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On Bank Consolidation in a Currency Union

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Abstract

The paper focuses on the impact of diversification on bank performance and how consolidation through mergers and acquisitions (M&A) affects the banking sector's stability in the Eastern Caribbean Currency Union (ECCU). The paper finds that a lower level of loan portfolio diversification explains higher non-performing loans and earnings volatility of indigenous banks, as compared to foreign competitors in the ECCU. We then simulate bank mergers both within and across ECCU countries by combining individual banks' balance sheets. The simulation shows that a typical indigenous bank could better diversify against its idiosyncratic risk by merging with other banks across the border. In addition, we point out that M&A, leading to a more asymmetric banking sector, may increase systemic risk.

JEL Classification Numbers: G21; G28; G32

Keywords: Banking; Banking Regulation; Financial Stability

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I. INTRODUCTION

"Governments should try and use all means possible to push for a consolidation of their domestic banking systems, in a bid to shore up profits and strengthen their business model".

European Central Bank President Mario Draghi, September 2016

Technological change[1], higher economic sector volatility[2], more recently low interest rates[3], and higher regulatory costs[4] have driven a secular trend towards consolidation in the banking sector around the world. The process of bank consolidation has raised several questions for regulators and supervisors in both advanced and developing economies. Under which conditions bank consolidation through mergers and acquisitions (M&A) raises bank stability? Should the bank regulators and supervisors encourage within or cross-border consolidation? To what extent consolidation could increase systemic risk or decrease competition? In this paper, we address these questions by assessing some crucial advantages and disadvantages of bank consolidation within the context of a currency union.

Consolidation through mergers and acquisitions has been considered beneficial for the banking sector if banks do not dissipate the benefits by engaging in riskier lending behavior. Consolidation allows banks to exploit economies of scale and scope, cut costs through operational efficiencies, and spread the fixed costs entailed by technological change and regulation across a larger expense base, while improving diversification through better geographic reach. Although in the previous literature, operational efficiencies and economies of scale are often identified as the primary motivation of mergers and acquisitions, we find that substantial benefits can be seized by diversification through consolidation across different countries of a currency union.

Indigenous banks, being those defined as banks operating in a single-country market, often exhibit low levels of diversification of the loan portfolio. This is because the high operational costs required by geographical or sectoral diversification may prevent indigenous banks from

[1] While technology adoption in the banking sector (led by fin-tech competitors, expansion online services and increasing cybersecurity risk) improves efficiency, it requires significant upfront investment in highly depreciating capital at a time of low profitability. Banking-sector consolidation facilitates such lumpy investment through economies of scale.

[2] Over the past thirty years there has been a steady decline in aggregate volatility, but a large increase in the volatility of firms and economic sectors. The fall in aggregate volatility is mostly due to a decline in the correlation of growth rates across sectors (Comin, 2006). Such finding suggests that undiversified banks may be more prone to bankruptcy than diversified ones, stressing the importance of diversification as a main source of competitive advantage for banks.

[3] Low interest rates (and a flatter yield curve) have also put significant pressure on bank net interest margins. In response, in some countries banks had to involuntarily execute substantial cost-cutting plans.

[4] The implementation of Basel III, such as compliance with Bank Secrecy Act and anti-money laundering, stress testing, as well as general consumer compliance have increased the regulatory burden for the banking industry. Smaller banks' profitability has been impacted dramatically by the new regulatory framework.

(continued…)

expanding their operations across countries and economic sectors. Such "concentration risk" could persist even when indigenous banks try to diversify their loan portfolio across economic sectors within an undiversified economy, since those sectors are highly correlated due to a common country-specific risk. In both cases indigenous banks could be vulnerable to business cycle downturns[5]. Bank cross-border mergers and acquisitions may reduce the loan concentration risk through diversification, if the correlation between domestic and foreign economic sectors is low. Such reduction in concentration risk will in turn improve indigenous banks' resilience to business cycle downturns.

The paper comprises two parts. First, we investigate to what extent diversification can explain the structural differences regarding risk performance, such as non-performing loans (NPLs) and return on assets (ROA) volatility, between indigenous and foreign (multinational) banks in the eight countries of the Eastern Caribbean Currency Union (ECCU). We find that indigenous banks had more NPLs and higher ROA volatility than their foreign competitors in the ECCU from 2001 to 2015. To link such differences to the degree of diversification, we define a novel measure of loan-portfolio concentration risk which accounts for the correlation of loan returns based on the correlation of economic sectors to which banks lend. Such a measure overcomes the limitations of diversification measures in the previous literature that simply account for the number of loan sectors. Specifically, the cross-sectoral correlation is much more important than the number of sectors. A bank can be "poorly" diversified and exposed to concentration risk if its loans are extended to several highly-correlated sectors. We find that on average ECCU indigenous banks are poorly diversified as their measured concentration risk is higher in comparison to foreign banks. This could be the result of indigenous bank operating in a single-country market, in contrast with most foreign banks operating in multiple markets within the ECCU region.

In the second part, we investigate the potential effects of consolidation on improving individual banks' performance and the impact on financial stability. We simulate all possible merger scenarios of the ECCU indigenous banks in the fourth quarter of 2015 by combining the financial statements of the banks participating in the hypothetical mergers. We compare the post-merger loan-portfolio-concentration risk, the ROA volatility, and the z-score[6] to the pre-merger values. We find that on average mergers can improve individual banks' stability by lowering the concentration risk and the ROA volatility, and by increasing the z-score. Moreover, the simulation exercise shows that cross-border mergers reduce concentration risk more than within-border mergers in the ECCU. This result highlights the importance of geographic dispersion in bank diversification.

[5]About 85 percent of total bank that failed during the period 2008-2011 in the United States were small community banks that lack of diversification.

[6] The z-score is a measure of bank insolvency defined as (ROA+EA)/sd(ROA), where the ROA is the return as percent of assets, EA is equity as a percent of assets and sd(ROA) is the standard deviation of ROA as a proxy for the volatility of returns. It measures bank's capital in relation to the variability of its returns. It can be interpreted as a measure of distance to default which measures how much volatility in returns can be absorbed by capital without causing the insolvency of the bank. A higher z-score indicates a lower probability of insolvency.

(continued…)

However, the positive effect of mergers on individual banks' stability through the diversification effect can be partially offset by the contextual decrease in market competition and the increased asymmetry in banks' size[7]. The former may raise systemic risk by creating banks which are reputed to be "too-big-to-fail", while the latter can lead to disruptions in the inter-bank lending market. For example, if too many indigenous banks are merged into a large bank, the new merged bank could increase the exposure of the banking system to the "too-big-to-fail" risk despite a lower loan-portfolio concentration risk. In addition, asymmetry in the size of the banks could generate liquidity shortages in the interbank market due to the inability of small banks to provide enough liquidity in the case of a large bank hit by a liquidity shock. As a result, we recommend that the regulator should balance the positive and negative effects of bank consolidation on financial stability.

II. LITERATURE REVIEW

The paper contributes to two distinct strands of the economic literature: the effect of bank consolidation on individual banks' performance and on the stability of the banking sector. We argue that bank consolidation improves individual banks' performance by enhancing loan-portfolio diversification, but could negatively impact the overall banking-sector stability by introducing market asymmetry and increasing the "too-big-to-fail" problem.

Bank consolidation and bank performance

This strand of the economic literature suggests that bank consolidation enhances efficiency and improves diversification, thus improving bank profitability and stability. First, bank consolidation improves efficiency through economies of scale (Chandler, 1977; Gertner et al., 1994; Houston, et al., 1997; and Berger et al., 1999). Moreover, bank consolidation across different geographic regions allows individual banks to extend lending into economies that are imperfectly correlated and therefore can mitigate the negative effects of idiosyncratic shocks (e.g., Houston, et al., 1997, Houston et al., 1998, Gatev. et al., 2009, and Cornett et al., 2011). Some studies find that scale economies are less important than sector diversification only for medium and large banks and that small banks' performance does not improve through geographic diversification (Neely et al., 1997). On the contrary, other papers show that this effect is limited to small US community banks. The benefits of geographic diversification would be very limited since small community banks are not very exposed to local economic fluctuations (Meyer et al., 2001). Most studies find large benefits of mergers for small banks, but very small average gains for medium and average mergers (Boyd et al., 1998).

Bank consolidation and banking-sector stability

The existing literature on bank consolidation does not provide an unambiguous answer to the effects of consolidation on the stability of the banking sector. Some studies suggest that bank

[7] We introduce a measure of asymmetry in the banking sector inspired by the theoretical model by Carletti, Hartmann and Spagnolo (2007). Asymmetry in our paper is defined as the cross-sectional dispersion of total assets in the banking sector.

consolidation increases stability (if concentration creates market power that avoids incentives for excessive risk-taking and if size brings about diversification gains which are not offset by the adoption of new risks) and other studies suggest the opposite (if consolidation worsens too-big-to-fail problems, complicates monitoring in agency problems, generates organizational diseconomies). Correspondingly, the theoretical literature can be divided into two opposite views: the *competition*-fragility hypothesis and the *competition*-stability hypothesis.

Competition-fragility hypothesis

Some models predict that more concentrated and less competitive banking systems are more stable, as profits provide a buffer against fragility and curb incentives to take excessive risks. This theory known as "charter value" was introduced by Marcus in 1984 and expanded by Chan, Greenbaum and Thakor (1986), and Keeley (1990). In these models, banks choose the level of risk of their loan portfolios and they can shift risk on depositors. Competition increases pressure on profits and strengthens incentives to take excessive risk, making the whole banking sector more fragile. On the contrary, under low competition, higher profits are expected to curb incentives to take risk. Moreover, some studies suggest that high competition reduces loan screening since it reduces the informational rents which can be extracted by information acquisition and therefore increases the fragility of the banking sector (Allen and Gale, (2000, 2004)).

An additional channel through which competition can negatively affect stability is the interbank market. Perfect competition reduces incentives of banks to provide liquidity to their peers. Allen and Gale (2000) show that under perfect competition no bank has incentive to provide liquidity, increasing the likelihood of bank failures due to liquidity shocks. Moreover, Saez and Shi (2004) show that cooperation on the interbank market improves when it involves a small number of banks.

Several studies have argued that more concentrated banking systems may create larger banks which can better diversify their loan portfolios. This strand of the literature was initiated by the seminal paper of Diamond (1984), Ramakrishanan and Takhor (1984), Boyd and Prescott (1986), Williamson (1986) and Allen (1990).

A final argument refers to the number of banks to be supervised by the authorities. If a more concentrated banking system reduced the number of banks, there may be better surveillance. According to Allen and Gale (2000), the US banking sector has been traditionally more unstable than the Canadian or U.K. since it has a larger number of banks. The argument refers to market structure rather than competition.

Competition-Stability hypothesis

In contrast with the charter value-hypothesis, several studies have proposed the opposite view that a less competitive banking sector could be more fragile. Boyd and De Nicolo (2005) show that concentration and fragility can be positively correlated. In their model, market concentration increases interest rates and induces borrowers to assume greater risks.

Moreover, according to the proponents of the competition stability-hypothesis, the policy maker can be more concerned about the risk of bank failures when the system is more concentrated and banks will tend to receive implicit guarantees since they are reputed "too big to fail". According to Mishkin (1999), such implicit guarantee may result in banks having more incentives to take risks and may lead to higher systemic risk.

The empirical literature

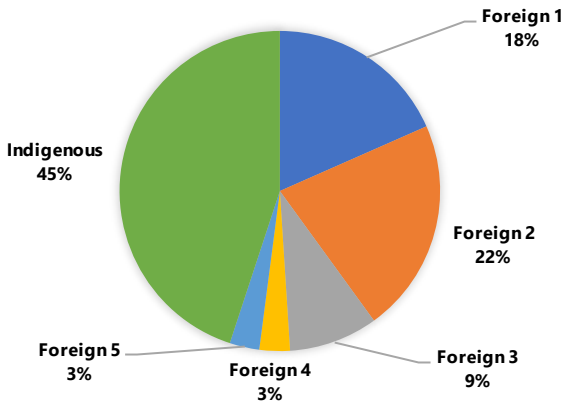
The empirical literature is also quite divided on the impact of bank consolidation on systemic risk. Some part of the empirical literature finds that bank mergers are associated with lower bank risk. Paroush (1995) shows that higher market power following mergers stems from diversification gains. Craig and Santos (1997) confirm the risk reduction effect (where risk is measured by the *z*-score statistic of default probability and by stock return volatility) and relate it to the benefits from diversification. Benston, Hunter and Wall (1995) argue, based on pre-merger earnings volatility and target acquirer correlation, that the motivation for mergers in the US banking sector during the first half of the 1980s must have been risk reduction through diversification.

Clarck and Wheelock (1997) observe that in the United States banks' earnings are highly correlated with the economic growth of the states where banks are located, indicating that cross-state bank consolidation may help diversify state-specific risk. Similarly, Hughes et al (1999) find that inter-state expansion of banks in the United States leads to a reduction in insolvency risk through the diversification of local risks. Another paper by Amihud et al (2003) addresses a similar issue, but for cross-border M&A covering many countries between 1985 and 1998. Their main result is that cross-border mergers do not lead to post-merger risk increasing behavior and should not be opposed by regulators. Moreover, they highlight that, in contrast with other cross-border mergers, cross-border mergers occurring within the European Union improve post-merger bank stability, suggesting that the benefits of diversification prevail on the exchange rate risk when mergers occur within a currency union.

III. STYLIZED FACTS ABOUT THE ECCU BANKING SECTOR

The ECCU banking system is a competitive marketplace with a large presence of foreign banks. As of quarter 4, 2015, there were 18 banks in the ECCU banking system: 3 foreign incorporated foreign banks, 2 locally incorporated foreign banks, and 13 indigenous banks. We classify both foreign incorporated foreign banks and locally incorporated foreign banks as foreign banks. The total assets in the ECCU banking system amounted to EC$ 28.1 billion (176.7% of the region's GDP). As showed in Figure 1, total assets of foreign

Figure 1. Total Assets (2015Q4)



banks represent 55 percent of the total assets in the ECCU banking system. The St. Kitts-Nevis-Anguilla National Bank is currently the largest indigenous bank with a market share (measured by total assets) equal to 13 percent. Most indigenous banks are small with a market share between 2 and 3 percent. However, in each ECCU country, the market size of all indigenous banks is similar to that of foreign banks (Figure 2). The distribution of total deposits in the ECCU banking system mirrors this pattern too (Figure 3). 311-364 represent the ISO code for each country. According to the Herfindahl-Hirschman index (HHI), one of the main standard measures of industry concentration, the ECCU banking market is competitive.[8]

Figure 2. Assets in Each Country (2015Q4, in EC$)

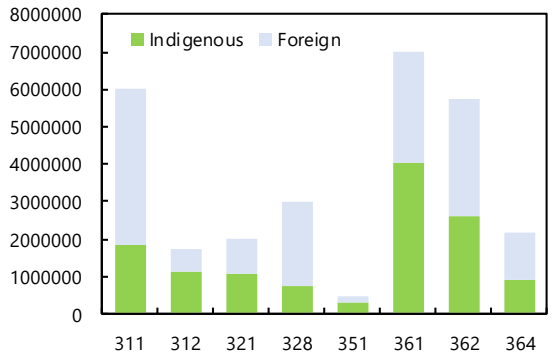


Figure 3. Deposits in Each Country (2015Q4, in EC$)

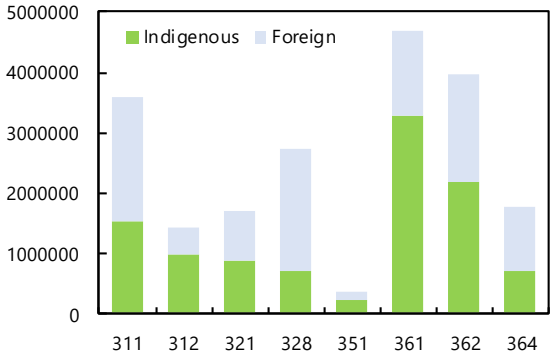


Figure 4 shows that the average level of NPL ratio between 2001 and 2015 rose for both indigenous and foreign banks in the ECCU banking system. Moreover, indigenous banks display higher NPL ratio compared to foreign banks in each year. Such difference in the NPL ratio between indigenous and foreign banks exists in most ECCU countries, except for Grenada and St. Vincent and the Grenadines[9]. The wide dispersion in the NPL ratio across individual banks (Figure 5) suggests that bank-specific factors contributed to the deterioration of bank assets' quality.

Figure 4. NPLs-to-assets Ratio (mean, in %)

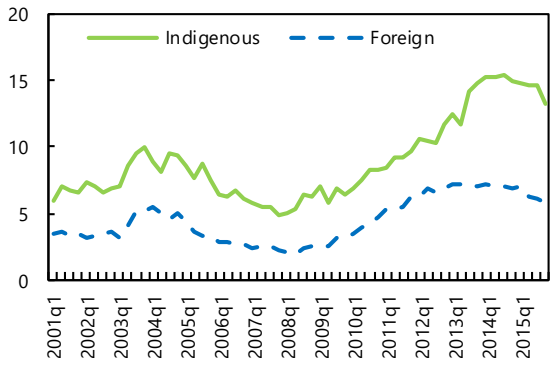
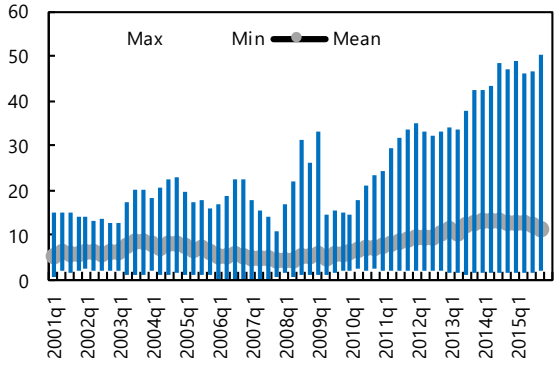


Figure 5. NPLs-to-assets Ratio (max, min, and mean, in %)

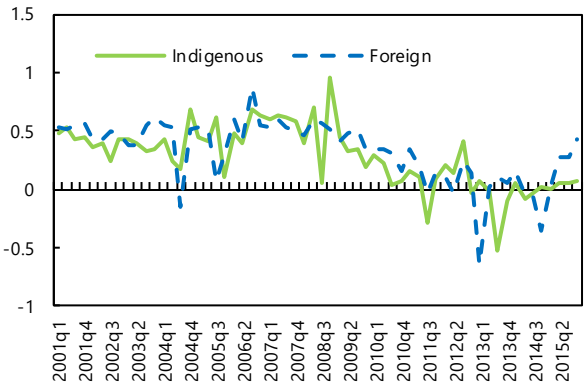


[8] The U.S. Department of Justice considers a market with an HHI of less than 1500 to be a competitive marketplace, the HHI index (calculated by total assets) for ECCU as of quarter 4 of 2015 is 1185.

[9] Results are available from authors upon request.

Indigenous and foreign banks are different in other perspectives besides NPLs. Measures of bank profitability, such as return on assets (ROA), are very similar over the long term between the two types of banks regardless of ownership. The data show no statistically significant difference between indigenous and foreign banks in terms of average return on assets in our sample (Figure 6). On the contrary, a striking difference emerges with respect to ROA volatility. On average, the volatility of the ROA of indigenous banks is almost twice as much as the volatility of the ROA of foreign banks (0.704 vs. 0.391)[10], suggesting a higher vulnerability to bankruptcy risk for the indigenous banking sector.

Figure 6. ROA (mean, in %)



IV. EMPIRICAL ANALYSIS

A. The Data

Our quarterly dataset was provided by the Eastern Caribbean Central Bank. The sample spans the period 2001Q1-2015Q4 and has universal coverage of banks operating in the eight ECCU independent countries. A total of 21 banks is included in the sample, 16 are indigenous and 5 are foreign. As showed by Table 1, most foreign banks operate in more than one country. In contrast, every indigenous bank operates in a single country. We consolidate multi-country banks' financial accounts. Bank A, D, E, F, O are the five foreign banks in our sample. 311-364 represents the ISO codes for the eight countries in the ECCU region. A mark sign means the bank operates in the corresponding country.

Table 1. Distribution of Foreign Banks

	311	312	321	328	351	361	362	364
Bank A	✓	✓	✓	✓	✓	✓	✓	✓
Bank D	✓	✓	✓	✓		✓	✓	✓
Bank E	✓		✓		✓	✓	✓	
Bank F	✓			✓		✓	✓	✓
Bank O				✓				

The panel data consists of observations on multiple bank measures of performance including NPLs, ROA, ROA volatility, etc. Our plan is to estimate how such indicators respond to a constructed measure of loan-portfolio-concentration risk. For any given bank operating in any given country, loans are extended to 14 different economic sectors. We adopt sectoral real

[10] The unit is in percentage point. ROA volatility is calculated as the standard deviation of ROA from 2001Q1 to 2015Q4.

(continued…)

GDP growth rates as a proxy for expected loan returns.[11] However, the classification of economic sectors in the bank-loan data differs from that reported in the GDP data. To this end, we reclassify economic sectors to match the two datasets as indicated in Table 2. After the reclassification, the combined dataset contains 12 sectors in each of the eight ECCU countries, for a total of 96 lending sectors.[12]

Table 2. GDP and Bank Loan Sectors

#	Original GDP sectors	Original loan sectors
1	Agriculture, Livestock and Forestry	Agriculture
2	Fishing	Fisheries
3	Mining & Quarrying	Mining & Quarrying
4	Manufacturing	Manufacturing
5	Electricity & Water	Utilities
6	Construction	Construction & land development
7	Wholesale & Retail Trade	Distributive Trades
8	Transport, Storage and Communications	Transportation & Storage
9	Public Administration, Defense & Compulsory Social Security	Public Administration
10	Hotels & Restaurants	Tourism
		Entertainment & Catering
11	Financial Intermediation	Financial Institutions
	Real Estate, Renting and Business Activities	
12	Education	Professional & Other Services
	Health and Social Work	
	Other Community, Social & Personal Services	

Measuring portfolio concentration risk

The first step of our study consists in exploring whether geographical concentration explains the persistent difference in the NPL ratio and the earnings volatility between indigenous and foreign banks. The most commonly adopted measure of concentration is the Hirschman-Herfindahl Index (HHI). The HHI is used by most regulators around the world to measure portfolio concentration (diversification). A low value of the HHI denotes less concentration, and hence more diversification across economic sectors. Acharya et al. (2006) use this measure to assess the level of portfolio diversification for the Italian banks. A major limitation of the HHI is the inability to factor in the volatility of each sector and the cross-sectoral correlations. Some lending sectors may be more volatile than others. Moreover, since sectors are correlated, a better measure of concentration should consider how business-cycle shocks from different sectors are reduced or amplified depending on the level of cross-sector covariance.

To overcome these limitations, we construct a variable, called loan-portfolio-concentration risk, that explains the level of diversification of each individual bank's loan portfolio within the ECCU loan market. It captures both the exposure of the loan portfolio to each sector of the

[11] The correlation between economic growth rates and NPLs is very high suggesting that real GDP growth rates represent a good proxy for the realized loan returns.

[12] Besides the 13 original loan sectors in Table 3, ECCU banks also lend to households (in personal loans). We redistribute personal loans into the 12 final economic sectors proportionally using the share of sectoral GDP in total GDP as the weight. The implicit assumption is that households' ability to pay back depends on their income coming from these 12 sectors.

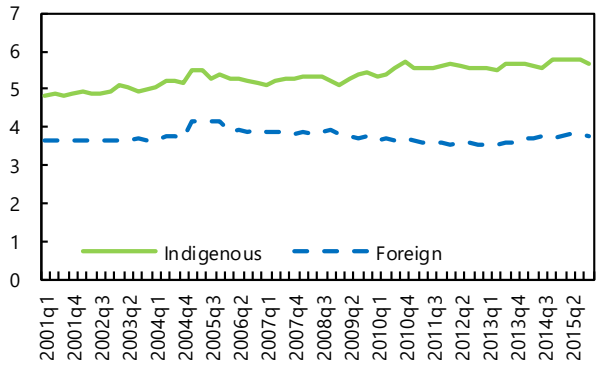
economy in each country and the correlations across those sectors. The variable is calculated as the standard deviation of the expected loan return of the bank's total loan portfolio over the period from 2001 to 2015, where the expected loan return of each sector in each country is proxied by the corresponding sectoral real GDP growth rate. As shown in Table 2, we identify a total of 96 sectors (12 for each of the eight ECCU countries) to which banks can extend loans. The concentration risk can be defined as:

$$CR_{jt} = (\alpha_{jt}' P \alpha_{jt})^{1/2}$$

The variance-covariance matrix P (96*96) is built using the real GDP growth rates of the 96 sectors from 2001 to 2015. The column vector α_{jt} (96*1) measures the loan portfolio share in the 96 sectors of bank *j* in quarter *t*, and the standard deviation of the loan portfolio is calculated by the square root of $\alpha_{jt}' P \alpha_{jt}$, which we call concentration risk (CR_{jt}). When the bank issues loans to sectors that are uncorrelated or negatively correlated, CR_{jt} is low. In other words, lower portfolio concentration indicates a better diversified portfolio.

As shown in the Figure 7, in the years prior to the global financial crisis, the average concentration risk was growing for both indigenous and foreign banks, which means that banks were poorly diversified, being exposed to highly correlated sectors. After the financial crisis, we notice a behavioral change in portfolio allocation between indigenous and foreign banks. Foreign banks started to diversify more, but indigenous banks' exposure to concentration risk continued to increase.

Figure 7. Loan-portfolio-concentration Risk (mean, in %)



B. The Model

We adopt the following panel regression specification to investigate the impact of measured loan-portfolio-concentration risk on banks' performance:

$$y_{jt} = \alpha_j + \beta CR_{jt-1} + \boldsymbol{\gamma}' \boldsymbol{X}_{jt} + \varepsilon_{jt}$$

The dependent variable y_{jt} represents the performance of bank *j* in quarter *t*.[13] We focus on the non-performing loans (NPLs) ratio and the ROA volatility. CR_{jt-1} is the lagged loan-portfolio-concentration risk as described in the previous paragraph. $\boldsymbol{X}_{jt}$ denotes a full set of control variables including bank controls, U.S. recession dummies and year dummies, while α_j represents the individual-bank fixed effects. The idea behind this control variables is that individual banks' performance is affected by both bank-level fundamentals and exogenous economic conditions.

[13] Multinational banks have been combined to a consolidated account.

We first include banks' equity ratio (total equity to total assets) and the deposit ratio (total deposits to total assets) to control for capital structure. Although the Modigliani-Miller theorem (1958) predicts that the NPL ratio and the ROA volatility should be independent of bank capital structure, there may be several reasons that could explain a violation of the theorem. A typical example from the economic literature emphasizes the role of moral hazard. Under-capitalized banks may engage in riskier activities, leading to high NPL ratio and ROA volatility. In contrast, banks with higher equity-to-asset ratios may invest in safer assets. Given the positive relationship between risk and return, these banks may display lower ROA on average.

On the asset side, we control for the loan ratio (total loan to total assets) following Boyd et al. (2009) since banks with a higher percentage of loans as total assets are expected to be riskier. We also include the provision ratio to control for bank's own expectation of risk in the upcoming period. Loan provisioning is a measure of banks' expectation of future NPLs. Adding these two control variables in the regressions is necessary to take into account bank's risk-taking behavior. Banks with higher loan-to-assets ratios or higher provisioning may signal higher future NPLs.

In addition, we include a dummy variable that indicates whether a bank-quarter observation displays negative equity. We also use two different types of time dummies to control for time-varying factors that are common to all banks. One is a U.S. economic recession dummy which equals 1 for the period from 2001Q1 to 2001Q4, and from 2007Q4 to 2009Q2; the other one is a set of year dummies from 2001 to 2015.

Table 3 (Panel A) describes the definition of the variables and Table 3 (Panel B) shows the summary statistics for both indigenous and foreign banks. We see that the average concentration risk of indigenous banks is higher than that of foreign banks. Moreover, indigenous banks report higher NPL ratios on average and their earnings are more volatile than the values reported by foreign banks. We observe a greater portion of indigenous banks (4%) reporting negative equity compared to foreign banks (2.3%).

Table 3 - Panel A. Definition of Variables

Our **bank-level core variables** are listed as follows:	
***CR*:**	Concentration risk
***ROA*:**	Earnings before tax / Total assets
***SD (ROA)*:**	Standard deviation of ROA
***NPL ratio*:**	NPL / (lag) Total assets
Bank control variables include:	
***Loan ratio*:**	Total loans / Total assets
***Provision ratio*:**	Loan-loss provision / Total assets
***Deposit ratio*:**	Deposits / Total assets
***Equity ratio*:**	Equity / Total assets
***Troubled-bank dummy*:**	equal to 1 if equity<=0
Time dummies include:	
***US Recession dummy*:**	equal to 1 if 2001Q1-2001Q4, 2007Q4-2009Q2
***Year dummies*:**	2001-2015

Table 3 - Panel B. Sample Statistics

Panel-B1: Indigenous Banks	**Obs**	**Mean**	**St. Dev.**	**Median**
Concentration Risk (%)	833	5.340	2.354	4.951
ROA (%)	833	0.280	0.691	0.314
SD (ROA) (%)	833	0.602	0.354	0.531
NPL Ratio (%)	833	8.942	8.310	6.456
Loan Ratio (%)	833	57.576	15.368	60.611
Provision Ratio (%)	833	3.476	6.322	1.642
Deposit Ratio (%)	833	79.479	9.553	80.226
Equity Ratio (%)	833	9.882	11.729	11.017
Troubled-Bank	833	0.040	0.195	0.000
Panel-B2: Foreign Banks	**Obs**	**Mean**	**St. Dev**	**Median**
Concentration Risk (%)	300	3.746	0.818	3.620
ROA (%)	300	0.328	0.438	0.409
SD (ROA) (%)	300	0.391	0.076	0.399
NPL Ratio (%)	300	4.472	2.326	4.047
Loan Ratio (%)	300	56.813	10.082	57.512
Provision Ratio (%)	300	1.930	1.237	1.599
Deposit Ratio (%)	300	73.024	12.307	76.396
Equity Ratio (%)	300	6.193	4.799	6.882
Troubled-Bank	300	0.023	0.151	0.000

C. Panel Regression Analysis

In this section, we estimate the panel regression model as specified in section B with bank fixed effects and standard errors clustered at bank level. The clustered standard error allows us to consider simultaneously both the heteroscedasticity and the serial correlations of the error term. The purpose of the empirical analysis is to test the following two hypotheses regarding the impact of the loan concentration on banks' performance.

Hypothesis 1: Higher loan-portfolio-concentration risk leads to higher NPL ratio.

Hypothesis 2: Higher loan-portfolio-concentration risk leads to more volatile ROA.

With respect to Hypothesis 1, we test whether higher portfolio-concentration risk leads to higher NPL ratio. The results of the model estimation (Table 4) confirm this hypothesis. Each column of Table 4 reports the estimates corresponding to six different choices of the control variables.[14] Column (1) shows that an increase of concentration risk by 1 percent leads to a 2 percent increase in the NPL ratio. This result is robust under different model specifications with different controls.

[14] Scenarios include no control, only recession dummy, only year dummies, only bank control, bank control plus recession dummy and bank control plus year dummy.

Besides the concentration risk, the other control variables are also meaningful in their reported sign. The lagged loan ratio contributes positively to the current NPL ratio. This is consistent with our expectation that larger loan portfolio size signals extra risk-taking. The lagged provision ratio positively contributes to the NPL ratio as expected, since banks increase loan-loss provisioning in anticipation of higher risk – the same argument applies to the lagged equity ratio – banks may (or are required by the regulators to) deleverage *ex ante* in response to an expected increase in the future level of NPLs. In our model, the lagged provision ratio and the equity ratio act as reduced-form proxies for the bank and the regulators' expected NPLs. After controlling for these two variables, the coefficient of concentration risk remains significant, indicating that ECCU banks can still improve risk management through loan-portfolio diversification. On the contrary, the deposit ratio is not very significant in explaining the NPL ratio. This result is not surprising given that deposits represent the main type of liabilities for the ECCU banks. Therefore, deposit ratio could be highly (but negatively) correlated with the equity ratio. Finally, the troubled-bank dummy is positively correlated with the NPL ratio as expected.

Table 4. NPL ratio

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	NoDummy	RecDummy	YrDummy	NoDummy	RecDummy	YrDummy
Lag CR	2.017***	1.915***	1.472***	1.144***	1.065***	0.876***
	(0.606)	(0.620)	(0.480)	(0.167)	(0.178)	(0.196)
Lag Loan Ratio				0.094**	0.107**	0.124***
				(0.042)	(0.045)	(0.038)
Lag Provision Ratio				1.227***	1.191***	1.176***
				(0.201)	(0.180)	(0.158)
Lag Deposit Ratio				-0.093*	-0.098*	-0.080
				(0.053)	(0.052)	(0.047)
Lag Equity Ratio				0.258**	0.248**	0.274***
				(0.099)	(0.093)	(0.093)
Troubled Bank				9.726**	9.599**	8.609**
				(3.953)	(3.941)	(3.658)
Observations	1,112	1,112	1,112	1,112	1,112	1,112
R-squared	0.086	0.121	0.284	0.592	0.611	0.659
Number of Banks	21	21	21	21	21	21

Robust standard errors in parentheses

***** p<0.01, ** p<0.05, * p<0.1**

As discussed in the previous paragraph, expected NPLs can affect both the loan-loss provision and the equity ratio. If banks form their NPLs expectation based on the actual level of NPLs, there would exist potential dynamic feedbacks from NPLs to *future* provision and equity ratios. Therefore, we extend our estimation in Table 4 to a standard panel vector auto-regression system with one lag (VAR(1)), allowing lagged NPL ratio to affect variables on the right-hand side. We follow the algorithm developed by Abrigo and Love (2015). We use forward orthogonal transformation to cancel bank-level fixed effects and estimate the system using the

generalized method of moments (GMM) as in Arellano Bond (1991). We use one-period lagged variables as instruments for the transformed regression equation; because of the forward transformation, lagged bank variables are valid instruments.

The impulse response of the NPL ratio to a structural shock on concentration risk is derived by employing the Cholesky decomposition to impose short-term restrictions. Bank-level variables are placed in the following order: Deposit ratio, Equity ratio, Loan ratio, Concentration risk, Provision ratio, NPL ratio and Troubled-bank dummy. Since bank's deposits are not affected by the other variables contemporaneously, they are ranked first. In any period, the level of deposits and the level of equity determine the amount of bank's lending and the allocation of the loan portfolio across different economic sectors. The latter determines concentration risk, which may affect the provision ratio given the bank's expectation of NPLs. The actual NPL ratio follows the provision ratio. The troubled-bank dummy comes last since actual NPLs could cause a bank to report negative equity.

Figure 8 shows the cumulative impulse response function of the NPL ratio to a unit structural shock of the concentration risk over a period of 6 quarters after the shock. The shaded area represents the 90 percent confidence interval calculated by 500 times bootstrap. The higher concentration risk significantly increases the NPL ratio, in line with the results reported in Table 5 (column (4)). Figure 9 shows the same impulse response function when year dummies are included to control for swings in the macroeconomic fundamentals. Results are robust when we replace the year dummies with the U.S. economic recession dummy.

Figure 8. Cumulative IRF of NPL Ratio to Concentration Risk

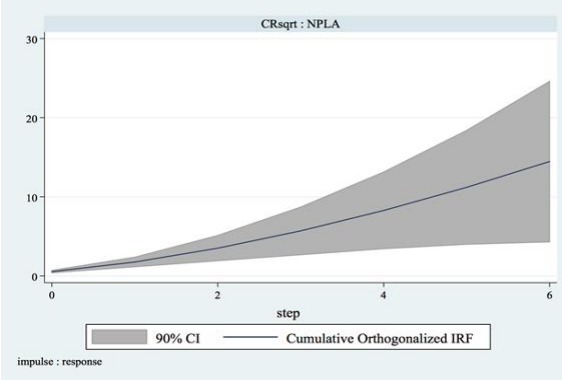
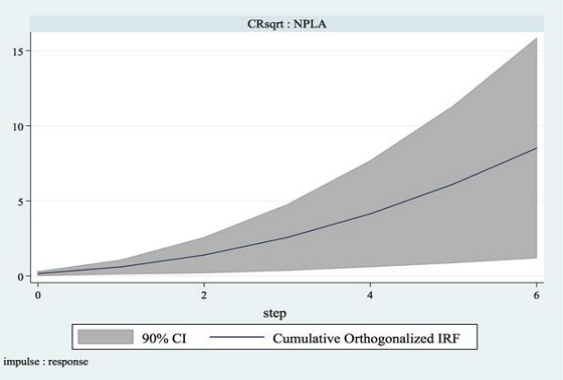


Figure 9. Cumulative IRF with Year Fixed Effects



As a robustness check we reverse the order of the Loan ratio and the Equity ratio, by letting the former affect the latter contemporaneously. The purpose of this PVAR exercise is to consider a potential precautionary motive behavior, which may induce a bank to increase equity when it expands lending. Results remain unchanged. Therefore, the estimation of a system of dynamic panel regressions under short-term restrictions confirms that a positive shock on concentration risk significantly increases banks' NPL ratio as summarized in the Hypothesis 1 and Table 4.

To test the Hypothesis 2, we use the standard deviation of the ROA, calculated by quarterly data from 2001 to 2015, as dependent variable. Given that this variable is time invariant, we

replace each of the right-hand-side variables with the corresponding time-series average from 2001 to 2015. Instead of the panel fixed effects, we use a dummy variable that equals 1 for foreign banks and equals 0 for indigenous banks to control for the potential structural differences between foreign and indigenous banks. Table 5 shows that portfolio concentration risk increases the ROA volatility: a one-standard-error increase in concentration risk raises the median indigenous bank's ROA volatility by about 38 percent.[15]

Table 5. ROA volatility and Concentration Risk

	Estimates
Average Concentration Risk	0.086*
	(0.047)
R-squared	0.816
Average Bank Controls	Yes
Foreign Dummy	Yes

Robust standard errors in parentheses
***** p<0.01, ** p<0.05, * p<0.1**

To summarize, higher loan portfolio concentration results in a significant increase in the NPL ratio and to a more volatile ROA. Therefore, the higher concentration risk caused by the lack of diversification is a potential explanation for the differences in the NPL ratio and the ROA volatility between foreign and indigenous banks.

V. MEASURING THE IMPACT OF MERGERS ON FINANCIAL STABILITY

The analysis developed in the previous section indicates that the lack of loan diversification could be the cause of indigenous banks' higher NPLs and ROA volatility. The lack of diversification, due to each indigenous bank operating in a small undiversified economy, may be overcome through bank consolidation. In this section, we show the consequences of bank mergers on financial stability.

We focus on the 13 indigenous banks operating in the fourth quarter of 2015 and simulate all possible merger combinations by consolidating their financial accounts and loan portfolios.[16] We obtain 78 two-bank mergers, 286 three-bank mergers, 715 four-bank mergers, 1287 five-bank mergers, 1716 six-bank mergers until the extreme scenario where all the thirteen indigenous banks merge in one regional bank. In each case, we measure the average properties of each cluster. We determine whether the new merged banks are more stable than each separate bank before merger and we study the impact of mergers on market structure, such as market concentration and asymmetry.

[15] The result is calculated as 0.086*2.354/0.531=18%.

[16] In other words, we implicitly assume that banks do not re-optimize after merging together, which is apparently not true under rational expectations. However, such an assumption gives a lower bound of the benefits of merging.

The first outcome of the merger simulations is that the average loan-portfolio-concentration risk is a declining function of the number of merged banks. The results, shown in Table 6, are a direct consequence of the portfolio diversification effect caused by mergers. In the first column, we report the number of original banks included in the merger. The second column reports the *average* concentration risk of all banks after the merger. For example, when the number of original banks in merger equals 2, the average concentration risk for the 78 potentially new banks is equal to 5.28. As the number of original banks in merger increases, the post-merger concentration risk declines on average. If all indigenous banks merge into one bank, the concentration risk would be only 4.34. Compared to the current average concentration risk of indigenous banks (5.34), this value (4.34) is much closer to the average concentration risk of foreign banks of 3.7.

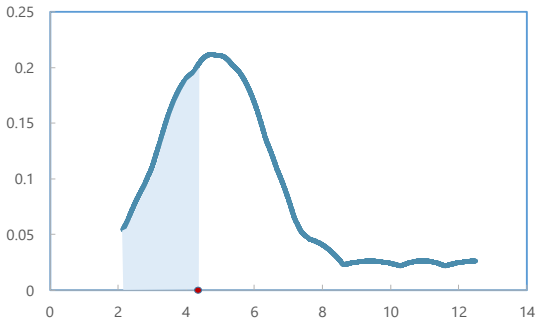
Table 6. Post-merger Concentration Risk

Number of Banks in Merger	Average Concentration Risk
2	5.284
3	4.983
4	4.798
5	4.677
6	4.592
7	4.529
8	4.480
9	4.441
10	4.409
11	4.383
12	4.360
13	4.341

Potential benefits of mergers could be underestimated for two reasons. First, banks may re-optimize their portfolio after mergers. Second, the values of the concentration risk, calculated for the simulated merged banks, display a significant degree of heterogeneity within each cluster. Hence, any comparison based on average indexes could misrepresent the size of the mergers' benefits.

To better illustrate this point, we consider the two-bank merger scenario, as an example. There are 78 possible two-side mergers for the 13 indigenous banks. Each of the 78 possible outcomes is characterized by a different value of the post-merger concentration risk. The kernel-fitted distribution of the 78 values is shown in Figure 10. We use the red dot to indicate the value of the concentration risk corresponding to the scenario where all indigenous banks merge together. The figure shows that around 36% of the bilateral merger outcomes (the shaded area) display lower values of the concentration risk than the value observed for the all-banks-merger scenario. Such heterogeneity also applies to other scenarios, when the merger involves more

Figure 10. Concentration Risk of Two-bank Mergers



Sources: ECCB and IMF staff Estimates

than two banks.[17] It originates from the mathematical foundation of diversification – the concentration risk is expected to decline only when bank portfolios are uncorrelated or negatively correlated.

Consequently, we conjecture that cross-country merged banks are more likely to be diversified than within-country merged banks. We test this conjecture statistically in Table-7. "Mean within" and "Mean cross" show the average concentration risk for all within-country and cross-country simulated mergers, respectively. "Within vs. Cross" shows the p-value of the t-test comparing the difference between the two groups. We find that on average cross-border mergers lead to significantly lower concentration risk than within-border mergers.

Table 7. Post-merger Concentration Risk: Within- vs. Cross-border

	Mean within	Mean cross	Within vs. Cross: p-value
Concentration Risk	6.179	4.590	0.088

We extend our evaluation of the mergers by focusing on other measures of banks' performance in addition to the concentration risk, such as the volatility of ROA and the Z-score (a standard measure of individual bank risk).[18] Simulated merger results are included in Table-8. As expected, mergers help reduce the ROA volatility and to increase Z-score on average.

Table 8. Post-merger ROA volatility and Z score

Number of Banks in Merger	Average SD (ROA)	Average Z-score
2	0.379	27.097
3	0.334	29.333
4	0.304	32.215
5	0.281	35.368
6	0.261	38.684
7	0.243	42.143
8	0.226	45.748
9	0.209	49.479
10	0.192	53.311
11	0.175	57.221
12	0.158	61.184
13	0.140	65.178

Besides the effects on individual banks' risk, mergers could also affect market competition and asymmetry in the banking sector. We measure market competition using the Herfindahl–Hirschman Index (HHI) of total loans. Higher values indicate a less competitive market. We measure asymmetry using the cross-sectional dispersion of total assets (normalized by $10e^6$), with higher values indicating a more asymmetric market. Such experiments are relevant because less competitive or asymmetric credit markets could undermine financial stability. The former may raise systemic risk by creating banks which are reputed to be "too-big-to-fail", while asymmetry in the size of banking sector can lead to disruptions in the inter-bank lending

[17] Results are available from the authors upon request.

[18] We use the standard deviation of ROA (SD(ROA)) from 2001 to 2015 to measure ROA volatility. We measure Z-score = (ROA + Equity / Assets) / SD(ROA).

(continued…)

market. Results are showed in Table 9.[19] We re-calculate both indexes using the deposits data, but results remain similar.

Table 9. Post-merger Market HHI and Asymmetry

Number of Banks in Merger	Average HHI-Loan	Average Asymmetry-Asset
2	1182	1.740
3	1233	1.788
4	1308	1.876
5	1409	2.009
6	1534	2.176
7	1685	2.384
8	1861	2.645
9	2062	2.980
10	2288	3.373
11	2539	3.749
12	2815	4.091
13	3117	4.464

In conclusion, we find that mergers of the indigenous banks could result in lower individual bank risk; however, mergers also lead to a less competitive as well as more asymmetric banking sector, decreasing the stability of the banking sector. Macroprudential policies could be very useful to minimize the negative consequences of mergers. Moreover, our analysis shows that cross-border mergers are generally better than within-country mergers since they are expected to improve banks' performance and stability through the diversification channel.

VI. CONCLUSION

Among the possible consolidation strategies, mergers and acquisitions (M&A) are often considered the most desirable ones since they allow banks to achieve economies of scale and scope, enhance revenues and reduce costs through operational efficiencies and synergies.

In the context of the ECCU banking sector, we show that the diversification of geographic loan markets could reduce the vulnerability of indigenous banks to idiosyncratic shocks. We estimate the effect of banks' loan-portfolio concentration on banks' risk performance historically. The evidence suggests that, in line with the recommendations of traditional portfolio and banking theories, diversification of bank assets through expansion in other regional markets could help ECCU indigenous banks to reduce NPLs and earnings' volatility.

Moreover, we show through merger simulations that cross-border consolidation of the indigenous banking sector can improve individual banks' stability. Despite such improvement, we further show that mergers may, on the other hand, decrease the competition and increase the asymmetry of the banking sector. Such results introduce a trade-off between the need to consolidate and the too-big-to-fail risk which may be managed through stronger supervision and prudential regulation.

[19] In all calculations, when indigenous banks are merged together, foreign banks remain unchanged in the market.

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