

Incomplete supervisory cooperation

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Abstract

Banking supervisors frequently cooperate across countries, but cooperation only imperfectly covers the global operations of large banking groups. We show that this causes significant third-country externalities. Using hand-collected supervisory cooperation data, we document that banking groups shift lending activities and risk into third-country subsidiaries when cooperation agreements cover their operations in other countries. The implied country-level increase in the share of foreign loans is 16%. We also show that countries do not internalize third-country effects when making cooperation decisions, resulting in a 26 percentage point higher propensity to cooperate. Overall, our results highlight a need for “cooperating on cooperation”.

Keywords: Supranational cooperation; externalities; cross-border banking

JEL codes: G1, G2.

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1 Introduction

Large banks operating across many countries dominate the global banking landscape. Banking supervisors frequently cooperate to contain risks at these banks. However, cooperation is predominantly established at the country level (involving two or more countries) and hence does not necessarily match the geographical footprint of banking groups. Examining a sample of 254 cooperation agreements, we find that, on average, an agreement covers only 41% of the operations (in terms of the number of host countries) of banking groups headquartered in the countries participating in the agreement. Figure 1 depicts coverage across countries, showing that it is often low in countries that host many banking groups.¹

Using hand-collected data on supranational cooperation agreements, this paper shows, first, that incomplete coverage causes significant risk-shifting into third countries and, second, that this may result in inefficient cooperation decisions. We start by examining whether cooperation causes risk-shifting within banking groups. Specifically, using data for 113 banking groups during 1995-2013, we investigate whether (and how) risk allocation into a specific (foreign) subsidiary changes when cooperation in the remaining banking group changes due to new cooperation agreements being formed. For this, we construct a *group-host country* level cooperation index, which measures the extent to which supranational cooperation agreements cover the group's parent-subsidiary structure (excluding the subsidiary's country). The setup allows us to control for a large set of effects, particularly any country-level push or pull factors. In our most stringent specification, we compare two subsidiaries in the same country whose parent banks are also from identical countries. Identification comes from the fact that the parent banks have a different geographic footprint in their (residual) subsidiary structure and are hence differentially affected when other countries sign cooperation agreements with the home country.

We find that lending in a subsidiary increases when supervisory cooperation between the country of the parent bank and the other host countries of the group increases. The

¹For instance, coverage in the U.K. and South Africa is about 20%. For some countries, coverage is also very high. The Central American Council of Banking Supervisors (a multilateral agreement) closely matches the footprint of the involved multinational banks, resulting in high coverage for Panama, Costa Rica, and the Dominican Republic (higher than 90%).

effect is economically large: a one-standard-deviation change in cooperation coverage increases subsidiary lending on average by 20%. The subsidiary-level estimates also imply large country-level effects. For instance, our estimates suggest that the combined effect of cooperation agreements outside a country is to increase a country's share of foreign loans by 16%. We also find that the lending increase goes along with higher riskiness of the subsidiary in general, as the balance sheet becomes more leveraged, and there are no potentially offsetting effects, such as through safer or more profitable lending.

The results are consistent with supervisory cooperation making it more difficult for banks to take risks in the countries covered by cooperation,² causing risk-shifting to third countries. This is in line with the theory showing that cooperation between national supervisors and the supranational supervisory architecture more broadly, influence banks' behavior. Calzolari and Loranth (2011) show that the allocation of supervisory responsibilities affects a bank's incentives to expand outside its home country and the organizational form chosen for the expansion. Calzolari, Colliard, and Loranth (2019) show that cooperation between national supervisors increases monitoring of banks, providing incentives for banks to close foreign operations or to convert them into branches. Colliard (2020) considers the trade-off between local supervisors treating banks more leniently but obtaining more information and shows that this encourages banks to integrate their cross-border activities. In Loranth, Segura, and Zheng (2022), a supranational architecture allows for voluntary support within a banking group, affecting banks' ex-ante risk-taking incentives.

We next study how different dimensions of supervisory cooperation coverage affect risk-shifting. We find that risk-shifting is mitigated (that is, lending responds less to cooperation between the home supervisor and the supervisors of other host countries) when the subsidiary country cooperates with the home country, as well as when it cooperates with the other host countries of the group. This is consistent with the idea that risk-shifting into a subsidiary is more difficult when the local supervisor cooperates with the countries from which the risk is shifted. Moreover, we find that risk-shifting

²Consistent with this, we show a decline in lending at subsidiaries directly covered by the cooperation agreement. Identification, however, is less clean for the direct effect as we can no longer compare subsidiaries for identical host-home country pairs.

is mitigated when the subsidiary country has stricter supervision and better market discipline – relative to other countries in which the group has foreign operations.

We also analyze risk-shifting at the level of individual loans. Specifically, we examine *for a given loan* through which subsidiary a group originates the loan. Ivanov and Wang (2022) show that changes in the allocation of supervisors result in adjustments in syndicated lending. In our context, we expect supervisory cooperation to cause banks to shift syndicated loans away from subsidiaries covered by cooperation. In line with the subsidiary-level analysis, we find that the probability of allocating a specific syndicated loan to a particular subsidiary increases in the supervisory coverage of the rest of the banking group. The effect is stronger for riskier loans, again consistent with risk-shifting.

The presence of third-country effects will result in inefficient cooperation decisions if countries do not internalize the impact of cooperation on others. Based on a simple model of optimal cooperation, we show that two countries' joint benefit from cooperating increases in the extent to which the banking groups present in the countries can shift risk to third countries.³ However, if the two countries take into account the effect on welfare in other countries, such risk-shifting opportunities are irrelevant for cooperation gains. Using panel estimation, we find that the propensity of two countries to cooperate significantly increases in proxies of third-country risk-shifting opportunities, indicating that countries do not (fully) internalize the external effects. Specifically, our estimates imply that if countries were to fully internalize these effects, the likelihood of cooperation among a random pair of countries would be 26 percentage points lower. Since cooperation also entails significant costs,⁴ this indicates the presence of inefficiencies in the global cooperation agreement landscape.

Notably, the possibility for countries to form *successive* agreements may worsen outcomes. The reason is that cooperation between, say, countries A and B increases the incentives for a third country to form cooperation agreements but purely to reverse the

³This mirrors a long-standing discussion in international trade, resulting from the proliferation of *Free Trade Agreements* (FTAs). Such agreements benefit partner countries by increasing trade among them; however, they may hurt non-partner countries through trade diversion. See, for instance, Anderson and Yotov (2016) for an empirical analysis of third-country effect of FTAs.

⁴Those costs arise in a narrow sense from setting up and maintaining cooperation, but also more broadly because cooperation in practice entails imposing uniform standards on heterogenous countries (countries differ for instance regarding their preferences or legal frameworks).

risk-shifting from A and B. Thus, inefficient agreements may cause a sequence of further inefficient agreements. A potential solution to this problem is to require cooperation agreements to match the geographic parameter of affected banking groups closely. While this may be feasible in specific cases, countries often share several banking groups that widely differ in their geographic footprint. Another alternative is multilateral agreements involving a set of countries as large as possible. However, such agreements also have a downside as they will tend to involve more heterogenous countries that are more difficult to subject to common supervisory standards. A third solution is to establish a good practice that countries contemplating cooperation should also consult supervisors in other countries where their banks operate (“cooperate on cooperation”), mitigating both actual risk-shifting and the potential for inefficient cooperation.

This paper relates to several strands of the literature. First, our analysis is predicated on the idea that cooperation among supervisors and regulators alters their behavior (in turn, giving banks incentives to adjust). There is significant theoretical literature showing why this may be the case. Dell’Arricia and Marquez (2006) find that uncoordinated regulation leads to too low capital adequacy standards, as individual national regulators do not take into account the benefits of higher capital adequacy standards for other countries. Acharya (2003) shows that coordinating capital adequacy ratios across countries affects resolution policies, possibly in undesirable ways. Freixas (2003) and Goodhart and Schoenmaker (2009) show that relying on ad-hoc ex-post arrangements to recapitalize failing cross-border banks leads to underprovision of resources; ex-ante agreements are needed to overcome coordination problems between supervisors. Niepmann and Schmidt-Eisenlohr (2013) show that (uncoordinated) national governments’ decisions on recapitalizing failing banks are inefficient if banking systems are linked through interbank markets.⁵ Carletti, Dell’Arricia, and Marquez (2020) show that centralizing supervision affects information collection by local regulators.

Beck, Silva-Buston, and Wagner (2022) analyze cooperation decisions and show that they are consistent with an externality-heterogeneity trade-off (e.g., Dell’Arricia and Marquez (2006)). They find that supervisory cooperation is more likely among countries

⁵On the empirical side, Beck, Todorov, and Wagner (2013) analyze interventions into banks during the Global Financial Crisis, showing that cross-border linkages lead to distortions in the national intervention decisions, consistent with the presence of externalities.

and more likely to be intense, and is implemented faster, when there are externalities from bank failures *between* these countries, and when countries are homogeneous. Beck, Silva-Buston, and Wagner (2022) also examine the effectiveness of cooperation at the level of the *consolidated* banking group and find that cooperation lowers risk for the smaller cross-border banking groups, but not for the larger ones. Our risk-shifting results provide an explanation for why cooperation is not effective for the very large banks as those are also the ones that have subsidiaries in many different countries and hence possess abundant risk-shifting opportunities.

Our paper also relates to the empirical literature on the effects of regulation on multinational banks. These papers have shown that higher capital requirements for multinational banks are associated with a reduction in both cross-border credit (e.g., Aiyar et al. 2014a; Forbes et al. 2017), domestic credit (Aiyar et al. 2014b) and foreign lending standards (Ongena, et al. 2013).⁶ Several papers have also provided evidence for regulatory arbitrage arising from regulation and supervision by examining international bank flows (Houston, Lin, and Ma, 2012), trust-preferred securities (Boyson et al. 2016), international bank M&As (Karolyi and Taboada, 2015), subsidiaries of U.S. Bank Holding Companies (Frame, Mihov, and Sanz, 2019), syndicated lending (Demirgüç-Kunt, Horváth and Huizinga, 2019). Our paper contributes to this literature by showing that material risk-shifting can result from banking groups being incompletely covered by cooperation agreements.

The paper proceeds as follows. The next section describes the data and our empirical strategy. Section 3 contains the empirical analysis of cooperation and bank lending. Section 4 analyzes countries' cooperation decisions. The final section concludes.

2 Data and empirical strategy

We use hand-collected data on supervisory cooperation agreements from Beck, Silva-Buston and Wagner (2022, henceforth BSW). The dataset contains information on

⁶On a broader level, our findings are also consistent with prior empirical evidence showing that banks adjust behavior in response to changes in regulatory frameworks (Barth, Caprio, and Levine, 2004; Laeven and Levine, 2009) as well as supervisory frameworks (Gopalan, Kalda, and Manela, 2021; Eber and Minoiu, 2016), and shift risks to business lines or countries with less stringent regulation (Buch and DeLong, 2008).

cooperation at the country-pair level (but such cooperation may also originate from a multilateral agreement) between 1995 to 2013. It spans a set of 93 countries in Europe, the Americas, Africa, and the Trans-Tasman Union.⁷ BSW (2022) describe the data in more detail.

Our main analysis takes place at the subsidiary level. We consider foreign subsidiaries whose parent banks are located in one of the 93 countries covered in the cooperation database. To identify these subsidiaries, we rely on the Claessens and Van Horen (2014) database containing information on home countries, defined by a 50% ownership threshold.⁸ We match these subsidiaries with unconsolidated data from Bankscope to obtain balance sheet variables.

To calculate group-level cooperation indices, we require ownership information on the subsidiaries' banking groups. As the Claessens and Van Horen (2014) database contains information on the country of the owner of a subsidiary (but not the actual parent bank), we hand-collect information on ownership (defined as majority ownership) from annual reports, banks' and regulators' websites, and newspaper articles.⁹ We drop banking groups that have only (foreign) subsidiaries in a single country (as there is then no possibility to shift risks across countries), and subsidiaries with loan growth exceeding 200%. This leaves us with 113 banking groups. Those groups have, in total, 663 subsidiaries, spanning 116 host countries and 40 home countries. The most common case is a subsidiary in a developing country with a parent from a developed country (54%, using the country classification of the IMF), followed by both subsidiary and parent being from a developed country (31% of cases), and the case of both subsidiary and parent being from a developing country (14% of cases). A group has, on average, 10 (foreign) subsidiaries located in 9 countries (indicating that having more than one foreign subsidiary in the same country is not common).

Figure 2 shows the example of the Royal Bank of Scotland (RBS). RBS has sub-

⁷Based on the guidelines of the Basel committee, supervisory cooperation takes principally four different forms: a Memorandum of Understanding for information sharing and on-site inspection, a College of Supervisors, a Memorandum of Understanding on crisis management and resolution and a supranational supervisor. As there is significant measurement error in classifying actual agreements into these four forms, we will focus in our study on the existence of any cooperation agreement.

⁸The Claessens and Van Horen (2014) data accounts for more than 90 percent of the assets of the banking systems considered in the database.

⁹Ownership frequently changes due to M&As. To minimize measurement errors, we employed a data collection process where two research assistants independently collected ownership data, and a third one checked in case of any discrepancies.

sidiaries in nine countries, eight of which are in developing countries. In 2008, only one subsidiary was covered by a cooperation agreement (the subsidiary in Mexico). However, in 2009, the United Kingdom signed cooperation agreements with three countries (Ireland, Poland, and Romania). As a result, the fraction of subsidiaries covered by cooperation agreements increased significantly, and the question arises whether this may be followed by risk-shifting into the subsidiaries not covered by cooperation agreements.

In our main analysis, we relate lending in a foreign subsidiary to the extent to which the subsidiary's group is covered by cooperation. Specifically, we run the following regression for a subsidiary s

$$\text{Log}(Loans)_{s,g,c,p,t} = \beta_0 + \beta_1 \text{Group coop}_{g,c,t-1} + \beta_2 X_{s,t-1} + \gamma_s + \delta_{g,c} + \alpha_{c,p,t} + \epsilon_{s,g,c,p,t}, \quad (1)$$

where g denotes the subsidiary's group, p and c are the country where parent (home) and subsidiary (host), respectively, are located and t denotes year. *Group cooperation* measures the degree to which the assets of the (foreign) subsidiaries of the subsidiary's group g are covered by a cooperation agreement. We calculate this index *excluding* subsidiaries located in the subsidiary's host country c itself:

$$\text{Group coop}_{g,c,t} = \sum_{k \neq c} w_{g,k,t} \cdot \text{Cooperation}_{k,p,t},$$

where $w_{g,k,t} = \frac{\text{ForeignAssets}_{g,k,t}}{\sum_{k \in K} \text{ForeignAssets}_{g,k,t}}$ and $\text{Cooperation}_{k,p,t}$ is a dummy variable indicating the existence of cooperation between the home country and a specific subsidiary host country. For example, Figure 2 shows that RBC's *Group Cooperation* for an Argentinian subsidiary is 0.1% in 2008, indicating low residual cooperation as only Mexico is cooperating with the United Kingdom in that year. In 2009, however, this number increased to 93% since cooperation now covers the assets of three additional host countries.

$X_{s,t-1}$ is a set of control variables at the subsidiary level, and γ_s are subsidiary fixed effects. We include host and home country-time fixed effects and even home-host country-time fixed effects. The latter will absorb all effects from the home and host countries, including bilateral effects. In our most stringent specification, identification will come from the fact that two subsidiaries located in the same country with parents

that are also headquartered in identical countries are differentially exposed to third countries signing cooperation agreements with the home country as the geographic footprint of banking groups differs. In our regressions, we also include group-host country-level fixed effects, $\delta_{g,c}$ (this is relevant in the case of an acquisition, following which a subsidiary may become part of another group). Standard errors are clustered at the group and host-country level (two-way clustering) to control for the possibility that lending is correlated across groups and host countries. This clustering is consistent with our variable of interest (*Group Cooperation*) showing variation at this level.

For the bank-level variables, we include *Log(assets)* as an indicator of size, *Liquid assets/TA* as a measure of the liquidity of the bank, *Capital-ratio* as a measure of bank capitalization, *Loan/Deposits* as a measure of intermediation intensity, *Non-interest income to total income* to proxy for the business model, *Loan loss provisions over total loans* as indicator of lending quality. This follows the literature that has explored the relationship between bank characteristics and lending (see, e.g., Aiyar et al. (2014a)).

Panel A of Table 1 provides summary statistics. Due to missing observations in our control variables (mainly the capital ratio), the cross-section consists of only 364 subsidiaries (the remaining subsidiaries of the 113 banking groups still enter the data though through the cooperation index).¹⁰ The mean *Group Cooperation* of a subsidiary is 0.51, indicating that, on average, about half of the assets of the foreign operations of the group outside the subsidiary country are covered by a cooperation agreement.¹¹ The table shows significant variation in this variable: the 25th and 75th percentiles are 0.18 and 0.86, respectively. Figure 3 depicts the evolution of mean *Group Cooperation* over time. It shows a steady increase during the sample period, reflecting that cooperation has increased markedly over the sample period.

In our regressions, we also control for cooperation between the home country and the subsidiary country itself. The table shows that mean *Subsidiary Cooperation* is 0.5 and thus similar to the one of *Group Cooperation* (and as Figure 3 shows, its

¹⁰To examine whether our sample of (cross-sectional) subsidiaries is representative, we regress $\text{Log}(\text{loans})$ on a narrower set of controls ($\text{log}(\text{assets})$, $\text{liquid assets}/\text{TA}$, LLP/TL , and $\text{loan}/\text{deposits}$). In this regression, a dummy variable for being present in our baseline sample is insignificant, indicating the lending by our sample subsidiaries does not materially differ.

¹¹This is number is higher than the average bank coverage of a specific agreement (which was about 0.41, see Figure 1), possibly reflecting a sequence of agreements.

upward trend is also similar).¹² In some regressions we also include the propensity of the home country to cooperate (*Home Cooperation*), defined as the share of countries (out of all countries in Claessens and Van Horen) with which the country cooperates. This variable takes a mean of 0.15, indicating a limited overall propensity to cooperate across countries.

Panel A in Table 2 provides information on the correlation among the main variables for the subsidiary sample. Two points are noteworthy. First, *Group Cooperation* and *Subsidiary Cooperation* are only very modestly correlated (correlation coefficient of 0.09). Second, *Group Cooperation* and *Home Cooperation* (that is, the overall propensity of the home country to cooperate) are positively correlated (correlation coefficient of 0.35). The latter is partly mechanical – because when the home country cooperates more with other countries, this may also tend to cover some countries where foreign subsidiaries are located.

In our subsidiary-level analysis, we also study how various country characteristics are related to risk-shifting. To examine this, we consider various proxies for strictness in the subsidiary host country relative to the strictness in the other (foreign) countries the group is operating in: whether the supervisor has the power to force insolvency (*Insolvency power*) or to take specific actions and correct problems (*Supervisor power*), the minimum provisions under which a loan is classified as sub-standard (*Provision stringency*) and whether local market discipline is undermined by a very generous deposit insurance (*Size DI*). For each variable, we take the difference between the host country and the asset-weighted value of the other host countries in the banking group, normalized to the range [0,1]. We obtain the regulatory data from Barth, Caprio, and Levine (1999, 2003, 2007, and 2011), available for 1999, 2003, 2007, and 2011. We take the values of the last survey for the missing years.

We also examine risk-shifting effects that include the extensive margin. To this end, we aggregate a group’s subsidiaries at the host-country level.¹³ We run the following

¹²We mainly view *Subsidiary Cooperation* as a control – its coefficient cannot be interpreted in a causal way since subsidiary cooperation may result from anticipated changes in loan growth in the subsidiary country.

¹³Thus, we now also capture when a banking group opens an *additional* subsidiary in the host country. We do not have cases in our sample of a banking group entering a (foreign) country in which it does not have a subsidiary yet.

regression, now at the *group-host country-level*:

$$Y_{g,c,p,t} = \beta_0 + \beta_1 \text{Group coop}_{g,c,t-1} + \beta_2 X_{g,c,t-1} + \gamma_{g,c} + \alpha_{c,p,t} + \epsilon_{g,c,p,t}, \quad (2)$$

Our dependent variables in these regressions are lending $\text{Log}(\text{loans})$ and Asset growth of a group in a given host country, but we also consider the (change in the) number of subsidiaries $\Delta \text{Subsidiaries}$ in a given host country to isolate the extensive margin. Bank controls are the same as in the subsidiary regressions aggregated at the group-host country level. We include the same set of fixed effects as in the subsidiary-level regressions, except for subsidiary fixed effects. Standard errors are clustered at the group and host-country level (two-way clustering). Panel B of Table 1 shows the descriptive statistics. $\text{Log}(\text{loans})$ has a mean of 7.1 and a standard deviation of 1.9. The average asset growth of banking groups in a given host country in this sample is 8% (and standard deviation of 24%), whereas the average variation in the number of subsidiaries is -0.007 (and standard deviation of 0.12). This suggests that banking groups tend to expand by increasing the size of existing subsidiaries rather than opening new ones.

In the last part of our analysis, we examine risk-shifting at the *loan-level*. For this, we obtain loan data from Thomson Reuters’s Dealscan database, which contains loan-level information on a large number of syndicated loans across the globe. We then examine for each group present in the syndicate of a given loan facility, through which of its subsidiaries it originates the loan.

Specifically, we first identify all groups associated with (foreign) subsidiaries in the syndicate. For this, we manually match foreign subsidiaries in our data with lenders in Dealscan. For each of the banking groups related to the matched subsidiaries, we expand the data and consider all of their (foreign) subsidiaries and assign to them a one if they are present in the syndicate and zero otherwise (thus, “not chosen” subsidiaries also enter the regression). The regressions are hence at the loan-facility-group-subsidiary level. Similar to the subsidiary-level analysis, we will now examine whether the likelihood that a given loan is originated in a group’s subsidiary in a specific country depends on the cooperation of other host countries in which the group operates. The regression

takes the following form:

$$Prob(Loan)_{f,s,g,c,p,t} = \beta_0 + \beta_1 Group\ coop_{g,c,t-1} + \beta_2 X_{s,t-1} + \gamma_s + \delta_{g,f} + \alpha_{c,p,t} + \mu_{g,c} + \epsilon_{f,s,g,c,p,t}, \quad (3)$$

where f indicates facility (segment of the loan). The bank-level regressors and fixed effects are as in the previous regression line. However, we now include additionally facility-group fixed effects to compare subsidiaries from the same group and a given facility. Hence, all time-varying loan, borrower, and group-specific characteristics are controlled for. In some regressions, we also include borrower country-host country-year fixed effects to account for home bias in lending. We fit a linear probability model to estimate this equation to avoid biases arising from the incidental parameters problem in non-linear panel data models with fixed effects (Neyman and Scott (1948)). Standard errors are clustered at the banking group and host country level (two-way clustering).

Panel C of Table 1 presents the descriptive statistics. After excluding missing observations in the relevant variables, our final expanded dataset comprises 3137 loans, provided by 54 banking groups, to 1592 borrowers. The average likelihood of a subsidiary within a group being chosen is 6.1%. This low number reflects that the groups in the loan sample are larger than in the subsidiary sample and hence have a large number of subsidiaries (reducing the likelihood that a specific subsidiary is chosen).

In our loan-level analysis, we also study whether loan extension probability differs depending on borrower risk. For this, we additionally match our data with Compustat to add borrower balance sheet data to our database.¹⁴ To measure borrower risk, we consider the borrower’s logarithm of sales as a proxy for *Size*, and a borrower’s S&P Global Market Intelligence *Rating* (larger and higher-rated borrowers are expected to have lower default risk).

3 Empirical results

We begin with a visual examination of subsidiary lending and group cooperation, similar to a diff-in-diff graph. Specifically, we compare lending at subsidiaries that experience a material increase in group cooperation (treated subsidiaries) with subsidiaries that

¹⁴We thank Chava and Roberts (2008) for sharing their data link between Dealscan and Compustat.

do not (control subsidiaries). A subsidiary is defined as treated if an annual change in group cooperation is larger than the sample median in the sample period. A subsidiary is assigned to the control group if the annual variation in group cooperation is always below the median in the sample period. We match treated subsidiaries to control subsidiaries in the same country and year. Figure 4 shows lending for both groups of subsidiaries (the shaded area indicates when a subsidiary faces an increase in group cooperation according to the treatment definition). The figure shows that lending at treated subsidiaries rises after the treatment, whereas the control subsidiaries experience a reduction in lending. Notably, the figure shows no significant upward or downward trend in lending for treated and control subsidiaries before the treatment (parallel trend assumption).

3.1 Baseline results

Table 3 contains our baseline analysis, where we examine how the cooperation coverage of the banking group affects lending to a subsidiary. All regressions include *Group Cooperation*, *Subsidiary Cooperation* and a set of standard subsidiary-level controls. We also include subsidiary fixed effects and group-host country fixed effects (the latter only matters when another group takes over a subsidiary).

The results in Table 3 show an increase in lending growth in a given subsidiary, if the home country supervisor increases cooperation with other host country supervisors, providing the first evidence of banking groups reacting to changes in supervisory cooperation. We can see that *Group cooperation* obtains a positive and significant coefficient (0.235), consistent with risk-shifting into a subsidiary following the cooperation of the home country with other host countries. Column (1) includes additionally the propensity of the home country to cooperate (*Home Cooperation*), which enters positively and marginally significant, and host country-year fixed effects, which absorb all local factors, for example, changes in the attractiveness of the subsidiary country as an investment destination. *Subsidiary cooperation* obtains a negative coefficient (though insignificant).

Turning to the (lagged) bank-level control variables, (log) assets obtains a significant positive coefficient that is near one, indicating that banks target relatively constant loan-

to-asset ratios. The ratio of loans to deposits obtains a positive significant coefficient as well, suggesting that higher loan growth following an increase in supervisory cooperation is not (entirely) funded with deposit growth, but rather through other forms of debt or equity. Finally, banks with higher loan loss provisions lend less, as do banks with a business model focusing on non-traditional activities (as captured by non-interest income as a share of total income).

Column (2) additionally includes home country-year fixed effects (and hence drops *Home Cooperation*). This now also controls for all push factors coming from the home country, for example, due to changing economic conditions or regulation changes. The coefficient on *Group Cooperation* increases in value (coefficient of 0.364) and remains significant.

Column (3) is the most saturated model and will be our baseline. In this specification, we also include host country-home country-year fixed effects (hence, drop the host-country-year and home country-year fixed effects). This means we now also fully control for all factors at the bilateral level (for example, the home and host country may sign a trade agreement, facilitating banking flows among the countries). Note that the inclusion of these fixed effects also subsumes *Subsidiary Cooperation*. The coefficient on *Group Cooperation* remains positive (0.578) and significant.¹⁵ The estimates imply that *Group Cooperation* has an economically meaningful impact on subsidiary risk-taking. In particular, loans increase by 20% following a one standard deviation increase in *Group Cooperation*. This translates into \$1.3 billion more lending at the average subsidiary. Importantly, the subsidiary-level estimates also imply meaningful amounts at the country-level: Aggregating all subsidiaries in a host-country, we find that the implied increase in foreign loans (as a share of the host country's total loans) is 16%.

The remaining columns of Table 3 examine the robustness of the baseline result. Due to our fixed effects structure, our analysis fully controls for any time-varying host or home country factors, even at the level of the country-pair. Identification arises because for a given host-home country-pair subsidiaries belong to banking groups with different geographic footprints and are hence differentially affected by cooperation between third

¹⁵We re-estimate our model excluding Loans/Deposits as this variable may be mechanically correlated to our dependent variable. The results remain unchanged.

countries and the home country. This limits endogeneity concerns mainly to the group level. Furthermore, we focus on third-country effects, which limits endogeneity arising from cooperation resulting from the subsidiary's risk-taking.

One source of endogeneity may conceivably arise if a group decides to shift activities from one subsidiary to a subsidiary in another country, and trigger a change in cooperation there (with the home country), in which case a correlation between subsidiary lending and *Group Cooperation* may result.¹⁶ This would require the subsidiary to be fairly large such that a partial relocation could possibly trigger a change in cooperation in other countries. In column (4), we thus limit the sample to subsidiaries smaller than 10% of assets of the (consolidated) parent bank. In addition, in column (5), we exclude all observations where the combined foreign activities of the group (excluding the subsidiary country) exceed 10% of the combined banking sectors in which the group operates. In these samples, it is implausible that reallocations away from the subsidiary country can have meaningful implications for other countries incentives to cooperate. Columns (4) and (5) show that the coefficient on *Group Cooperation* has a very similar coefficient as the one in the baseline regression (column (3)), and remains significant.

A second source of (group-level) endogeneity may arise with respect to the asset weights that are used to calculate the cooperation index. For example, risk-shifting suggests that over time the footprint in countries with low cooperation increases. This lowers *Group Cooperation* (by reducing weights in high cooperation countries), possibly creating a spurious correlation with subsidiary lending. To completely exclude any effects due to (changes in) asset weights, we also run a robustness test where we calculate the *Group Cooperation* using equal-weighting among subsidiaries in column (6). The coefficient on group cooperation drops in size (to 0.444) but remains economically meaningful, a one-standard-deviation increase in *Group Cooperation*, increases lending by 15% (the coefficient is now significant at the 10% level).

In our baseline analysis, we control for acquisitions by assigning subsidiaries the (fixed-effect) of their new parent group following the acquisition. An alternative treat-

¹⁶The analysis in Section 4 suggests that risk-shifting opportunities (as proxied by the existence of third-country subsidiaries) affect cooperation incentives. Thus, abolishing a subsidiary in a host country may lead to a change in group cooperation by lowering other countries' incentives to cooperate. Note that this argument runs through the extensive margin (the existence of a third-country subsidiary provides risk-shifting opportunities), whereas we consider here changes in lending at existing subsidiaries.

ment is excluding subsidiaries acquired over the sample period. Column (7) shows that the sample then falls to 1,375 observations. The coefficient on *Group Cooperation* remains similar in size and significance to the baseline.

Our main analysis focuses on the analysis of *Group Cooperation* on subsidiary lending, which allows us to control for home country- host country-year fixed effects. The analysis for *Subsidiary Cooperation* does not permit this, and identification is hence less tight. Nonetheless, in column (8), we present an analysis tailored to examining the effect of subsidiary cooperation. In this column, we replace the home country-host country-year fixed effects by host country-year and home country-year fixed effects (they would otherwise subsume *Subsidiary Cooperation*). In addition, we cluster at the host country and home country level (two-way clustering), to reflect that this is now the variation of the variable of interest. The subsidiary cooperation variable obtains a coefficient of -0.105, which is significant at the 5% level (the magnitude of the coefficient is consistent with the one obtained in column (2) of Table 3).¹⁷

In unreported regressions (available on request), we examine the robustness of our main findings to alternative forms of clustering of the standard errors, including two-way clustering at the host country and year-level and banking group and year-level, confirming our baseline results.

In summary, our results indicate that an increase in cooperation between home and host country supervisors increases lending in subsidiaries in countries not subject to the change in cooperation. These results provide an explanation for the results obtained in BSW (2022) who find that supervisory cooperation does not reduce overall risk for the very large banking groups (the coefficient estimate for risk at the group level in BSW is insignificant).¹⁸ The ineffectiveness of cooperation is explained with significant

¹⁷It should be noted that (theoretically) the impact of supervision on risk-taking is not necessarily a negative one (see, for example, Dell’Ariccia and Marquez (2006), Beck, Todorov and Wagner (2013) and Calzolari, Colliard and Lóránth (2019)), however, most mechanisms suggest a positive effect. For example, cooperation should lead to higher supervisory stringency as supervisors then take into account the cost of bank failure to other countries (that is, they start to internalize negative externalities).

¹⁸Complete ineffectiveness of cooperation would suggest that the coefficients on group cooperation and subsidiary cooperation add to zero (ignoring size differences across subsidiaries). Whereas we take our estimate for subsidiary cooperation with a grain of salt (due to less clean identification), we note that the sum of the coefficients in column (8) of Table 3 is indeed not significantly different from zero. It should also be noted that our estimate of the coefficient on subsidiary cooperation may underestimate the true effect due to reverse causality (i.e., high risk in a subsidiary may trigger more cooperation).

potential for high risk-shifting among the largest banks: the large banks in BSW (2022) have, on average subsidiaries in five different countries, lower than in our sample,¹⁹ but much higher than the number of countries spanned by subsidiaries in the small bank sample (2).

Table 4 examines next how the expansion in lending is funded and whether it is associated with higher risk for the subsidiary. In principle, more lending does not need to result in more risk if it is supported by capital or if it leads to substitution away from other (high-risk) assets. Column (1) of the table first shows that *Group Cooperation* leads to significantly higher asset growth, suggesting that the lending increase is not just funded by reallocating from other activities. Column (2) examines next where the additional funding comes from, showing that equity growth declines (the coefficient is negative and significant). This suggests that supervisory cooperation is associated with higher reliance on debt.

Columns (3) to (5) of Table 4 examine other indicators of bank risk. More lending – even though funded by leverage – does not necessarily imply higher overall risk if such lending is safer, more profitable, or reduces profit volatility (for example, because of better diversification in the lending portfolio). Columns (3) to (5) thus consider, subsequently, loan loss provisions, ROE, and the variability of ROE. *Group cooperation* does not enter significantly in the loan loss provisions and standard deviations of ROE regressions, while it enters negatively and significantly in the ROE regression, indicating lower profitability of the new lending. Summing together, the results in Table 4 suggest that the lending increase is also associated with an overall higher risk in the subsidiary.

Tables 3 and 4 have considered the intensive margin: how existing subsidiaries react to *Group Cooperation*. However, banking groups may also adjust through entry and exit. To include the extensive margin in our analysis, Table 5 consolidates all subsidiaries of a banking group in a specific (host) country, thus capturing the effect of forming additional subsidiaries or selling subsidiaries.²⁰ We can see that *Group Coop-*

¹⁹For the banking groups in our sample, we obtain similar results to BSW, in particular, supervisory cooperation has no effect on the risk at the level of the banking group (regression output is available on request).

²⁰The analysis of the extensive margin should be interpreted with some caution: Calzolari, Colliard, and Loranth (2019) have shown that supervisory cooperation creates incentives to convert affected subsidiaries into branches. It is less clear whether and how third-country cooperation (which is studied here) would affect organizational structure in a specific host country, however, one should be aware of

eration increases lending in a host country (column 1) and leads to higher asset growth there (column 2). In particular, the coefficients suggest that a one-standard-deviation increase in cooperation increases lending and assets growth on average by 14% and by 6 percentage points, respectively. In column (3), we aim to isolate the extensive margin by examining the change in the number of subsidiaries owned by a banking group in a specific host country. As mentioned previously, banks rarely have more than one subsidiary in a country (the average number of subsidiaries conditional on having a presence in the country is 1.1), suggesting limited potential for adjustments through the extensive margin. Nonetheless, we find a positive and significant relationship between *Group Cooperation* and the number of subsidiaries. The coefficient estimate of 0.261 is economically meaningful, implying that a one-standard-deviation increase in cooperation changes the number of subsidiaries by 0.1.

In summary, the results in Table 5 show that the results also hold for various dimensions of the extensive margin.

3.2 Heterogeneity

We next examine whether the extent of risk shifting to a third country subsidiary depends on the characteristics of the subsidiaries, their host-countries, and the applicable supervisory framework.

Table 6 first studies whether and how the lending increases at a subsidiary depend on the characteristics of the subsidiary itself. In column (1), we examine the size of the subsidiary as measured by its assets. The interaction terms between assets and *Group Cooperation* obtains a negative coefficient, suggesting that the economic effect is smaller at larger subsidiaries. The coefficient is insignificant though. In column (2), we examine whether cooperation between home and host supervisors matters for the impact of changes in cooperation with third countries. It may be more difficult for a banking group to shift risk into a subsidiary that is located in a country that cooperates with the home country (note that while in Table 3 we examined the direct

the possibility that changes in the number of subsidiaries may simply reflect changes in organizational form that may not have any direct risk implications. Unfortunately, we do not have data available for cross-border branching.

effect of subsidiary cooperation, here we gauge how the impact of *Group Cooperation* is affected by subsidiary cooperation). The interaction effect of subsidiary cooperation with *Group Cooperation* indeed obtains a negative and significant coefficient, and is (in absolute terms) almost identical to the direct effect of *Group Cooperation*.

In column (3), we interact *Group Cooperation* with an indicator of the extent to which the subsidiary supervisor cooperates with other countries where the group has subsidiaries. The interaction of *Group Cooperation* with this indicator enters negatively and significantly, suggesting that cooperation of the subsidiary's supervisor with other host countries limits risk-shifting. Finally, column (4) includes the squared term of *Group Cooperation*. As more and more countries cooperate, the potential for risk-shifting within the residual banking group becomes more and more limited, meaning that risk-shifting arising from even more cooperation can only occur via the remaining unaffected subsidiary.²¹ This suggests that the effect of *Group Cooperation* is an increasing one. Consistent with this, the quadratic terms enter positively and significantly in column (4).

The results in Table 7 show that the increase in lending in third country subsidiaries are more muted in host countries with more stringent supervision and more market discipline. Here, we study whether the cooperation-induced risk allocation into a subsidiary depends on the strictness of regulation and supervision in the subsidiary host country. We would expect that lending increases that are motivated by regulatory arbitrage to be less pronounced when regulation and supervision in the subsidiary host country is strict. To examine this, we investigate *relative* stringency, specifically, we consider various proxies for strictness in the subsidiary host country relative to the average (asset-weighted) strictness in the other (foreign) countries the group is operating in: whether the supervisor has the power to force insolvency (*Insolvency power*) or to take specific actions and correct problems (*Supervisory power*), the minimum provisions under which a loan is classified as sub-standard (*Provision stringency*) and whether local market discipline is undermined by a very generous deposit insurance (*Size DI*).

In each case, the interaction effect with *Group Cooperation* is significant and with a

²¹To illustrate, consider a group with n subsidiaries. If the parent country cooperates with one subsidiary country only, risk can be shifted equally into the remaining $n - 1$ subsidiaries. However, if cooperation coverage increases from $n - 2$ to $n - 1$ subsidiaries, there is only one subsidiary left, which then will have to absorb all the risk-shifting.

sign that suggests that the relationship between *Group Cooperation* and lending is less intense in countries with higher supervisory stringency and stronger market discipline. Specifically, the three interaction terms with supervisory measures enter negatively and significantly while the interaction with the proxy for deposit insurance generosity enters positively and significantly.

The role of the host country’s regulatory framework is also of economic significance. Specifically, a one-standard-deviation increase in cooperation increases loans by 22%, 24%, and 28% for the average values of *Insolvency power*, *Supervisory power*, and *Provision stringency*, while the same change increases loans by 14%, 15%, 12% at the 75th percentile of these variables, thus a reduction in lending growth by a third to one-half. The effect is smaller in the case of a deposit insurance; a one-standard-deviation increase in cooperation increases loans by 29% at the average value of *Size DI*, while it increases loans by 30% at the 75th percentile.

Taken together, these results suggest that cooperation-induced lending increases in a subsidiary are higher when local oversight is weak and when market discipline is limited, consistent with a risk-shifting motivation.

3.3 Loan-level analysis

We now study risk-shifting at the level of individual loans. Specifically, we examine whether a banking group is more likely to originate a loan in a subsidiary country when (residual) group cooperation is higher.

The results in Table 8 show that this is the case. Column (1) is the baseline regression, which includes, besides the fixed effects considered in the subsidiary analysis, additionally facility-group fixed effects. *Group Cooperation* obtains a coefficient of 0.059, significant at the 5%-level. The coefficient suggests that one standard deviation in group cooperation increases the probability that this subsidiary is chosen for origination by 2 percentage points, which is a sizeable effect as the unconditional probability is 6%. Column (2) excludes next observations where more than one subsidiary from a group participates in the facility, confirming our findings. Column (3) controls for “home bias”, that is, a higher likelihood of a subsidiary extending a loan to a borrower from the same country. Specifically, we include borrower country-host country-year

fixed effects. The coefficient drops to 0.0291 but remains significant at the 5% level.

An advantage of considering individual loans is that we can examine borrower risk. If risk-shifting considerations drive the loan reallocation, we would expect stronger effects for riskier loans. Columns (4) to (6) consider three different proxies of borrower risk: loan spreads, borrower size (smaller firms are riskier), and leverage.²² The last two variables indicate whether the borrower belongs to the top 25th percentile of each variable in the sample. In each case, the interaction terms of *Group Cooperation* with proxies for borrower risk indicate that the effect is magnified for riskier borrowers, consistent with risk-shifting motives.

In sum, the loan-level regressions confirm our subsidiary-level regression: an increase in supervisory cooperation between the parent bank and other hosts country supervisors result in a higher probability that a given syndicated loan tranche is being booked on this subsidiary's balance sheet, a probability that increases in the riskiness of borrower and loan, in line with the risk-shifting hypothesis.

4 Incomplete coverage and cooperation inefficiency

The analysis in the preceding sections has shown that banking groups shift risks into the third countries when faced with higher supervisory cooperation. In other words, cooperation between two countries creates a negative externality on third countries. Our estimates point to a large magnitude of risk-shifting induced by changes in cooperation (specifically, a one-percentage-point increase in group cooperation increases lending in a subsidiary by about 20%). This is not an issue as long as the coverage of supervisory agreements matches well the geographic perimeter of the involved banking groups. However, a cooperation agreement made during our sample period (which may be of bilateral or multilateral nature) covers on average only 41% of the subsidiary countries of the banking groups headquartered in the agreement countries. Incomplete coverage of cooperation agreements, coupled with sizeable risk-shifting externalities from cooperation implied by our estimates, suggest that actual cooperation decisions have imposed significant negative effects on third countries. If countries do not internalize the ad-

²²The analysis of loan spreads comes with the caveat that loan spreads themselves may also reflect the risk appetite of the bank (that is, a bank with risk-shifting motives may price a loan more aggressively).

verse effects they cause on other countries, this also suggests that more cooperation agreements have been formed than what is optimal from a global welfare perspective.

In the following we hence investigate whether (or not) countries internalize third country effects when deciding upon cooperation. We do this by amending the analysis of cooperation decisions in Beck, Silva-Buston and Wagner (2022). BSW study supervisory cooperation decisions made by countries and link them to the benefits and cost of cooperation. The underlying theoretical framework is the externality-heterogeneity trade-off for centralizing decision-making.²³ The benefit to cooperation (a form of centralized decision-making) is that two countries can better internalize *bilateral* externalities arising because their banking systems are linked with each other. In particular, joint supervision can consider that more stringent supervision in one country may benefit the other country by reducing externalities from cross-border bank failures, leading to more efficient supervisory decisions. The cost of cooperation comes in the form of differences across countries, for instance, because of differences in preferences or legal systems. Such differences make it challenging to agree on common standards and implement cooperation. Following the externality-heterogeneity trade-off, cooperation between two countries should thus be more likely when (bilateral) externalities are significant and when (bilateral) heterogeneity is limited.

In Appendix B, we introduce a new factor in the analysis of optimal cooperation decisions: risk-shifting into third countries. Using a simple model, we show that when banks in two countries have operations in a third country, the two countries' gain from cooperating increases. The mechanism is the following. Faced with higher supervisory scrutiny following cooperation, banking groups will shift some risks abroad (into the third country) instead of trying to hide them in the two cooperation countries. The consequence is that the risk reduction in the cooperation countries is larger than when risk-shifting opportunities are absent. In other words, cooperation becomes more effective from the viewpoint of the two countries.²⁴ However, risk-shifting opportunities

²³See the literature on optimal currency unions (McKinnon (1963)) or fiscal decentralization (Oates (1972)). For an application to banking, see Dell'Arricia and Marquez (2006) or Beck and Wagner (2016).

²⁴The analysis also shows that cooperation leads to higher risk reduction for the involved countries when there is cooperation with third countries as well (the reason is that it then reverses inward risk-shifting). This points to the possibility of successive (but potentially inefficient) agreements: Cooperation between A and B shifts risks into C, which then provides incentives for C to start cooperating, and so on.

do not increase the total gain (taking into account the third country as well) from cooperation, simply because risk-shifting is zero-sum at the world level.

The model thus predicts that when countries do not (fully) internalize third country effects, their propensity to cooperate increases in risk-shifting opportunities. However, if they fully internalize third country effects, risk-shifting opportunities become irrelevant to the cooperation decision. We incorporate this into the empirical analysis of cooperation decisions as follows. Following BSW, we perform a panel regression at the country-pair level:

$$Cooperation_{i,j,t} = \beta_0 \cdot Bilateral\ share_{i,j,t-1} + \beta_1 \cdot Risk\ shifting_{i,j,t-1} + \gamma_{i,j} + \delta_t + \epsilon_{i,j,t}. \quad (4)$$

In this regression, $Cooperation_{i,j,t}$ is a dummy indicating the existence of a cooperation agreement between i and j in year t . $Bilateral\ share_{i,j,t-1}$ is the proxy for bilateral externalities among the two countries. Following BSW, this variable is measured as the share of banking subsidiaries operating in one country (expressed as a fraction of the host country's banking system) that are headquartered in the other country, averaged across the pair. This variable captures the intensity of bilateral externalities of banking failures. Theory suggests $\beta_0 > 0$, as when bilateral externalities are high, there are larger gains from cooperation (cooperation allows to internalize such externalities, leading to more efficient supervisory decisions).

The variable $Risk\ shifting_{i,j,t-1}$ measures the opportunities for banking groups headquartered in the two countries to shift risks into third countries. It is calculated as the number of subsidiaries in third countries through which a joint banking group operates, first averaged across groups according to their asset share in the subsidiary country,²⁵ and then averaged across the country pair. In variations of this measure, we calculate it only including subsidiaries in case the third country has no cooperation agreement with the parent country (reflecting the notion that when there is cooperation, risk-shifting becomes harder). Based on our analysis of risk-shifting and cooperation incentives in Appendix B, we expect $\beta_1 > 0$ if countries do not internalize third country effects, and

²⁵For instance, consider that in country i only two banks operate, which are both headquartered in j . Suppose the first group has no other foreign operations, whereas the second group has four other subsidiaries in other countries. The risk-shifting variable for country i then takes the value of 2 ($= 0.5 \cdot 0 + 0.5 \cdot 4$) when the banks have equal market share in country i .

otherwise $\beta = 0$.

The regression equation includes country-pair fixed effects, $\gamma_{i,j}$. These fixed effects will capture country heterogeneity (the cost to cooperation), which has been found to be fairly constant over time in BSW. Finally, the regression includes time-fixed effects to capture general trends in the propensity to cooperate over time. We estimate this model conditional on both countries having presence in the other country, as otherwise, joint risk-shifting opportunities are absent. As with the loan probability model in Section 3.3, we apply a linear probability model to avoid biases arising from the incidental parameters problem. Standard errors are robust to heteroskedasticity.²⁶

Table 1 Panel D provides first summary statistics. The mean of the cooperation variable is 65%, higher than in the bank-level analysis. The mean of *Risk shifting* is 75%, indicating considerable risk-shifting possibilities. We also see that this variable has a relatively high variance (standard deviation of 0.24), showing that risk-shifting opportunities differ significantly across countries.²⁷

Table 9 reports the regression results. In column (1), we first consider averaging across groups according to the foreign asset share in the subsidiary country. The coefficient on *Bilateral share* takes a coefficient of 0.034 (significant at the 5% level). The positive coefficient is consistent with the prediction that higher bilateral externalities increase the gains from cooperation (see BSW). The coefficient on *Risk shifting* is 0.776 (significant at 1% level). This is consistent with risk-shifting opportunities making cooperation more effective for the country-pair, leading to more cooperation when countries do not internalize the negative effects on other countries.

Columns (2) to (5) consider the robustness of this result to variations in the measurement of risk-shifting opportunities. Because foreign presence might be small in a given host country, in column (2), we switch to risk-shifting averaged across groups according to the asset share in the subsidiary country (instead of foreign assets). The

²⁶We do not cluster at each country's level (two-way clustering) to avoid problems arising from too few clusters (see, e.g., Cameron, Gelbach and Miller (2008)).

²⁷The extent to which cooperation between two countries imposes externalities on third countries will depend on several factors, for instance, whether the two countries host multinational banking groups that operate in many other countries. In the polar case, externalities are fully absent when two countries have only joint banking groups with no operation in third countries. In our data of actual cooperation agreements, when two countries sign an agreement, this involves, on average, 6 other countries (that is, the banking groups headquartered in the two countries have subsidiaries that span six different countries). The interquartile range is between 2 to 11.

coefficient remains significant (now at 1% level) and has a similar magnitude (0.0916). In column (3), we only count subsidiaries if they are in a country that does not cooperate with the parent country, reflecting that risk-shifting into cooperation-country subsidiaries is more difficult.²⁸ The coefficient increases in size (0.135). In column (4), we use equal weights to average across groups to calculate the risk-shifting variable of the previous column. The idea of using equal weights is to reduce endogeneity concerns. As the analysis in the first part of the paper has shown, groups tend to increase the size of their subsidiaries in countries with low cooperation, which may create a correlation between our risk-shifting variable (which uses subsidiary size as input) and bilateral cooperation.²⁹ We calculate the risk-shifting variable using constant subsidiary weights over time to shut down any channel from changing subsidiary sizes. Given that our bilateral fixed effects will absorb any time-invariant effect of the subsidiary structure, identification now solely arises due to new cooperation agreements with third countries being formed over time. We see in column (4) a lower coefficient of (0.0412), although still significant. Column (5) modifies the risk-shifting variable by using the joint groups' assets share in third countries not covered by cooperation, again using constant weights to aggregate at the host country level. We still obtain a positive coefficient (0.357), significant at the 1% level.

The estimates in Table 9 imply economically meaningful magnitudes. For example, focusing on the coefficient in column (5), a one-standard-deviation change in the risk-shifting variable changes the likelihood of cooperation by 12 percentage points, a considerable amount given that the unconditional likelihood of cooperation in our dataset is 65%. We can also use the regression results to obtain an estimate of by how much the presence of risk-shifting opportunities has (inefficiently) increased the propensity of countries to cooperate. Recall for this that $\beta_1 > 0$ reflects the extent to which two countries increase their likelihood of cooperation because they do not internalize third country effects. We can hence obtain an estimate of cooperation inefficiency by comparing a country pair's propensity to cooperate if the risk-shifting variable is set to zero with the cooperation propensity if the risk-shifting variable takes the actual value.

²⁸In Table 6 (column (2)), we found that risk-shifting into a subsidiary is more muted when the subsidiary country cooperates with the parent country.

²⁹This is expected to create a negative correlation between cooperation and (asset-weighted) risk-shifting opportunities, the opposite of what we find in Table 9.

Given a mean of the risk-shifting variable of 0.75, our estimates imply that the presence of risk-shifting opportunities increases the likelihood of cooperation on average by 26 percentage points.

Our analysis here has focused on the countries creating the externalities through cooperation. We can also illustrate the vulnerability of countries to cooperation by other countries arising from risk-shifting. For this, we calculate a vulnerability-index on a country level. Specifically, for each subsidiary located in a country, we calculate the extent to which the residual parent-subsidiary structure of the corresponding banking group is covered by cooperation (this is similar to the group cooperation index used in the first part of the analysis).³⁰ This measures inward risk-shifting pressure at the subsidiary level. We then average across banks using their asset-share in the host country. Figure 5 summarizes the results, showing considerable variation in vulnerabilities across countries. For instance, some countries with a high presence of international banks, such as several Eastern European countries, display high exposure to risk-shifting. In contrast, some developed countries that mainly act as home countries, such as the United Kingdom or Belgium, or developing countries that have signed agreements covering the footprint of international banks, such as Panama, show low vulnerability to risk-shifting.

5 Conclusions

This paper has shown that incomplete coverage of supervisory cooperation agreements causes significant risk-shifting. Higher cooperation results in more lending and risk in foreign subsidiaries not covered by that cooperation, with material country-level implications. The extent to which risks are shifted into unaffected subsidiaries depends on the strength of supervision and market discipline in the subsidiary host country relative to the rest of the group. The extent of risk-shifting also depends on whether the supervisor of the subsidiary country cooperates with supervisors in the home country and supervisors in other host countries of the banking group. Notably, our results also suggest that cooperation creates potential conflicts across countries. Cooperation

³⁰In this calculation, we modify the group cooperation index to account for the fact that a subsidiary's host country may have signed an agreement with its home country. Risk-shifting vulnerability is set to zero for this subsidiary, in line with our results in Table 6 (column (2)), where we show risk shifting is reduced when this is the case.

between two countries may benefit those countries by leading to risk being shifted to third countries. Such cooperation externalities point to the possibility that actual cooperation decisions made by pairs of countries (or sets of countries) lead to inefficient outcomes, providing a rationale for “cooperating on cooperation”.

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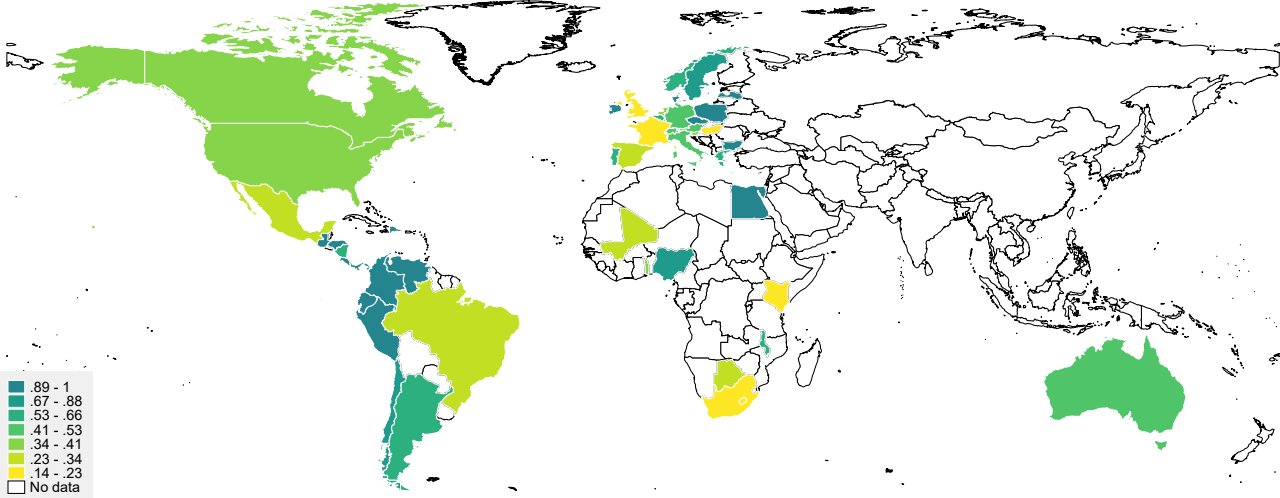
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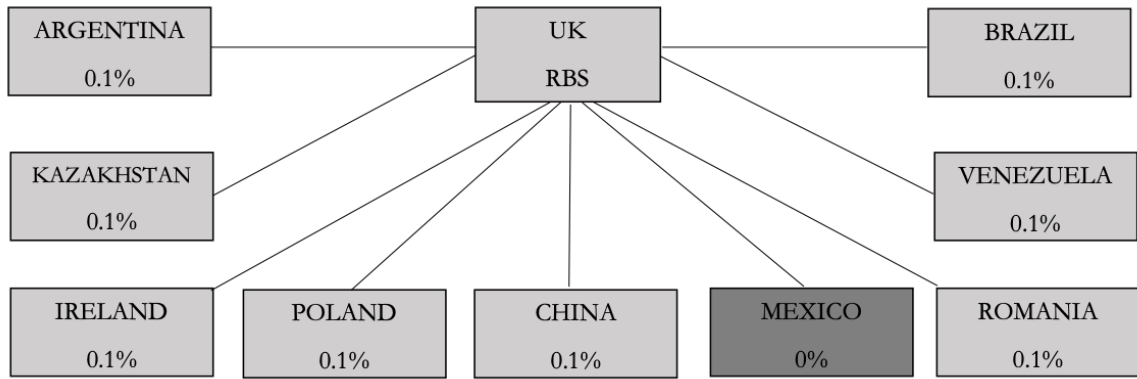
6 Figures

Figure 1. Geographic distribution of agreements' coverage

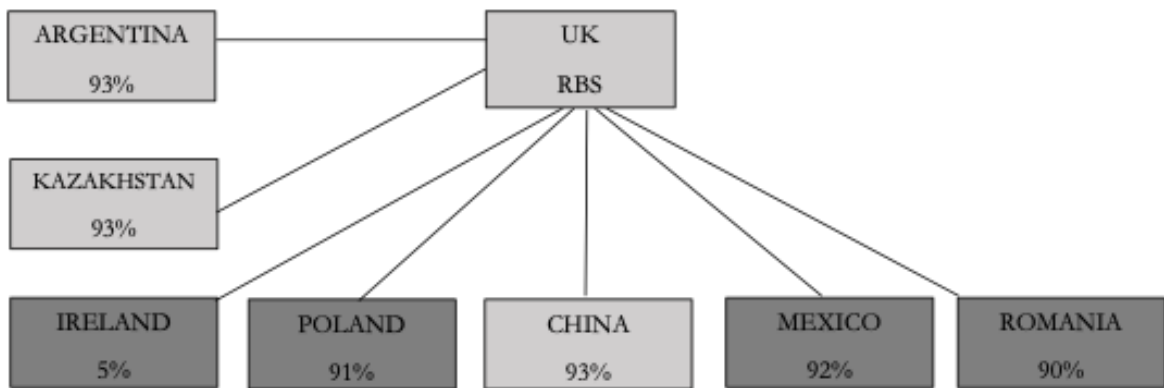


The figure shows the cooperation coverage of banks headquartered in an individual country. Darker green areas represent higher coverage, measured as the country banking groups' asset-weighted average share of host countries covered in an agreement.

Figure 2. Group cooperation Royal Bank of Scotland



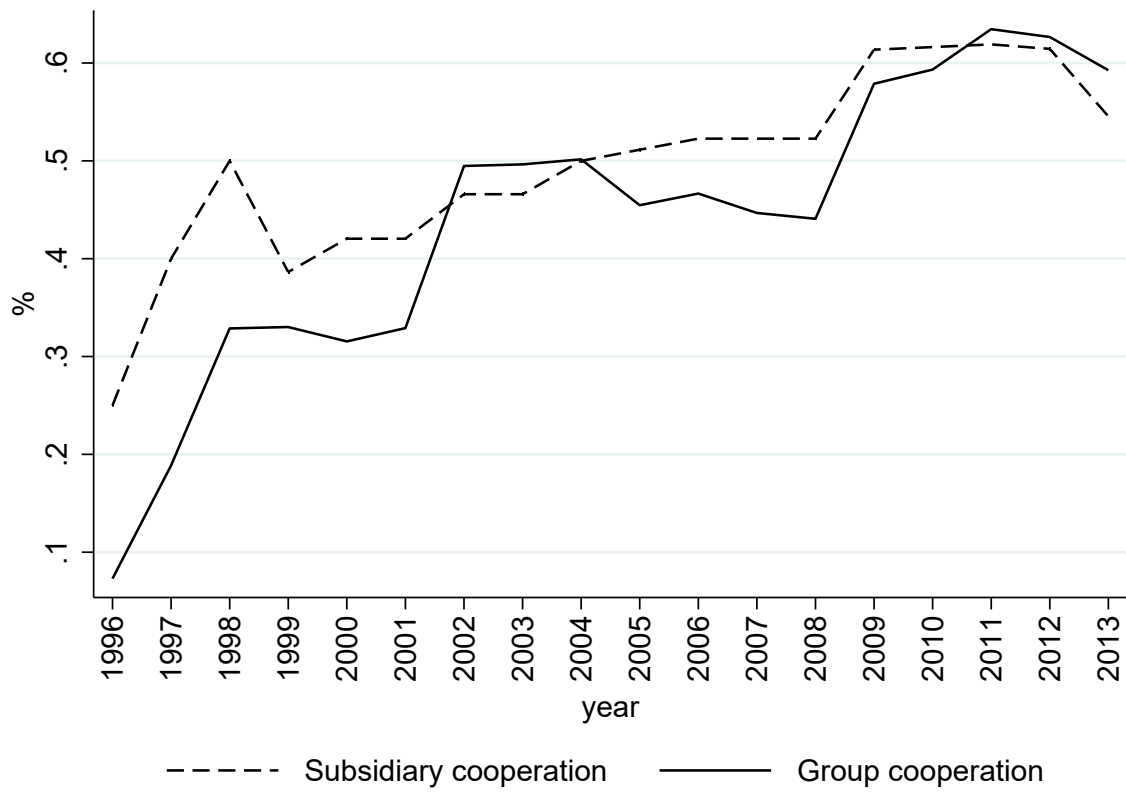
(a) Royal Bank of Scotland 2008



(b) Royal Bank of Scotland 2009

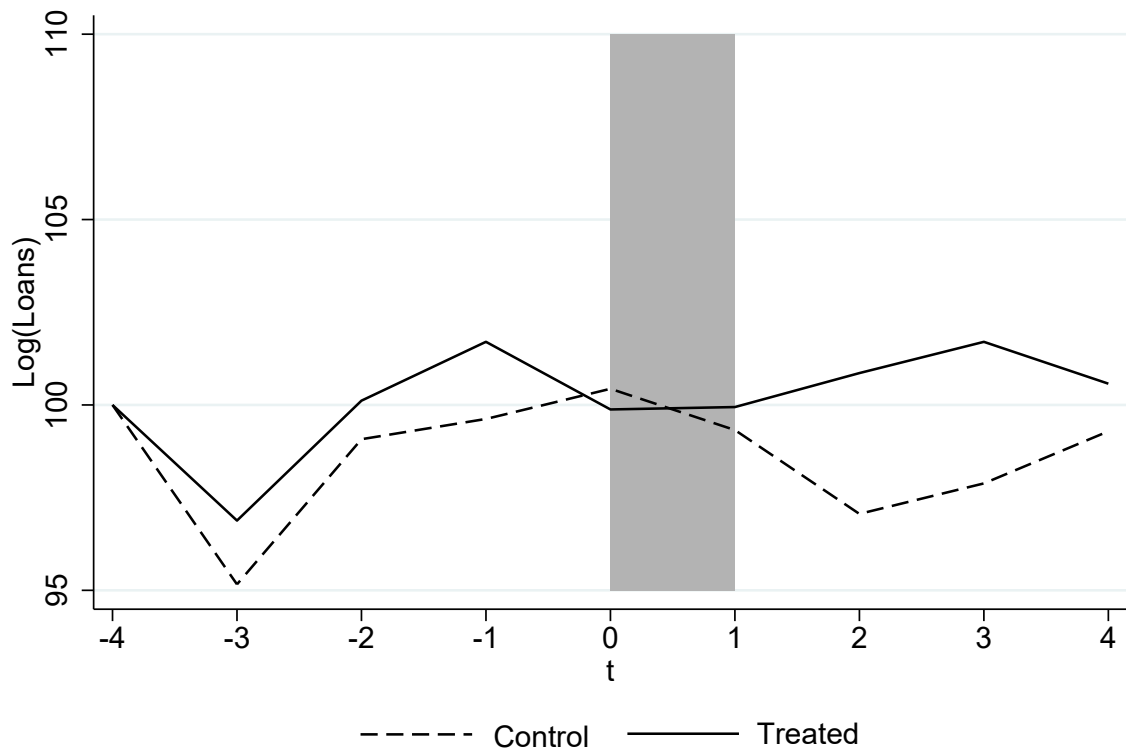
The figure shows group cooperation change for the Royal Bank of Scotland group between 2008 and 2009. The boxes indicate the host countries where the group operates (subsidiaries in Brazil and Venezuela were closed in 2009). Dark gray boxes indicate cooperation between the two countries, and light gray boxes indicate no cooperation exists. The percentage in each box is the group cooperation index for each country (as defined in Section 2), calculated as the asset-weighted cooperation indicator between the UK and the Royal Bank of Scotland's subsidiaries' host countries, excluding the subsidiary's country.

Figure 3. Evolution of cooperation



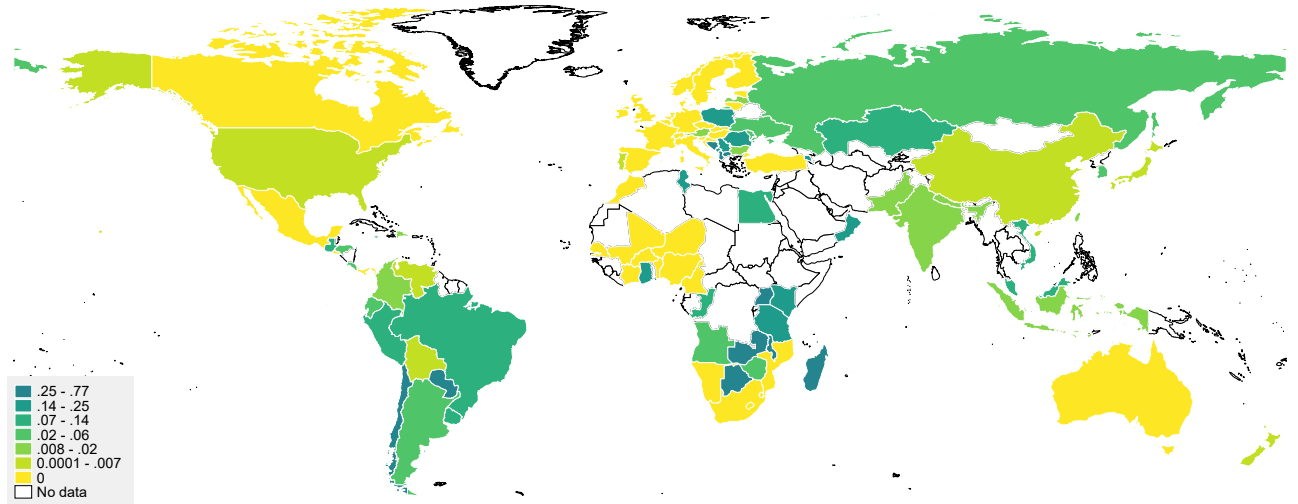
The figure shows the evolution of the average subsidiary and group cooperation across all foreign subsidiaries in the sample.

Figure 4. Lending and group cooperation



The figure shows the subsidiaries' average $\text{Log}(\text{Loans})$ by time and treatment group. A subsidiary is defined as treated if a yearly change in group cooperation is larger than the sample median. A subsidiary is assigned to the control group if the annual variation in group cooperation is always below the median in the sample period. We match treated subsidiaries to control subsidiaries in the same country and year. The vertical shaded area indicates when a subsidiary increases group cooperation according to the treatment definition.

Figure 5. Geographic distribution of vulnerability



The figure shows the risk-shifting vulnerability of individual countries. Darker green areas represent higher vulnerability, measured as the asset-weighted average share of third host countries of the banking groups operating in a country covered by a cooperation agreement.

7 Tables

Table 1: Descriptive statistics

<i>Panel A: Subsidiary-level regressions</i>						
	N	mean	sd	p25	p50	p75
Log(loans)	1,508	6.957	1.904	5.696	6.859	8.275
Group cooperation	1,508	0.509	0.348	0.184	0.559	0.855
Subsidiary cooperation	1,508	0.5	0.5001	0	0.5	1
Home cooperation	1,508	0.151	0.087	0.080	0.145	0.210
EW Group cooperation	1,508	0.435	0.267	0.25	0.5	0.625
Other subsidiaries cooperation	1,171	0.290	0.319	0	0.157	0.561
Log(assets)	1,508	7.707	1.829	6.420	7.592	8.985
Liquid assets/TA	1,508	0.268	0.190	0.126	0.220	0.374
Capital ratio	1,508	19.146	14.479	12.61	15.7	20.035
Loan/Deposits	1,508	0.516	0.224	0.367	0.542	0.679
Non interest inc./TI	1,508	0.308	0.218	0.162	0.273	0.404
LLP/TL	1,508	0.016	0.024	0.002	0.009	0.020
Assets growth	1,085	0.076	0.240	-0.037	0.065	0.188
Equity growth	1,084	0.099	0.267	-0.020	0.083	0.200
ROE	1,083	0.075	0.175	0.028	0.091	0.158
SD(ROE)	663	0.087	0.210	0.019	0.035	0.076
Δ Insolvency power	1,460	0.147	0.235	-0.004	0.156	0.298
Δ Supervisory power	1,441	0.228	0.239	0.068	0.195	0.353
Δ Provision stringency	1,249	0.279	0.219	0.139	0.300	0.457
Δ Size DI	983	0.024	0.120	-0.003	0.002	0.009

<i>Panel B: Group-host country-level regressions</i>						
	N	mean	sd	p25	p50	p75
Log(loans)	1,049	7.174	1.883	5.912	7.047	8.497
Assets growth	1,049	0.076	0.242	-0.040	0.068	0.191
Δ Subsidiaries	1049	-0.007	0.119	0	0	0
Group cooperation	1,049	0.528	0.345	0.210	0.587	0.855
Log(assets)	1,049	7.981	1.806	6.702	7.893	9.210
Liquid assets/TA	1,049	0.258	0.180	0.125	0.213	0.349
Capital ratio	1,049	18.289	9.922	12.730	15.580	19.660
Loan/Deposits	1,049	0.697	0.308	0.508	0.708	0.875
Non interest inc./TI	1,049	0.307	0.213	0.159	0.270	0.402
LLP/TL	1,049	0.018	0.031	0.003	0.009	0.021

<i>Panel C: Facility-Subsidiary-Group-level regressions</i>						
	N	mean	sd	p25	p50	p75
P(loans)	14,396	0.061	0.240	0	0	0
Group cooperation	14,396	0.611	0.326	0.396	0.730	0.873
Log(assets)	14,396	8.494	1.876	7.006	8.344	9.994
Liquid assets/TA	14,396	0.291	0.204	0.127	0.252	0.413
Capital ratio	14,396	18.030	14.129	12.5	15.19	18.04
Loan/Deposits	14,396	0.492	0.222	0.352	0.499	0.657
Non interest inc./TI	14,396	0.326	0.209	0.208	0.291	0.420
LLP/TL	14,396	0.014	0.022	0.001	0.006	0.016
Loan spread	14,396	226.541	141.118	115	200	300
Borrower size	6,152	0.249	0.432	0	0	0
Borrower rating	6,190	0.234	0.423	0	0	0

Panel D: Host country-Home country-level regressions

	N	mean	sd	p25	p50	p75
Subsidiary cooperation	230	0.648	0.479	0	1	1
Bilateral share	230	0.062	0.106	0.006	0.023	0.048
Risk shifting	230	0.751	0.244	0.582	0.794	1

This table reports summary statistics of the main regression variables. The statistics in Panel A are based on annual data at the bank-level. The statistics in Panel B are based on annual data aggregated at the group-host country level. The loan probability in Panel C is based on facility-group level data, whereas bank and borrower data in this panel are based on annual data at the bank and borrower level, respectively. The statistics in Panel D are based on annual data aggregated at the host country-home country level. The sample period spans from 1995 to 2013. Definition and sources of variables are listed in Appendix A.

Table 2: Correlations

<i>Panel A: Subsidiary-level regressions</i> ($N=1,508$)										
	Log(loans)	Home coop.	Subsidiary coop.	Group coop.	Log(assets)	Liquid/TA	Capital ratio	Loan/Dep.	Non interest inc./TI	LLP/TL
Log(loans)	1									
Home coop.	0.117	1								
Subsidiary coop.	0.273	0.101	1							
Group coop.	0.007	0.350	0.092	1						
Log(assets)	0.905	0.181	0.269	0.0013	1					
Liquid/TA	-0.256	0.013	-0.019	-0.026	-0.026	1				
Capital ratio	-0.342	0.034	-0.028	0.026	-0.235	0.290	1			
Loan/Dep.	0.318	-0.064	0.130	0.051	-0.027	-0.701	-0.301	1		
Non interest inc./TI	-0.292	0.058	-0.104	0.073	-0.118	0.343	0.175	-0.475	1	
LLP/TL	-0.234	-0.058	-0.088	0.056	-0.230	-0.094	0.079	-0.011	0.015	1
<i>Panel B: Group-Host country-level regressions</i> ($N=1,049$)										
	Log(loans)	Asset growth	Δ Subsidiaries	Group coop.	Log(assets)	Liquid/TA	Capital ratio	Loan/Dep.	Non interest inc./TI	LLP/TL
Log(loans)	1									
Asset growth	0.002	1								
Δ Subsidiaries	0.021	0.056	1							
Group coop.	-0.006	-0.041	0.029	1						
Log(assets)	0.927	-0.017	-0.021	-0.010	1					
Liquid/TA	-0.250	-0.028	-0.022	0.002	-0.028	1				
Capital ratio	-0.390	0.008	0.007	-0.004	-0.303	0.242	1			
Loan/Dep.	0.270	0.055	0.064	0.012	-0.001	-0.632	-0.174	1		
Non interest inc./TI	-0.271	-0.019	0.002	0.114	-0.118	0.329	0.200	-0.423	1	
LLP/TL	-0.254	-0.076	-0.052	0.024	-0.222	-0.057	0.218	0.018	0.048	1
<i>Panel C: Facility-Subsidiary-Group-level regressions</i> ($N=14,396$)										
	P(loan)	Home coop.	Subsidiary coop.	Group coop.	Log(assets)	Liquid/TA	Capital ratio	Loan/Dep.	Non interest inc./TI	LLP/TL
P(loan)	1									
Home coop.	-0.095	1								
Subsidiary coop.	0.143	0.019	1							
Group coop.	-0.140	0.481	0.054	1						
Log(assets)	0.208	0.094	0.135	-0.022	1					
Liquid/TA	-0.039	0.070	-0.036	0.026	-0.102	1				
Capital ratio	-0.032	0.063	0.105	0.105	-0.106	0.234	1			
Loan/Dep.	0.041	-0.104	0.109	-0.003	-0.056	-0.698	-0.306	1		
Non interest inc./TI	-0.006	0.043	-0.091	0.071	-0.137	0.408	0.174	-0.477	1	
LLP/TL	-0.234	-0.055	-0.082	-0.096	-0.125	-0.128	-0.062	-0.042	0.007	1

Panel D: Host country-Home country-level regressions
(*N=230*)

	Subsidiary coop.	Risk shifting	Bilateral share
Subsidiary coop.	1		
Risk shifting	-0.117	1	
Bilateral share	-0.326	0.026	1

This table reports correlations between the main regression variables. The statistics in Panel A are based on annual data at the bank-level. The statistics in Panel B are based on annual data aggregated at the group-host country level. The statistics in Panel C are based on annual data aggregated at the host country level. The loan probability in Panel D is based on facility-group level data, whereas bank and borrower data in this panel are based on annual data at the bank and borrower level, respectively. The statistics in Panel E are based on annual data aggregated at the host country-home country level. The sample period spans from 1995 to 2013. Definition and sources of variables are listed in Appendix A.

Table 3: Lending

	(1) Log(loans)	(2) Log(loans)	(3) Log(loans)	(4) Log(loans)	(5) Log(loans)	(6) Log(loans)	(7) Log(loans)	(8) Log(loans)
				< 10% parent TA banking sector	excl. > 10%	equally weighted	excl. change group	
Group $coop_{t-1}$	0.235* (0.134)	0.364** (0.177)	0.578*** (0.184)	0.703*** (0.257)	0.662*** (0.136)		0.692*** (0.251)	0.329** (0.130)
Subsidiary $coop_{t-1}$	-0.0261 (0.0393)	-0.118* (0.0642)						-0.105** (0.0450)
Home $coop_{t-1}$	0.188 (0.658)							
EW Group $coop_{t-1}$						0.444* (0.262)		
Log(assets) $_{t-1}$	0.943*** (0.330)	0.980** (0.407)	1.148*** (0.315)	1.183*** (0.320)	1.122*** (0.273)	1.152*** (0.353)	1.160*** (0.324)	0.996*** (0.303)
Liquid assets/TA $_{t-1}$	0.430* (0.240)	0.501* (0.295)	0.784** (0.389)	0.834* (0.442)	0.751* (0.393)	0.741* (0.417)	1.199** (0.473)	0.402 (0.240)
Capital ratio $_{t-1}$	0.00139 (0.00214)	0.000882 (0.00127)	0.000201 (0.00156)	0.000194 (0.00151)	0.000405 (0.00118)	0.000697 (0.00145)	-0.000386 (0.00208)	0.00105 (0.00127)
Loan/Deposits $_{t-1}$	2.491*** (0.647)	2.733*** (0.813)	3.692*** (0.783)	3.801*** (0.775)	4.505*** (0.723)	3.755*** (0.881)	3.999*** (0.873)	2.667*** (0.662)
Non interest inc./TL $_{t-1}$	-0.361** (0.177)	-0.284 (0.229)	-0.334 (0.238)	-0.291 (0.231)	-0.283 (0.228)	-0.393 (0.254)	-0.291 (0.266)	-0.285 (0.215)
LLP/TL $_{t-1}$	-1.189*** (0.432)	-1.629** (0.726)	-0.767 (1.627)	-0.851 (1.679)	-1.905 (1.174)	-0.240 (1.626)	-0.202 (1.846)	-1.764** (0.726)
Subsidiary FE	Y	Y	Y	Y	Y	Y	Y	Y
Host x Group FE	Y	Y	Y	Y	Y	Y	Y	N
Host x Year FE	Y	Y	N	N	N	N	N	Y
Home x Year FE	N	Y	N	N	N	N	N	Y
Host x Home x Year FE	N	N	Y	Y	Y	Y	Y	N
Observations	1,508	1,508	1,508	1,358	1,267	1,508	1,375	1,508
R-squared	0.47	47	0.64	0.65	0.70	0.62	0.68	0.46

This table presents the results of regressions of subsidiary lending on group and subsidiary cooperation. The dependent variable is a subsidiary's $Log(loans)$. *Group coop.* is an asset-weighted dummy indicating cooperation between the subsidiary home country and its subsidiaries' host countries, excluding the subsidiary's country. *EW Group coop.* is an equally-weighted dummy indicating cooperation between the subsidiary home country and its subsidiaries' host countries, excluding the subsidiary's country. *Subsidiary coop.* is a dummy equal to one if there exists cooperation between the subsidiary home country and its subsidiaries' host countries, excluding the subsidiary's country. The sample period spans from 1995-2013. Definitions and sources of control variables are listed in Appendix A. Models (1) to (7) are estimated with two-way clustered standard errors at the banking group and host country level (in parentheses), model (8) is estimated with two-way clustered standard errors at the home and host country level (in parentheses). ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 4: Risk

	(1)	(2)	(3)	(4)	(5)
	Assets growth	Equity growth	LLP/TL	ROE	SD(ROE)
Group coop. $t-1$	0.226*** (0.0539)	-0.176** (0.0807)	0.00766 (0.0178)	-0.133** (0.062)	-0.0520 (0.0365)
Log(assets) $t-1$		-0.136*** (0.0416)	0.00386 (0.0143)	-0.071** (0.032)	0.0525 (0.0483)
Liquid assets/TA $t-1$	0.418* (0.230)	-0.303 (0.234)	0.0138 (0.0234)	-0.053 (0.098)	-0.111* (0.0627)
Capital ratio $t-1$	0.00185*** (0.000621)	-0.000433 (0.00104)	0.000142 (0.000119)	-0.00004 (0.0001)	0.00101 (0.00134)
Loan/Deposits $t-1$	0.529*** (0.134)	0.748*** (0.202)	-0.0643*** (0.0187)	0.260** (0.105)	-0.173 (0.117)
Non interest inc./TI $t-1$	0.176*** (0.0619)	-0.201*** (0.0622)	0.0144*** (0.00490)	0.015 (0.056)	0.0195 (0.0357)
LLP/TL $t-1$	-1.611** (0.808)	3.446** (1.706)		1.193 (0.893)	-0.746 (1.016)
Subsidiary FE	Y	Y	Y	Y	Y
Host x Group FE	Y	Y	Y	Y	Y
Host x Home x Year FE	Y	Y	Y	Y	Y
Observations	1,085	1,084	1,066	1,083	663
R-squared	0.13	0.17	0.10	0.09	0.09

This table presents the results of regressions of risk indicators on group cooperation. The dependent variables are subsidiary's *Asset growth* in column (1), *Equity growth* in column (2), *LLP/TL* in column (3), *ROE* in column (4), and *SD(ROE)* in column (5). *Group coop.* is an asset-weighted dummy indicating cooperation between the subsidiary home country and its subsidiaries' host countries, excluding the subsidiary's country. The sample period spans from 1995-2013. Definitions and sources of control variables are listed in Appendix A. All models are estimated with two-way clustered standard errors at the banking group and host country level (in parentheses). ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 5: Extensive margin

	(1)	(2)	(3)
	Log(loans)	Asset growth	Δ Subsidiaries
Group coop. $_{t-1}$	0.766*** (0.257)	0.172*** (0.0530)	0.251* (0.135)
Log(assets) $_{t-1}$	1.085** (0.454)		-0.00149 (0.110)
Liquid assets/TA $_{t-1}$	0.607* (0.358)	0.414 (0.261)	0.0736 (0.257)
Capital ratio $_{t-1}$	-0.0140 (0.0110)	0.00133 (0.00122)	0.00440** (0.00198)
Loan/Deposits $_{t-1}$	1.020*** (0.327)	0.190 (0.155)	-0.175 (0.118)
Non interest inc./TI $_{t-1}$	-0.356 (0.501)	0.241 (0.152)	-0.0907 (0.104)
LLP/TL $_{t-1}$	-3.455 (3.011)	-0.779 (0.788)	-1.317* (0.769)
Host x Group FE	Y	Y	Y
Host x Home x Year FE	Y	Y	Y
Host FE	N	N	N
Year FE	N	N	N
Observations	1,049	1,049	1,049
R-squared	0.63	0.17	0.09

This table presents the results of regressions of group expansion on group cooperation. The dependent variables are group's *Log(loans)* in column (1), *Asset growth* in column (2), and Δ *Subsidiaries* in column (3). *Group coop.* equals the asset-weighted cooperation dummy between the subsidiary home country and its subsidiaries' countries, excluding the subsidiary's country. Observations are grouped together at the banking group-host country level. The sample period spans from 1995-2013. Definitions and sources of control variables are listed in Appendix A. Models are estimated with two-way clustered standard errors at the group and host country level (in parentheses). ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 6: Impact of subsidiary (country) characteristics

	(1)	(2)	(3)	(4)
	Log(loans)	Log(loans)	Log(loans)	Log(loans)
Group coop. $_{t-1}$	0.553*** (0.198)	0.547*** (0.154)	0.0821 (0.0884)	0.610*** (0.190)
Group coop. $_{t-1}$ *Log(assets) $_{t-1}$	-0.237 (0.159)			
Group coop. $_{t-1}$ *Subsidiary coop. $_{t-1}$		-0.506*** (0.167)		
Group coop. $_{t-1}$ *Other subsidiaries coop. $_{t-1}$			-0.821** (0.400)	
Group coop. $_{t-1}$ *Group coop. $_{t-1}$				0.632* (0.328)
Other subsidiaries coop. $_{t-1}$			0.210 (0.138)	
Log(assets) $_{t-1}$	0.917*** (0.219)	0.942*** (0.255)	0.414*** (0.0917)	0.962*** (0.253)
Liquid assets/TA $_{t-1}$	0.853** (0.402)	0.809** (0.383)	0.0965 (0.159)	0.769** (0.382)
Capital ratio $_{t-1}$	0.00117 (0.00157)	0.000351 (0.00160)	0.000393 (0.000946)	0.000258 (0.00160)
Loan/Deposits $_{t-1}$	3.707*** (0.722)	3.630*** (0.775)	2.028*** (0.459)	3.671*** (0.785)
Non interest inc./TI $_{t-1}$	-0.233 (0.187)	-0.294 (0.243)	0.0269 (0.0658)	-0.332 (0.236)
LLP/TL $_{t-1}$	-1.376 (1.487)	-1.017 (1.507)	-3.418*** (0.761)	-0.793 (1.712)
Subsidiary FE	Y	Y	Y	Y
Host x Group FE	Y	Y	Y	Y
Host x Home x Year FE	Y	Y	Y	Y
Observations	1,508	1,508	1,171	1,508
R-squared	0.65	0.64	0.30	0.65

This table presents the results of regressions of subsidiary lending on group cooperation. The dependent variable is a subsidiary's $Log(loans)$. $Group\ coop.$ is an asset-weighted dummy indicating cooperation between the subsidiary home country and its subsidiaries' host countries, excluding the subsidiary's country. All variables included in the interaction terms are mean centered. The sample period spans from 1995-2013. Definitions and sources of control variables are listed in Appendix A. All models are estimated with two-way clustered standard errors at the banking group and host country level (in parentheses). ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 7: Supervisory strictness and market discipline

	(1)	(2)	(3)	(4)
	Log(loans)	Log(loans)	Log(loans)	Log(loans)
Group coop. $_{t-1}$	0.629*** (0.179)	0.697** (0.319)	0.788** (0.305)	0.826*** (0.237)
Δ Insolvency power $_{t-1}$	1.356** (0.529)			
Group coop. $_{t-1}$ * Δ Insolvency power $_{t-1}$	-1.433** (0.564)			
Δ Supervisory power $_{t-1}$		0.0398 (0.362)		
Group coop. $_{t-1}$ * Δ Supervisory power $_{t-1}$		-2.219*** (0.810)		
Δ Provision stringency $_{t-1}$			0.225 (0.705)	
Group coop. $_{t-1}$ * Δ Provision stringency $_{t-1}$			-2.435** (1.121)	
Δ Size DI $_{t-1}$				0.693 (2.135)
Group coop. $_{t-1}$ * Δ Size DI $_{t-1}$				3.281*** (0.429)
Log(assets) $_{t-1}$	0.878*** (0.208)	0.911*** (0.245)	0.936*** (0.241)	0.976*** (0.313)
Liquid assets/TA $_{t-1}$	0.368 (0.321)	0.456 (0.328)	0.715 (0.446)	0.453 (0.405)
Capital ratio $_{t-1}$	-0.000680 (0.00139)	-8.15e-05 (0.00139)	-0.000308 (0.00179)	-0.000432 (0.00153)
Loan/Deposits $_{t-1}$	3.422*** (0.526)	3.601*** (0.603)	3.711*** (0.650)	4.021*** (0.793)
Non interest inc./TI $_{t-1}$	-0.312 (0.221)	-0.240 (0.199)	-0.297 (0.191)	-0.187 (0.237)
LLP/TL $_{t-1}$	-0.992 (1.224)	-2.183** (0.990)	-0.769 (0.957)	-1.922 (1.407)
Subsidiary FE	Y	Y	Y	Y
Host x Group FE	Y	Y	Y	Y
Host x Home x Year FE	Y	Y	Y	Y
Observations	1,435	1,405	1,199	934
R-squared	0.69	0.67	0.70	0.70

This table presents the results of regressions of subsidiary lending on group cooperation. The dependent variable is a subsidiary's $Log(loans)$. $Group\ coop.$ is an asset-weighted dummy indicating cooperation between the subsidiary home country and its subsidiaries' host countries, excluding the subsidiary's country. $Insolvency\ power$ is an index that indicates the power to declare a bank insolvent. $Supervisory\ power$ is an index that indicates supervisory power. $Provision\ stringency$ is the minimum provision required as loans become sub-standard, doubtful and loss. $Size\ DI$ is the size of the deposit insurance fund relative to total bank assets. All regulatory variables correspond to the difference between the regulatory indicator of the host country and the asset-weighted average indicators of the other countries in the banking group, normalized to the range [0,1]. All variables included in the interaction terms are mean centered. The sample period spans from 1995-2013. Definitions and sources of control variables are listed in Appendix A. All models are estimated with two-way clustered standard errors at the banking group and host country level (in parentheses). ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 8: Loan probability

	(1)	(2)	(3)	(4)	(5)	(6)
	P(loan)	P(loan)	P(loan)	P(loan)	P(loan)	P(loan)
Group. $coop_{t-1}$	0.0591** (0.0287)	0.0592** (0.0288)	0.0291** (0.0135)	0.0706*** (0.0155)	0.322*** (0.099)	0.123*** (0.046)
Group $coop_{t-1}$ *Loan spread				0.000335** (0.000134)		
Group $coop_{t-1}$ *Borrower size					-0.296** (0.122)	
Group $coop_{t-1}$ *Borrower rating						-0.177** (0.088)
Log(assets) $_{t-1}$	-0.0327 (0.0617)	-0.0330 (0.0618)	-0.0143 (0.0562)	-0.0337 (0.0462)	-0.173 (0.108)	-0.194* (0.107)
Liquid assets/TA $_{t-1}$	-0.0266 (0.171)	-0.0267 (0.172)	-0.110 (0.150)	-0.0130 (0.0748)	-0.145 (0.139)	-0.057 (0.128)
Capital ratio $_{t-1}$	0.000690 (0.00306)	0.000688 (0.00306)	0.00230 (0.00205)	0.000731 (0.00164)	-0.00104 (0.00213)	-0.0015 (0.0021)
Loan/Deposits $_{t-1}$	-0.0350 (0.0911)	-0.0353 (0.0913)	-0.0375 (0.0701)	-0.0147 (0.0686)	-0.388*** (0.147)	-0.288** (0.126)
Non interest inc./TI $_{t-1}$	-0.0898 (0.112)	-0.0901 (0.112)	0.0707 (0.0776)	-0.0921* (0.0520)	-0.198** (0.086)	-0.247*** (0.085)
LLP/TI $_{t-1}$	0.589 (0.610)	0.592 (0.615)	0.559 (0.537)	0.588 (0.524)	2.316 (1.409)	4.454* (1.410)
Subsidiary FE	Y	Y	Y	Y	Y	Y
Host x Group FE	Y	Y	Y	Y	Y	Y
Host x Home x Year FE	Y	Y	N	Y	Y	Y
Facility x Group FE	Y	Y	Y	Y	Y	Y
Home x Year FE	N	N	Y	N	N	N
Borrower country x Host x Year FE	N	N	Y	N	N	N
Observations	14,396	14,314	14,396	14,396	6,152	6,190
R-squared	0.001	0.001	0.002	0.002	0.01	0.01

This table presents the results of regressions of loan extension probability on group cooperation. The dependent variable is a subsidiary's *Loan probability*. *Group coop.* is an asset-weighted dummy indicating cooperation between the subsidiary home country and its subsidiaries' host countries, excluding the subsidiary's country. *Loan spread* corresponds to the facility spread. *Borrower Size* is a dummy variable equal to one if the borrower's logarithm of sales is larger than the 75th percentile of this variable in the sample. *Borrower Ratings* is a dummy variable equal to one if the borrower's S&P Global Market Intelligence rating is larger than the 75th percentile of this variable in the sample. Interaction terms in column (4) are mean centered. The sample period spans from 1995-2013. Definitions and sources of control variables are listed in Appendix A. Models in (1)-(3) are estimated with two-way clustered standard errors at the banking group and host country level, model in (4) is estimated with clustered standard errors at the facility level, and models in (5) and (6) are estimated with clustered standard errors at the borrower level. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 9: Cooperation

	(1)	(2)	(3)	(4)	(5)
	# Subsidiaries	# Subsidiaries	# Subsidiaries no cooperation	# Subsidiaries no cooperation	Group's assets share no cooperation
	Foreign Asset-weighted	Asset-weighted	Asset-weighted	Equal-weighted	Equal-weighted
Risk shifting $_{t-1}$	0.0338** (0.0153)	0.0916*** (0.0342)	0.135* (0.0780)	0.0412** (0.0203)	0.357*** (0.136)
Bilateral share $_{t-1}$	0.776*** (0.274)	0.655** (0.314)	0.731** (0.364)	1.048*** (0.291)	1.124*** (0.256)
Host x Home FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Observations	230	230	230	230	230
R-squared	0.07	0.07	0.06	0.07	0.08

This table presents the results of regressions of cooperation probability on risk shifting probabilities. The dependent variable is a country pair *cooperation probability*. *Risk shifting* is a country pair's average risk shifting possibilities, measured by the foreign asset-weighted number of subsidiaries located in third countries where the groups from country i in country j operate (column (1)), and vice versa; the asset-weighted number of subsidiaries located in third countries where the groups from country i in country j operate (column (2)), and vice versa; and the group's asset share of subsidiaries located in third countries where the groups from country i in country j operate, and vice versa (column (5)). Columns (3) to (5) only includes in the calculation subsidiaries located in third countries with no cooperation with the home country. *Bilateral share* is a country pair average assets from country j operating in country i and vice versa, as a share of the host county banking system. The sample period spans from 1995-2013. Definitions and sources of control variables are listed in Appendix A. All models are estimated with robust standard errors (in parentheses). ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

A Variable definitions

Variable	Definitions	Source
<i>Risk indicators</i>		
Log(loans)	Natural logarithm of loans in US dollars at the subsidiary level or aggregated at the group-host country level.	Authors' calculation using Bankscope data.
Assets growth	Assets annual growth at the subsidiary level or aggregated at the group-host country level..	Authors' calculation using Bankscope data.
Debt growth	Liabilities annual growth.	Authors' calculation using Bankscope data.
Equity growth	Equity annual growth.	Authors' calculation using Bankscope data.
LLP./TL	Loan-loss provisions divided by total loans.	Authors' calculation using Bankscope data.
ROE	Net-income over equity.	Authors' calculation using Bankscope data.
SD(ROE)	Three-year standard deviation of net-income over equity from years t to $t+2$.	Authors' calculation using Bankscope data.
P(loan)	Dummy variable equal to one if the subsidiary has extended a syndicated loan and zero otherwise	LPC Dealscan database.
Δ Subsidiaries	Annual change of a banking group's number of subsidiaries in a given host country.	Authors' calculation using Bankscope data.
<i>Cooperation variables</i>		
Group cooperation	Asset-weighted dummy indicating cooperation between the subsidiary home country and its subsidiaries' host countries, excluding the subsidiary's country.	Authors' calculations based on Bankscope data and cooperation data from Central Banks' and Supervisory authorities' websites and other sources.
Subsidiary cooperation	Dummy equal to one in there exists cooperation between the subsidiary's home country and the subsidiary's country.	Cooperation data from Central Banks' and Supervisory authorities' websites and other sources.
Home cooperation	Share of countries the subsidiary's home country is cooperating with over all countries in Claessens and Van Horen (2014).	Cooperation data from Central Banks' and Supervisory authorities' websites and other sources.
Other subsidiaries cooperation	Asset-weighted dummy indicating cooperation between the subsidiary host country and other subsidiaries' host countries.	Authors' calculations based on Bankscope data and cooperation data from Central Banks' and Supervisory authorities' websites and other sources.
<i>Subsidiary controls</i>		
Log(assets)	Natural logarithm of total assets in US dollars.	Authors' calculation using Bankscope data.
Liquid/TA	Liquid assets over total assets.	Authors' calculation using Bankscope data.
Capital ratio	Sum of tier 1 and tier 2 capital as a percentage of risk-weighted assets.	Authors' calculation using Bankscope data.
Loan/Deposits	Total loans over deposits.	Authors' calculation using Bankscope data.
Non-interest income/Income	Total non-interest income over total income.	Authors' calculation using Bankscope data.
Loss prov./TL	Loan-loss provisions divided by total loans.	Authors' calculation using Bankscope data.

Regulatory variables

Δ Insolvency power	Difference between the insolvency power index of the host country and the asset-weighted insolvency power index of the other countries in the banking group, normalized to the range [0,1]. The insolvency power index indicates whether the supervisory authority has the power to declare a bank insolvent. Higher values indicate greater power.	Authors' calculation using Wold Bank survey on bank regulation (Barth, Caprio and Levine, 1999, 2003, 2007 and 2011) and Bankscope data.
Δ Supervisory power	Difference between the supervisory power of the host country and the asset-weighted supervisory power of the other countries in the banking group, normalized to the range [0,1]. The supervisory power index indicates whether the supervisory authority has the power to take specific actions to prevent and correct problems. Higher values indicate greater power.	Authors' calculation using Wold Bank survey on bank regulation (Barth, Caprio and Levine, 1999, 2003, 2007 and 2011) and Bankscope data.
Δ Provision stringency	Difference between the provision stringency of the host country and the asset-weighted provision stringency of the other countries in the banking group, normalized to the range [0,1]. Provision stringency is the minimum provision required as loans become sub-standard, doubtful and loss. Higher values indicate greater stringency.	Authors' calculation using Wold Bank survey on bank regulation (Barth, Caprio and Levine, 1999, 2003, 2007 and 2011) and Bankscope data.
Δ Size DI	Difference between the size of the deposit insurance fund of the host country and the asset-weighted size of the deposit insurance fund of the other countries in the banking group, normalized to the range [0,1]. The size of the deposit insurance fund is measured relative to total bank assets.	Authors' calculation using Wold Bank survey on bank regulation (Barth, Caprio and Levine, 1999, 2003, 2007 and 2011) and Bankscope data.

Facility variables

Loan spread Borrower size	Loan spread Dummy equal to one if the borrower's logarithm of sales is larger than the 75th percentile of this variable in the sample.	Loan Pricing Corporation's Dealscan database Author's calculations based on Compustat data.
Borrower rating	Dummy equal to one if the borrower's S&P Global Market Intelligence rating is larger than the 75th percentile of this variable in the sample.	Author's calculations based on Compustat data.

Country-pair variables

Cooperation	Dummy variable equal to one if country i and country j cooperate in supervision.	Central Banks' and Supervisory authorities' websites and other sources.
Risk shifting	Corresponds to a country pair's average risk shifting possibilities, measured by the number of subsidiaries located in third countries where the groups from country i in country j operate, and vice versa; and the group's asset share of subsidiaries located in third countries where the groups from country i in country j operate, and vice versa.	Authors' calculations based on Bankscope data and cooperation data from Central Banks' and Supervisory authorities' websites and other sources.
Bilateral share	Corresponds to a country pair average assets from country j operating in country i and vice versa, as a share of the host county banking system.	Authors' calculations based on Bankscope data and cooperation data from Central Banks' and Supervisory authorities' websites and other sources.

B Risk-shifting opportunities and cooperation incentives

This section analyzes how the possibility to shift risks into third countries may affect the incentives of two countries to cooperate. Consider two potential cooperation countries, A and B, that are home to one banking group each. The banking groups have subsidiaries in the other country, and possibly in a third country C. The two banking groups are fully symmetric (from the perspective of A and B), allowing us to focus the analysis on the banking group headquartered in country A.

This group decides on the level of risk-taking x_i in each country it operates a subsidiary, resulting in total bank risk $x = x_B + x_C$ ($x = x_B$ if there is only a subsidiary in B). The bank perceives benefits $b(x) > 0$ ($b'(x) > 0, b''(x) < 0$) from risk-taking. This can be seen as the reduced-form outcome of a setting where due to risk-shifting incentives (for instance arising from the presence of deposit insurance) banks have private benefits from operating with higher risk, though at a declining scale. Risk-taking in a specific subsidiary may lead to detection by the supervisor of the subsidiary country. In particular, if a bank takes risk x_i in a subsidiary i , the likelihood of being detected is $\pi(x_i)$ with $\pi'(x_i), \pi''(x_i) > 0$ (higher risk-taking makes detection more likely, and increasingly so). If risk-taking is detected, the bank receives a penalty $p > 0$. When the subsidiary country cooperates with the 's parent country, the likelihood of detection increases by factor $q > 1$ (for example, information exchange among the supervisors may lower a bank's chances of hiding risk).

Risk-taking in a subsidiary causes social costs of s ($s > 0$) per unit of risk in the subsidiary country, for instance, because in the case of failure, local firms suffer. The objective of cooperation is to reduce risk-taking. Specifically, supervisors will choose cooperation to minimize sx_i . There is also a cost c (> 0) to cooperation, arising for instance from country heterogeneity (see Beck, Silva Buston, Wagner, 2022). In terms of timing, the supervisors of A and B first announce whether they cooperate, following which banking group(s) decide on their risk-taking.

We solve the game backwards, starting with the case where the banking group does not have operations in country C. When A and B do not cooperate, the banking group

will choose x_B to maximize $b(x_B) - \pi(x_B)p$, whereas in the case of cooperation the objective function becomes $b(x) - q\pi(x_B)p$, reflecting an increased probability of being detected. The associated FOCs are

$$b'(x_B^0) = \pi'(x_B^0)p, \quad (5)$$

$$b'(x_B^1) = q\pi'(x_B^1)p, \quad (6)$$

showing that cooperation lowers risk-taking: $x_B^1 < x_B^0$. The countries will thus cooperate iff $s(x_B^0 - x_B^1) > c$ (with x_B^0 and x_B^1 being determined by (5) and (6)).

If the banking group also has a subsidiary in a third country (C), risk-taking in both subsidiaries contributes to the bank's overall level of risk-taking. Given that the bank is now effectively twice the size, its total benefit from risk-taking is $2b(\frac{y_B + y_C}{2})$ (thus, if the bank sets $y_B = y_C$, its benefit per subsidiary is $b(y_B)$, as in the case of a single subsidiary). The underlying idea is that risk has benefits and costs at the level of the consolidated bank, for instance by causing default of the banking group. The associated FOCs in the case of no-cooperation and cooperation are now

$$b'(\frac{y_B^0 + y_C^0}{2}) = \pi'(y_B^0)p \text{ and } b'(\frac{y_B^0 + y_C^0}{2}) = \pi'(y_C^0)p, \quad (7)$$

$$b'(\frac{y_B^1 + y_C^1}{2}) = q\pi'(y_B^1)p \text{ and } b'(\frac{y_B^1 + y_C^1}{2}) = \pi'(y_C^1)p. \quad (8)$$

We can first see that – as to be expected – the level of risk-taking in the no-cooperation case is the same in both subsidiaries ($y_B^0 = y_C^0$) and identical to before: $y_B^0 = x_B^0$. The level of risk-taking in the case of cooperation, however, differs. As (8) shows, risk-taking in country B is less attractive than in country C. Thus, the group will focus its risk-taking more on country C: $y_B^1 < y_C^1$ (this follows from $q\pi'(y_B^1) = \pi'(y_C^1)$). From this it follows that $s(y_B^0 - y_B^1) > s(x_B^0 - x_B^1)$, that is, the bilateral gains to cooperation have increased.³¹ This will make it more likely that a (random) pair of countries will cooperate. Or put differently, there are parameter values for which

³¹Our analysis implicitly assumes that risk-shifting to third countries is only possible if there are already operations in the third country (intensive margin). However, consistent with our results in Table 4, banking groups may also form new subsidiaries (extensive margin). However, formation of new subsidiaries is relatively costly (compared to expanding on the intensive margin) and hence our result will prevail, that is, (existing) third country operations will make risk-shifting easier and hence cooperation more attractive.

countries would cooperate if the groups have operations in C but not otherwise.

Next, we look at the case where country A cooperates with country C (for example, due a prior agreement). The applicable FOCs are now

$$b'\left(\frac{z_B^0 + z_C^0}{2}\right) = \pi'(z_B^0)p \text{ and } b'\left(\frac{z_B^0 + z_C^0}{2}\right) = q\pi'(z_C^0)p, \quad (9)$$

$$b'\left(\frac{z_B^1 + z_C^1}{2}\right) = q\pi'(z_B^1)p \text{ and } b'\left(\frac{z_B^1 + z_C^1}{2}\right) = \pi'(z_C^1)p. \quad (10)$$

We can see that – due to symmetry in cooperation – the risk-taking under cooperation is identical the one that obtains when the bank has no third-country operations: $z_B^1 = x_B^1$. However, risk-taking under no-cooperation is now higher than when there are no third-country operations: $z_B^0 > x_B^0$. The reason is that cooperation between *A* and *C* now pushes risk into *B*. Taken together this, again, means that there are higher benefits from cooperation compared to the case of no third-country operations.

Finally, we look at optimal cooperation decisions when countries take into account global welfare when making cooperation decisions. Specifically, we consider a fully symmetric allocation across countries (with one banking group headquartered in each country) and we consider that all three countries implement bilateral cooperation. Prior to cooperation, risk-taking of the group headquartered in country *A* is given by (5) and thus identical to risk-taking when there is no foreign subsidiary (x_B^0). After cooperation, risk-taking is determined by equation (10), and thus also identical to risk-taking without foreign operations (x_B^1). The gains from cooperation are thus unchanged when risk-shifting is introduced.