

CONCENTRATION IN ASIA'S CROSS-BORDER BANKING

DETERMINANTS AND IMPACTS

Ana Kristel Lapid, Rogelio Mercado Jr., and Peter Rosenkranz

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and Peter Rosenkranz

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ABSTRACT

Cross-border bank positions in Asia and the Pacific 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 to the design of appropriate policies for promoting financial development and safeguarding 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 openness of capital account and trade, as well as better 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. We find no impact on bank profitability for the region.

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

JEL codes: E44, F36, G21, O16

I. INTRODUCTION

Cross-border bank credit is dominated by a small number of very large links between banks in one country and borrowers in another. Most of these large cross-border banking links are mainly between major advanced economies. However, some of these advanced economies, whose financial sector ownership is more concentrated, engage in greater cross-border lending especially to borrowers in countries whose banking systems are less concentrated. In addition, cross-border bank credit is also characterized by higher and more concentrated interbank credit than credit to nonbank financial institutions. But linkages with nonbank financial institutions have grown after the 2008–2009 global financial crisis, with their exposures being highly concentrated (Aldasoro and Ehlers 2019; Aldasoro, Huang, and Kemp 2020; Barrell and Nahhas 2020).

These stylized patterns suggest that cross-border bank holdings and transactions between economies can be highly concentrated. To date, there remains a lack of empirical literature on the causes and consequences of high cross-border bank concentration, as existing papers tend to focus on the patterns of cross-border concentration. But such high concentration of cross-border bank claims and liabilities exposes economies to financial spillovers and risks emanating from few counterparties. While economies are insulated from shocks from noncounterparties, tighter liquidity conditions in dominant counterparties may lead to a considerable decline in cross-border credit. In addition, higher concentration of cross-border bank counterparties may lead to higher borrowing cost, as compared to those with more diversified counterparties. Hence, high concentration can reduce competitiveness of cross-border financial intermediation with negative implications on the domestic borrowing and lending conditions.

Yet most studies on bank concentration, apart from those discussed earlier, focus on the concentration within the domestic banking sector. Several studies find that increased domestic bank concentration leads to a more stable financial market and fewer crises. Some papers find an ambiguous relationship between domestic bank concentration and credit risk (Barrell and Karim 2020; Beck, Demirguc-Kunt, and Levine 2006; Çifter 2015). Using the Herfindahl–Hirschman Index (HHI), Schaeck, Cihak, and Wolfe (2009) show domestic 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).

In this paper, we address the lack of an empirical assessment on the determinants and impacts of cross-border bank concentration. Previous studies mostly either characterized the patterns of cross-border bank concentration or focused on domestic bank concentration.¹ To the best of our knowledge, no study has considered the drivers and impacts of high concentration. Hence, considering the determinants and impacts of cross-border bank concentration contributes to the existing literature by applying a concentration measure, in particular the HHI, in a cross-border context instead of domestic bank concentration. We then use the computed HHI as a dependent variable to assess the determinants of cross-border bank concentration, and as an independent variable to assess its impacts. Consequently, this paper moves beyond providing stylized facts and patterns of cross-border bank concentration by considering covariates and potential outcomes.

¹ See Barrell and Karim (2020); Beck, Demirguc-Kunt, and Levine (2006); and Çifter (2015).

The focus of this paper is warranted as identifying the determinants and impacts of high bank concentration will help enhance our understanding of cross-border bank exposures and possible spillovers. Assessing the impacts of high concentration on bank credit, stability, and profitability will facilitate the identification and design of appropriate policies to minimize the risks of high concentrations. In particular, understanding the impact of high HHI on bank measures will allow authorities to mitigate the adverse effects of having elevated cross-border bank exposures, and, hence, help maintain banking sector stability. Our empirical approach allows us to identify factors that can increase or decrease cross-border bank concentration, and then assess how those affect banking sector credit, stability, and profitability.

To this end, we construct a cross-border bank concentration measure using HHI for 47 advanced and emerging economies in Asia and the Pacific from 2000 to 2019. The use of HHI as our preferred cross-border bank concentration is justified as it provides a clear methodological procedure in which available cross-border bank holdings data can be used to measure cross-border concentration. In addition, it has also been used in recent literature that describes the patterns of cross-border bank concentration for both advanced and emerging economies (Aldasoro and Ehlers 2019; Aldasoro, Huang, and Kemp 2020). Our HHI measure captures concentration of an economy's cross-border bank positions vis-à-vis several counterparties. Using the Bank for International Settlements (BIS) International Banking Statistics database to construct our measure of cross-border bank holdings, we estimate HHI measures on a host of potential determinants, including trade and financial openness, per capita income, and political and macroeconomic stability. Additionally, we then use the same measure to assess its impacts on banking sector measures, such as domestic credit growth, nonperforming loans (NPLs), and return on assets (ROA) and return on equity (ROE).

The focus on advanced and emerging economies in Asia and the Pacific sample warrants several justifications. First, the region's financial systems generally rely heavily on the banking sector as the main source of corporate financing and 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 Asia and the Pacific 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 on financial intermediation and on macroeconomic and financial stability.

To preview our results, our computed HHI measure shows that Asia and the Pacific exhibits an elevated cross-border concentration that is exceeded only by the Americas. However, the region has considerable variations across subregions. For instance, the Pacific exhibits high concentration, whereas East Asia and Oceania have low concentrations. 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 more closed economies tend to depend on a few cross-border bank counterparties. On impacts, we find that bank concentration tends to decrease domestic credit and the level of NPLs, while our results on bank profitability are inconclusive.

Our findings complement existing research on the implications and risks of cross-border banking exposures, amid increasing financial interconnectedness in Asia and the Pacific, by adding the dimension of cross-border bank concentration to the analysis (ADB 2017, 2020; Dungey, Kangogo,

and Volkov 2019). A number of existing studies identify cross-border interbank exposures as a source of contagion, and discuss its particular relevance for emerging economies, including in Asia and the Pacific (Park and Shin 2017, 2018; Matousek 2019). Cerutti (2015) analyzes drivers of cross-border banking exposures during the global financial crisis and highlights the relevance of global and domestic financial conditions.

Overall, this paper adds two main contributions. First, it is one of the few studies to consider the importance of concentration in *cross-border* bank 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 previous studies have not considered.

The remainder of the paper is as follows. Section II discusses the construction of the cross-border bank concentration measure and related stylized facts. Section III introduces the empirical specification; and followed by a discussion of the empirical findings in section IV. Section V concludes and suggests policy considerations.

II. CROSS-BORDER BANK CONCENTRATION: CONSTRUCTION AND STYLIZED FACTS

A. Construction of Cross-Border Bank Concentration Measure

The HHI (Herfindahl 1950; Hirschman 1945, 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 cross-border bank concentration indices for 47 economies in Asia and the Pacific from 2001 to 2019, as defined below:

$$HHI_{i,t} = \sum_{j=1}^N (s_{j,t}^i)^2 \quad (1)$$

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 percent 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 A6.2.²

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 1 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 among all BIS

² See BIS. Locational Banking Statistics. <https://stats.bis.org/statx/srs/table/a6.2> for raw data.

reporting countries.³ 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.

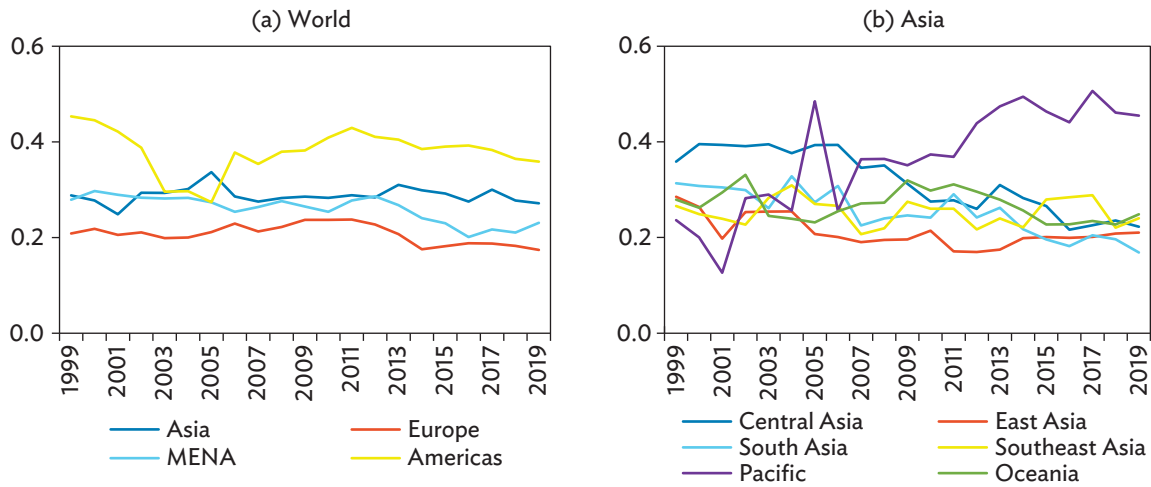
The HHI concentration measure, besides being commonly used to quantify concentration, captures both the number of linkages and size of linkages, which is essential when looking into cross-border bank positions. It is therefore also used in industrial policy to examine market competitiveness when analyzing implications of mergers and acquisitions (Laderman 1995). The Gini coefficient would be another option, but it is more widely used in measuring and analyzing inequality. Avila et al. (2013) point out that while concentration and inequality are related concepts, the former measures the size and number of loan exposures, while the latter pertains to the distribution of a portfolio. 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 an industry. Meanwhile, the Lerner index measures the market power of a firm or bank, capturing the gap between price and the marginal cost. The higher the index, the higher the market power of a firm is (World Bank Global Financial Development Database). While the asset concentration measure captures the degree of concentration, it arbitrarily determines the number of banks (top three or top five) that would ascertain bank concentration. Moreover, it is more aptly used as a measure of inequality among firms in a sector. Meanwhile, both the Boone indicator and the Lerner index do not consider information about the number of linkages. For these reasons, we chose to use the HHI as 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 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. However, the degree of cross-border bank concentration across the subregions of 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 trend. East Asia and Oceania show comparably low average cross-border bank concentrations, although on an upward trend since 2017, while that of Southeast Asia has trended downward in the same period.

³ While the BIS Locational Banking Statistics include a limited number of reporting economies, they cover most counterparty economies. Although the concentration index is sensitive to the number of counterparties, the fact that few reporting economies have holdings or liabilities to a counterparty suggest the latter's high cross-border concentration.

Figure 1: Cross-Border Bank Concentration (HHI Total)

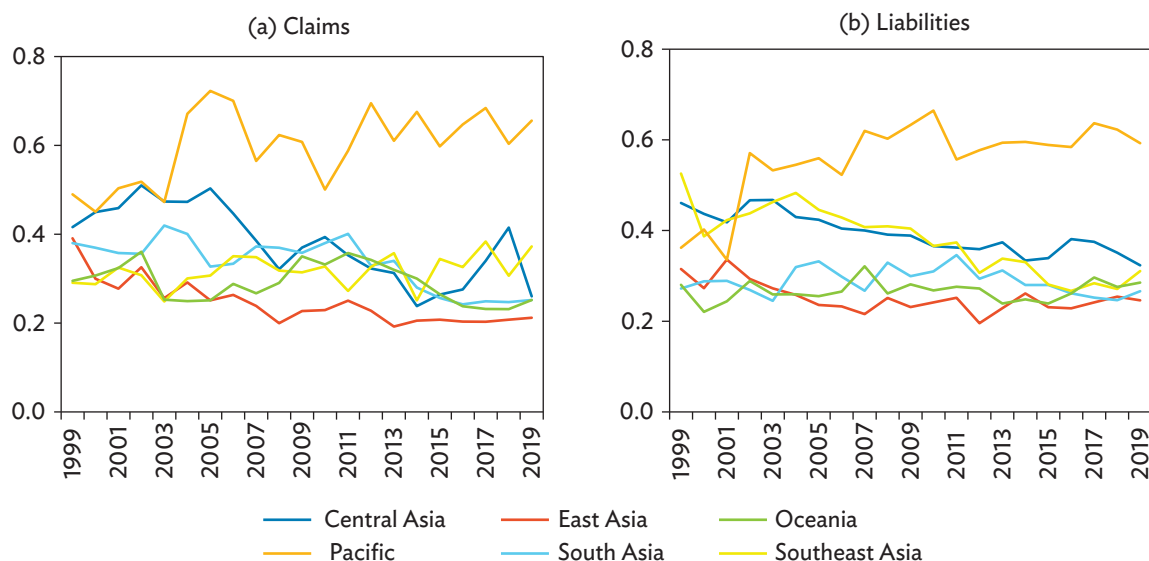


HHI = Herfindahl-Hirschman index, MENA = Middle East and North Africa.

Notes: Americas includes 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 includes Central Asia, East Asia, South Asia, Southeast Asia, Oceania, and the Pacific. Europe includes Austria, Belarus, Belgium, Bosnia and Herzegovina, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Portugal, the Russian Federation, Serbia, Slovakia, Slovenia, Spain, Switzerland, and Ukraine. MENA includes Algeria, Egypt, Islamic Republic of Iran, Israel, Jordan, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, Turkey, and the United Arab Emirates. Central Asia includes Armenia, Azerbaijan, Georgia, Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan. East Asia includes Hong Kong, China; Japan; Mongolia; the People's Republic of China; the Republic of Korea; and Taipei, China. Oceania includes Australia and New Zealand. Pacific includes the Federated States of Micronesia, Fiji, Kiribati, the Marshall Islands, Nauru, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu. South Asia includes Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. Southeast Asia includes Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste, and Viet Nam.

Source: Authors' calculations using data from Bank for International Settlements. Locational Banking Statistics. <https://stats.bis.org/statx/srs/table/a6.2> (accessed October 2020).

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

Figure 2: Cross-Border Bank Concentration, Asia by Cross-Border Position (HHI Total)

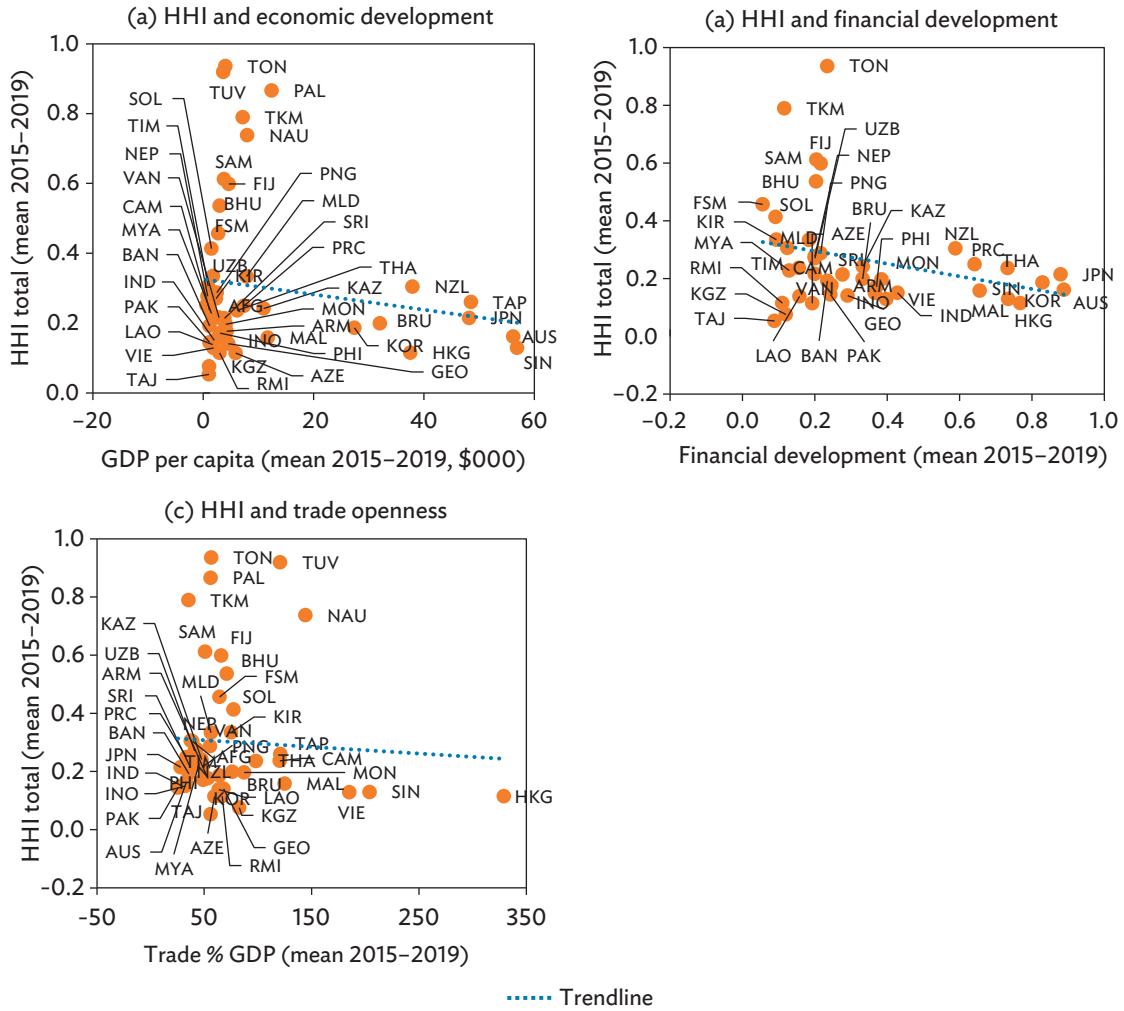
HHI = Herfindahl-Hirschman index.

Notes: Central Asia includes Armenia, Azerbaijan, Georgia, Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan. East Asia includes Hong Kong, China; Japan; Mongolia; the People's Republic of China; the Republic of Korea; and Taipei, China. Oceania includes Australia and New Zealand. Pacific includes the Federated States of Micronesia, Fiji, Kiribati, the Marshall Islands, Nauru, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu. South Asia includes Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. Southeast Asia includes Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste, and Viet Nam.

Source: Authors' calculations using data from Bank for International Settlements. Locational Banking Statistics. <https://stats.bis.org/statx/srs/table/a6.2> (accessed October 2020).

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 economies 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. Figure 3 further illustrates there are economies exhibiting high economic or financial development that 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. For example, in Figure 3a, Australia, Japan, and Singapore have relatively high gross domestic product per capita, while their HHIs are in the low and medium range (0–0.25).

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



AFG = Afghanistan; ARM = Armenia; AUS = Australia; AZE = Azerbaijan; BAN = Bangladesh; BHU = Bhutan; BRU = Brunei Darussalam; CAM = Cambodia; FIJ = Fiji; FSM = Federated States of Micronesia; GDP = gross domestic product; GEO = Georgia; HKG = Hong Kong, China; HHI = Herfindahl-Hirschman index; IND = India; INO = Indonesia; JPN = Japan; KAZ = Kazakhstan; KIR = Kiribati; KGZ = Kyrgyz Republic; KOR = Republic of Korea; LAO = Lao People's Democratic Republic; MAL = Malaysia; MLD = Maldives; MON = Mongolia; MYA = Myanmar; NAU = Nauru; NEP = Nepal; NZL = New Zealand; PAK = Pakistan; PAL = Palau; PHI = Philippines; PRC = People's Republic of China; RMI = Republic of the Marshall Islands; SIN = Singapore; SOL = Solomon Islands; SRI = Sri Lanka; TAJ = Tajikistan; TAP = Taipei, China; THA = Thailand; TIM = Timor-Leste; TKM = Turkmenistan; TON = Tonga; TUV = Tuvalu; UZB = Uzbekistan; VAN = Vanuatu; VIE = Viet Nam.

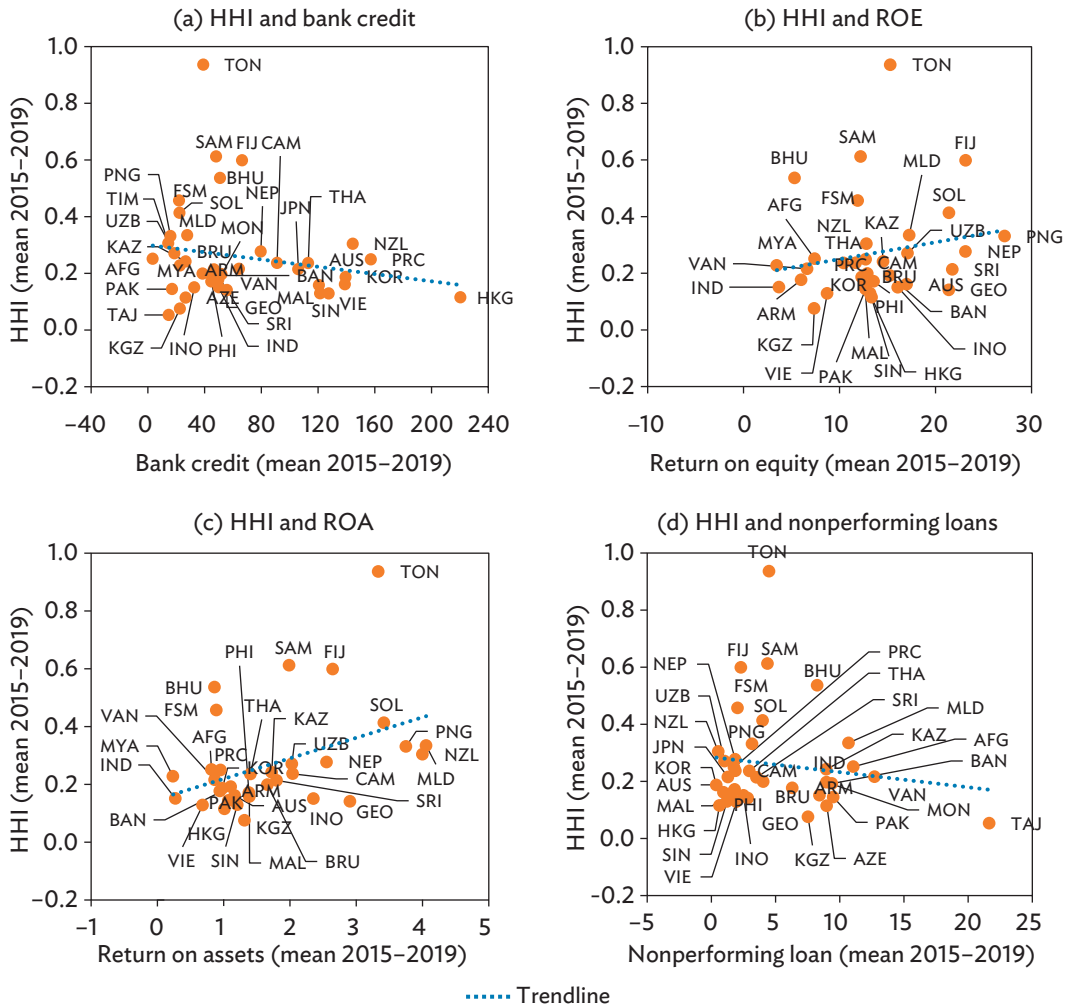
Sources: Authors' calculations using data from Bank for International Settlements. Locational Banking Statistics. <https://stats.bis.org/statx/srs/table/a6.2> (accessed October 2020); International Monetary Fund (IMF). Financial Development Index Database. <https://data.imf.org/?sk=f8032e80-b36c-43b1-ac26-493c5b1cd33b>; IMF. International Financial Statistics. <https://data.imf.org/IFS>; and World Bank. World Development Indicators. <https://datacatalog.worldbank.org/dataset/world-development-indicators> (all accessed December 2020).

As regards to indicators of the domestic banking sector, cross-border bank concentration appears to be negatively associated with levels of domestic credit, primarily driven by small economies (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. The negative relationship does not hold when only considering large economies in the sample. On the other hand, cross-border bank concentration has a positive relationship with bank profitability (ROA and ROE, 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. The positive relationship robustly holds for HHI and ROA, while the relationship between HHI and ROE does not hold when only considering large economies in the sample. The results are supported by Figure 5, which examines the relationship between domestic bank concentration and competition measures. In particular, these are the 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 (ROA and ROE), 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, Çifter (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.

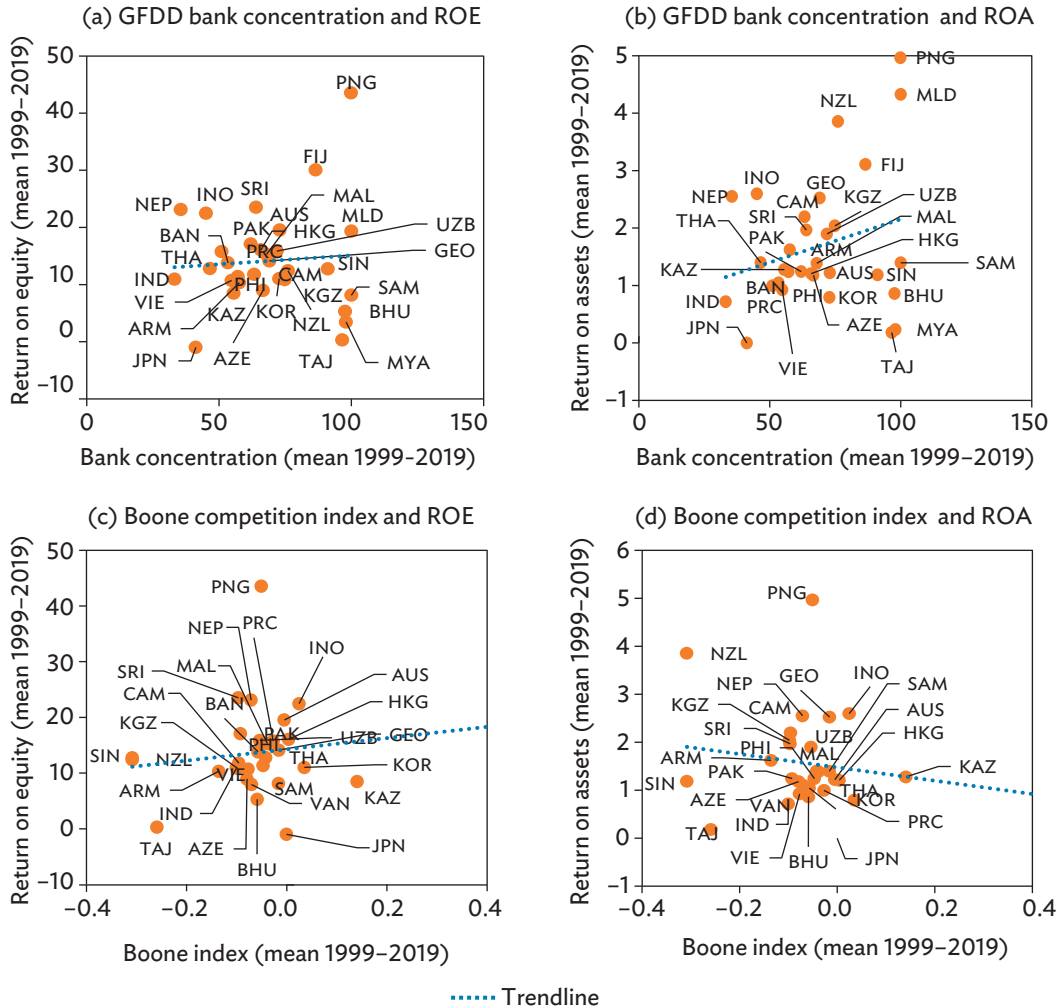
Figure 4: Correlation of HHI with Bank Credit, Stability, and Profitability



AFG = Afghanistan; ARM = Armenia; AUS = Australia; AZE = Azerbaijan; BAN = Bangladesh; BHU = Bhutan; BRU = Brunei Darussalam; CAM = Cambodia; FIJ = Fiji; FSM = Federated States of Micronesia; GEO = Georgia; HKG = Hong Kong, China; HHI = Herfindahl-Hirschman Index; IND = India; INO = Indonesia; JPN = Japan; KAZ = Kazakhstan; KGZ = Kyrgyz Republic; KOR = Republic of Korea; MAL = Malaysia; MLD = Maldives; MYA = Myanmar; MON = Mongolia; NEP = Nepal; NZL = New Zealand; PAK = Pakistan; PNG = Papua New Guinea; PHI = Philippines; PRC = People's Republic of China; ROA = return on assets; ROE = return on equity; SAM = Samoa; SIN = Singapore; SRI = Sri Lanka; SOL = Solomon Islands; TAJ = Tajikistan; THA = Thailand; TIM = Timor-Leste; UZB = Uzbekistan; VAN = Vanuatu; VIE = Viet Nam.

Sources: Authors' calculations using data from Bank for International Settlements. Locational Banking Statistics. <https://stats.bis.org/statx/srs/table/a6.2> (accessed October 2020); International Monetary Fund (IMF). Global Financial Stability Report Financial Soundness Indicators Database. <https://data.imf.org/FSI>; IMF. International Financial Statistics. <https://data.imf.org/IFS>; and World Bank. World Development Indicators. <https://datacatalog.worldbank.org/dataset/world-development-indicators> (all accessed December 2020).

Figure 5: Correlation of Domestic Bank Concentration with Profitability



ARM = Armenia; AUS = Australia; AZE = Azerbaijan; BAN = Bangladesh; BHU = Bhutan; CAM = Cambodia; GEO = Georgia; GFDD = global financial development database; HKG = Hong Kong, China; IND = India; INO = Indonesia; JPN = Japan; KAZ = Kazakhstan; KGZ = Kyrgyz Republic; KOR = Republic of Korea; MAL = Malaysia; MYA = Myanmar; NEP = Nepal; NZL = New Zealand; PAK = Pakistan; PNG = Papua New Guinea; PHI = Philippines; PRC = People's Republic of China; ROA = return on assets, ROE = return on equity; SAM = Samoa; SIN = Singapore; SRI = Sri Lanka; TAJ = Tajikistan; THA = Thailand; UZB = Uzbekistan; VAN = Vanuatu; VIE = Viet Nam.

Sources: Authors' calculations using data from International Monetary Fund. Global Financial Stability Report Financial Soundness Indicators Database. <https://data.imf.org/FSI/>; and World Bank. Global Financial Development Database. <https://www.worldbank.org/en/publication/gfdr/data/global-financial-development-database> (both accessed December 2020).

III. EMPIRICAL SPECIFICATIONS

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

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

where HHI refers to either HHI total (HHI_TOT), HHI 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, and so 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. Estimating equation (2) yields 36 clusters which is sufficient to avoid using bootstrapped standard errors given the country sample size. 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 fixed effects. Hence, pooled estimates are also presented. To help reduce endogeneity, we use lag regressors by 1 year for both pooled ordinary least squares (OLS) and fixed effects estimations. The use of lagged regressors along with fixed effects further reduces endogeneity as it addresses simultaneity and omitted variable bias.

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 the 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).⁴

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

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

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 NPLs, while bank profitability includes ROA and ROE. Lagged 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. For bank credit, NPL, and bank profitability measures, there are 40, 37, and 37 clusters, respectively, which

⁴ Financial centers include Australia; Hong Kong, China; India; Japan; Malaysia; the People's Republic of China; the Republic of Korea; Singapore; and Taipei, China. These financial centers are based on Morris, Mainelli, and Wardle (2020).

are sufficient to avoid using bootstrapped standard errors. In addition, all regressors are lagged to reduce endogeneity issues.⁵ Equation (3) is estimated using both pooled and fixed effects estimation.

Estimation on credit growth and levels include interest rates, economic growth, and inflation. Higher interest rates tend 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 growth increases the provision of bank credit as demand for credit rises. The inclusion of lagged per capita income and the bank credit level captures a possible convergence mechanism, wherein economies with low initial credit and per capita income might experience faster credit growth (Lane and McQuade 2014). We expect that high concentration of cross-border bank holdings will reduce credit growth as fewer cross-border counterparties provide credit.

For NPLs, average economic growth captures the impact of business cycles on loan quality. Higher interest rates raise the cost of debt payments, and hence will increase NPLs. 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 NPLs. 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, or (ii) 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, we include economic growth, inflation, and political stability 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 Pabón, and Contreras 2018). For NPLs and bank profitability estimations, the determinants are limited to those discussed earlier in the paper 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: Afghanistan; Armenia; Australia; Azerbaijan; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; the Federated States of Micronesia; Fiji; Georgia; Hong Kong, China; India; Indonesia; Japan; Kazakhstan; Kiribati; the Kyrgyz Republic; the Lao People's Democratic Republic; Malaysia; Maldives; the Marshall Islands; Mongolia; Myanmar; Nauru; Nepal; New Zealand; Pakistan; Palau; Papua New Guinea; the People's Republic of China; the Philippines; the Republic of Korea; Samoa; Singapore; Solomon Islands; Sri Lanka; Taipei, China; Tajikistan; Thailand; Timor-Leste; Tonga; Turkmenistan; Tuvalu; Uzbekistan; Vanuatu; and Viet Nam. The Appendix presents data definitions, notes, and sources.

⁵ We considered dealing with the issue of endogeneity between banking sector measures and our HHI measures by using two-stage least squares regression. However, given the weakness of the potential instruments we tried, we opted to use lagged regressors instead.

IV. 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 do 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 1% of gross domestic product increase in trade openness is significantly associated with lower HHI_TOT by around 0.05 percentage points (column 4). These results indicate that Asia and the Pacific economies that are highly open in 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 exposure to a 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 cross-border holdings and liabilities to economies with higher political stability are significantly larger, being an attractive borrower and 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)–(8).

These findings are consistent across several sensitivity tests. First, we use a financial development index sourced from the International Monetary Fund, instead of per capita income, to directly test the impact of financial development. The results are the same (Table A2.1). Second, as trade and capital account openness may be correlated, such that economies 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 A2.2). 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 just a few cross-border counterparties only, and hence both would be related. The findings indicate that the results are similar to those presented in Table 1, but inflation volatility and financial centers tend to be significant in fewer specifications, unlike in the baseline results.

However, the estimated coefficients for domestic bank concentration show inconclusive results (Table A2.3). 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 effects and pooled OLS specifications (in columns 3, 4, 6, and 8), the estimated coefficients are positive; that is, 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 a subset of economies in the sample, which are subsumed by the fixed effects.

Table 1: Determinants of Herfindahl–Hirschman Index

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	HHI_TOT	HHI_TOT	HHI_TOT	HHI_TOT	HHI_CLM	HHI_CLM	HHI_LIA	HHI_LIA
Capital openness	2.607 (1.747)	2.613 (1.994)	-3.370** (1.526)	-3.675** (1.547)	-0.606 (1.564)	-2.860* (1.610)	2.929 (1.916)	-1.576 (1.429)
Trade openness	0.040 (0.072)	0.056 (0.073)	-0.054*** (0.018)	-0.040** (0.018)	-0.003 (0.042)	-0.032 (0.024)	-0.033 (0.033)	-0.063*** (0.021)
Per capita income	-27.263* (14.470)	-10.107* (5.542)	-3.837** (1.801)	-1.801 (1.913)	-11.829* (6.536)	-5.541* (2.744)	-7.689** (3.179)	-7.412*** (1.931)
Political stability	0.202 (0.128)	0.140 (0.121)	0.374*** (0.118)	0.336*** (0.108)	0.003 (0.128)	0.462*** (0.107)	0.042 (0.079)	0.433*** (0.100)
Inflation volatility	0.893*** (0.303)	0.719** (0.322)	1.741*** (0.631)	1.470** (0.624)	0.217 (0.350)	1.350* (0.718)	0.125 (0.271)	0.350 (0.369)
Financial center				-7.768** (3.224)		-13.688*** (3.915)		-6.437* (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

FE = fixed effects, HHI = Herfindahl–Hirschman Index, HHI_CLM = HHI claims, HHI_LIA = HHI liabilities, HHI_TOT = HHI total.

Notes: Dependent variables are HHI_CLM, and HHI_LIA, and HHI_TOT. All regressors are lagged except Financial center. Per capita income in log values. Sample includes economies in Asia and the Pacific. Robust clustered standard errors at country level are in parenthesis. Estimation yields 36 clusters. *** p<0.01, ** p<0.05, * p<0.1.

Sources: Authors' estimates.

In summary, our results show that economies in Asia and the Pacific 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 Asia and the Pacific. Specifically, a 1 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 A2.4). 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 A2.5). Taken together, the results indicate that higher cross-border bank concentration in Asia and the Pacific tends to lower domestic credit levels and growth.

Table 2: Impact of Herfindahl–Hirschman Index on Bank Credit Growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	HHI_TOT	HHI_CLM	HHI_LIA	HHI_TOT	HHI_TOT	HHI_CLM	HHI_LIA	HHI_TOT
HHI	-0.107** (0.050)	0.015 (0.038)	0.019 (0.070)	-0.072 (0.048)	-0.070** (0.032)	0.004 (0.019)	-0.012 (0.033)	-0.088** (0.034)
Per capita income	-4.960 (3.892)	-3.504 (4.193)	-3.518 (4.468)	4.766 (4.772)	-1.193** (0.446)	-1.047** (0.472)	-1.112** (0.474)	-0.226 (0.635)
Interest rate	-0.244 (0.358)	-0.239 (0.382)	-0.245 (0.378)	-0.373 (0.311)	0.191 (0.146)	0.198 (0.148)	0.202 (0.146)	0.073 (0.159)
GDP growth	0.166 (0.336)	0.055 (0.365)	0.038 (0.385)	-0.169 (0.339)	0.316 (0.265)	0.376 (0.261)	0.354 (0.271)	0.369 (0.261)
Inflation	-0.314 (0.281)	-0.334 (0.294)	-0.330 (0.287)	-0.248 (0.265)	-0.321 (0.228)	-0.345 (0.238)	-0.346 (0.238)	-0.310 (0.230)
Bank credit level (lag)				-0.264*** (0.060)				-0.054** (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	FE	FE	FE	FE	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS

FE = fixed effects, GDP = gross domestic product, HHI = Herfindahl–Hirschman Index, HHI_CLM = HHI claims, HHI_LIA = HHI liabilities, HHI_TOT = HHI total, OLS = ordinary least squares.

Notes: Dependent variable is bank credit growth (%). All regressors are lagged. FE refers to country fixed effects. Per capita income in log values. Sample includes economies in Asia and the Pacific. Robust clustered standard errors at country level are in parenthesis. Estimation yields 40 clusters. *** p<0.01, ** p<0.05, * p<0.1.

Sources: Authors' estimates.

Table 3: Impact of Herfindahl–Hirschman Index 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** (0.033)	-0.000 (0.020)	-0.017 (0.035)	-0.088** (0.035)	-0.208** (0.102)	-0.159* (0.094)	-0.425*** (0.138)	-0.020* (0.011)
Per capital income	-0.852* (0.492)	-0.857 (0.528)	-0.899* (0.523)	-0.237 (0.655)	11.152** (4.560)	11.013** (4.605)	10.083** (4.311)	-0.141 (0.309)
Interest rate	0.165 (0.148)	0.185 (0.150)	0.186 (0.149)	0.073 (0.159)	-1.703*** (0.545)	-1.608*** (0.516)	-1.616*** (0.491)	-0.035 (0.038)
GDP growth	0.361 (0.269)	0.397 (0.270)	0.380 (0.277)	0.367 (0.266)	0.267 (0.800)	0.154 (0.752)	-0.063 (0.750)	0.190** (0.072)
Inflation	-0.319 (0.229)	-0.345 (0.238)	-0.347 (0.240)	-0.310 (0.230)	0.144 (0.156)	0.098 (0.138)	0.033 (0.159)	-0.024 (0.025)
Financial center	-2.210 (1.434)	-1.277 (1.477)	-1.481 (1.482)	0.184 (1.682)	42.807*** (15.321)	42.743*** (15.688)	40.256*** (14.848)	-0.225 (1.035)
Bank credit level (lag)				-0.055** (0.023)				1.000*** (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 OLS	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS

GDP = gross domestic product, HHI = Herfindahl–Hirschman Index, HHI_CLM = HHI claims, HHI_LIA = HHI liabilities, HHI_TOT = HHI total, OLS = ordinary least squares.

Notes: Dependent variables are bank credit levels and growth (%). All regressors are lagged, except Financial center. Per capita income in log values. Sample includes economies in Asia and the Pacific. Robust clustered standard errors at country level are in parenthesis. Estimation yields 40 clusters. *** p<0.01, ** p<0.05, * p<0.1.

Sources: Authors' estimates.

Next, the covariation between HHI and NPLs is assessed. Table 4 indicates that higher cross-border bank concentration of assets (claims) reduces NPLs. In particular, 1 percentage point increase in HHI claims is significantly associated with lower NPLs of around 0.1% in Asia and the Pacific. This new finding implies that NPLs 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 specifications, the results disappeared suggesting the importance of lag effects of NPLs (Table A2.6). We also run a sensitivity test by adding bank assets as one of the regressors. The results are the same (Table A2.7). In summary, the estimates provide some evidence that higher bank concentration of cross-border assets tends to lower NPLs in Asia and the Pacific.

Table 4: Impact of Herfindahl–Hirschman Index on Nonperforming Loans

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	HHI_TOT	HHI_CLM	HHI_LIA	HHI_CLM	HHI_TOT	HHI_CLM	HHI_LIA	HHI_CLM
HHI	-0.039 (0.054)	-0.100* (0.059)	-0.005 (0.045)	-0.052 (0.040)	-0.016 (0.021)	-0.044** (0.018)	-0.017 (0.024)	-0.008 (0.009)
Per capita income	-9.296*** (2.267)	-10.156*** (2.083)	-8.926*** (2.554)	-2.646* (1.495)	-1.743*** (0.504)	-1.841*** (0.512)	-1.777*** (0.502)	-0.280 (0.224)
Interest rate	0.269 (0.213)	0.271 (0.185)	0.268 (0.220)	-0.016 (0.120)	0.195** (0.075)	0.228*** (0.082)	0.200** (0.078)	-0.013 (0.050)
GDP growth	-0.498*** (0.181)	-0.521*** (0.168)	-0.486*** (0.178)	-0.207 (0.134)	-0.324** (0.154)	-0.383** (0.150)	-0.320** (0.150)	-0.071 (0.089)
Inflation	-0.028 (0.123)	-0.053 (0.110)	-0.032 (0.121)	0.155*** (0.047)	-0.093 (0.151)	-0.113 (0.148)	-0.095 (0.150)	0.147** (0.055)
Budget balance	0.075 (0.152)	0.088 (0.136)	0.052 (0.147)	0.093 (0.068)	0.015 (0.126)	0.034 (0.128)	0.015 (0.127)	-0.002 (0.033)
NPL (lag)				0.570*** (0.117)				0.673*** (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	FE	FE	FE	FE	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS

FE = fixed effects, GDP = gross domestic product, HHI = Herfindahl–Hirschman Index, HHI_CLM = HHI claims, HHI_LIA = HHI liabilities, HHI_TOT = HHI total, NPL = nonperforming loan, OLS = ordinary least squares.

Notes: Dependent variable is nonperforming loans (%). All regressors are lagged. FE refers to country fixed effects. Per capita income in log values. Sample includes economies in Asia and the Pacific. Robust clustered standard errors at country level are in parenthesis. Estimation yields 37 clusters. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Sources: Authors' estimates.

For bank profitability, we find no evidence suggesting that bank profitability measures, such as ROA and ROE, 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.⁶ Second, it is also possible that bank profitability measures are unresponsive to cross-border bank concentration. There is no *a priori* 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, for example, 2000s versus 2010s, as cross-border banking exposures were considerably higher in the period before the global financial crisis. But the results indicate no significant impact of HHI on bank profitability measures.⁷

⁶ Bank-level analysis is beyond the scope of this study.

⁷ The results are available upon request.

Table 5: Impact of Herfindahl–Hirschman Index on Bank Profitability

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	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 (0.012)	0.002 (0.006)	-0.007 (0.011)	0.004 (0.013)	0.004 (0.009)	0.011 (0.014)	-0.119 (0.172)	0.036 (0.076)	-0.137 (0.179)	-0.041 (0.164)	-0.031 (0.087)	0.006 (0.165)
GDP growth	-0.101 (0.100)	-0.103 (0.102)	-0.101 (0.101)	-0.076 (0.088)	-0.076 (0.086)	-0.072 (0.089)	-2.184 (2.012)	-2.208 (2.048)	-2.184 (2.012)	-1.884 (1.722)	-1.885 (1.707)	-1.870 (1.739)
Inflation	0.068 (0.076)	0.068 (0.075)	0.068 (0.076)	0.050 (0.082)	0.051 (0.082)	0.051 (0.082)	1.103 (1.386)	1.106 (1.385)	1.113 (1.397)	1.246 (1.482)	1.244 (1.489)	1.251 (1.487)
Political stability	0.005 (0.015)	0.005 (0.015)	0.004 (0.015)	0.006 (0.008)	0.006 (0.007)	0.005 (0.007)	0.078 (0.161)	0.077 (0.159)	0.077 (0.161)	0.019 (0.090)	0.017 (0.068)	0.005 (0.079)
Bank assets	-0.011** (0.005)	-0.011** (0.004)	-0.011** (0.005)	-0.000 (0.003)	-0.000 (0.003)	0.001 (0.003)	-0.176** (0.084)	-0.172** (0.082)	-0.179** (0.088)	0.011 (0.032)	0.012 (0.040)	0.018 (0.033)
Financial center				-0.786** (0.328)	-0.765** (0.349)	-0.770** (0.323)				2.094 (2.491)	1.996 (2.783)	2.444 (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	FE	FE	FE	Pooled OLS	Pooled OLS	Pooled OLS	FE	FE	FE	Pooled OLS	Pooled OLS	Pooled OLS

FE = fixed effects, GDP = gross domestic product, HHI = Herfindahl–Hirschman Index, HHI_CLM = HHI claims, HHI_LIA = HHI liabilities, HHI_TOT = HHI total, OLS = ordinary least squares. Notes: Dependent variables are return on assets and return on equity (%). All regressors are lagged except Financial center. Per capita income in log values. FE refers to country fixed effects. Sample includes economies in Asia and the Pacific. Robust clustered standard errors at country level are in parenthesis. Estimation yields 37 clusters. *** p<0.01, ** p<0.05, * p<0.1. Sources: Authors' estimates.

V. CONCLUDING REMARKS AND POLICY CONSIDERATIONS

This paper presents a new measure of cross-border bank concentration of total holdings, claims and liabilities for 47 Asia and the Pacific economies from 2000 to 2019. The stylized facts show that the region has one of the highest cross-border bank concentrations, implying 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.

Assessing the impact of cross-border bank concentration on banking sector measures of credit growth, banking stability and profitability, we uncover several new findings about the impacts of cross-border bank exposures of economies in Asia and the Pacific. First, the results show that higher bank concentration is significantly associated with lower bank credit growth and bank credit, which has implications for domestic financial intermediation. Second, evidence suggests that higher NPLs are associated with the 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 exposure, it is important for economies to maintain trade and capital account openness as these tend to lower cross-border bank exposure. In the same vein, financial development is vital in reducing banking sector external concentration, and the 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 NPLs, there is merit in considering the concentration of banking sector external exposures in resolving 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, while on the other hand, excessive credit growth and increased credit risk could reveal risks to financial stability. To swiftly tackling rising NPLs, effective NPL resolution mechanisms are needed.

Third, the region should continue developing long-term local currency bond markets, including corporate bonds, to help diversify domestic financing sources. Capital markets 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 borrowing emerging economy). Likewise, the diversification of corporate financing channels could reduce the dependency on a few cross-border banking counterparties and associated risks.

The ASEAN+3 Asian Bond Markets Initiative serves as an example that has helped promote the development of regional capital markets. This would need to be accommodated by broadening the domestic and regional investor base, including through encouraging more institutional investors such as government pension funds or regional life insurers to buy long-term securities. An analysis of

volatilities in cross-border positions by counterparty region revealed that intraregional bank claims and liabilities exhibit lower volatility than the ones with European Union or United States counterparts (ADB 2019).

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. Although the 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. The Chiang Mai Initiative Multilateralization, and the related ASEAN+3 Macroeconomic Research Office provide good examples for the ASEAN+3 region.⁸ These efforts would need to be complemented through effective domestic financial regulation and supervision, for example, through adoption of the Basel III standards.

⁸ Association of Southeast Asian Nations (Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam) plus Japan, the People's Republic of China, and the Republic of Korea.

APPENDIX 1

Table A1: Data Descriptions and Sources

Variable	Notes	Sources
Bank assets	Bank assets to GDP (%)	International Monetary Fund (IMF), International Financial Statistics (IFS); and World Bank, Global Financial Development Database (GFDD)
Bank credit	Domestic credit to private sector by banks (% of GDP)	World Bank, Worldwide Governance Indicators (WGI)
Budget balance	5-year moving average of government budget balance in % of GDP	IMF, World Economic Outlook (WEO) Databases
Capital openness	Chinn-Ito standardize capital account openness index. 2018 values extended to 2019.	Chinn and Ito (2006).
Domestic bank concentration	Domestic bank concentration (%)	World Bank, GFDD
Financial center	Dummy variable with value of 1 if an economy has a city considered a financial center, and 0 otherwise.	Morris, Mainelli and Wardle (2020).
Financial development	Financial development index, scaled to 100	IMF, Financial Development Index Database
GDP growth	5-year average of annual GDP growth	IMF, WEO Databases; and World Bank, WGI
HHI claims (HHI_CLM)	HHI for cross-border bank claims (assets) as discussed in Section 2. Computed values scaled to 100.	Computed based on the Bank for International Settlements (BIS), Locational Banking Statistics Dataset
HHI liabilities (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
HHI total (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
Inflation	Annual change in consumer price index (%)	IMF, WEO Databases; and World Bank, WGI
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.	IMF, IFS
Interest rate	Lending rate per annum (%) and policy rate (%) for Lao PDR, Nepal, New Zealand, and Uzbekistan	IMF, IFS; national sources; and World Bank, World Development Indicators (WDI)
Nonperforming loan (NPL)	NPL ratio in %	CEIC; national sources; and World Bank, WDI

continued on next page

Table A1 *continued*

Variable	Notes	Sources
Per capita income	Log value of real per capita GDP in constant United States dollar prices	World Bank, WDI
Political stability	Percentile rank of political stability	World Bank, WGI
Return on asset (ROA)	ROA of banking sector (%)	IMF, Global Financial Stability Report Financial Soundness Indicators (GFSR FSI) Database
Return on equity (ROE)	ROE of banking sector (%)	IMF, GFSR FSI Database
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, WDI

Source: Authors' compilation.

APPENDIX 2

Table A2.1: Sensitivity Test—Determinants of Herfindahl–Hirschman Index
(Using Financial Development)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	HHI_TOT	HHI_TOT	HHI_TOT	HHI_TOT	HHI_CLM	HHI_CLM	HHI_LIA	HHI_LIA
Capital openness	2.120 (1.876)	1.825 (1.953)	-3.759** (1.472)	-3.699** (1.494)	-1.349 (1.356)	-3.275** (1.417)	2.439 (1.913)	-2.403 (1.433)
Trade openness	0.038 (0.076)	0.055 (0.078)	-0.042*** (0.015)	-0.038** (0.016)	-0.003 (0.048)	-0.025 (0.021)	-0.033 (0.035)	-0.055*** (0.015)
Financial development	0.016 (0.283)	-0.082 (0.152)	-0.224*** (0.056)	-0.215*** (0.075)	-0.260 (0.225)	-0.487*** (0.154)	-0.163 (0.125)	-0.511*** (0.089)
Political stability	0.131 (0.115)	0.101 (0.115)	0.330*** (0.097)	0.320*** (0.096)	-0.047 (0.127)	0.398*** (0.083)	0.010 (0.083)	0.336*** (0.083)
Inflation volatility	1.157** (0.441)	1.038** (0.434)	1.540** (0.663)	1.354** (0.643)	0.548 (0.481)	1.180 (0.711)	0.342 (0.259)	0.274 (0.337)
Financial center				-1.053 (3.906)		-0.314 (7.663)		5.604 (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

FE = fixed effects, HHI = Herfindahl–Hirschman Index, HHI_CLM = HHI claims, HHI_LIA = HHI liabilities, HHI_TOT = HHI total.

Notes: Dependent variables are HHI_CLM, HHI_LIA and HHI_TOT. All regressors are lagged except Financial center. Per capita income in log values. Robust clustered standard errors at country level are in parenthesis. Estimation yields 36 clusters. *** p<0.01, ** p<0.05, * p<0.1.

Sources: Authors' estimates.

Table A2.2: Sensitivity Test—Determinants of Herfindahl–Hirschman Index
(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 (0.075)	0.067 (0.074)	-0.067*** (0.019)	-0.053*** (0.019)	-0.003 (0.041)	-0.050** (0.025)	-0.021 (0.035)	-0.072*** (0.021)
Per capita income	-18.892 (14.381)	-8.175 (5.323)	-4.415** (2.042)	-2.833 (2.074)	-12.330* (6.300)	-7.441*** (2.378)	-6.366* (3.178)	-7.049*** (2.186)
Political stability	0.132 (0.128)	0.100 (0.112)	0.306** (0.115)	0.271** (0.110)	-0.079 (0.128)	0.483*** (0.097)	0.016 (0.081)	0.395*** (0.095)
Inflation volatility	0.917** (0.353)	0.737** (0.362)	1.524** (0.663)	1.231* (0.659)	0.106 (0.351)	1.191* (0.702)	0.254 (0.251)	0.321 (0.347)
Financial center				-7.993*** (2.889)		-14.101*** (3.887)		-8.404** (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

FE = fixed effects, HHI = Herfindahl–Hirschman Index, HHI_CLM = HHI claims, HHI_LIA = HHI liabilities, HHI_TOT = HHI total.

Notes: Dependent variables are HHI_CLM, HHI_LIA, and HHI_TOT. All regressors are lagged except Financial center. Per capita income in log values. Robust clustered standard errors at country level are in parenthesis. Estimation yields 36 clusters. *** p<0.01, ** p<0.05, * p<0.1.

Sources: Authors' estimates.

Table A2.3: Sensitivity Test—Determinants of Herfindahl–Hirschman Index
(Adding Domestic Bank Concentration)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	HHI_TOT	HHI_TOT	HHI_TOT	HHI_TOT	HHI_CLM	HHI_CLM	HHI_LIA	HHI_LIA
Capital openness	0.350 (1.217)	0.582 (1.228)	-2.810* (1.442)	-2.852* (1.418)	-0.884 (1.289)	-2.196 (1.372)	0.525 (1.015)	-0.401 (1.462)
Trade openness	0.007 (0.046)	0.013 (0.052)	-0.055*** (0.018)	-0.051*** (0.018)	-0.007 (0.029)	-0.040* (0.023)	-0.025 (0.028)	-0.062*** (0.015)
Per capita income	-8.915 (10.548)	-15.753** (5.789)	-2.204 (2.002)	-1.936 (1.878)	-19.777*** (6.317)	-4.261* (2.304)	-6.206** (2.682)	-5.439*** (1.451)
Political stability	0.037 (0.116)	0.063 (0.098)	0.229* (0.134)	0.227* (0.131)	-0.022 (0.124)	0.276** (0.127)	0.088 (0.077)	0.181 (0.132)
Inflation volatility	0.838 (0.519)	0.713 (0.447)	1.507 (0.916)	1.450* (0.853)	0.345 (0.405)	1.311 (0.900)	-0.257 (0.191)	-0.402 (0.483)
Bank concentration	-0.104* (0.061)	-0.067 (0.061)	0.200** (0.086)	0.212** (0.080)	-0.138* (0.069)	0.307*** (0.085)	0.024 (0.072)	0.226** (0.088)
Financial center				-2.175 (2.741)		-6.955* (3.582)		-0.721 (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

FE = fixed effects, HHI = Herfindahl–Hirschman Index, HHI_CLM = HHI claims, HHI_LIA = HHI liabilities, HHI_TOT = HHI total.

Notes: Dependent variables are HHI_CLM, HHI_LIA, and HHI_TOT. All regressors are lagged except Financial center. Per capita income in log values. Sample includes economies in Asia and the Pacific. Robust clustered standard errors at country level are in parenthesis. Estimation yields 36 clusters. *** p<0.01, ** p<0.05, * p<0.1.

Sources: Authors' estimates.

Table A2.4: Sensitivity Test—Impact of Herfindahl–Hirschman Index 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 (0.048)	0.031 (0.034)	0.026 (0.064)	-0.088** (0.034)	-0.009 (0.020)	-0.039 (0.038)
Per capita income	4.766 (4.772)	6.537 (4.913)	6.301 (4.995)	-0.226 (0.635)	-0.306 (0.675)	-0.321 (0.669)
Interest rate	-0.373 (0.311)	-0.375 (0.324)	-0.383 (0.321)	0.073 (0.159)	0.112 (0.160)	0.102 (0.164)
GDP growth	-0.169 (0.339)	-0.258 (0.354)	-0.280 (0.379)	0.369 (0.261)	0.406 (0.263)	0.379 (0.267)
Inflation	-0.248 (0.265)	-0.259 (0.275)	-0.253 (0.266)	-0.310 (0.230)	-0.339 (0.238)	-0.344 (0.244)
Bank credit level	-0.264*** (0.060)	-0.279*** (0.063)	-0.277*** (0.061)	-0.054** (0.022)	-0.043* (0.022)	-0.049** (0.024)
Observations	721	721	721	721	721	721
R-squared	0.181	0.178	0.177	0.064	0.050	0.052
Estimation	FE	FE	FE	Pooled OLS	Pooled OLS	Pooled OLS

FE = fixed effects, GDP = gross domestic product, HHI = Herfindahl–Hirschman Index, HHI_CLM = HHI claims, HHI_LIA = HHI liabilities, HHI_TOT = HHI total, OLS = ordinary least squares.

Notes: Dependent variable is bank credit growth (%). All regressors are lagged. FE refers to country fixed effects. Per capita income in log values. Sample includes economies in Asia and the Pacific. Robust clustered standard errors at country level are in parenthesis. Estimation yields 40 clusters. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Sources: Authors' estimates.

Table A2.5: Sensitivity Test—Impact of Herfindahl–Hirschman Index on the Level of Bank Credit

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

FE = fixed effects, GDP = gross domestic product, HHI = Herfindahl–Hirschman Index, HHI_CLM = HHI claims, HHI_LIA = HHI liabilities, HHI_TOT = HHI total, OLS = ordinary least squares.

Notes: Dependent variable is bank credit (% GDP). All regressors are lagged. FE refers to country fixed effects. Per capita income in log values. Sample includes economies in Asia and the Pacific. Robust clustered standard errors at country level are in parenthesis. Estimation yields 40 clusters. *** p<0.01, ** p<0.05, * p<0.1.

Sources: Authors' estimates.

Table A2.6: Sensitivity Test—Impact of Herfindahl–Hirschman Index 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 (0.026)	-0.052 (0.040)	-0.029 (0.023)	-0.014 (0.010)	-0.008 (0.009)	-0.009 (0.009)
Per capita income	-2.261 (1.384)	-2.646* (1.495)	-1.970 (1.359)	-0.303 (0.220)	-0.280 (0.224)	-0.295 (0.225)
Interest rate	-0.028 (0.122)	-0.016 (0.120)	-0.027 (0.126)	-0.022 (0.047)	-0.013 (0.050)	-0.018 (0.048)
GDP growth	-0.188 (0.125)	-0.207 (0.134)	-0.174 (0.121)	-0.082 (0.089)	-0.071 (0.089)	-0.067 (0.087)
Inflation	0.177*** (0.061)	0.155*** (0.047)	0.171*** (0.055)	0.153** (0.059)	0.147** (0.055)	0.151** (0.058)
Budget balance	0.093 (0.066)	0.093 (0.068)	0.086 (0.070)	0.004 (0.033)	-0.002 (0.033)	-0.001 (0.033)
NPL (lag)	0.589*** (0.107)	0.570*** (0.117)	0.593*** (0.102)	0.675*** (0.081)	0.673*** (0.083)	0.675*** (0.080)
Observations	558	558	558	558	558	558
R-squared	0.731	0.734	0.728	0.694	0.693	0.693
Estimation	FE	FE	FE	Pooled OLS	Pooled OLS	Pooled OLS

FE = fixed effects, GDP = gross domestic product, HHI = Herfindahl–Hirschman Index, HHI_CLM = HHI claims, HHI_LIA = HHI liabilities, HHI_TOT = HHI total, NPL = nonperforming loan, OLS = ordinary least squares.

Notes: Dependent variable is nonperforming loans (%). All regressors are lagged. FE refers to country fixed effects. Per capita income in log values. Sample includes economies in Asia and the Pacific. Robust clustered standard errors at country level are in parenthesis. Estimation yields 37 clusters. *** p<0.01, ** p<0.05, * p<0.1.

Sources: Authors' estimates.

Table A2.7: Sensitivity Test—Impact of Herfindahl–Hirschman Index on Nonperforming Loans
(with Bank Assets)

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

FE = fixed effects, GDP = gross domestic product, HHI = Herfindahl–Hirschman Index, HHI_CLM = HHI claims, HHI_LIA = HHI liabilities, HHI_TOT = HHI total, OLS = ordinary least squares.

Notes: Dependent variable is nonperforming loans (%). All regressors are lagged. FE refers to country fixed effects. Per capita income in log values. Sample includes economies in Asia and the Pacific. Robust clustered standard errors at country level are in parenthesis. Estimation yields 37 clusters. *** p<0.01, ** p<0.05, * p<0.1.

Sources: Authors' estimates.

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Concentration in Asia's Cross-Border Banking

Determinants and Impacts

Regional banking systems in Asia and the Pacific are not only increasingly integrated but also tend to be concentrated to a few counterparties only, exposing the region to financial risk and policy spillovers. This study assesses the determinants and impacts of the region's cross-border banking concentration. It constructs and analyzes cross-border bank concentration measures for 47 economies in Asia and the Pacific from 2000 to 2019. Results suggest that higher capital account, trade openness, and 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.

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