024)
Observations	721	721	721	721	721	721
R-squared	0.181	0.178	0.177	0.064	0.050	0.052
Estimation	F.E.	F.E.	F.E.	Pooled	Pooled	Pooled

Notes: Dependent variable is bank credit growth (%). HHI_ refers to HHI_TOT (HHI total); HHI_CLM (HHI Claims); and HHI_LIA (HHI Liabilities). All regressors are in lagged. Fixed effects refer to country fixed effects. Per capita income in log values. Sample includes Asia and Pacific economies. Robust clustered standard errors are in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table S5 Sensitivity Test: Impact of HHI on the Level of Bank Credit

	(1) HHI_TOT	(2) HHI_CLM	(3) HHI_LIA	(4) HHI_TOT	(5) HHI_CLM	(6) HHI_LIA
HHI_	0.010	0.013	-0.013	-0.019*	-0.007	-0.020
	(0.013)	(0.010)	(0.019)	(0.011)	(0.009)	(0.014)
Per Capital Income	6.834***	6.840***	6.527***	-0.155	-0.173	-0.181
	(2.495)	(2.422)	(2.373)	(0.331)	(0.336)	(0.335)
Interest Rate	-0.150**	-0.149**	-0.147**	-0.035	-0.026	-0.031
	(0.063)	(0.063)	(0.064)	(0.038)	(0.036)	(0.038)
Ave GDP Growth	-0.136	-0.123	-0.113	0.186**	0.187**	0.177**
	(0.129)	(0.117)	(0.119)	(0.071)	(0.073)	(0.071)
Inflation	0.028	0.028	0.027	-0.024	-0.030	-0.032
	(0.027)	(0.027)	(0.026)	(0.025)	(0.026)	(0.028)
Bank Credit Level	0.852***	0.853***	0.854***	0.999***	1.001***	0.998***
	(0.062)	(0.061)	(0.061)	(0.016)	(0.016)	(0.017)
Observations	721	721	721	721	721	721
R-squared	0.988	0.988	0.988	0.985	0.985	0.985
Estimation	F.E.	F.E.	F.E.	Pooled	Pooled	Pooled

Notes: Dependent variable is bank credit (% GDP). HHI_ refers to HHI_TOT (HHI total); HHI_CLM (HHI Claims); and HHI_LIA (HHI Liabilities). All regressors are in lagged. Fixed effects refer to country fixed effects. Per capita income in log values. Sample includes Asia and Pacific economies. Robust clustered standard errors are in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table S6 Sensitivity Test: Impact of HHI on Nonperforming Loans (with Lagged NPL)

	(1)	(2)	(3)	(4)	(5)	(6)
	HHI_TOT	HHI_CLM	HHI_LIA	HHI_TOT	HHI_CLM	HHI_LIA
HHI	-0.042	-0.052	-0.029	-0.014	-0.008	-0.009
	(0.026)	(0.040)	(0.023)	(0.010)	(0.009)	(0.009)
Per Capita Income	-2.261	-2.646*	-1.970	-0.303	-0.280	-0.295
	(1.384)	(1.495)	(1.359)	(0.220)	(0.224)	(0.225)
Interest Rate	-0.028	-0.016	-0.027	-0.022	-0.013	-0.018
	(0.122)	(0.120)	(0.126)	(0.047)	(0.050)	(0.048)
Ave GDP Growth	-0.188	-0.207	-0.174	-0.082	-0.071	-0.067
	(0.125)	(0.134)	(0.121)	(0.089)	(0.089)	(0.087)
Inflation	0.177***	0.155***	0.171***	0.153**	0.147**	0.151**
	(0.061)	(0.047)	(0.055)	(0.059)	(0.055)	(0.058)
Ave Budget Balance	0.093	0.093	0.086	0.004	-0.002	-0.001
	(0.066)	(0.068)	(0.070)	(0.033)	(0.033)	(0.033)
NPL (L)	0.589***	0.570***	0.593***	0.675***	0.673***	0.675***
	(0.107)	(0.117)	(0.102)	(0.081)	(0.083)	(0.080)
Observations	558	558	558	558	558	558
R-squared	0.731	0.734	0.728	0.694	0.693	0.693
Estimation	F.E.	F.E.	F.E.	Pooled	Pooled	Pooled

Notes: Dependent variable is nonperforming loans (%). HHI_ refers to HHI_TOT (HHI total); HHI_CLM (HHI Claims); and HHI_LIA (HHI Liabilities). All regressors are in lagged. Fixed effects (F.E.) refer to country fixed effects. Per capita income in log values. Sample includes Asia and Pacific economies. Robust clustered standard errors are in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table S7 Sensitivity Test: Impact of HHI on Nonperforming Loans (with Bank Assets)

	(1) HHI_TOT	(2) HHI_CLM	(3) HHI_LIA	(4) HHI_TOT	(5) HHI_CLM	(6) HHI_LIA
HHI	-0.046	-0.103*	-0.008	-0.015	-0.044**	-0.017
	(0.056)	(0.060)	(0.046)	(0.022)	(0.017)	(0.026)
Per Capita Income	-12.429***	-13.187***	-11.877***	-1.834**	-1.862**	-1.853**
	(2.656)	(2.512)	(3.053)	(0.735)	(0.742)	(0.728)
Interest Rate	0.302	0.305	0.300	0.194**	0.219**	0.197**
	(0.210)	(0.182)	(0.219)	(0.078)	(0.086)	(0.079)
Ave GDP Growth	-0.377**	-0.399**	-0.368**	-0.319**	-0.376**	-0.316**
	(0.170)	(0.154)	(0.171)	(0.153)	(0.151)	(0.149)
Inflation	-0.037	-0.063	-0.040	-0.059	-0.079	-0.061
	(0.123)	(0.111)	(0.121)	(0.142)	(0.139)	(0.141)
Ave Budget Balance	0.062	0.080	0.035	0.039	0.049	0.037
	(0.161)	(0.147)	(0.155)	(0.142)	(0.146)	(0.142)
Bank Assets	0.067**	0.067**	0.064**	0.003	-0.000	0.002
	(0.030)	(0.030)	(0.029)	(0.016)	(0.016)	(0.017)
Observations	568	568	568	568	568	568
R-squared	0.505	0.526	0.500	0.202	0.217	0.202
Estimation	F.E.	F.E.	F.E.	Pooled	Pooled	Pooled

Notes: Dependent variable is nonperforming loans (%). HHI_ refers to HHI_TOT (HHI total); HHI_CLM (HHI Claims); and HHI_LIA (HHI Liabilities). All regressors are in lagged. Fixed effects (F.E.) refer to country fixed effects. Per capita income in log values. Sample includes Asia and Pacific economies. Robust clustered standard errors are in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Appendix 1: Sample Classification and Codes

Americas:
Argentina, Brazil, the Bolivarian Republic of Venezuela, Canada, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Haiti, Honduras, Mexico, Nicaragua, Paraguay, Peru, the United States and Uruguay.

Asia and the Pacific (47 economies), by subregion:

Central Asia
Armenia (ARM), Azerbaijan (AZE), Georgia (GEO), Kazakhstan (KAZ), Kyrgyz Republic (KGZ), Tajikistan (TJK), Turkmenistan (TKM) and Uzbekistan (UZB).

East Asia
Hong Kong, China (HKG); Japan (JPN); Mongolia (MNG); the People's Republic of China (CHN); the Republic of Korea (KOR); and Taipei,China (TWN).

Oceania
Australia (AUS) and New Zealand (NZL).

The Pacific
the Federated States of Micronesia (FSM), Fiji (FJI), Kiribati (KIR), Marshall Islands (MHL), Nauru (NRU), Palau (PLW), Papua New Guinea (PNG), Samoa (WSM), Solomon Islands (SLB), Tonga (TON), Tuvalu (TUV), and Vanuatu (VUT).

South Asia
Afghanistan (AFG), Bangladesh (BGD), Bhutan (BTN), India (IND), Maldives (MDV), Nepal (NPL), Pakistan (PAK) and Sri Lanka (LKA).

Southeast Asia
Brunei Darussalam (BRN), Cambodia (KHM), Indonesia (IDN), Lao People's Democratic Republic, Malaysia (MYS), Myanmar (MMR), the Philippines (PHL), Singapore (SGP), Thailand (THA), Timor-Leste (TLS) and Viet Nam (VNM).

Europe:
Austria, Belarus, Belgium, Bosnia and Herzegovina, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Portugal, the Russian Federation, Serbia, Slovak Republic, Slovenia, Spain, Switzerland, and Ukraine.

Middle East and North Africa (MENA):
Algeria, Egypt, Islamic Republic of Iran, Israel, Jordan, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, Turkey, and the United Arab Emirates.

Appendix 2: Data Descriptions and Sources

Variable	Notes	Sources
HHI_TOT	Herfindahl-Hirschman Index (HHI) for total cross-border bank holdings (claims plus liabilities) as discussed in Section 2. Computed values scaled to 100.	Computed based on BIS Locational Banking Statistics Dataset
HHI_CLM	HHI for cross-border bank claims (assets) as discussed in Section 2. Computed values scaled to 100.	Computed based on BIS Locational Banking Statistics Dataset
HHI_LIA	HHI for cross-border bank liabilities as discussed in Section 2. Computed values scaled to 100.	Computed based on BIS Locational Banking Statistics Dataset
Capital account openness	Chinn-Ito standardize capital account openness index. 2018 values extended to 2019.	Chinn and Ito (2006).
Trade openness	Merchandise trade as a share of GDP is the sum of merchandise exports and imports divided by the value of GDP (%).	World Bank, World Development Indicators
Per capita income	Log value of real per capita GDP in constant US$ prices	World Bank, World Development Indicators
Political Stability	Percentile rank of political stability	World Bank, World Governance Indicators
Inflation Volatility	Computed as annual standard deviation of monthly inflation rate. Data for Australia, Fed. States of Micronesia, Palau, New Zealand, Papua New Guinea, and Tuvalu were based on quarterly values.	International Monetary Fund, International Financial Statistics
Financial Center	Dummy variable with value of 1 if an economy is a financial center, and 0 otherwise.	Based on China Development Institute
Bank Credit	Domestic credit to private sector by banks (% of GDP)	World Bank, World Governance Indicators
Interest Rate	Lending rate per annum (%) and policy rate (%) for Lao PDR, Nepal, New Zealand, and Uzbekistan	World Bank, World Development Indicators; International Monetary Fund, International Financial Statistics; and national sources
Ave GDP Growth	5-year average of annual GDP growth	World Bank, World Governance Indicators; and International Monetary Fund, World Economic Outlook Database
Inflation	Annual change in consumer price index (%)	World Bank, World Governance Indicators; and International Monetary Fund, World Economic Outlook Database
NPL	Nonperforming loans ratio in %	World Bank, International Monetary Fund, and national sources

Variable	Notes	Sources
Ave Budget Balance	5-year moving average of government budget balance in % of GDP	International Monetary Fund
ROA	Return on assets of banking sector (%)	International Monetary Fund, Financial Soundness Indicators and Global Financial Stability Report
ROE	Return on equity of banking sector (%)	International Monetary Fund, Financial Soundness Indicators and Global Financial Stability Report
Bank Assets	Bank assets to GDP (%)	World Bank and International Monetary Fund
Financial Development	Financial development index, scaled to 100	International Monetary Fund
Domestic Bank Concentration	Domestic bank concentration (%)	World Bank, Global Financial Development Database