Online Appendix: Global Banking: Endogenous Competition and Risk Taking

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Appendix

A Loan Demand: Micro-foundation

Firms get funds and can invest only in one national market. As markets are symmetric, we drop market indices. In each market there is continuum of firms with heterogenous outside options for investment. Firms' outside options k follow a continuous distribution with c.d.f. $G(k)$ for $k \geq 0$. Each firm can make only one unit investment yielding return:

$$p(r^I)(r^I - r^L). \tag{1}$$

The firm will make the investment as long as its expected profit does not fall short of its outside option. As a result investment is governed by a cutoff rule. Only firms with $p(r^I)(r^I - r^L) \geq \overline{k}$ invest, where $\overline{k}$ corresponds to the outside option of marginal firms that are indifferent between investing or not: $\overline{k} \equiv p(r^I)(r^I - r^L)$. In this setup, the demand for loans is equal to the total number of firms that invest:

$$L = G(\bar{h}) = G(p(r^I)(r^I - r^L)) \tag{2}$$

where r^I and r^L are linked by the firm's FOC:

$$\frac{d(p(r^I)(r^I - r^L))}{dr^I} = p_1(r^I)(r^I - r^L) + p(r^I) = 0 \tag{3}$$

In order to find under which conditions $r^L(L)$ satisfies $r^{L\prime}(L) < 0$ and $r^{L\prime\prime}(L) \leq 0$, we can totally differentiate (2) and use (3) to obtain

$$\frac{dL}{dr^L} = -g(p(r^I)(r^I - r^L))p(r^I) < 0 \tag{4}$$

and then

$$\frac{d^2L}{d\left(r^L\right)^2} = g'(p(r^I)(r^I - r^L))\left(p(r^I)\right)^2 \geq 0. \tag{5}$$

Hence, $r^{L\prime}(L) < 0$ always holds and $r^{L\prime\prime}(L) \leq 0$ also holds as long as

$$g'(.) \geq 0. \tag{6}$$

B Liability Risk: Random Deposit Withdrawals

While some of the market-based risk metrics considered in our empirical analysis capture both asset risk and liability risk, the model in the main text considers only the endogenous build-up of the former type of risk. To investigate how banks' foreign expansion may also affect liability risk, we consider the simpler case of $\rho = 1$ but now allow banks to be subject to random deposit withdrawals ('bank runs') that may impair their survival.

Specifically, we endogenize exit by introducing a fixed exit cost $\kappa^{exit} > 0$ and a log-normally distributed idiosyncratic liquidity shock λ_t with cumulative density function $\Phi(\lambda_t)$.[1] A bank hit by a large enough shock is forced to exit. If we use $\widetilde{\lambda}_t$ to denote the

[1] We can think of idiosyncratic liquidity shocks as signals on deposits' withdrawals that might trigger a widespread run on deposits. See Angeloni and Faia (2013) and Rossi (2015) for further details on macroeconomic models with banks' default that are induced by bank runs triggered by coordination problems on signals.

threshold value of λ_t above which exit happens, the endogenous aggregate exit rate is then given by $1 - \Phi(\widetilde{\lambda}_t)$. The threshold $\widetilde{\lambda}_t$ corresponds to the realization of the liquidity shock that makes a bank indifferent between staying in the market and exiting. This is the case when its charter value $\widetilde{V}_t$ equals the exit cost so that $\widetilde{\lambda}_t$ is defined by the 'free exit condition':

$$\widetilde{V}_t = \widetilde{\Pi}_t + \widetilde{\Pi}_t^* + (1 - \Phi(\widetilde{\lambda}_t))\mathbb{E}_t \left\{ \widetilde{V}_{t+1} \right\} = \kappa_t^{exit} \tag{7}$$

where $\widetilde{\Pi}_t = p(L_t^T) \left(r_t^L - r_t^D \widetilde{\lambda}_t - \xi \right) \ell_t$ and $\widetilde{\Pi}_t^* = p(L_t^T) \left(r_t^L - r_t^D \widetilde{\lambda}_t - \xi - \mu \right) \ell_t^*$.

The equilibrium of the model with endogenous exit is thus fully characterized by a non-linear system of seven equations. They include the six equilibrium equations in Section 3.1: banks operating profits (14), domestic banks' profit maximizing condition (15), foreign banks' profit maximizing condition (16), total loans (17), banks' free entry condition (12) and the law of motion of the banks' number (13). The additional equation is (7) above. This system of seven equations can be solved in seven unknown variables: $\ell_t, \ell_t^*, L_t^T, N_t, N_t^a, \Pi_t + \Pi_t^*$ and $\widetilde{\lambda}_t$.

As for calibration, based on pre-crisis estimates of entry costs and scrap values, Temesvary (2014) reports that banks could recover roughly 75% of their entry costs when closing their foreign offices. Accordingly, we set the exit cost κ_t^{exit} to 25% of the entry cost κ_t (i.e. $\kappa_t^{exit} = \kappa_t/4$).The calibrated values of all other parameters remain the same as in Section 3.1.

Figure B1 reports the simulation results of the model with endogenous exit. Comparison with the analogous Figure 1 with exogenous exit reveals that, as the monitoring cost μ decreases the behavior of the key variables of our reduced-form analysis, namely the success probability and the Boone indicator, is essentially unaffected. Moreover, also leverage decreases as consistent with the reduced-form results in Section 4.[2]

[2]In Figure B1 leverage is defined as $\Phi(\widetilde{\lambda}_t)/p(r^I)$, which is the mean ratio of deposits to loans.

Figure B1 – Banking globalization with random deposit withdrawals

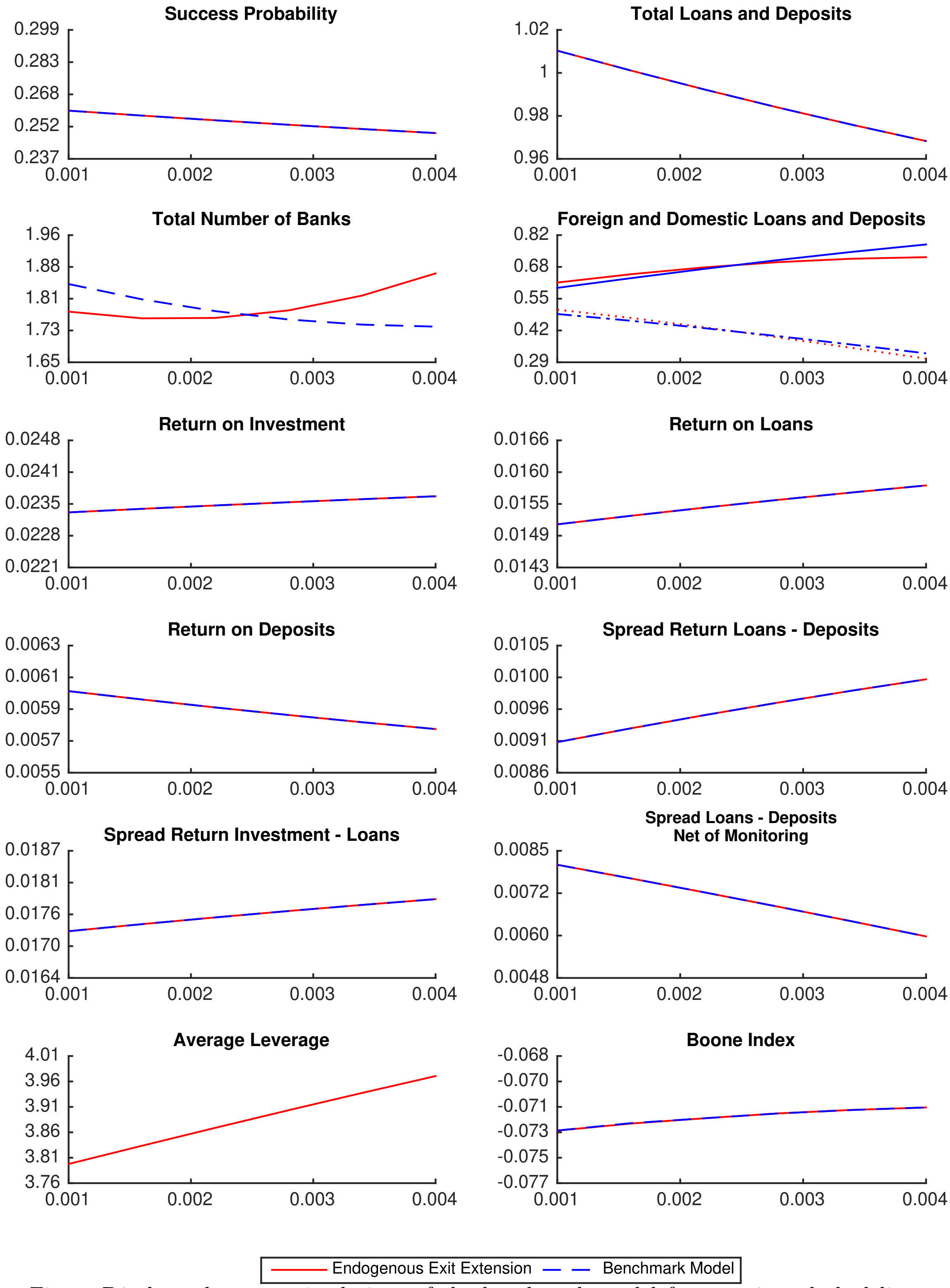

Figure B1 shows long-run simulations of the benchmark model for $\rho = 1$ as dashed lines and simulations for the model with random deposit withdrawals as solid lines. In the panel “Foreign and Domestic Loans and Deposits” dashed-dotted lines and dotted lines represent foreign loans/deposits. The variables of interest are reported on the vertical axis, while μ increases rightward on the horizontal axis. The effects of increased banking globalization (i.e. lower μ) can be gauged by moving from right to left on the horizontal axis.

C Cross-Border Lending

The business model of multinational banks is one in which internationalization takes place through horizontal expansion, while the business model of cross-border lending is one in which internationalization takes place through vertical integration. We assume that, differently from multinational banks, cross-border lenders have a lighter foreign presence. This can be captured by a lower setup cost for foreign operations, which we normalize to zero. Accordingly, the overall fixed cost of a cross-border lender is $\kappa - \kappa^d$, where κ and κ^d are the overall fixed cost and the subsidiary setup cost of a multinational bank respectively.

A cross-border lender r headquartered in market H raises deposits $D_{r,H}$ in its domestic market and allocates them to domestic loans $L_{r,HH}$ and foreign loans $L_{r,HF}$. We use $D_{r,HH}$ and $D_{r,FH}$ to denote the complementary amounts of deposits allocated to loans in H and F respectively, so that we have $D_{r,HH} = L_{r,HH}$, $D_{r,FH} = L_{r,FH}$ and $D_{r,H} = D_{r,HH} + D_{r,HF} = L_{r,HH} + L_{r,HF}$. The lender then chooses $L_{r,HH}$ and $L_{r,HF}$ so as to maximize expected profit:

$$\begin{aligned} \Pi_H &= p(r_H^I)\left(r_H^L\left(L_H^T\right)L_{r,HH} - r_H^D(D_H^T)L_{r,HH} - \xi L_{r,HH}\right) \\ &+ p(r_F^I, a_F)\left(r_F^L\left(L_F^T\right)L_{r,HF} - r_H^D(D_H^T)L_{r,HF} - \xi L_{r,HF} - \mu L_{r,HF}\right) \\ &- \left(\kappa - \kappa^d\right). \end{aligned}$$

The first order condition for profit maximization is:

$$\begin{aligned} \frac{\partial \Pi_H}{\partial L_{r,HH}} &= p_1(r_H^I) r_H^{I\prime}\left(r_H^L\right) r_H^{L\prime}\left(L_H^T\right)\left(r_H^L\left(L_H^T\right)L_{r,HH} - r_H^D(D_H^T)L_{r,HH} - \xi L_{r,HH}\right) \\ &+ p(r_H^I)\left(r_H^{L\prime}\left(L_H^T\right)L_{r,HH} + r_H^L\left(L_H^T\right) - r_H^{D\prime}(D_H^T)L_{r,HH} - r_H^D(D_H^T) - \xi\right) \\ &- p(r_F^I, a_F) r_H^{D\prime}(D_H^T)L_{r,HF} = 0. \end{aligned} \tag{8}$$

Note that, as higher $L_{r,HH}$ increases interest payments also for deposits used for $L_{r,FH}$, the lender's first order condition can not be separated between markets as it was the case with multinational banks. This generates a *novel trade-off*. On the one hand, as $r_H^D(D_H^T)$ increases with D_H^T, being forced to tap a single market for deposits drives the deposit return up, which by itself would increase the loan rate. On the other hand, the lack of foreign competition for domestic deposits puts downward pressure on the deposit return, which by itself would decrease the loan rate. Hence, for the same number of banks, it is not obvious whether one should expect cross-border lending to lead to more or less risk taking than multinational banking.

For simplicity, we focus on the symmetric deterministic equilibrium with $\mu = 0$. In this case, symmetry implies that in equilibrium the total amount of loans offered by home and foreign banks in a market equals the total amount of deposits raised in the same market ($L^T = D^T$). This is due to the fact that home and foreign banks supply the same amounts of deposits rather than to the fact that banks can finance loans only with local deposits as in the case of multinational banks. Using our functional forms, the first order condition (8) becomes:

$$L^T\left[\frac{1}{\alpha} - (\nu + \gamma) L^T - \xi\right] + \left[\frac{1}{\alpha} - 2(\nu + \gamma) L^T - \xi\right]\ell - \gamma L^T \ell = 0.$$

Hence, after imposing $L^T = N^a \ell$, we can solve for the total amount of loans extended by cross-border lenders in each market:

$$L^T_{cbl} = N^a \ell = \frac{\frac{1}{\alpha} - \xi}{\nu + \gamma} \frac{(N^a + 1) - \frac{1}{2}}{(N^a + 2) + \left(N^a + \frac{\gamma}{\nu+\gamma}\right)}, \tag{9}$$

which shows that, also in the case of cross-border lending, a larger number of active banks raises the total amount of loans, thus reducing risk-taking. Expression (9) can be compared with its analogue in the case of multinational banks:

$$L^T_{mnb} = N^a \ell = \frac{\frac{1}{\alpha} - \xi}{\nu + \gamma} \frac{N^a + 1}{N^a + 2}.$$

Three comments are in order. First, for a given number of active banks N^a, cross-border lenders raise a smaller total amount of deposits and thus supply a smaller total amount of loans ($L^T_{cbl} < L^T_{mnb}$). Second, for a given initial number of active banks N^a, the increase in competition caused by the same increase in the number of active banks leads to a smaller increase in deposits and loans with cross-border lenders than with multinational banks ($dL^T_{cbl}/dN_a < dL^T_{mnb}/dN_a$). Hence, for given N^a, multinational banking generates less risk taking than cross-border lending ($p_{cbl} > p_{mnb}$) and more competition reduces risk by a larger extent ($dp_{cbl}/dN_a < dp_{mnb}/dN_a$). Third, when instead the number of active banks is endogenously determined by free entry, multinational banking still generates less risk than cross-border lending provided that the additional fixed cost of setting up a foreign subsidiary is not too large. Too see this, note that, for given N_a and net of the corresponding overall entry cost, the maximized profit of a cross-border lender evaluates to

$$\Pi_{cbl} = \frac{\alpha\nu\left(\frac{1}{\alpha} - \xi\right)^3}{(\gamma + \nu)^2} \frac{(2N^a + 1)^2\left(\frac{5\gamma+3\nu}{\gamma+\nu} + 2N^a\right)}{8N^a\left(\frac{3\gamma+2\nu}{\gamma+\nu} + 2N^a\right)^3} - [1 - \beta(1-\varrho)]\left(\kappa - \kappa^d\right),$$

while the profit of a multinational bank evaluates to:

$$\Pi_{mnb} = \frac{\alpha\nu\left(\frac{1}{\alpha} - \xi\right)^3}{(\nu + \gamma)^2} \frac{(N^a + 1)^2}{N^a (N^a + 2)^3} - [1 - \beta(1-\varrho)]\,\kappa.$$

Both Π_{cbl} and Π_{mnb} are decreasing in N^a and go to zero as N^a goes to infinity. However, it can be shown that the multinational bank's profit gross of the overall entry cost is larger than the cross-border lender's for any value of N^a. It then follows that for $\kappa^d = 0$ the multinational banking free entry condition $\Pi_{mnb} = 0$ holds for a value of N^a that is larger than the one at which the cross-border lending free entry $\Pi_{cbl} = 0$ holds. By continuity, this also holds for $\kappa^d > 0$ provided that κ^d is not too large. Otherwise, when κ^d is large enough, the reverse happens with $\Pi_{mnb} = 0$ holding for a value of N^a that is smaller than the one at which $\Pi_{cbl} = 0$ holds. Higher risk taking associated with cross-border lending is in line with evidence reported by IMF (2015) that the increase in cross-border lending prior to the 2007 produced larger default after the crisis erupted and this was followed by extensive re-trenchment (see also Milesi-Ferretti and Tille, 2011).

D Sample Description

This appendix section is largely based on the appendix section of Faia, Laffitte and Ottaviano (2019).

Our analysis exploits a novel dataset providing the number of foreign affiliates opening for the 15 biggest G-SIBs banks in Europe between 2005 and 2014.
We consider the following banks: Banco Santander (BSCH), Barclays (BARC), BNP Paribas (BNPA), BPCE Groupe (BPCE), Credit Suisse (CRES), Credit Agricole (AGRI), Deutschebank (DEUT), HSBC , ING Direct (INGB), Nordea (NDEA), Royal Bank of Scotland (RBOS), Société Générale (SOGE), Standard Chartered (SCBL), UBS (UBSW) and UniCredit (UNCR).
We identify 37 destination countries in Europe: Albania, Austria, Belgium, Bulgaria, Bosnia-Herzegovina, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, Latvia, Malta, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovenia, Slovakia, Spain, Sweden, Switzerland, Turkey, Ukraine and the United Kingdom.
The panel is balanced, as we consider for each bank all potential host countries and years; if a bank did not establish an affiliate in a foreign country in a given year, the count of its openings is assumed to be equal to zero.

E Risk Metrics

This appendix section is largely based on the appendix section of Faia, Laffitte and Ottaviano (2019).

Our empirical analysis looks at the impact of bank expansion in foreign countries on bank risk. In order to capture the fact that bank risk is multidimensional, we use a variety of different risk metrics that can be decomposed between individual risk metrics and systemic risk metrics.

E.1 Individual Risk Metrics

Five individual risk metrics are used: (log) CDS price, loan-loss provisions, (log) standard deviation of returns, leverage and (log) Z-Score.

- **CDS price:** Bloomberg
- **Loan-loss provisions:** Orbis Bank Focus
- **Returns:** Datastream
- **Leverage:** Centre for Risk Management of Lausanne and complemented with data from the V-Lab
- **Z-Score:** The Z-Score is defined as follows: $\text{Z-score} = \frac{\text{ROA} + \text{Capital Asset Ratio}}{\sigma(returns)}$. The ROA and the Capital Asset Ratio comes from Orbis Bank Focus and the returns come from Datastream.

E.2 Systemic Risk Metrics

We use four different metrics for systemic risk: the long-run marginal expected shortfall, the SRISK metric and the Δ CoVaR computed using two different methods.

Long-Run Marginal Expected Shortfall The Marginal Expected Shortfall (MES) and its long-run version (LRMES) has been introduced in the seminal papers of Acharya et al. (2017) and Brownlees and Engle (2017). The MES corresponds to the firm's expected equity loss following the fall of the market under a given threshold. It is defined as a 2% market drop in one day for the MES and as a 40% market drop over six months for the LRMES. The LRMES will give the marginal contribution of a bank to the systemic risk following the market decline. Formally, the LRMES for bank i, in a market M and cumulative returns between t and t+6 $R_{i,t:t+6}$ is:

$$LRMES_{i,t:t+6} = -\mathbb{E}\left[R_{i,t:t+6} | R_{M,t:t+6} \leq -40\%\right] \tag{10}$$

Higher LRMES corresponds to a higher contribution of the bank to the systemic risk. Our measure of LRMES comes from the Center for Risk Management of Lausanne and has been computed following methods adapted for European banks (see Engle, Jondeau and Rockinger, 2012). The construction of LRMES combines DCC, GARCH and copula models.

SRISK This measure has been proposed by Acharya, Engle and Richardson Acharya, Engle and Richardson (2012) and Brownlees and Engle (2017). The SRISK is based on MES but takes into account the liabilities and the size of the bank. Following Acharya, Engle and Richardson (2012), SRISK is defined as:

$$LRMES_{it} = max\Big[0; \left[kL_{it} - 1 + (1-k)LRMES_{it}\right] W_{it}\Big] \tag{11}$$

with k being the prudential capital ratio, L_{it}, the leverage of the bank and W_{it} the market capitalization. This definition highlights that SRISK increases with the market capitalization and the leverage.

Δ CoVaR The ΔCoVaR measure has been proposed by Adrian and Brunnermeier Adrian and Brunnermeier (2016). The CoVaR corresponds to "the value at risk (VaR) of the financial system conditional on institutions being under financial distress". The ΔCoVaR is then defined as the difference between the CoVaR when bank i is under distress and the CoVaR when bank i is in its median state.

The $VaR(p)$, the VaR at the confidence level p is defined as the loss in market value that is exceeded with a probability $1-p$ in a given period. For instance the $VaR(5\%) = x$ corresponds to an expected loss lower than x in 95% of the cases. Formally $VaR(p)$ of the market return r_i is defined as:

$$\mathbb{P}(r_i \leq VaR_i(p)) = p \tag{12}$$

The CoVaR is defined as the VaR of a bank conditional on some event $\mathbb{C}(r_i)$ affecting bank i returns:

$$\mathbb{P}(r_i \leq CoVaR^{i|\mathbb{C}(r_i)}(p) | \mathbb{C}(r_i)) = p \tag{13}$$

The ΔCoVaR is then computed as the difference between the CoVaR when the loss is equal to the VaR (distress event) and the CoVaR in a normal situation (defined as the median return):

$$CoVaR^{i|r_{it}=VaR_{it}(p)} - CoVaR^{i|r_{it}=Median(r_{it})} \tag{14}$$

This definition of the ΔCoVaR allows its estimation using simple quantile regressions techniques.

We estimate the ΔCoVaR for our 15 banks following the methodology and the codes of Adrian and Brunnermeier (2016). As ΔCoVaR can be estimated using returns on equity or on CDS, we choose to compute both.

The ΔCoVaR extends the VaR measure to take into account the contribution of each institution to the overall risk in the market. The metric is especially designed to compare the contribution of different banks to the systemic risk. As stated by Adrian and Brunnermeier (2016) the ΔCoVaR is not equivalent to the VaR.

Data Sources As for data sources, CDS prices come from Bloomberg and equity prices from Datastream. Both are averaged to obtain monthly (for computing Δ Covar) and yearly (as left-hand side variables) measures. The LRMES and the SRISK metrics are taken from the Centre for Risk Analysis of Lausanne and correspond to a yearly average using four values by year.[3] Concerning the variables used as states in the Δ CoVaR estimation: the VIX is taken from the Chicago Boards Option Exchange; the S&P composite index from Datastream; the Moody's Seasoned Baa Corporate Bond Yield Relative to Yield on 10-Year Treasury Constant Maturity, the three-months yield, the ten-years yield and the LIBOR rate come from the Federal Reserve Bank of Saint Louis. All these variables are averaged to obtain monthly values.

F Boone Indicator

F.1 Computation

In this section we provide details on the Boone indicator is computed in the model and in the data. For the empirical part we compute the Boone indicator following Schaeck and Čihák (2010).

In industrial organization the Boone indicator is defined as the elasticity of profits to marginal cost in a given market. Schaeck and Čihák (2010) consider the following simple model of oligopolistic competition. Bank i's demand curve is

$$p(q_i, q_{j\neq i}) = a - bq_i - d\sum_{j\neq i} q_j \tag{15}$$

with profits

$$\pi_i = (p_i - c_i)\, q_i. \tag{16}$$

The FOC for profit maximization is

$$a - 2bq_i - d\sum_{j\neq i} q - c_i = 0 \tag{17}$$

where $d < b$ measures product differentiation. With N competitors, bank i's profit maximizing size is:

$$q_i(c_i) = \frac{(2b/d - 1)\, a - (2b/d + N - 1)c_i + \sum_{j\neq i} c_j}{[2b + d(N-1)]\,(2b/d - 1)}.$$

[3]The results are robust to redefining the annual LRMES/SRISK as the one at the end of December.

Empirically, Schaeck and Čihák (2010) estimate the Boone indicator through a regression base on the reduced form:

$$\pi_{it} = \alpha + \beta \ln c_{it},$$

where π_{it} are the profits of bank i at time t as a proportion of total assets (ROA). As marginal cost is not observed, they use average cost as a proxy and regress π_{it} on it. More precisely, they run the following regression:

$$\pi_{it} = \alpha_i + \sum_{t=1,\ldots,T} \beta_t d_t \ln c_{it} + \sum_{t=1,\ldots,T-1} \gamma_t d_t + u_{it} \tag{18}$$

where π_{it} are the profits of bank i at time t as a proportion of total assets (ROA), c_{it} is average variable costs, d_t is a time dummy and u_{it} is the error term. Profits increase for banks with lower marginal costs ($\beta < 0$). Thus, an increase in competition raises profits of a more efficient bank relative to a less efficient one. The stronger the effect (i.e., the larger the β in absolute value), the stronger is competition.

As for data, they use use average cost of bank i as a share of total income. Average costs comprise interest and personnel expenses, administrative and other operating expenses. Income consists of commission and trading income, interest income, fee income, and other operating income.

Note that Schaeck and Čihák (2010) only consider oligopolistic competition in the loan market, while our model also features oligopsony in the deposit market. Therefore we adapt their definition by replacing the return on loans with the loan to deposit margin. Recall that we have defined $m(L_t^T) = \left[\frac{1}{\alpha} - (\nu + \gamma)L_t^T - \xi\right]$.

Then, defining $p = \alpha\nu L_t^T/2$, with perfectly correlated projects ex-ante expected and ex-post average domestic profits are:

$$\Pi_t = p\ m(L_t^T)\ \ell_t$$

as the success rate equals p for all banks.

Note that the ex-ante expected and ex-post average *profits as a proportion of total assets* (ROA) are:

$$\pi_t = \frac{\Pi_t}{\ell_t} = \begin{cases} p\ m(L_t^T) & \text{with perfectly correlated shocks} \\ \left(1 - \hat{\varkappa}G(\hat{\varkappa}) - \int_{\hat{\varkappa}}^1 G(\varkappa, p)dx\right)\ m(L_t^T) & \text{with imperfectly correlated shocks} \end{cases}$$

Using $\pi_t^{CN}(\xi, \mu)$ to denote the corresponding equilibrium values of π_t, the Boone indicator can then be defined as:

$$B_t(\xi, \mu) = \frac{d \ln \pi_t^{CN}(\xi, \mu)}{d \ln \xi}$$

F.2 Descriptive Statistics

Table F1 describes the Boone indicator (BI) across Europe in 2014 revealing substantial variation. With reference to our G-SIBs, the average value in host countries is -1.62, while it is -0.09 in origin countries as the latter tend to be less competitive than the average. This is particularly the case of France, Italy and the Netherlands, while Luxembourg, Spain, Switzerland and United Kingdom have more competitive banking sectors.

Table F2 reports for each origin country the percentage of openings happening in host countries that are more competitive than the origin one according to the Boone indicator. In the third column this percentage is conditioned to a positive entry event in the market. For France, Germany, Italy and the Netherlands more than two thirds of their openings are in more competitive host countries. There is no large difference between the unconditional rate and the conditional rate indicating that there is no systematic bias towards expanding in countries with high or low competition index. Differently, a very small fraction of Spanish openings target more competitive countries, as Spain has a very competitive financial sector according to the BI. Finally, Sweden, Switzerland and the United Kingdom are close to the median BI. However, for these three countries the conditional rate is lower, suggesting that these countries generally tend to expand into less competitive destinations compared with the set of opportunities that contains all bilateral combinations.

Table F1 – Boone indicator

Country	Boone	Country	Boone	Country	Boone	Country	Boone
Albania	-.05	Spain	-.61	Italy	0	Russia	-.08
Austria	-.02	Estonia	-.1	Lithuania	0	Serbia	-.11
Belgium	-.02	Finland	.09	Luxembourg	-50.06	Slovakia	-.01
Bulgaria	.21	France	0	Latvia	-.15	Slovenia	11.34
Bosnia Herzegov.	-.03	United Kingdom	-.05	Malta	-.13	Sweden	-.05
Switzerland	-.07	Greece	0	Netherlands	.13	Turkey	-.03
Cyprus	0	Croatia	-.05	Norway	.03	Ukraine	.09
Czechia	-.07	Hungary	-.1	Poland	-.08		
Germany	-.03	Ireland	.65	Portugal	-1.03		
Denmark	-.07	Iceland	-.19	Romania	0		

Table F2 – Expansion and host market competition

Origin country	% of more competitive host countries	% of more competitive host countries (Openings> 0)
France	72	71
Germany	63	66
Italy	73	77
Netherlands	88	89
Spain	4	3
Sweden	46	38
Switzerland	46	32
United Kingdom	47	34

Note: The second column displays the share of host countries that are more competitive that the origin country in the first column. The third columns displays the share of host countries that are more competitive that the origin country in the first column conditional on entry by origin country's banks.

G Robustness tests

G.1 Generated Regressor Issue

Our baseline specification follows the literature using gravity instrumental variables as common practice.[4] Nonetheless, our instrument is a generated regressor and this may affect the standard errors of our regressions (see Pagan, 1984). Our specification includes three stages: an initial stage, in which we estimate the expansions through gravity, and the two stages of the IV estimation. We checked the robustness of our first-stage IV estimates to bootstrapped standard errors. Specifically, we bootstrapped the estimates of the two first stages (see columns 3 and 4 of Table 3). The bootstrapping procedure takes into account the panel structure of the data by sampling panels instead of observations. See Table G1 for results. The standard errors are computed using 1000 replications. The standard errors of the estimates as well as the Sanderson-Windmeijer F-stats remain close to those obtained without bootstrapping.

G.2 Identification Strategy

As discussed in the main text, our identification mainly relies on shocks in destination countries. We argued there that these shocks can be considered exogenous as endogeneity would imply that shocks in destination countries affect simultaneously both risk measured at the level of the headquarter and expansion. In this subsection, we provide a robustness test in which we drop destination countries where a bank has a large cross-border exposure, that is, where local shocks are (if at all) most likely to affect the overall risk of the banking group. We extract data on banks' cross-border exposures in 2012 from Duijm and Schoenmaker (2020) and drop from our sample destination countries that represent more than 5% of the cross-border exposure of a bank. This leads us to drop 165 bank-destination country pairs (corresponding to 2.84% of all country pairs). Our main results are robust to this check. Table G2 and Table G3 for corresponding results.

[4]See e.g. Goetz, Laeven and Levine (2013), Levine, Lin and Xie (2016) and Faia, Laffitte and Ottaviano (2019) for applications to international finance and banking.

Table G1 – Replication of columns 3 and 4 of Table 3 with bootstrapped standard errors.

	(1) Higher	(2) Lower
$\hat{Higher}$	1.525***	0.221
	(0.365)	(0.211)
$\hat{Lower}$	0.668	1.430***
	(0.646)	(0.442)
ln(Tot Assets)	6.738	1.794
	(8.534)	(1.703)
ROA	-2.568	-0.669
	(3.001)	(1.054)
Income diversity	1.453	-0.0453
	(5.667)	(1.605)
Asset diversity	7.154	6.044
	(10.51)	(5.021)
Tier1/Asset	0.0678	-0.0509
	(0.170)	(0.0657)
Deposits/Asset	0.00744	-0.00273
	(0.0215)	(0.00429)
Av. regulation	0.514	-0.0380
	(0.717)	(0.439)
Net interest margin	473.8	269.7
	(419.5)	(221.3)
Observations	136	136
R-squared	0.548	0.538
Sanderson-Windmeijer F-stat (SW)	10.86	19.64

Bootstrapped standard errors in parentheses (1000 replications).
*** p<0.01, ** p<0.05, * p<0.1

Table G2 – Expansion, competition and individual risk metrics: drop biggest exposure

		(1)	(2)	(3)	(4)
		No controls		**Controls**	
		OLS	2SLS	OLS	2SLS
ln(CDS)	Higher Competition	-0.00710**	-0.0105	-0.00943***	-0.0169***
		(0.00287)	(0.00664)	(0.00244)	(0.00588)
	Lower Competition	-0.00478	-0.0381	0.00387	-0.0121
		(0.00571)	(0.0286)	(0.00795)	(0.0203)
	Observations	145	145	136	136
	R-squared	0.965	0.957	0.982	0.978
	F-Test 1st		3.721		4.085
LLP	Higher Competition	-0.0150	-0.0181	-0.0116	-0.0393**
		(0.0193)	(0.0212)	(0.0108)	(0.0194)
	Lower Competition	0.0126	-0.0528	0.0291	0.0379
		(0.0136)	(0.0709)	(0.0184)	(0.0507)
	Observations	143	143	135	135
	R-squared	0.285	0.245	0.651	0.624
	F-Test 1st		3.840		4.144
ln(σ returns)	Higher Competition	-0.00581***	-0.0112***	-0.00677***	-0.0153***
		(0.00186)	(0.00422)	(0.00220)	(0.00443)
	Lower Competition	0.00119	-0.00743	0.00464	0.00762
		(0.00377)	(0.0191)	(0.00506)	(0.0145)
	Observations	145	145	136	136
	R-squared	0.895	0.887	0.924	0.915
	F-Test 1st		3.721		4.085
ln(Z-score)	Higher Competition	0.00582*	0.00754	0.00648***	0.0121***
		(0.00305)	(0.00610)	(0.00217)	(0.00380)
	Lower Competition	0.00205	0.0231	-0.00334	-0.0122
		(0.00718)	(0.0289)	(0.00711)	(0.0128)
	Observations	135	134	135	134
	R-squared	0.842	0.828	0.910	0.906
	F-Test 1st		3.491		3.843
Leverage	Higher Competition	-0.268**	-0.821***	-0.332	-0.884***
		(0.122)	(0.275)	(0.230)	(0.283)
	Lower Competition	-0.480***	-0.0461	-0.569**	-0.204
		(0.157)	(0.782)	(0.262)	(0.748)
	Observations	145	145	136	136
	R-squared	0.587	0.551	0.685	0.648
	F-Test 1st		3.721		4.085

Robust standard errors in parentheses. We apply a small-sample correction for the instrumental variable estimations. Each regression includes bank and year fixed effects. Control Set: ln(Total Assets), Income Diversity, Asset Diversity, Tier1 ratio and Deposit-to-asset ratio, average regulation, net interest margin and specific time-trend for Italy and Spain. Higher Competition (resp. Lower) stands for openings in host countries more (resp. less) competitive than the origin country according to the Boone index. Kleibergen-Paap rk Wald F statistic are displayed in the "F-Test 1st" line. For all regressions, the the p-value of the Anderson-Rubin test of the significance of the endogenous regressors is lower than 0.006. *** p<0.01, ** p<0.05, * p<0.1

Table G3 – Expansion, competition and systemic risk metrics : drop biggest exposure

		(1)	(2)	(3)	(4)
		No controls		**Controls**	
		OLS	2SLS	OLS	2SLS
LRMES	Higher Competition	-0.160	-0.222	-0.202	-0.218*
		(0.179)	(0.144)	(0.174)	(0.125)
	Lower Competition	-0.447	-0.725	-0.303	-0.539
		(0.271)	(0.497)	(0.320)	(0.521)
	Observations	145	145	136	136
	R-squared	0.644	0.633	0.716	0.711
	F-Test 1st		3.721		4.085
SRISK	Higher Competition	-0.342	-0.975**	-0.415	-0.990**
		(0.356)	(0.404)	(0.377)	(0.424)
	Lower Competition	-0.784**	-1.946	-0.697	-1.804
		(0.363)	(1.182)	(0.454)	(1.331)
	Observations	145	145	136	136
	R-squared	0.673	0.592	0.765	0.698
	F-Test 1st		3.721		4.085
ΔCoVaR CDS	Higher Competition	-0.00133	-0.00462*	-0.000568	-0.00522
		(0.00285)	(0.00250)	(0.00189)	(0.00378)
	Lower Competition	0.00292	0.0191**	0.00492	0.0328**
		(0.00852)	(0.00915)	(0.00653)	(0.0152)
	Observations	145	145	136	136
	R-squared	0.687	0.662	0.756	0.687
	F-Test 1st		3.721		4.085
ΔCoVaR Equ.	Higher Competition	-0.000453	-0.00104**	-0.000420	-0.00124**
		(0.000429)	(0.000513)	(0.000515)	(0.000551)
	Lower Competition	0.000509	-0.00197	9.70e-05	-0.000920
		(0.000868)	(0.00221)	(0.000905)	(0.00215)
	Observations	145	145	136	136
	R-squared	0.852	0.833	0.866	0.855
	F-Test 1st		3.721		4.085

Robust standard errors in parentheses. We apply a small-sample correction for the instrumental variable estimations. Each regression includes bank and year fixed effects. Control Set: ln(Total Assets), Income Diversity, Asset Diversity, Tier1 ratio and Deposit-to-asset ratio, average regulation, net interest margin and specific time-trend for Italy and Spain. Higher Competition (resp. Lower) stands for openings in host countries more (resp. less) competitive than the origin country according to the Boone index. Kleibergen-Paap rk Wald F statistic are displayed in the "F-Test 1st" line. For all regressions, the the p-value of the Anderson-Rubin test of the significance of the endogenous regressors is lower than 0.006. *** p<0.01, ** p<0.05, * p<0.1

H Simulations with fixed number of banks

In Figure H1 we repeat the simulations, but hold the number of banks fixed, something which amounts to shutting off the endogenous entry channel.

Figure H1 – Banking globalization with fixed number of Banks

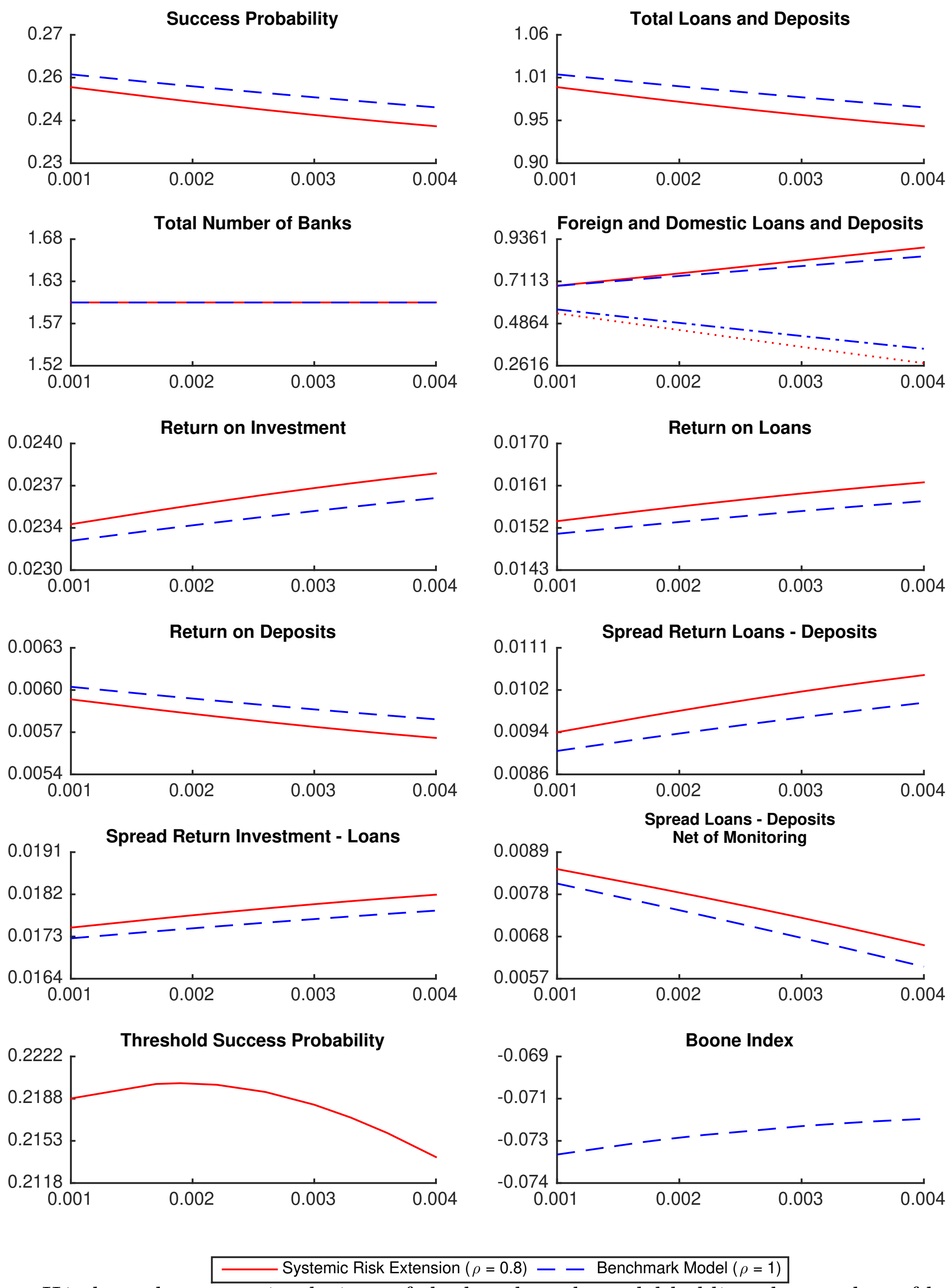

Figure H1 shows long-run simulations of the benchmark model holding the number of banks in the domestic and foreign market fixed. Dashed lines display simulations for $\rho = 1$ and solid lines results for the case of $\rho = 0.8$. In the panel "Foreign and Domestic Loans and Deposits" dashed-dotted lines and dotted lines represent foreign loans/deposits. The variables of interest are reported on the vertical axis, while μ increases rightward on the horizontal axis. The effects of increased banking globalization (i.e. lower μ) can be gauged by moving from right to left on the horizontal axis.

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