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ScienceDirect
Journal of Banking & Finance 31 (2007) 1633–1647
Journal of BANKING & FINANCE
www.elsevier.com/locate/jbf

Concentration and foreign penetration in Latin American banking sectors: Impact on competition and risk ☆

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Received 1 July 2005; accepted 14 November 2006
Available online 23 January 2007

Abstract

In the 1990s, Latin American banking sectors experienced an accelerated process of concentration and foreign penetration that prompted diverse views regarding its implications for the competitive behavior of banks and the financial stability of the system. In this paper, we examine these issues exploiting a rich bank-level database for eight Latin American countries. We find that, while increased concentration did not weaken banking competition within the region, foreign penetration appears to have led to a less competitive industry. Moreover, we find that bank risk has been negatively associated with competition which, coupled with the previous finding, explains the positive link between banking sector stability and foreign penetration revealed by the data.

JEL classification: E44

Keywords: Banking; Finance; Concentration; Competition

☆ The authors are grateful to Cesar Serra and Luciana Moscoso for their invaluable research assistance, to our editor and one anonymous referee, and participants in the First IDB/OECD Latin American Competition Forum and the World Bank/JBF Conference on Globalization and Financial Services in Emerging Economies, for their useful comments on an earlier draft.
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0378-4266/$ - see front matter
doi:10.1016/j.jbankfin.2006.11.003

1. Introduction

The last decade witnessed important changes in the banking industry in most Latin American countries. While participation of foreign banks more than doubled in many cases, banking concentration increased mainly due to a process of consolidation led by mergers that in many instances were triggered by financial crises and regulatory tightening.[1] These twin developments have raised concerns about their impact on competition (in particular, borrowing costs and banking efficiency) and financial stability. The purpose of this study is to assess whether and how the consolidation and internationalization processes have affected the competitive environment and the stability of the banking sectors in the region.

Despite the general belief that bank consolidation generates a more concentrated system and, as a consequence, a less competitive one, there is no clear analytical argument supporting this view in the literature.[2] For example, a merger between firms serving overlapping or identical markets reduces competition and increases efficiency by eliminating duplication of activities. Alternatively, it is not at all clear whether competition and concentration should go in opposite directions. At any rate, a wide range of studies that analyze the US and EU experiences conclude that mergers seem to have been pro-competitive in general.[3] In addition, bank consolidation could result from an increase in the substitutability of bank services leading to stiffer competition.[4]

The impact of consolidations and concentration on system stability is also an open question. Theoretically, competition may have a deleterious impact on stability if it causes banks' charter value to drop, thus reducing the incentives for prudent risk-taking behavior. Stiffer competition, instead, could lead to more aggressive risk taking, as documented in some empirical studies.[5] On the other hand, a concentrated system, to the extent that it implies the presence of a few relatively large banks, is more likely to display a "too big to fail" problem whereby large banks increase their risk exposure anticipating a bailout (Hughes et al., 1999). In addition, banking sector consolidation in Latin America has largely reflected the acquisition of local banks by bigger foreign institutions, a process underscored by episodes of financial distress and in part related to the lower perceived vulnerability of foreign banks to financial shocks.[6]

In turn, empirical tests of the link between foreign penetration and competition within the bank industry have not been conclusive.[7] Similarly, the few papers that tests the link between foreign penetration and financial stability in developing countries have yielded mixed results, either when the latter is measured as systemic crisis propensity (Beck et al., 2005) or as bank risk-taking behavior (Crystal et al., 2002). It has to be noted that the competition measures used in this literature, namely, profitability or net margins (with lower margins and profits signaling a more competitive environment) have important

[1] See Levy Yeyati and Micco (2003).

[2] See Carletti et al. (forthcoming) and Yanelle (1997).

[3] For the US see Avery et al. (1998), Kroszner and Strahan (1998) and Berger et al. (1997). For the EU see Vives (2001).

[4] See Matutes and Vives (2000) and Cordella and Levy Yeyati (2001) for an analytical discussion, and Prati and Schinasi (1999) and Schargrodsky and Sturzenegger (2000), for empirical applications.

[5] See Cerasi and Daltung (2000) and Keeley (1990).

[6] Indeed, during episodes of financial turmoil, it is common to observe a flight to quality that tends to result in a larger concentration of deposits in foreign-owned banks.

[7] See Claessens et al. (2001), Unite and Sullivan (2003) and Levine (2003).

caveats, particularly in the context of Latin America where foreign banks have often entered through the purchase of distressed banks during crises, periods that tend to be associated with low profits and (due to high risk premiums) high interest rate margins. The same applies, to a lesser degree, to financial stability measures.[8] At any rate, the consequences of the recent internationalization and consolidation of banking sectors in the region is still under discussion.

In this paper, we exploit a rich bank-level balance sheet and income database for eight relatively homogeneous Latin American countries to revisit these issues.[9] Based on the full sample of banks for eight Latin American countries (Argentina, Brazil, Chile, Colombia, Costa Rica, El Salvador, Mexico and Peru), we estimate Panzar and Rosse's (1987) competitive behavior parameter for each country and year, which we believe provides a more precise gauge of the evolution of the degree of competition over time than the traditional indirect measures used in the literature. We use this measure to test whether and how changes in the degree of competition relate to changes in concentration and foreign participation.

We find that, while there is no evidence that concentration significantly reduced competition in the industry, foreign penetration appears to have led to a less competitive environment, a finding further confirmed by a positive link between foreign penetration and bank profits.

Next, we examine how competition, concentration and internationalization influence banking stability, where the latter is proxied alternatively by Roy's (1952) Z-score (a distance-to-default measure) and by the non-performing loan ratio. By exploring the impact of foreign entry on both competition and risk, we can identify risk effects that are due to changes in the degree of competition induced by foreign entry. More precisely, we find, again, that increased concentration has virtually no influence on bank insolvency risk. By contrast, the latter is positively related with competition, and through this channel, negatively influenced by foreign penetration – despite the fact that foreign banks in our sample exhibit higher risk indicators due to higher leverage ratios and more volatile returns.

The plan of the paper is the following. Section 2 describes the data and the estimation of the competition indicator, and presents related econometric results. Section 3 moves to banking fragility issues, addressing the link between competition, concentration and internationalization, on the one hand, and bank insolvency risk, on the other. Section 4 concludes.

2. The data

In this paper, we use a detailed balance sheet database comprising all commercial banks in eight Latin American countries: Argentina, Brazil, Chile, Colombia, Costa Rica,

[8] For example, systemic crisis propensity may understate actual bank risk when measured over a limited period of time in which risk may not be realized, and is silent about bank-specific risk, which is likely to be most influenced by foreign entry. An internationalized banking sector may be partially isolated from bank runs due to the implicit insurance of highly capitalized parents, irrespectively of the risk-taking behavior of foreign-owned institutions. More generally, if protected banking sectors generate inefficient institutions, foreign penetration may simply capture the benign systemic effect of market liberalization. On the other hand, bank risk measures such as loan loss provisions may reflect an increase in loan losses (hence, greater risk) rather than less risk-taking as assumed by Unite and Sullivan (2003).

[9] The sample includes Argentina, Brazil, Chile, Colombia, Costa Rica, El Salvador, Mexico and Peru.

El Salvador, Mexico and Peru. The source, in all cases, is the national central bank or the superintendence of banks, when autonomous.[10]

2.1. Measures of concentration and foreign penetration

While there is a wide array of concentration measures proposed in the industrial organization literature,[11] hardly any of them have been used in the empirical banking literature with the exception of the k-firm concentration ratio (CR_k) and the Herfindahl–Hirschman index (HHI). For the sake of comparability, in this paper we use these two measures (CR_3 and CR_5 in the case of the concentration ratio) based on total bank assets.[12] In turn, we measure foreign penetration as the foreign-owned to total asset ratio (FASSETS), where foreign banks are defined as those controlled by institutions with headquarters in developed countries.[13]

2.2. Measures of competition

To measure competition we follows the well known Panzar and Rosse's (PR) approach, which have been used in several studies to test competition for the European banking industry.[14]

Following the literature, we estimate the following standard specification of the reduced-form revenue equation that allows H to vary on a yearly basis:

$$\ln \mathrm{FINR}_{\mathrm{it}} = \alpha_i + \sum_y (\beta_y \ln \mathrm{AFR}_{\mathrm{it}} + \gamma_y \ln \mathrm{PPE}_{\mathrm{it}} + \delta_y \ln \mathrm{PCE}_{\mathrm{it}}) + \eta \ln \mathrm{OI}_{\mathrm{it}} + \sum_j \xi_j \ln \mathrm{BSF}_{jit} + \sum_j \lambda_j X_{jt} + v_{\mathrm{it}}, \quad (1)$$

where β_y, γ_y, δ_y, are set to 0 if quarter t does not belongs to year y. FINR is the ratio of (gross) total financial revenue to total assets. AFR represents the ratio of annual interest expenses to total funds, or the Average Funding Rate. PPE is the ratio of personnel expenses to the total balance sheet, or the (approximated) Price of Personnel Expenses). PCE represents the ratio of physical capital expenditure and other expenses to fixed assets, or the (approximated) Price of Capital Expenditure. BSF are bank specific exogenous factors (fundamentals), lagged one quarter, reflecting differences in risks, costs, and size of the bank: (i) risk component, proxied by equity (EQ) and loans (LO) ratios, and by the liquid-

[10] See the Appendix for bank data coverage, definitions and summary statistics. Crisis years such as Argentina 2001 and Brazil 1994 were deliberately excluded from our sample.

[11] For a survey, see Bikker and Haaf (2001a).

[12] In addition, we computed the concentration measures also for a subset of markets (private deposits, private credit, mortgage loans and consumer loans). Concentration indicators are highly correlated.

[13] Control is defined as a minimum 51% stake. Alternatively, we used the ratio of foreign to total banks. We refer the reader to Levy Yeyati and Micco (2003) for the results using this indicator. Banks controlled by foreign institutions located in developing (typically neighboring) countries are treated as domestic banks. As discussed in Levy Yeyati and Micco (2003), many of them are subsidiaries of a non-financial firms that specialize in financial services tied to the activities of the parent. More generally, they do not benefit from the greater financial sophistication and implicit parent guarantee that has been associated in the literature with foreign banks in developing countries.

[14] Bikker and Haaf (2001b) present a summary of early studies and results.

ity (CASH) ratio, all normalized by total assets, (ii) differences in the deposit mix (in turn, related to funding costs), captured by demand deposits from customers to total customer and short-term funding (DDC), and (iii) size, proxied by the log of total real assets (LASSETS), where assets are deflated by the CPI. OI represents the ratio of Other Income to the Total Balance Sheet, a proxy for income from off-balance sheet activities. And X represents time-variant macroeconomic factors such as the reference interest rate (INT) and the inflation rate (INF).[15]

In turn, we estimate the parameter H defined, for each year y, as the sum of the elasticities of the reduced-form revenues with respect to factor prices, FINR, AFR and PPE

$$H_y = \beta_y + \gamma_y + \delta_y. \tag{2}$$

The PR model shows that $H \leqslant 0$ under monopoly, $0 < H \leqslant 1$ under monopolistic competition (arguably a more realistic characterization of banks' interaction), and $H = 1$ under perfect competition. Thus, while values significantly different from zero or one would indicate monopolistic competition, the magnitude of H can be interpreted as an inverse measure of the degree of monopolistic power (alternatively, a measure of the degree of competition).

In our specification we allow for time-varying Hs.[16] Estimating parameter changes over time is key to the purposes of our paper for two reasons. From a methodological perspective, the parameter H depends on industry-specific characteristics.[17] Thus, by extension, it is not straightforward to see to what extent cross-country variations reveal differences in long-run equilibrium. As a result, a simple cross-country comparison is likely to lead to misleading conclusions unless other country-specific characteristics are controlled for. A closer look at within-country parameter changes, by contrast, is more likely to provide useful information about the evolution of competition and its determinants.

From a practical perspective, on the other hand, since our interest lies in the correlation between the consolidation and foreign penetration *trends* and the evolution of competition, our emphasis lies clearly on the dynamic, as opposed to the cross-section, dimension.

With this in mind, and in order to avoid imposing restrictions on the way the parameter changes while maximizing precision, we compute time-varying Hs using observations for the whole period to maximize the precision of our estimates, and without imposing undue restrictions on the way they evolve over time.

2.3. Measures of bank risk

We measure solvency risk as the probability that losses in a given year (negative returns) exceed the bank's equity capital (EQ). Normalizing returns and equity by the bank's assets and using the Chebishev inequality[18]

[15] Reference and inflation rates are sourced from the World Bank's World Development Indicators.

[16] Few papers allows for time-varying Hs, the exceptions are Molyneux et al. (1994) and Bikker and Haaf (2001b) for developed countries, and Gelós and Roldós (2004) for developing ones.

[17] As Bresnahan (1989) puts it, industries have idiosyncratic characteristics that affect firm's conduct, therefore "...practitioners in this literature are skeptical of using comparative statics of variations across industries or markets as revealing anything, except when the markets are closely related".

[18] See Roy (1952).

$$P\left(\mathrm{ROA}_{it} \leqslant -\frac{\mathrm{EQ}_{it}}{A_{it}}\right) \leqslant \frac{\sigma^2_{\mathrm{ROA}_{it}}}{\left(\mu_{\mathrm{ROA}_{it}} + \frac{\mathrm{EQ}_{it}}{A_{it}}\right)^2} \equiv \frac{1}{Z^2_{it}}, \tag{3}$$

where ROA_{it} and E_{it} are bank i's returns on assets and capital over total assets in period t, and $\mu_{\mathrm{ROA}_{it}}$ and $\sigma^2_{\mathrm{ROA}_{it}}$ are the mean and variance of the distribution of ROA_{it}. More precisely, we estimate Z_{it} for each bank and year, using the sample mean and variance of quarterly ROA over a three-year period (that is, over the previous 12 quarters) as our estimate of $\mu_{\mathrm{ROA}_{it}}$ and $\sigma^2_{\mathrm{ROA}_{it}}$.[19]

Note that the variable Z_{it} defined above is a proxy for the probability of insolvency of bank i at time t or, more precisely, the probability of a negative shock to profits that forces the bank to default. A smaller Z (a larger risk exposure) can be associated with narrower returns (due, for instance, to greater inefficiency or reduced market power), larger return volatility (due to poorer diversification or a less conservative choice of investments), or higher leverage (due to lower capitalization). Thus, Z is a composite that weighs in three factors traditionally associated with higher risk. As a robustness check, the results reported below include tests of these three risk factors separately.[20]

3. Econometric results

Our empirical testing proceeds in four steps. First, we estimate our measure of competition, the parameter H, for each year as well as for the period as a whole, according to our baseline specification. Second, we test whether and how this parameter correlates with the evolution of bank concentration and foreign participation over time.[21] Finally, we examine the link between concentration and foreign participation, on the one hand, and banking stability, as proxied by bank-specific Zs, on the other.

3.1. Concentration, foreign penetration and competition

In Table 1, we report weighted least squared (WLS) estimates of a time-invariant H for each country, where observations are weighted by the banks' asset share.[22] While most of the previous studies tend to focus on large banks, our dataset include all banks in the system. Therefore, the WLS procedure, by weighting larger banks more heavily, captures better the behavior of the representative bank.[23] WLS have a couple of additional advantages. First, by using banks' asset share as weights we can read our results as reflecting the average level of competition faced by borrowers in the system. Second, under the reasonable assumption that measurement errors are decreasing with bank size, WLS yield more precise estimates. Finally, if banks' behavior (market power) differs significantly with

[19] For a discussion of Z index and empirical applications, see De Nicoló (2000) and De Nicoló et al. (2005).

[20] Our estimates of Z proved to be significantly and negatively correlated *over time* with other conventional risk measures such as the non-performing loan ratio, the interbank interest rate, bank funding costs, and the capital-asset ratio. Results are available from the authors on request.

[21] In non reported results, we regress bank returns on H to check whether a more competitive environment, as measured by an increase in H, is reflected in narrower margins and lower returns.

[22] Time-invariant Hs are calculated by setting $\beta_y = \beta$, $\gamma_y = \gamma$, and $\delta_y = \delta$ for all y.

[23] For comparison with previous studies, we use OLS to compute time-invariant H. OLS and WLS coefficients are comparable. See Levy Yeyati and Micco (2003).

Table 1
Estimates of time-invariant H (bank-level panel data, WLS)

	Argentina	Brazil	Chile	Colombia	Costa Rica	México	Peru	El Salvador
AFR	0.327	0.778	0.591	0.436	0.555	0.740	0.398	0.490
	(0.047)***	(0.014)***	(0.043)***	(0.031)***	(0.018)***	(0.023)***	(0.019)***	(0.026)***
PPE	0.191	0.075	0.186	0.051	0.081	0.106	0.233	0.077
	(0.044)***	(0.052)	(0.066)***	(0.030)*	(0.029)***	(0.028)***	(0.036)***	(0.041)*
PCE	0.013	0.070	0.102	0.111	0.019	−0.026	0.009	0.061
	(0.022)	(0.010)***	(0.033)***	(0.032)***	(0.010)*	(0.012)**	(0.023)	(0.032)*
OI	0.048	−0.026	−0.004	−0.007	−0.035	0.046	0.010	0.016
	(0.027)*	(0.011)**	(0.009)	(0.009)	(0.018)*	(0.015)***	(0.012)	(0.011)
EQ	0.071	−0.042	0.152	0.093	−0.212	0.008	−0.164	0.033
	(0.023)***	(0.021)**	(0.034)***	(0.026)***	(0.033)***	(0.027)	(0.036)***	(0.041)
LO	0.237	−0.015	0.077	0.008	0.164	−0.033	0.391	0.321
	(0.051)***	(0.011)	(0.033)**	(0.066)	(0.021)***	(0.024)	(0.052)***	(0.059)***
DDC	0.030	0.011	0.074	−0.008	−0.003	0.039	−0.034	0.053
	(0.024)	(0.007)	(0.030)**	(0.014)	(0.008)	(0.008)***	(0.018)*	(0.020)***
CASH	−0.010	−0.000	−0.001	−0.102	−0.048	−0.000	0.270	0.065
	(0.002)***	(0.000)**	(0.000)***	(0.030)***	(0.032)	(0.000)***	(0.082)***	(0.071)
LASSETS	0.004	−0.123	−0.028	−0.063	−0.117	0.044	−0.095	0.045
	(0.024)	(0.031)***	(0.035)	(0.043)	(0.022)***	(0.023)*	(0.020)***	(0.031)
INT	0.025	−0.002	−0.004	0.005	0.001	0.001	−0.000	−0.002
	(0.005)***	(0.001)*	(0.001)***	(0.001)***	(0.002)	(0.001)	(0.001)	(0.002)
INF	−1.078	−0.520	4.920	0.834	0.147	0.443	0.281	0.188
	(1.071)	(0.680)	(1.848)***	(0.284)***	(0.337)	(0.304)	(0.414)	(0.402)
Constant	−1.016	2.261	1.047	−0.007	1.069	0.059	−0.075	−1.248
	(0.276)***	(0.457)***	(0.439)**	(0.671)	(0.421)**	(0.186)	(0.247)	(0.456)***
Observations	2337	4808	968	831	716	832	766	326
R-Squared	0.7810	0.9399	0.9777	0.8787	0.9497	0.9582	0.8895	0.9253
H[a]	0.5315	0.9229[b]	0.8794[c]	0.5982	0.6553	0.8194	0.6405	0.6281

Robust standard errors in parentheses. *, ** and *** represents significant at 10%, 5% and 1%, respectively. AFR represents the ratio of annual interest expenses to total funds (logs), PPE is the ratio of personnel expenses to the total balance sheet (logs), PCE is Deposits over assets (logs), OI represents Other income over assets (in logs), EQ represents Equity over assets (logs), LO is Loans over assets (logs), DDC is Demand deposits over total deposits (logs), CASH is Cash over assets (in logs), LASSETS represents Assets over CPI (logs), INT is interest rate and INF represents Quarterly inflation rate.

Note: Observations are weighted using banks' assets share.

[a] $H = 0$ (monopoly), and $H = 1$ (perfect competition) rejected at the 1% significance level unless otherwise indicated.

[b] Significantly different from 1 at 20%.

[c] Significantly different from 1 at 5%.

size, the evolution of an unweighed estimate of H may be spuriously reflecting changes in the size distribution as a result of the consolidation process.

The perfect competition ($H = 1$) and monopoly ($H = 0$) hypotheses are rejected at conventional levels for all countries. Time-invariant Hs reported at the bottom of the table are directly comparable with similar estimates found in the literature. Interestingly, our estimates of H for Latin American countries do not differ in range and cross-country variability for those found in more developed countries. However, as noted, cross-country comparisons of the H indicator can be highly misleading.

We henceforth center our analysis on the results that can be inferred from the dynamic dimension, for which we need to measure the evolution of the H parameter. WLS

Table 2
Estimates of time-varying H (bank-level panel data, WLS)

	Argentina	Brazil	Chile	Colombia	Costa Rica	México	Peru	El Salvador
1993							0.512	
1994			0.856			0.830	0.544	
1995	0.482	0.811	0.909	0.552	0.636	0.864	0.535	
1996	0.507	0.847	0.878	0.515	0.626	0.864	0.529	
1997	0.521	0.859	0.871	0.520	0.625	0.850	0.535	0.695
1998	0.517	0.860	0.841	0.564	0.651	0.866	0.563	0.674
1999	0.504	0.842	0.900	0.576	0.667	0.814	0.582	0.703
2000	0.501	0.837	0.836	0.582	0.642	0.805	0.550	0.719
2001		0.828	0.851	0.571	0.645	0.792	0.588	0.734
2002		0.859	0.870	0.591	0.641	0.800	0.568	0.672
Average	0.506	0.843	0.868	0.559	0.642	0.832	0.551	0.699
Std. dev.	0.014	0.017	0.025	0.028	0.014	0.030	0.024	0.025
Max. Diff.	0.038***	0.050***	−0.073***	0.076*	−0.042***	0.074***	0.076***	−0.062**
F-Test	0.000	0.010	0.001	0.078	0.000	0.000	0.000	0.023

Notes: In all cases, $H = 0$ (monopoly), and $H = 1$ (perfect competition) are rejected at the 5% significance level, based on robust standard errors.
Max. Diff. is the difference between the largest and smallest H for each country. *, **, *** indicates that it is significantly different from zero at 1%, 5%, and 10% respectively (F-test reports the p-values of the previous test). Observations are weighted using banks' assets share.

estimates of time-varying Hs are presented in Table 2.[24] As can be seen, while the parameter is relatively stable and comparable with the time-invariant estimates, it still shows considerable variation over time. Indeed, the difference between the highest and lowest values of H over the period is significantly different from zero for all countries, as indicated by the tests reported at the bottom of the table.[25]

Estimates of H can be used to address the link between *changes* in concentration and foreign penetration, on the one hand, and *changes* in competition, on the other. Table 3 reports the results from regressions of H on our measures of concentration and foreign penetration. Column 1 uses OLS with country and year fixed effect. Our results show that while changes in concentration seems to exert no significant influence on H, foreign participation shows a negative and significant effect on competition. One could argue that if, for individual countries, foreign banks (and new entrants in general) are more likely to enter in less competitive markets that offer higher intermediation margins, the resulting negative cross-section correlation between foreign participation and competition would be captured by the country fixed effects. However, the same argument also implies that, if for any reason a country becomes increasingly less competitive, the number of foreign banks in the country may increase *pari passu*. If so, the observed negative dynamic correlation reported in the table may be due to the reverse direction of causality.

The last three columns in Table 3 deal with this potential endogeneity problem by instrumenting foreign entry. As instrument, we use the contemporaneous average of the foreign

[24] The coefficients corresponding to other regressors are similar to those reported in the previous table.
[25] Reassuringly, the estimated H are significantly and negatively correlated *over time* with bank returns (a more straightforward measure often used as a proxy for banking competition in the literature (Levy Yeyati and Micco, 2003).

Table 3
Concentration, foreign penetration and competition (country-level panel data)

	(1) OLS	(2) IV	(1) IV	(2) IV
Log#Banks	−0.052	−0.052	−0.053	−0.057
	(0.027)*	(0.027)*	(0.028)*	(0.027)**
FASSETS	−0.096	−0.084	−0.084	−0.081
	(0.029)***	(0.031)***	(0.032)**	(0.033)**
CR_3	0.032	0.029		
	(0.093)	−0.093		
CR_5			0.013	
			−0.09	
HHI				−0.047
				−0.248
Observations	63	63	63	63
R-Squared	0.98	0.98	0.98	0.98
Fixed effect	Country and year			

Standard errors in parentheses.
FASSETS in country *i* at time *t* instrumented by the average of FASSETS for all countries other than *i* at time *t*.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

shares in the rest of the countries in the sample. This variable, while highly correlated with the foreign share in individual countries (due to common internationalization trends in Latin America), is unlikely to be caused by the local competitive environment. As can be seen, the foreign share coefficient is remarkably robust, dispelling endogeneity concerns.

3.2. Foreign penetration and banking stability

We turn next to the impact of foreign penetration on banking stability, which we test by running bank-level regressions of our measure of bank risk, Z, against the share of foreign assets and the degree of competition as captured by H. To control for macroeconomics conditions we also include controls for real growth and exchange rate volatility (both measured over the three-year period over which the Z-score is computed). Finally, we control for bank fixed effect in all specifications except in columns (6)–(8) where we replace bank effects by a proxy for bank size and a foreign ownership dummy. All regressions include either a time trend or time dummies.

Table 4 reports the results.[26] The macroeconomic controls have the expected sign (economic growth reduces bank risk whereas exchange rate volatility increases it) and are significant in most cases. Competition, in turn, increases bank risk, while the coefficients of bank concentration (measured here as CR_3) and foreign participation fail to be significant.

As before, the results bear the question of whether the incidence of foreign penetration on risk confirms its reported impact on competition. To tackle this question, in columns (4) and (5) we replicate the exercise in columns (1) and (3) this time excluding the

[26] The paper compute Z based on quarterly data over the previous three years and excluding the 2% tails the distribution of ROA. Results using a 2- and 4-year window or including the tails yield similar results.

Table 4
Concentration and banking fragility (bank-level panel data, WLS)

Dep. var.	Z								NPL
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
H	−22.03	−20.893	−19.193			−17.031	−13.198		0.785
	(11.054)*	(9.632)*	(10.660)**			(8.564)*	(7.963)**		(0.249)***
FASSETS_AVG	−0.406	−0.226	0.179	2.744	2.955	0.747	1.589	3.519	0.005
	(2.114)	(1.898)	(1.741)	(2.829)	(2.529)	(1.601)	(1.387)	(1.737)*	(0.047)
Δlog(GDP)	0.079	0.087	0.091	0.117	0.131	0.11	0.132	0.162	−0.003
	(0.056)	(0.054)	(0.066)	(0.049)*	(0.056)*	(0.046)*	(0.054)*	(0.048)***	(0.001)***
s_{ER}	−0.604	−0.643	−0.998	−0.606	−1.147	−0.612	−1.144	−1.28	0.029
	(0.339)**	(0.323)*	(0.446)*	(0.428)	(0.056)*	(0.321)**	(0.415)***	(0.446)***	(0.078)
CR_3_AVG		−4.101							
		(7.087)							
DFOR_3						−0.553	−0.539	−0.552	
						(0.190)***	(0.178)***	(0.171)***	
LASSETS_AVG						0.414	0.417	0.416	
						(0.148)***	(0.151)***	(0.153)***	
Year	−0.085	−0.082		−0.228		−0.139			0.000
	(0.169)	(0.148)		(0.225)		(0.128)			(0.004)
Observations	2279	2279	2279	2279	2279	2261	2261	2261	996
R-Squared	0.78	0.78	0.78	0.76	0.77	0.39	0.4	0.4	0.81
Fixed effects	Bank	Bank	Bank, year	Bank	Bank, year	Country	Country, year	Country, year	Bank

Robust errors clustered by country in parentheses.

Notes: Z is computed based on the last three years, excluding observations from the 2%-tails of ROA. Observations are weighted using banks' assets share at the country level (each country has the same weight in the regressions). All control variables are measured based on the three-year period over which Z is computed. LASSETS_AVG: average of the log of bank assets. FASSETS_AVG: average share of foreign-owned over total bank assets. Δlog(GDP): cumulative growth. s_{ER}: standard deviation of monthly exchange rate changes. DFOR_3: dummy that takes the value one whenever a bank has been foreign-owned for (at least) the last three years. NPL: Non-performing loans over total loans; available for Chile, Colombia, Costa Rica, México, Perú, El Salvador.

* Significant at 5%.

** Significant at 10%.

*** Significant at 1%.

competition measure. As expected, the coefficient of foreign competition are positive and larger than before, albeit not significant.

To explore this link further, in columns (6)–(8) we replace bank effects by a foreign ownership dummy and a size variable. This time, the positive link between foreign penetration and risk is positive and significant when the competition indicator is dropped in column (8). Interestingly, the foreign dummy is negative and strongly significant in both cases, suggesting that, while foreign penetration tend to increase the market power of the representative bank, foreign banks are individually characterized by a higher risk profile than their domestic counterparts. The results in the table are robust to the use of the non-performing loan ratio (NPL) as an alternative measure of bank risk (column 9),[27] as well as to the use of a semi-logarithmic specification (Levy Yeyati and Micco, 2003).

[27] The sample, however, is severely reduced, as data are available only for Chile, Colombia, Costa Rica, Mexico, Peru, and El Salvador.

How specific is this higher risk profile to foreign banks and where is it coming from? We examine this issue more closely in Table 5, where we run regressions of Z and its individual components on a foreign bank dummy, a size variable, and a country-year fixed effect that controls for all country-specific (time-varying or invariant) effects. The results confirm the previous finding in a quite general way. Column (1) shows that the Z-score is significantly higher for foreign banks. Expected returns on assets, however, are not influenced by foreign ownership (column (2)). By contrast, columns (3) and (4) show that foreign banks exhibit higher leverage ratios and larger return volatility than national banks. The same is true when we use a semi-logarithmic specification (columns (5)–(7)).[28]

It is possible that, since many foreign banks entered the Latin American market purchasing formerly national banks in distress, these findings may be capturing the transitorily higher risk of the recently acquired bank. To test this hypothesis, in columns (8) and (9) we revise our foreign dummy to single out banks that were owned by foreign institutions at least for four and five years (that is, were acquired one and two years before the beginning of the period over which Z is computed). The results confirm our previous findings in both cases.

Thus, the link between foreign participation and banking fragility does not appear to be associated with a lower risk profile of foreign banks. Indeed, due to higher leverage ratios and more volatile returns, foreign banks score worse than their domestic peers, suggesting that link needs to be explained through the impact of foreign penetration on the competitive environment.[29]

Table 6 reports results of country-level regressions that confirm the findings in Table 5. The table presents the results based on three alternative measures of country-specific banking sector fragility: the weighted average of Z and that of its log, and the Z based on aggregate data for the system as a whole (*System Z*), which broadly corresponds to systemic risk (that is, risk that cannot be diversified away within the baking sector). Controls for country and year effects are always included.

The coefficients display the expected sign, with risk positively correlated with economic growth and negatively correlated with exchange rate volatility. Concentration, once again, has no influence on bank risk. Size, on the contrary, is positively related, with large (and presumably more diversified) banks exhibiting lower risk profiles. Foreign penetration, in turn, is positively and significantly correlated with risk only through its effect on competition. Once H is included, the coefficient of foreign penetration ceases to be significant and even turns negative in some cases. For all three banking fragility measures the results are comparable, although *System Z* appears to be the less sensitive to the presence of foreign banks. In sum, we can conclude that, while foreign banks in Latin America are not characteristically less risky than the rest, foreign penetration was accompanied by a decline in competition and an increase in profitability that, possibly through the disciplining effect of a higher charter value, exerted a positive influence on banking sector fragility.

[28] We report $\text{Log}(\mu_{\text{ROA}} + \text{EQ/A})$, to avoid missing observations due to negative returns. Regressions using $\text{Log}(\mu_{\text{ROA}})$ yield similar results at the expense of a smaller sample. Results are available from the authors.

[29] Assets are measured at book value from banks' balance sheets. Then, higher observed leverage ratios may be related with lower capital requirements on risk-weighted assets in line with the Basel criteria applied in many countries in our sample. For the purposes of our argument, however, it suffices to show that the increase in banking stability as a result of foreign penetration is not driven by the lower risk profiles of foreign banks.

Table 5
Concentration and banking fragility-Z-components (bank-level panel data, WLS)

Dep. var.	Z	ROA	EQ/A	σ_{ROA}	Log(Z)	Log($\mu_{ROA} + \mu_{EQ/A}$)	Log(σ_{ROA})	Z	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
DFOR_3	−0.551			0.059	−0.271	−0.133	0.169		
	(0.113)***			(0.020)***	(0.066)***	(0.056)**	(0.042)***		
LASSETS_AVG	0.398			−0.116	0.215	0.043	−0.196	0.360	0.362
	(0.039)***			(0.007)***	(0.022)***	(0.020)**	(0.014)***	(0.042)***	(0.042)***
DFOR_1	−0.039	−0.014							
		(0.032)	(0.004)***						
LASSETS	0.036	−0.014							
		(0.012)***	(0.001)***						
DFOR_4								−0.417	
								(0.122)***	
DFOR_5									−0.377
									(0.124)***
Observations	2261	2331	2331	2287	1883	1886	2287	1811	1811
R-Squared	0.46	0.14	0.26	0.42	0.41	0.33	0.63	0.45	0.45

Robust errors clustered by country in parentheses. All regressions include fixed effects for each country-year pair. *Note*: Z, μ_{ROA}, $\mu_{EQ/A}$ and σ_{ROA} are computed based on the last three years excluding extreme values of ROA. Observations are weighted using banks' assets share at the country level (each country has the same weight in the regressions). DFOR_n is a foreign bank dummy that takes the value one whenever a bank has been foreign-owned for the last n years. LASSETS_AVG computed as the average of the log of bank assets over the last three years.

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

Table 6
Concentration and banking fragility (country-level panel data, WLS)

	Z				ln(Z)		*System Z*	
	(2)	(3)	(4)	(5)	(6)	(7)	(13)	(14)
FASSETS_AVG	2.744	2.872	4.288	0.678	2.014	0.547	5.691	−0.477
	(1.302)**	(1.157)**	(1.295)***	(1.417)	(0.576)***	(0.662)	(3.123)*	(4.659)
Δlog(GDP)	0.153	0.164	0.185	0.120	0.085	0.059	0.632	0.512
	(0.065)**	(0.059)**	(0.062)***	(0.066)*	(0.020)***	(0.025)**	(0.143)***	(0.165)***
σ_{ER}	−1.204	−1.383	−1.573	−1.059	−0.705	−0.502	−3.776	−2.630
	(0.540)**	(0.539)**	(0.566)***	(0.471)**	(0.231)***	(0.183)**	(1.338)***	(1.553)
CR_3_AVG		−7.140						
		(4.271)						
LASSETS_AVG_CTRY			1.268		0.488		3.466	
			(0.536)**		(0.168)***		(1.026)***	
H				−14.206		−5.998		−13.380
				(7.493)*		(2.663)**		(17.571)
Observations	47	47	47	47	47	47	47	47
R-Squared	0.83	0.85	0.87	0.85	0.91	0.90	0.91	0.88

Robust errors clustered by country in parentheses. All regressions include country and year effects.
Note: Z is the average Z weighted by bank' assets share, at the country level. *System Z* is computed by aggregating bank level data at the country level.
All control variables are measured based on the three-year period over which Z is computed. LASSETS_AVG_CTRY: country average of LASSETS_AVG (defined as the average of the log of bank assets over the last three years). FASSETS_AVG: average share of foreign-owned over total bank assets. Δlog(GDP): cumulative growth. σ_{ER}: standard deviation of monthly exchange rate changes.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

4. Final remarks

In this paper, we used a detailed balance sheet database for eight Latin American banking sectors to explore the consequences of the recent consolidation and internationalization process on competition and banking sector fragility. We found that increased concentration appears to have had no influence in either front. By contrast, we found that foreign penetration weakened banking competition, that the latter is negatively related with bank risk and that, as a result of the previous two findings, foreign penetration has indeed induced lower levels of risk.

The evidence presented here suggests an interpretation. In recurrently shaken emerging Latin American markets, national banks may be seen as imperfect substitutes of foreign branches or subsidiaries, because of actual differences in their menu of products as well as in terms of the value of the brand name and the perception of an implicit insurance provided by their parents. If so, by increasing the degree of product differentiation, foreign penetration in emerging economies would reduce competition and, through higher profits and charter value, the representative bank's risk appetite, notwithstanding the fact that foreign banks can reap these oligopolistic rents while choosing a higher risk profile. Reconciling the findings of this paper along these or alternative lines appears a fruitful topic for future research.

Appendix. Bank variables

Assets, Equity, Loans, Total Deposits, Demand Deposits Cash are banks level during the quarter. Financial Revenue, Financial Expenditure, Overhead Costs (not including financial revenues, commissions and fees not related with intermediation activities and income from non-financial investments during the quarter), Depreciation, Interest expenditures (due to payments of deposits interests) and Other Income are quarter flow variables.

The Foreign variable is a Dummy that takes the value of one if 50% or more of equity is hold by foreigners.

Non Performing Loans is the average of loans classified as overdue and those where legal action has been taken during the quarter. Loans are considered non-performed when the corresponding principal or interests payments have not been paid at the end of the month (Tables A1 and A2).

Table A1
Coverage–Number of banks per country and year

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Argentina			139	118	112	101	91	85		
Brazil			258	253	242	228	218	208	196	145
Chile		34	31	31	29	29	29	28	28	25
Colombia			39	39	39	39	32	29	28	27
Costa Rica			29	30	30	29	27	24	22	21
Mexico		20	33	40	39	34	33	30	31	32
Peru	15	19	21	22	24	26	23	19	15	15
El Salvador					18	18	18	15	14	13

Table A2
Summary statistics of the variables used in the tests

Variable	Mean	Std. dev.	Min.	Max.
Country-level data				
H	0.70	0.14	0.48	0.91
Log#Banks	3.65	0.83	2.56	5.55
FASSETS	0.25	0.20	0.01	0.78
CR_3	0.47	0.16	0.21	0.71
CR_5	0.61	0.16	0.33	0.86
HHI	0.11	0.05	0.04	0.21
Note: 63 observations				
Bank-level data				
Z	35.04	34.33	0.05	380.59
ROA	0.00	0.01	−0.06	0.05
EQ/A	0.20	0.17	0.00	0.97
σ_{ROA}	0.01	0.01	0.00	0.06
H	0.75	0.14	0.50	0.90
DFOR_3	0.32	0.47	0.00	1.00
LASSETS_AVG	17.88	4.37	5.42	25.47
Asset Share	0.02	0.04	0.00	0.31
LASSETS_AVG	0.25	0.14	0.01	0.65
Deltalog(GDP)	1.98	1.45	−0.99	7.11
σ_{ER}	0.17	0.25	0.00	0.96
Note: 2256 observations				

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