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LINKING THE CS OF FINANCIAL STABILITY: CRISES, COMPETITION, AND CONCENTRATION

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Abstract

This paper is a replication and extension of Schaeck, Cihak, and Wolfe (2009). In contrast to results for a heterogeneous set of countries in Schaeck, Cihak, and Wolfe (2009), findings herein indicate that there is a chance that competition engenders systemic banking crisis for ASEAN EMEs, and that although concentration may not increase the probability of a banking crisis, at decreasing levels of competition, increasing concentration could damage financial stability. When controls for regulation and macroprudential tools are introduced, the opposite effects of competition and concentration on financial stability becomes more apparent.

Keywords financial stability · concentration · competition · banking crises

1 Do competition and concentration engender financial stability?

In response to past crises, structural reforms, microprudential regulations, and macroprudential policy have been implemented. These would entail both positive and negative externalities. For instance, one negative externality arising from stronger deposit insurance scheme that aims to protect ordinary savers is an increase in moral hazard problems. More to the point, policy responses to make the financial system safer affect both competition and concentration: entry restrictions, and activity restrictions are barriers to entry that weaken competition, while increasing capital requirements encourages mergers resulting in increased concentration.

Do banking sector competition and concentration engender financial stability or fragility?

To answer this question, we first define financial stability. Similar to concepts like compactness of congressional districts, financial stability can be defined in many ways. However, the common denominator of these definitions is the absence of a crisis of financial origin—that is, the crisis brought to bear by the pandemic is not a financial crisis (although it could yet result in one), while the crisis of 2007-2009 is. In the current research, financial crisis is going to be defined as banking crisis as defined in Demirgüç-Kunt and Detragiache (2005). It is when at least one of the following conditions exists: the nonperforming assets of the banking sector is more than 10 percent of its aggregate assets; the fiscal cost of the economic rescue package is at least 2 percent of GDP; there is large-scale nationalization of banks; and there is widespread runs on banks or activation of emergency measures like deposit freezes, of prolonged bank holidays, or of generalized deposit guarantees.

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Meanwhile, according to Beck, Demircug-Kunt, and Levine (2005), the probability of a crisis occurring is linked to policies that hinder competition. The paper focuses on concentration and finds, additionally, that concentration does not sufficiently measure market power, that is, concentration and competition are proxies for different things.

It might seem obvious, then, that increasing competition among banks safeguards financial stability. After all, competition encourages efficiency and lower costs of financial intermediation, innovation, product differentiation, and, hopefully, increasing access to financial services. The answer is not so obvious since on the other hand, untrammelled competition could reduce interest margins and encourage excessive risk-taking. So, do we rein in competition then? But less competition would lead to increased market power allowing banks to charge higher-than-optimal interest rates, and, consequently, resulting in households and firms assuming the greater financial strain.

Corollarily, concentration (which can be loosely defined as only a few banks holding most of assets of the banking system) could give birth to too-big-to-fail banks that enjoy implicit guarantees from public funds. The Global Financial Crisis is a fresh memory.

Schaeck, Cihak, and Wolfe (2009) emphasizes that competition and concentration are not the same. Using 25 years of data for 45 economies, Schaeck, Cihak, and Wolfe (2009) finds robust results that competition—as measured by the H-statistic—and concentration both lower the probability of banking crisis. These results find support from one side of the theoretical debate positing that uncompetitive banking systems encourage banks to originate risky loans which subsequently result in system fragility. Furthermore, in banking sectors that are highly concentrated, preferences of regulators against letting banks that are too-big-to-fail devastate the financial and economic system unintentionally promote risky behavior among bank managers. But as a consequence, therefore, regulators will intervene to avoid failure and prevent crisis events. Meanwhile, Schaeck, Cihak, and Wolfe (2009) adds that since banks in concentrated markets are bigger, they can more easily diversify risk.

Schaeck, Cihak, and Wolfe (2009) uses the Panzar-Rosse H-statistic as the metric for competition and cites its analytical advantages. Monopolies would have Panzar-Rosse H-statistic $hstat < 0$ and monopolistic competition $0 < hstat < 1$ while perfectly competitive markets would have $hstat = 1$. (Panzar and Rosse (1987)) In other words, perfectly competitive banks would pass on the increase in its costs in its entirety to its clients.

In practice, the $hstat$ would be $\beta_1 + \beta_2 + \beta_3$ (Schaeck, Cihak, and Wolfe (2009), p.715) in the following reduced-form model in Claessens and Laeven (2004): (p.569)

$$\begin{aligned} \ln(R_t) = & \alpha + \beta_1 \ln(W_{1,it}) + \beta_2 \ln(W_{2,it}) + \beta_3 \ln(W_{3,it}) \\ & + \gamma_1 \ln(Y_{1,it}) + \gamma_2 \ln(Y_{2,it}) + \gamma_3 \ln(Y_{3,it}) + \delta DV + \varepsilon_{it} \end{aligned} \quad (1)$$

where R_i is the ratio of interest revenue to total assets (as a proxy for output price), $W_{1,it}$ is interest expenses-to-total deposits and money market funding (as proxy for the input price of deposits), $W_{2,it}$ is personnel expense-to-total assets (as a proxy for the price of labor), and $W_{3,it}$ is the share of other operating and administrative expenses in total assets (to proxy for the price of fixed capital). $Y_{1,it}$ controls for equity-to-total assets, $Y_{2,it}$ for net loans/total assets, and $Y_{3,it}$ is the log of total assets. DV is a vector of year dummies. The subscript i denotes individual banks, and t is for time.

In addition to the H-statistic, there are other measures of competition: the Herfindhal-Hirschman index (HHI), the Lerner index, and the Boone indicator. The Herfindhal-Hirschman index measures a firm's absolute size relative to the whole industry. In practice, it considers two factors: the number of firms and variance in market share distribution. The algorithm would tend to capture size rather than market dynamics. (Rhoades (1993)) Meanwhile, the Lerner index measures banks' margins, and where there is greater market power (i.e. less competition), margins are larger. Higher values of the Lerner index indicate greater market power since the bank is able to charge its clients more in excess of its marginal cost. (Lerner (1934)) Finally, the Boone indicator measures competition from an efficiency perspective. As competition heats up, more efficient banks should see their assets expand relatively more than less efficient banks, and the Boone indicator measures the extent to which this happens. Higher values of the Boone indicator suggests lower competition among banks. (Boone (2008))

For Leroy and Lucotte (2017), the answer to whether there is a competition-stability trade-off is more nuanced. The paper investigates both at the individual bank level and at the sector level

using the Lerner index as the proxy for competition, citing its advantages of being time-varying and individual-based compared to other competition metrics.

For individual banks, Z-score and Robert Merton’s distance-to-default metrics are used in Leroy and Lucotte (2017) as proxies for individual risk. The view that there is a competition-fragility nexus finds support in the results for individual-bank risk which indicate that competition increases risk-taking and individual bank fragility.

On the other hand, the opposite holds for systemic risk: market power or lack of competition increases systemic risk. More specifically, Leroy and Lucotte (2017) finds that although “systemic risk increases with the market power does not necessarily indicate that banks enjoying a higher degree of market power tend to display a riskier individual behavior [but rather that] market power tends to increase the deterioration of the capitalization of the system as a whole during a crisis.” (p.207) Thus, for systemic risk, we find a competition-stability nexus. For the systemic risk measure, Leroy and Lucotte (2017) uses SRISK which represents “how much a given financial institution contributes to the deterioration of the soundness of the system as a whole. Even if SRISK computation requires market and accounting bank specific-data, it differs from the Z-score and the distance-to-default because the measure is mostly driven by correlations in returns between the bank and the financial system as a whole.” (p.200)

Compared to competition, conventional measurement of concentration is more straightforward. Concentration is proxied by the proportion of a country’s total banking sector assets held by its three largest banks (Beck, Demirguc-Kunt, and Levine (2005)).

Gai, Haldane, and Kapadia (2011) finds that concentration (as well as complexity) causes financial instability, while macroprudential policy measures and regulations that focus on liquidity and systemically important financial institutions promote stability.

Meanwhile, Ijtsma, Spierdijk, and Shaffer (2017) cites empirical findings in the literature for both negative and positive impacts of concentration on financial stability. Even when financial stability is measured by z-scores such results persist. In Ijtsma, Spierdijk, and Shaffer (2017), the analysis of the impact of concentration on financial stability (for bank i and country m) are through:

$$z_{i,t}^{bank} = \alpha_i + \beta CM_{i,t} + \gamma \mathbf{B}_{i,t} + \delta \mathbf{C}_{i,t} + \theta \mathbf{DV} + \varepsilon_{i,t} \quad (2)$$

$$z_{m,t}^{country} = \lambda_i + \eta CM_{m,t} + \tau \mathbf{B}_{m,t} + \upsilon \mathbf{C}_{m,t} + \phi \mathbf{DV} + \varepsilon_{i,t} \quad (3)$$

CM is banking sector concentration measure. \mathbf{B} is vectors of bank control variables. \mathbf{C} is vectors of macroeconomic variables. \mathbf{DV} is vectors of year dummy variables.

This paper is a preliminary analysis on

- (1) examining the links between concentration and financial stability
- (2) understanding the links between competition and financial stability, and
- (3) assessing the interaction between concentration, competition, and macroprudential and financial regulation policies.

As a brief preview of the conclusion, assessments arising from the extension of Schaeck, Cihak, and Wolfe (2009) that focuses on four ASEAN emerging market economies and extends the time period to until 2020 result in both contradiction and confirmation of its results. Unlike in Schaeck, Cihak, and Wolfe (2009), increase in competition is found to increase banking sector fragility, but similar to Schaeck, Cihak, and Wolfe (2009), concentration is found to decrease the probability of systemic crisis. Some robustness in the relationship between banking fragility and competition and concentration emerge where competition (particularly as measured by the Lerner Index) and the interaction between competition and concentration persist when different proxies for macroprudential policies and banking regulations are introduced one at a time. Furthermore, the opposite impacts of competition and concentration on financial stability becomes more apparent when these controls for regulatory environment and macroprudential policy are added.

The findings suggest that when concentration increases in markets already highly competitive, banks could be hard pressed to assume more risk to increase profitability; consequently, there is competition-fragility nexus. On the other hand, when banking markets are already highly concentrated, increased competition would not encourage fragility or be good for stability, i.e., competition-stability link is established.

These findings are encouraging and justify further work on building rich datasets on z-scores on banking distress (akin to Ijtsma, Spierdijk, and Shaffer (2017), or Robert Merton’s distance-to-default), measures of concentration, and competition, and even extending to measures of centrality, and complexity first for the ASEAN and then for a more complete set of EMEs.

The paper is organized as follows: A replication of Schaeck, Cihak, and Wolfe (2009) is presented in Section 2. Section 3 extends the econometric approach in the previous section to the ASEAN-4 for the sample period 1980-2020. Section 4 concludes.

2 A replication of Schaeck, Cihak, and Wolfe (2009)

This paper replicates and extends the multivariate logit models in Schaeck, Cihak, and Wolfe (2009) (SCW2009). The dependent variable in these models is a dummy variable that takes the value 1 if there is a crisis and 0 otherwise. The probability that a banking crisis occurs at time t in country i is a function of n explanatory variables. The log-likelihood function of the models is: (p.717)

$$LnL = \sum_{t=1, \dots, T} \sum_{i=1, \dots, n} \{P_{i,t} \ln[F(\beta' X_{i,t})] + (1 - P_{i,t}) \ln[1 - F(\beta' X_{i,t})]\} \quad (4)$$

where $P_{i,t}$ is a dummy variable that takes on the value 1 when a banking crisis occurs in country i at time t and 0 otherwise, β is a vector of n coefficients, $\mathbf{X}_{i,t}$ is composed of the vectors of explanatory variables, and $F(\beta' \mathbf{X}_{i,t})$ is the cumulative probability distribution function evaluated at $\beta' \mathbf{X}_{i,t}$. The probability distribution is assumed to be logistic; thus, the β ’s are the effects of changes in the explanatory variables on $\ln\left(\frac{P_{i,t}}{1-P_{i,t}}\right)$.

To avoid feedback effects or endogeneity, the years after the onset of a crisis until such crisis has been resolved are excluded. Table 2 SCW2009 (p.719) indicates in its footnote that Indonesia, Philippines, and Thailand, among others, had crises that started in 1997-1998 (the Asian Financial Crisis) still ongoing in 2005. This explains the short sample period for ASEAN EMEs.

2.1 Data and variable definitions

The replication data are from the Dataverse repository Reed (2018), which obtained them from Schaeck, Cihak, and Wolfe (2009). The dataset for the replication is composed of 45 economies² with annual data from 1980–2005.

For the crisis dummy, SCW2009 follows the classification guide in Demirgüç-Kunt and Detragiache (2005). The crisis dummy—our dependent variable—takes the value of 1 if at least one of the following holds:

- the banking sector’s nonperforming assets/total assets is greater than 10 percent;
- the crisis rescue package is 2 percent of GDP or greater;
- there is large-scale nationalization of banks; or
- there is widespread bank runs or emergency measures (e.g., deposit freezes, prolonged bank holidays, or generalized deposit guarantees) are activated.

²Argentina, Austria, Bahrain, Bangladesh, Belgium, Brazil, Canada, Chile, Colombia, Costa Rica, Cyprus, Denmark, Dominican Republic, France, Germany, Greece, Hong Kong, India, Indonesia, Ireland, Israel, Italy, Japan, Kenya, Malaysia, the Netherlands, Nigeria, Norway, Pakistan, Panama, Paraguay, Peru, the Philippines, Portugal, Saudi Arabia, Senegal, South Africa, Sweden, Switzerland, Thailand, Tunisia, Turkey, the United Kingdom, the US, and Venezuela.

Table 1: Summary Statistics

Variable	Mean SCW2009	Mean	Std dev	Min	Max
GDP growth (lag)	3.4505	-0.10	3.78	-17.33	25.57
Inflation	15.0287	1.84	1.23	-4.26	6.88
Real interest rate	1.1214	1.15	17.69	-312.23	48.86
Depreciation	2.1880	1.90	2.91	-13.82	8.87
Terms of trade	4.0984	4.25	2.17	-8.23	29.78
Credit growth	11.2683	11.48	32.62	-81.19	447.81
Moral hazard index	1.3058	1.30	0.70	0.00	1.94
German legal origin	0.0886	0.09	0.29	0.00	1.00
French legal origin	0.3965	0.43	0.49	0.00	1.00
Scandinavian legal origin	0.0831	0.07	0.25	0.00	1.00
British legal origin	0.3910	0.39	0.49	0.00	1.00
Africa dummy	0.1267	0.11	0.32	0.00	1.00
Other dummy	0.4482	0.43	0.49	0.00	1.00
Latin America dummy	0.2057	0.21	0.41	0.00	1.00
G10 dummy	0.2193	0.25	0.43	0.00	1.00
Concentration	0.6734	0.67	0.16	0.35	0.98
H-statistic	0.3224	0.31	0.19	-0.08	0.79
Private credit/GDP	0.4485	0.52	0.38	0.00	2.18
Foreign ownership	0.1499	0.14	0.16	0.00	0.66
Government ownership	0.4697	0.43	0.33	0.00	1.00
Activity restrictions	9.7345	9.38	2.41	5.00	15.00
Entry restrictions	7.0573	7.03	1.63	0.00	8.00
Capital regulatory index	6.2054	6.19	1.59	3.00	10.00
Official supervisory power	10.6991	10.80	2.54	5.00	14.00
Private monitoring index	8.1037	8.13	1.25	6.00	11.00

* Source: Table 1, SCW2009, p.718; Author's estimates using Reed (2018) Dataverse dataset provided by SCW2009 authors

The explanatory variables are:

- GDP growth rate: The annual growth rate of real gross domestic product (GDP) is lagged by one period. Higher growth rate is expected to lower the probability of a banking crisis.
- Inflation rate: The annual percent change in the GDP deflator. Its expected effect on the probability of a crisis is ambiguous since inflation accompanies high GDP growth but could also indicate distress.
- Real interest rate: Nominal interest rate less inflation rate.
- Depreciation: The percent change in the exchange rate, domestic currency/US\$.
- Terms of trade: The terms of trade is the ratio of the index of export prices and the index of import prices multiplied by 100. Increases in the terms of trade means the country can buy more imports for a given quantity of exports indicating higher demand for its exports, thus, stronger domestic currency, and, therefore, lower probability of crisis. The change in the terms of trade is used.
- Credit growth: Growth rate of real domestic credit to the private sector from the banking sector. High growth rate could increase the probability of a crisis.
- Moral hazard index: SCW2009 defines this index as a measure of the 'generosity of design features of deposit insurance schemes'. A generous deposit insurance design could be thought to increase financial system fragility as it will tend to promote moral hazard.
- H-statistic: It is a proxy for the competitiveness of the banking sector using Eq. 1. Higher value indicates more competition.
- Concentration: The share of three largest banks to aggregate assets of the banking system. The average for the sample period is used.

The dummy variables for legal origins are important because they determine creditor rights. Dummy variables for region are included to categorize countries as African, Latin American, or others, and as either a G10 country or otherwise.

Control variables for the macroprudential, regulatory, and institutional environment from Barth, Jr, and Levine (2001) are also included in the dataset. Activity restrictions (higher value means more restrictions), entry restrictions (higher value means higher barrier to entry), and the capital regulatory indices (higher value means more stringent and higher barrier to entry) are proxies for market contestability.

Foreign ownership represents the proportion of bank assets owned by foreigners, while government ownership is the proportion that is government-owned.

Official supervisory power index is a proxy for the extent of the banking supervisors' power to take action to prevent banking problems. Higher value means greater power by the bank supervisor.

The private monitoring index is a function of the proportion of banks with international credit ratings, and the existence of an explicit deposit insurance, risk management protocols, and disclosure rules for off-balance sheet items. Higher value of the index means greater degree of monitoring.

Finally, the dates of the crises are important since we only include when the crisis first hit and do not include the subsequent years until the crisis is resolved to avoid endogeneity.

Table 1 presents the summary statistics of the dataset alongside the mean from the paper being replicated. Despite some differences between columns 2 and 3, the dataset from the Dataverse replicated three out of four logit models. The one that did replicate (Model 4 on Table 2 (on p.7)) differs only from Model 3 by the interaction term between competition and concentration measures. Thus, the different results for the replicated Model 4 are likely not due to these differences between column 2 and column 3 of Table 1 herein.

2.2 Replication results

The replication exercise successfully duplicates the main results that both competition and concentration individually promote financial stability. Except for the terms of trade, the macroeconomic variables have the expected signs. Higher GDP growth rate lowers the probability of a crisis. Higher inflation rate, real interest rate, depreciation (measured as growth rate therefore, higher values indicate depreciation in the domestic currency's value), and credit growth increase the probability of a banking crisis.

Model 1 is the baseline model. Model 2 adds H-statistic, the measure of competition used in SCW2009, to the baseline model. Model 3 is Model 1 with both H-statistic and the concentration measure, and Model 4 adds a term for the interaction of the competition and concentration measures. Despite minor differences in some coefficients and the standard error estimates, Models 1-3 were substantially replicated, but not Model 4 which nests Model 3 and uses the same dataset. In contrast to SCW2009's findings that both the competition and concentration measures remained statistically significant in Model 4 in Table 2, both are not statistically significant in the replication the last model. I note, though, that the pseudo R^2 for the original estimation of last model is 0.170 versus Model 3's 0.217. On the other hand, the pseudo R^2 of Model 4's replication is 0.218—very close to Model 3's 0.217. (Table 2, p.7)

Table 2: Logit Models Replication Results. Competition and concentration lowers probability of banking crisis.

Dependent Variable:	Baseline		With H-statistic		With H-stat and Concentration		With H-stat*Concentration	
	(1) SCW2009	(1) Replication	(2) SCW2009	(2) Replication	(3) SCW2009	(3) Replication	(4) SCW2009	(4) Replication
Banking Crisis								
GDP growth (lag)	-0.2527*** (0.0785)	-0.253*** (0.058)	-0.2554*** (0.0773)	-0.255*** (0.059)	-0.2640*** (0.0842)	-0.264*** (0.061)	-0.1908*** (0.0661)	-0.261*** (0.061)
Inflation	0.4218 (0.2767)	0.422* (0.255)	0.5328* (0.2985)	0.533** (0.268)	0.5125 (0.3154)	0.512* (0.273)	0.5729* (0.2971)	0.512* (0.273)
Real interest rate	0.0298* (0.0180)	0.030* (0.017)	0.0306 (0.0193)	0.031* (0.018)	0.0290 (0.0222)	0.029 (0.019)	0.0295 (0.0212)	0.028 (0.019)
Depreciation	0.0442 (0.0687)	0.044 (0.059)	0.0273 (0.0653)	0.027 (0.060)	0.0151 (0.0685)	0.015 (0.061)	-0.0042 (0.0674)	0.015 (0.061)
Terms of trade	0.1963*** (0.0469)	0.196 (0.143)	0.2680*** (0.0609)	0.268 (0.167)	0.2388** (0.0655)	0.239 (0.186)	0.2564*** (0.0811)	0.242 (0.186)
Credit growth	0.0005 (0.0006)	0.0005 (0.001)	0.0006 (0.0006)	0.001 (0.001)	0.0006 (0.0006)	0.001 (0.001)	0.0007 (0.0006)	0.001 (0.001)
Moral hazard index	0.3708 (0.3276)	0.371 (0.356)	0.5596 (0.3550)	0.560 (0.390)	0.4734 (0.3803)	0.473 (0.415)	0.2946 (0.3423)	0.453 (0.419)
German legal origin	0.4487 (1.1780)	0.449 (1.209)	0.2724 (1.2038)	0.272 (1.218)	0.5139 (1.1809)	0.514 (1.226)	0.3924 (1.1910)	0.505 (1.224)
French legal origin	1.1244* (0.5915)	1.124** (0.564)	0.8124 (0.6748)	0.812 (0.601)	1.2292** (0.6031)	1.229** (0.592)	1.1026* (0.6048)	1.253** (0.593)
Scandinavian legal origin	0.7364 (0.8832)	0.736 (0.875)	0.1937 (0.9042)	0.194 (0.898)	1.1016 (0.8323)	1.102 (0.962)	0.6969 (0.8555)	1.071 (0.971)
Africa dummy	0.5977 (0.8904)	0.598 (0.886)	0.6712 (0.9422)	0.671 (0.927)	1.0718 (0.9226)	1.072 (0.952)	1.2201 (0.8942)	0.973 (0.972)
Other dummy	0.2038 (0.6734)	0.204 (0.668)	0.5525 (0.6716)	0.553 (0.680)	0.9495 (0.7398)	0.950 (0.719)	1.3707* (0.7825)	0.928 (0.714)
Latin America dummy	-1.0271 (0.8322)	-1.027 (0.820)	-0.7543 (0.8183)	-0.754 (0.825)	-0.8618 (0.8182)	-0.862 (0.816)	-0.7434 (0.8722)	-0.964 (0.853)
H-statistic			-2.3116** (1.0644)	-2.312* (1.186)	-2.9703** (1.2328)	-2.970** (1.336)	-3.9930*** (1.4312)	0.420 (7.512)
Concentration					-3.4672** (1.4747)	-3.467** (1.523)	-4.9316*** (1.7041)	-2.365 (2.815)
H-statistic : Concentration							-7.9806 (9.3370)	-5.031 (11.023)
Observations	734	734	707	707	707	707	707	707
Pseudo r-squared	0.180	0.180	0.195	0.195	0.217	0.217	0.170	0.218

^a Source: Own estimates; Table 3, SCW2009

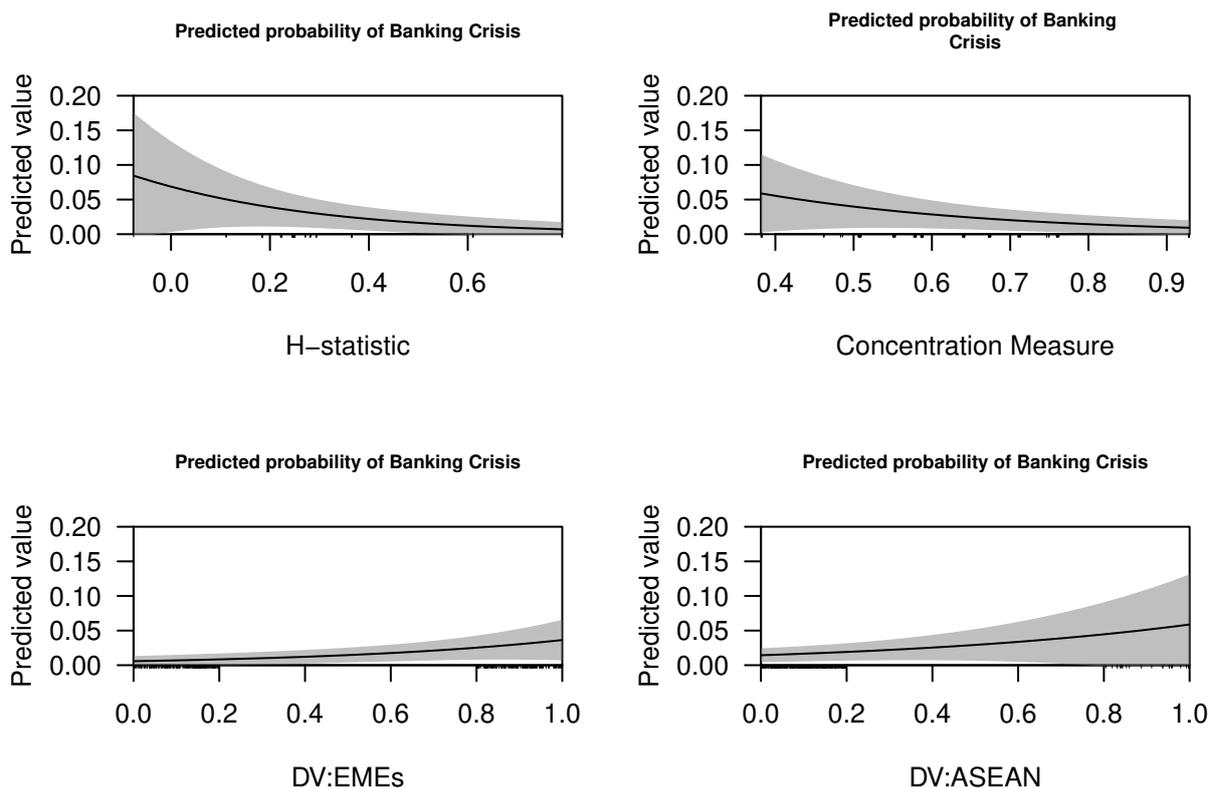


Figure 1: Changes in Predicted Probabilities of Banking Crisis (1980-2005). Increases in competition and concentration lower the predicted probability of a banking crisis. Non-EMEs and Non-ASEANs have lower predicted probability of a banking crisis.

2.3 Controlling for economic development status: Motivating the extension

First, as further validation of the contribution of competition and concentration to financial stability indicated by the previous replication exercise, the top row of Figure 1 shows the predicted probability of a banking crisis declining as H-statistic increases (top row, left panel) and as concentration declines (top row, right panel).

Meanwhile, in the literature on sovereign credit ratings determination or the ability and willingness of countries to service their obligations (e.g., Bagic and Bernabe 2011), economic development status—i.e., whether one is an advanced economy or an emerging market economy (EME)—is a significant factor. In the current case, when a dummy variable for EME is included as an extension of the original study, it is found to be statistically significant as well. Although the original dataset has a dummy variable for G10 to proxy economic development status, not all non-G10 are EMEs—for one, non-G10 would include frontier economies in addition to EMEs.

Model A in Table 3 is Model 1 (in Table 2) but with a dummy variable that takes the value 1 if country i is an EME economy, and 0 otherwise. Model B and C includes H-statistic and concentration, respectively. Lastly, Model D replaces the dummy variable for EMEs in Model C with that for ASEAN.

The results with respect to our quantities of interest are mostly consistent with SCW2009. For EMEs, competition promotes financial stability or lowers the probability of the occurrence of a banking crisis; however, the coefficient of concentration, although still negative, has turned insignificant. The dummy variable for the French legal origin became insignificant but the real GDP growth, inflation rate, real interest rate, moral hazard index (for specifications with competition and/or concentration measures) and the dummy variables for Latin America, and EMEs are significant and with most coefficients comparable to Model 1 estimates.

When the specification that includes both competition and concentration measures is evaluated for ASEAN, both competition and concentration have significant effects of lowering the probability of a banking crisis similar to SCW2009. Meanwhile, being ASEAN contributes positively to the probability of a crisis occurring. (Model D)

Table 3: Logit Models with Dummy Variables for EMEs and ASEAN

	<i>Dependent variable:</i> Banking crisis			
	(A)	(B)	(C)	(D)
GDP growth (lag 1 period)	-0.252*** (0.057)	-0.264*** (0.058)	-0.267*** (0.059)	-0.260*** (0.061)
Inflation	0.517* (0.279)	0.631** (0.291)	0.605** (0.292)	0.633** (0.292)
Real interest rate	0.033* (0.018)	0.034* (0.019)	0.032* (0.019)	0.029 (0.018)
Depreciation	0.106 (0.067)	0.084 (0.066)	0.066 (0.068)	0.014 (0.062)
Terms of trade	0.228 (0.190)	0.230 (0.181)	0.218 (0.193)	0.222 (0.202)
Credit growth	0.0001 (0.001)	0.0002 (0.001)	0.0003 (0.001)	0.0001 (0.001)
Moral hazard index	0.606 (0.412)	0.951** (0.477)	0.847* (0.489)	0.361 (0.434)
German legal origin	0.614 (1.259)	0.885 (1.308)	0.880 (1.294)	0.610 (1.242)
French legal origin	0.729 (0.559)	0.861 (0.582)	1.021* (0.590)	1.070* (0.593)
Scandinavian legal origin	1.300 (0.946)	1.142 (0.993)	1.609 (1.064)	1.421 (1.016)
Africa	0.049 (0.958)	0.614 (1.046)	0.784 (1.038)	0.914 (0.973)
Other	-0.731 (0.821)	-0.472 (0.843)	-0.253 (0.877)	0.298 (0.800)
LatinAmerica	-2.696** (1.057)	-2.524** (1.058)	-2.371** (1.058)	-0.948 (0.841)
Emerging Market Economy	1.903*** (0.684)	2.124*** (0.739)	1.864** (0.794)	
ASEAN				1.452** (0.699)
H-statistic		-3.103** (1.482)	-3.319** (1.531)	-2.437* (1.438)
Concentration			-1.758 (1.586)	-2.814* (1.673)
Constant	-7.498*** (1.452)	-7.778*** (1.533)	-6.402*** (1.955)	-4.887*** (1.768)
Observations	707	707	707	707
Log Likelihood	-97.378	-94.876	-94.249	-95.085
Akaike Inf. Crit.	224.756	221.753	222.498	224.171

Note: *p<0.1; **p<0.05; ***p<0.01

The bottom row in Figure 1 shows that the predicted probability of a banking crisis occurrence increases as one moves towards EMEs in general (bottom left) and towards ASEAN EMEs (bottom right) even as the errors around the predicted probabilities widen also. Focusing on ASEAN economies could help clarify the role of competition and concentration in the pursuit of financial stability for ASEAN emerging markets and reduce model uncertainties.

3 Focusing on emerging markets: ASEAN-4

The ASEAN-4 are Indonesia, Malaysia, the Philippines, and Thailand. Future work will include other EMEs in the ASEAN-10 as much as data will allow. These four ASEAN EMEs included in Schaeck, Cihak, and Wolfe (2009). Availability of EME data has been a challenge in the past. Application of SCW2009 at this time when longer time series and a richer dataset have since been generated and made available by national institutions is a good place to start and motivate future research directions and data generation priorities.

Table 4: Summary Statistics (ASEAN-4, 1980-2020)

Variable	Mean	Std dev	Min	Max
GDP growth rate	5.32	3.30	-9.57	13.29
Inflation	5.22	4.06	-1.14	19.70
Real interest rate	5.15	4.09	-4.58	18.83
Depreciation (growth rate local/USD)	2.65	8.51	-12.51	40.95
Terms of trade	-0.03	1.44	-5.90	2.99
Lending to private sector by banks/GDP	66.13	40.18	9.53	166.50
Moral hazard index	0.39	1.81	-1.34	2.98
French legal origin	0.49	0.50	0.00	1.00
British legal origin	0.51	0.50	0.00	1.00
Foreign reserves-to-IMF adequacy metric	1.59	0.57	0.83	2.90
Foreign reserves-to-external debt	54.53	43.64	6.66	171.26
Foreign reserves growth	4.24	7.64	-15.74	33.82
GDP deflator index	74.24	41.63	4.32	154.57
Concentration	0.55	0.15	0.29	1.00
H-statistic	0.35	0.19	0.13	0.85
Lerner Index	0.25	0.11	-0.01	0.52
Boone Indicator	-0.05	0.14	-0.44	0.07
Foreign ownership	0.15	0.09	0.07	0.34
Government ownership	0.36	0.24	0.12	0.99
Activity restrictions	8.59	2.35	5.00	12.00
Entry restrictions	7.85	0.36	7.00	8.00
Capital regulatory index	6.71	2.79	3.00	10.00
Official supervisory power	11.27	1.10	10.00	13.00
Private monitoring index	8.56	1.12	7.00	10.00

^a Sources: Reed (2018), Bandaranayake (2019), IMF WEO Database (October 2021), IMF International Financial Statistics, World Bank Indicators

The assessment extends the period to 1980-2020 and added foreign reserves metrics and two other measures of competition: the Lerner index and the Boone indicator. The extended estimates of the concentration measure, H-statistics, alternative competition, and moral hazard measures are from the Dataverse repository Bandaranayake (2019) (up to 2016), while data on regulatory indices are from Reed (2018) (series until 2011). These series from Bandaranayake (2019) and Reed (2018) are taken off from the original dataset and either remained constant throughout or were continued from SCW2009 with new estimates. For this extension and as motivation for updating these estimates, the latest available figures from these two data repositories are copied through to 2020 since these are structural and, thus, “slow moving” indicators. The full set of the macroeconomic data used for this extended focus on the ASEAN-4 is from International Monetary Fund (2021) and World Bank (2021), replacing fully the original series used in SCW2009 for these four economies.

The summary statistics of the smaller, more homogeneous set but with a longer time series highlights the significant differences of the two sets and further justifies this exercise to focus on these EMEs. (Table 4) It bears emphasizing that due to the different time spans of the two datasets, the following comparisons serve only to highlight differences in the datasets that could result in differences in findings between SCW2009 and this extension.

As to be expected from not-yet-matured economies, the mean GDP growth rate of the ASEAN-4 is higher. Post-GFC, ASEAN EMEs as a group contributed much of global output growth. On the other hand, the mean inflation for the new sample is much lower at 5 percent (versus 15 percent) due to the significant moderation in inflation worldwide in the last decade or so. In fact, before the COVID pandemic, low inflation (and even negative inflation) was a policy concern in some advanced economies.

Mean real interest rate of the ASEAN-4 is higher than the more heterogeneous original sample. Meanwhile, the mean terms of trade rate of change for the ASEAN-4 is negative compared to 4 percent of the original sample.

Updated data on private credit growth are not as easily available as the private credit-to-GDP so it was not included. In any case, the private credit-to-GDP ratio is not as easily subject to size bias and base effect as the growth rate of private credit. The 40-year mean credit-to-GDP ratio of the

ASEAN-4 is higher at 66 percent than the 45 percent 25-year mean of the original sample. It must be stressed that the different time frames means that the new dataset reflects the post-GFC ultra-easy monetary policy in Advanced Economies, particularly the US. Phenomena like this would shift the line in the sand for distress.

The moral hazard index of the original sample is also significantly higher at 1.3 relative to the ASEAN-4 mean of 0.39 reflecting their much less generous bank deposit insurance schemes.

As for the regulatory and governance environment indicators, both the share of government ownership of the banking sector and activity restrictions index are lower in ASEAN-4. These are consistent with the lower mean concentration in ASEAN-4. Smaller banks would likely be allowed to engage in more activities like bancassurance to (1) help them leverage on economies of scope, and (2) since they may not be “too-big-to-fail” or “too-interconnected” there is less chance that their failure would cause systemic risk. On the other hand, the mean of the indices on entry restrictions, capital requirements regulation, bank supervisory power, and private monitoring of banks are all higher for the ASEAN-4 relative to the original data. This comparison, however, must also account for the implementation of international benchmarks (like Basel II and then Basel III regulations) as well as the increasing weight that investors put on environmental, social and corporate governance (ESG) since early 2000s.

Different foreign reserves metrics are included in the extension of SCW2009 to reflect priors on the particular lesson that the Asian Financial Crisis left on EMEs. There are several rationales for an economy to increase its foreign reserves but foremost of which is to insure itself against devastating devaluation of its currency if capital inflows suddenly stop or capital suddenly leaves, which in turn distress its banking sector. Thus, it is expected that high level or increases in foreign reserves would lower the probability of a crises.³

Meanwhile, only the dummy variables for French and British legal origin remain as applicable to the ASEAN-4.

Finally, given the lack of newer vintage of H-statistics estimates and to motivate future endeavors on estimating measures of competition (and concentration) with greater accuracy and frequency, two other measures of competition are included: the Lerner index (Lerner (1934)) and the Boone indicator (Boone (2008)). Unlike the H-statistic for which increases in value indicates more competition, for both the Lerner index and the Boone indicator, increases in their values mean going from more competition to less competition.

3.1 Competition and concentration could increase probability of crisis

Visual inspection of Figure 1 (top row) and Figure 2 immediately tells us that new dataset does not generally follow the results of SCW2009. In the first column of Figure 2, we see that although the results from using the H-statistic (higher value means greater competition) and the Boone indicator (lower value means greater competition) show that greater competition lowers the probability of a banking crisis, the specification using the Lerner index indicate the opposite.

To be more specific, in Table 5, only Lerner index, as well as its interaction with concentration, is statistically insignificant. Results using the Lerner Index (higher value means less competition) indicate that lower competition decreases the probability of a banking crisis. Meanwhile, although not statistically significant in this specification, an increase in concentration, by itself, lowers the probability of a crisis. When the sign of the coefficient of the interaction of competition and concentration is positive, then higher value of the Lerner index increases the effect of concentration and a higher value of concentration increases the effect of the Lerner index on the probability of a crisis. Thus, at higher levels of concentration, lower competition would tend to increase the probability of systemic banking crisis, and with less competition (higher Lerner index), a rise in concentration increases the probability of a banking crisis.

For the Lerner model, at the mean, the total effects of both concentration and competition are positive, that is, increase the probability of banking crisis. On the other hand, and although the coefficients are statistically insignificant, the opposite holds for the H-statistic model and the Boone

³Although foreign reserves growth is statistically significant in predicting banking fragility, specifications including it fail the GIM test so it was removed at this time, but will be revisited in the future when more data are available.

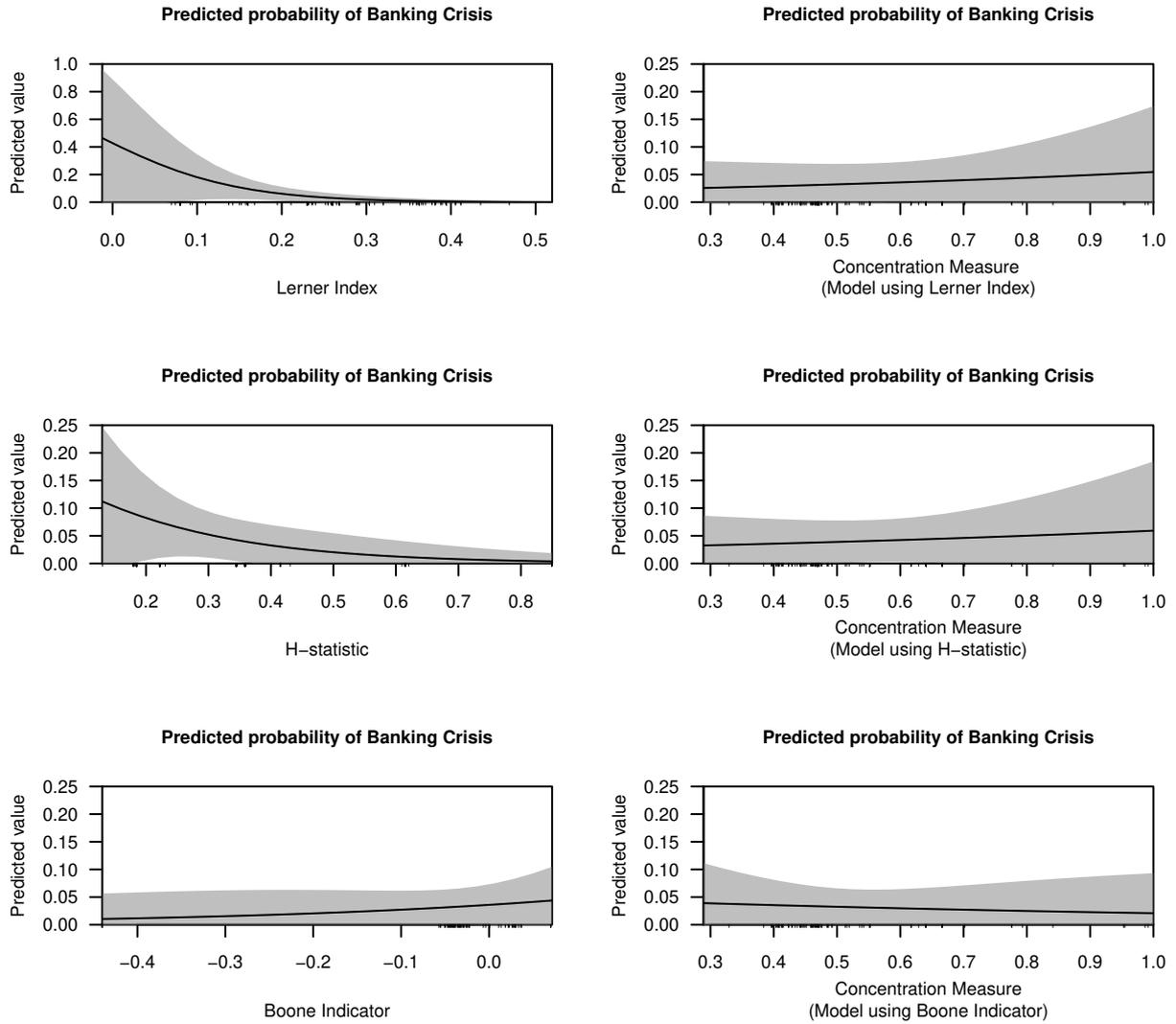


Figure 2: Predicted Probabilities of Banking Crisis and the Different Competition Measures (ASEAN-4). Increase in competition could increase on the predicted probability of crisis, contrary to results for the dataset with 45 heterogeneous economies (1980-2005). The effect of concentration on predicted probability of banking crisis is also not as clear cut.

Table 5: Logit Models with Different Competition Measures

Dependent Variable: Banking Crisis	H-statistic (pseudo R-squared = 0.12)		Lerner Index (pseudo R-squared = 0.24)		Boone Indicator (pseudo R-squared = 0.13)	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Intercept	-2.53	0.70	4.44	0.16	-1.60	0.43
Competition measure	-2.50	0.89	-31.99	0.02	28.26	0.17
Concentration measure	2.44	0.85	-7.99	0.11	-3.28	0.40
Real GDP growth	-0.18	0.05	-0.22	0.02	-0.14	0.11
Private credit-to-GDP	0.01	0.25	0.01	0.23	0.01	0.22
Competition:Concentration	-4.38	0.90	36.28	0.09	-46.53	0.11

^a Source: Author's estimates

Table 6: Models with Foreign Ownership Restriction

Dependent Variable: Banking Crisis	H-statistic		Lerner Index		Boone Indicator	
	Estimated coefficient	p-value	Estimated coefficient	p-value	Estimated coefficient	p-value
Intercept	-1.64	0.78	5.08	0.12	-0.29	0.91
Competition measure	-4.30	0.80	-34.15	0.02	33.07	0.13
Concentration measure	1.33	0.91	-8.38	0.11	-2.95	0.49
Real GDP growth	-0.17	0.05	-0.23	0.02	-0.15	0.11
Private credit-to-GDP	0.01	0.32	0.01	0.19	0.01	0.47
Foreign ownership restriction	-2.98	0.66	-2.77	0.74	-7.56	0.22
Competition:Concentration	-0.10	1.00	39.45	0.08	-52.02	0.09

^a Source: Author's estimates

indicator model since the coefficients of the interaction terms are negative with greater magnitude than the coefficients of the competition and concentration measures in these models.

Based on these results and from the subsequent regressions that tests the impact of macroprudential policy illustrated in Figure 3 (p.15) that the results using the Lerner index hold more consistently for the ASEAN-4 dataset. Recall that the H-statistic as defined in the dataset uses interest rate revenue while the Lerner Index measures how much it can charge over its marginal costs. Thus, the Lerner Index includes non-interest revenues. Consider this in conjunction with the lower mean activity restrictions for ASEAN-4. This could be the reason for the greater power of the Lerner index measure.

It bears repeating that unlike the results for the more heterogeneous set of countries used in SCW2009, this dataset of four ASEAN EMEs shows that there is a chance that concentration and competition could engender systemic banking crisis. But even though the foregoing results offer contradiction in the results relative to SCW2009, these align with Gai, Haldane, and Kapadia (2011) and some of the literature cited in Ijtsma, Spierdijk, and Shaffer (2017).

Nonetheless, more analysis with better data is called for given that the results for the competition-stability link are statistically significant only for one measure of competition. For one, a more up-to-date series for competition and concentration measures and more EMEs in the dataset could provide a stronger basis for inference. It would be interesting to see a more definitive result for the concentration-stability link.

3.2 Opposite impacts of competition and concentration on financial stability

The share of foreign ownership could be thought of a proxy for interconnectedness to the international financial markets—the influence of global governance standards on the local banking sector, and stature of the banking system among international investors. Presumably, stable and profitable banks and banking systems will attract foreign ownership. At the same time, domestic regulations could limit the entry of foreign banks and/or foreign ownership in domestic banks with the aim of limiting instabilities. In any case, foreign ownership (*foreigno*) is not statistically significant in any of the models in Table 6. Nevertheless, its negative coefficient supports the view that foreign ownership is associated with a stable banking sector. At the same time, controlling for foreign ownership turned the interaction of competition and concentration significant for the Boone model. Since the Boone indicator is higher for less competitive markets, then, the negative coefficient of the interaction term indicates opposite effects of competition and concentration on the probability of a crisis—a contradiction of the results in SCW2009. This result for the Boone model persist even when the foreign ownership variable is replaced with indicators for activity restrictions, entry restrictions, and capital requirement stringency.

The regulatory (or microprudential) and macroprudential policy environment has direct and indirect effects on the risk-taking behavior and business decisions of banks, thus, affecting competition and concentration in the banking sector. For instance, policies with respect to restrictions on activities the banks can engage in, legal and documentary requirements to engage in banking business (i.e., entry restrictions), and initial and ongoing bank capital requirements stringency (capital regulatory index) will have impacts on how contestable a market the banking sector is. Tables 7-11 show regression results when proxies for these policies and institutional constraints are added one at a time to the models in Table 5.

Table 7: Models with Activity Restriction

Dependent Variable: Banking Crisis	H-statistic		Lerner Index		Boone Indicator	
	Estimated coefficient	p-value	Estimated coefficient	p-value	Estimated coefficient	p-value
Intercept	-2.54	0.67	4.78	0.16	-2.86	0.26
Competition measure	-4.46	0.80	-36.06	0.02	29.38	0.15
Concentration measure	0.56	0.96	-9.42	0.08	-5.17	0.28
Real GDP growth	-0.21	0.03	-0.25	0.02	-0.19	0.05
Private credit-to-GDP	0.00	0.80	0.01	0.62	0.00	0.92
Activity restriction	0.18	0.43	0.14	0.61	0.36	0.21
Competition:Concentration	-0.26	0.99	41.41	0.07	-50.39	0.09

^a Source: Author's estimates

Table 8: Models with Entry Restrictions

Dependent Variable: Banking Crisis	H-statistic		Lerner Index		Boone Indicator	
	Estimated coefficient	p-value	Estimated coefficient	p-value	Estimated coefficient	p-value
Intercept	8.94	0.45	27.49	0.03	12.48	0.18
Competition measure	-4.69	0.84	-46.90	0.01	38.37	0.10
Concentration measure	2.05	0.89	-11.05	0.05	-4.10	0.32
Real GDP growth	-0.21	0.03	-0.30	0.01	-0.19	0.04
Private credit-to-GDP	0.01	0.45	0.01	0.43	0.01	0.39
Entry restrictions	-1.34	0.21	-2.51	0.06	-1.69	0.12
Competition:Concentration	-2.95	0.95	52.52	0.05	-60.98	0.06

^a Source: Author's estimates

An inspection of Figure 3 (on p.15) confirms that for the ASEAN-4, lower competition—as measured by the Lerner index (in blue)—lowers the probability of a crisis, or put another way, competition increases the risk of financial instability. More importantly, concentration turns significant again—but, again, only for the Lerner index models—upon controlling for policy tools and regulatory environment with respect to activity restriction (*activrest*), entry restriction (*entrybr*), capital regulation (*crindex*), official supervisory powers (*ospower*), and private monitoring (*pmindex*).

The activity restriction index is a function of restriction of banks relative to securities and insurance underwriting, brokering, dealing, and selling; and real estate investment, development, and management. Higher value of the index means greater restriction. It is not significant in any of the three models in Table 7 but concentration in the Lerner model is now significant, and is consistent with the findings in SCW2009 on the negative impact of concentration on the probability of a banking crisis occurrence.

The entry restrictions index pertains to legal requirements to obtain a banking license and takes a higher value at greater level of restrictions. Results from the Lerner model in Table 8 show that entry restrictions lower the probability of a crisis. Less competition, and higher concentration also lowers the probability of a crisis. The interaction term remains positive and significant, reinforcing the opposite effects of competition (as measured by the Lerner index) and concentration as they relate to financial stability.

Table 9: Models with Capital Regulatory Index

Dependent Variable: Banking Crisis	H-statistic		Lerner Index		Boone Indicator	
	Estimated coefficient	p-value	Estimated coefficient	p-value	Estimated coefficient	p-value
Intercept	0.46	0.95	10.10	0.07	2.01	0.58
Competition measure	-1.27	0.96	-42.83	0.03	33.10	0.11
Concentration measure	2.04	0.90	-11.41	0.06	-5.33	0.27
Real GDP growth	-0.22	0.02	-0.26	0.01	-0.18	0.05
Private credit-to-GDP	0.00	0.72	0.00	0.74	0.00	0.73
Capital regulatory index	-0.30	0.12	-0.33	0.19	-0.27	0.21
Competition:Concentration	-7.94	0.86	46.99	0.09	-52.18	0.08

^a Source: Author's estimates

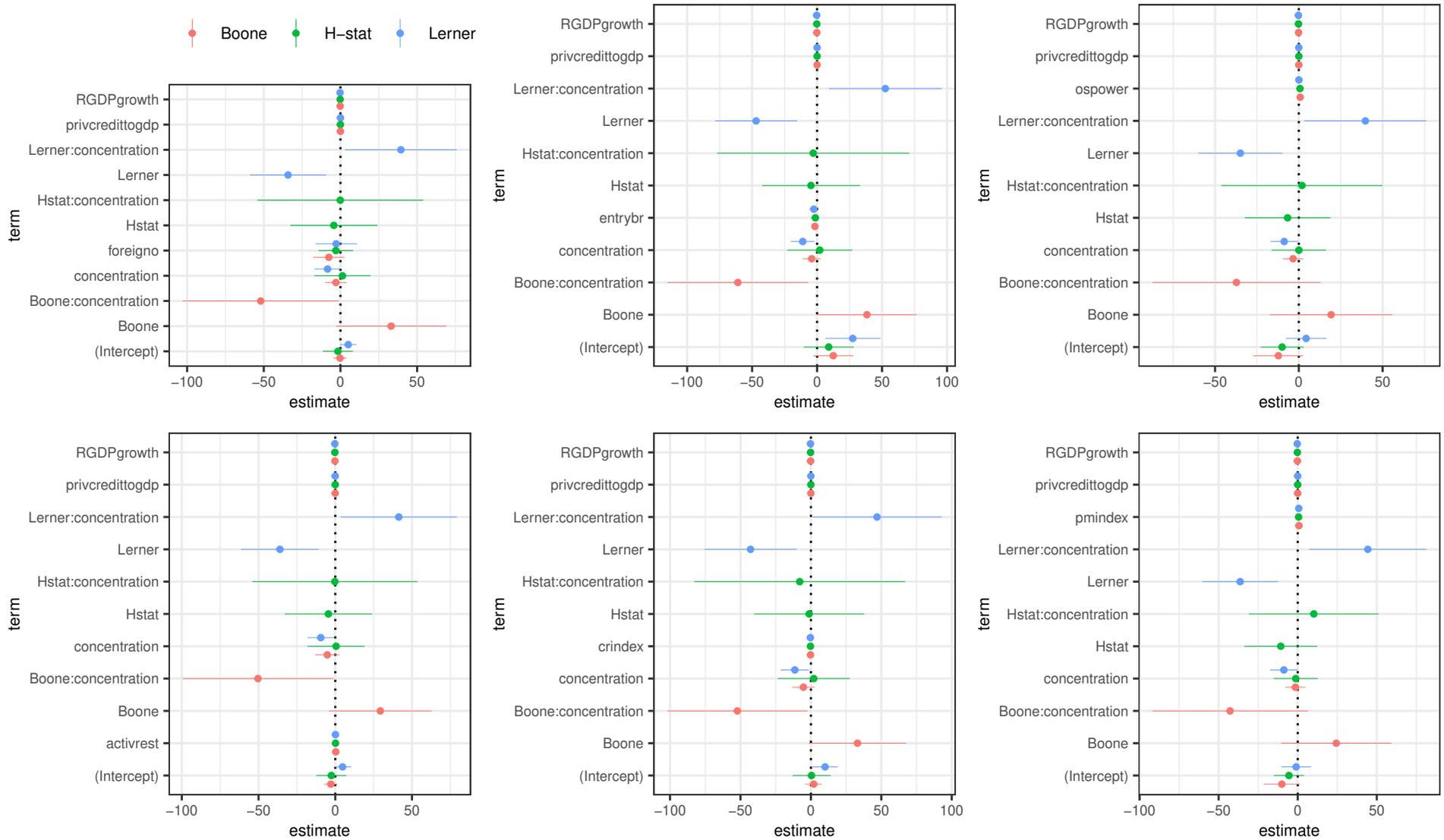


Figure 3: Logit models with different competition measures and with macroprudential policies and regulation (at 90 CI). The opposite impacts of competition and concentration on financial stability becomes apparent when controls for regulatory environment and macroprudential policy are introduced.

Table 10: Models with Index on Supervisory Powers

Dependent Variable: Banking Crisis	H-statistic		Lerner Index		Boone Indicator	
	Estimated coefficient	p-value	Estimated coefficient	p-value	Estimated coefficient	p-value
Intercept	-9.97	0.20	4.38	0.55	-12.20	0.18
Competition measure	-6.69	0.67	-34.85	0.02	19.28	0.39
Concentration measure	0.05	1.00	-8.72	0.08	-3.42	0.36
Real GDP growth	-0.20	0.03	-0.23	0.02	-0.16	0.09
Private credit-to-GDP	0.02	0.08	0.01	0.22	0.03	0.08
Supervisory powers index	0.73	0.15	0.06	0.91	0.83	0.22
Competition:Concentration	1.89	0.95	39.73	0.07	-37.21	0.22

^a Source: Author's estimates

Table 11: Models with Index on Private Monitoring of Banks

Dependent Variable: Banking Crisis	H-statistic		Lerner Index		Boone Indicator	
	Estimated coefficient	p-value	Estimated coefficient	p-value	Estimated coefficient	p-value
Intercept	-5.52	0.34	-0.99	0.86	-10.01	0.15
Competition measure	-10.71	0.44	-36.38	0.01	24.39	0.25
Concentration measure	-1.25	0.88	-8.74	0.10	-1.50	0.70
Real GDP growth	-0.20	0.03	-0.28	0.01	-0.17	0.09
Private credit-to-GDP	0.01	0.19	0.02	0.12	0.02	0.10
Index on private monitoring of banks	0.58	0.24	0.66	0.17	0.80	0.21
Competition:Concentration	10.17	0.68	44.34	0.05	-42.75	0.15

^a Source: Author's estimates

The indicator for capital regulatory index is the sum of overall capital stringency⁴ and initial capital stringency⁵, with higher values indicating greater strictness. It is not significant in any of the models in Table 9 although it is negative across the three models, indicating that strict rules on capital requirements lower the probability of a crisis. Previous results on the significance of competition and concentration measures and their interactions hold.

To control for the might of the banking supervisors in enforcing policies to promote a safe and sound banking system, an index on official supervisory powers is used (Table 10) A higher value of *ospower* indicates greater power of intervention and enforcement by the regulator. Again, previous results for the Lerner model persist: competition and concentration have opposite effects on fragility and the positive coefficient of their interaction means that a decrease in competition could increase the impact of concentration in the probability of a crisis, and the higher the degree of concentration, the higher the effect of competition.

Although not statistically significant, Table 11 shows that private monitoring could lower the probability of a systemic banking system fragility. The private monitoring index is a function of requirements for certified audit of banks, international credit rating for the 10 biggest banks, accounting standards and disclosure adherence, whether explicit deposit insurance exists, and if depositors were not fully compensated in previous bank failures. It takes a higher value as private monitoring increases. Again, previous results for the Lerner model persist.

4 Conclusion

In summary, competition and concentration have opposite impacts on the probability of a banking crisis for the ASEAN-4: less competition lowers the probability of a banking crisis while higher concentration lower the probability of systemic instability. Furthermore, a decrease in competition could increase the impact of concentration in the probability of a crisis, and the higher the degree of concentration, the higher the effect of competition.

These findings, thus, suggest that when concentration increases in markets already highly competitive, banks could be hard pressed to assume more risk to increase profitability; consequently, the competition-fragility nexus dominates. On the other hand, when banking markets are already

⁴Explicit requirement pertaining to the amount of capital banks must hold

⁵Whether assets other than cash, and government securities; and borrowed funds can be used as initial source of funds and for subsequent capital infusions; and whether the regulators verify these sources

highly concentrated, increased competition would not encourage fragility or be good for stability: competition-stability nexus.

Although the metrics for the regulatory, and institutional environment that were collected in the late 1990s might still provide insights. However, global banking standards have changed, not least because of the various Basel regulation issuances. In addition, given the devastating effects of the Asian Financial Crisis to the crisis-hit economies in the region, sweeping structural reforms were instituted. These, as well as the changes since the Global Financial Crisis, mean that updating these measures would be helpful in confirming the robustness of the foregoing findings. Nonetheless, since we can safely infer that the direction of the changes is towards increased macroprudential policies and better governance frameworks, the results here with respect to these provide useful insights.

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