The Economics of Supranational Bank Supervision

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Abstract

This paper examines the effectiveness of cooperation among bank supervisors using novel data on supranational agreements signed by 93 countries. Exploiting that globally operating banks are differently covered by these agreements, we show that supervisory cooperation generally improves bank stability. The magnitude of the effect is higher for smaller global banks, and when supervisors are more stringent and have access to higher quality information. We also show that actual supervisory cooperation varies across countries consistent with differences in economic costs and benefits to cooperation. This suggests that cooperation is not always desirable, despite being effective in reducing bank risk.

I. Introduction

The failure of internationally active financial institutions, such as Lehman Brothers, and cross border banks, such as Fortis, Dexia, or the Icelandic banks, played a prominent role during the Global Financial Crisis. Following the crisis, countries have significantly increased their efforts to cooperate in the supervision of their banks. Perhaps most notably, the Eurozone has now a common supervisor for large banks in the form of the Single Supervisory Mechanism at the ECB. However, very little is known about whether such cooperation is effective, and overall desirable.

This paper studies supervisory cooperation using hand collected information on agreements signed by 93 countries during the period 1995-2013. The bilateral (and sometimes multilateral) nature of cooperation creates bank level variation as cross border banks differ regarding the location of their subsidiaries. We use this setting to show that cooperation is generally effective in improving bank stability – but effectiveness depends critically on the supervisory environment as well as characteristics of the supervised bank itself. We also show that supervisory cooperation varies across country pairs consistent with proxies for economic costs and benefits of cooperation. Costs may thus outweigh the benefits for specific country

pairs, implying that more cooperation is not necessarily uniformly desirable. These findings are important not only for policy makers interested in designing financial safety nets, including cross border components, but also advance our understanding of costs and benefits of (supra)national decision making in banking policies.

An important contribution of our paper is the novel data on supervisory cooperation. Such cooperation can take different forms. Besides a common supervisor, there are more limited types of cooperation, such as agreements on information sharing or joint exercises on crisis prevention and resolution. Figure 1 plots the distribution of cooperation agreements across countries, showing that there is significant variation in the propensity with which individual countries form cooperation agreements. About a third of countries have cooperation agreements with less than 5% of the other countries, while a quarter of countries have agreements with more than 20% of countries.

We first examine the effectiveness of supervisory cooperation. Cooperation, if effective, should improve banking stability.[1] However, supervisors in practice face several constraints, such as limited legal powers, regulatory capture, imperfect information and/or political pressure, many of them being compounded in an international setting. Cooperation agreements – even though well intended – may hence not result in higher stability. We investigate the question of cooperation effectiveness exploiting bank level variation over time. We construct bank specific supervisory cooperation indices that measure the degree to which a global bank's parent-subsidiary structure is covered by cross border supervisory cooperation agreements.

Using panel analysis for a large sample of cross border banks and exploiting within bank intensity of cooperation over time, we find that a higher incidence of supervisory cooperation is associated with higher bank stability, as measured by the

[1]The theoretical impact of (effective) supervision on banking stability is not necessarily a positive one (see, for example, Dell'Ariccia and Marquez (2006), Beck, Todorov and Wagner (2013a) and Calzolari, Colliard and Lóránth (2018)), 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. In addition, cooperation also provides supervisors with additional sources of information that should result in better decision making.

Z-score or the bank's Marginal Expected Shortfall. The effect is economically large. For example, a standard deviation increase in supervisory cooperation intensity at the bank level improves the bank's Z-score by 24%. We find the association to be concentrated at the smaller institutions in our sample of cross border banks, consistent with supervision at larger banks being less effective due to too-big-to-fail and higher complexity.[2] Focusing on the sample of relatively smaller banks, we show that the link between cooperation and bank stability runs through asset risk. This is consistent with the notion that asset risk is difficult to observe and control at arms-length; intensive cooperation and information exchange should hence have a pronounced effect.[3] We also analyze how the characteristics of a country's supervisory and financial system influence the effectiveness of supervision. Among others, we find that effectiveness of cooperation increases both with the stringency of home and host supervision, as well as the quality of information that is available to supervisors.

The principal effectiveness of cooperation suggests that countries should cooperate in their banking supervision. This seems at odds with our data, which show that many countries have fairly low propensities to cooperate. However, absence of cooperation can be explained by the presence of (economic) costs to cooperation, which vary across countries, sometimes exceeding the gains to cooperation. Economic theory suggests that costs to cooperation (or, more generally, to a centralization of decision-making among independent jurisdictions) arise in the form of heterogeneity between countries, which may take the form of different preferences, or differences in economic and institutional structures. Externalities create benefits to cooperation and thus make cooperation more likely; when national decisions affect other countries, decentralized decision taking will be inefficient. In particular, individual countries may choose supervision levels that are insufficient from a global perspective as they will tend to ignore that the failure of their banks has international spillovers. By

[2]As our study focuses on large multinational (parent) banks, these "smaller" banks still comprise large systemically important banks based both in developed countries (e.g., Nordea Bank AB) and developing countries (e.g., Banco do Brasil).

[3]By contrast, bank leverage (which also affects the Z-score) is already well covered by existing (international) regulations, such as capital adequacy standards, and may hence be less affected by cooperation.

taking these spillovers into account, cooperation improves outcomes.[4]

The empirical results suggest that the cooperation pattern observed in the data vary consistently with (net) cooperation gains arising from externalities and heterogeneities. We examine three dimensions of cooperation at the bilateral level: the existence and intensity of cooperation between two countries, as well as the propensity of a given country pair to move to cooperation. In each case we find a composite proxy for bilateral externalities to be positively related to cooperation: higher externalities make it more likely that countries cooperate, that they cooperate in more intense forms (e.g., have a common supervisor instead of only exchanging information), and that they also accelerate cooperation. To the contrary, we find that a composite proxy for bilateral heterogeneities is negatively related to all three dimensions of cooperation.

Our analysis offers several important lessons for policy. First, cooperation improves banking stability but the impact depends critically on institutional characteristics, such as supervisory powers and access to information. Second, the effectiveness of cooperation declines with bank size. Third, a uniform global push towards more coordination of banking supervision – even though it is expected to improve banking stability — may not necessarily be optimal as the (net) gains from cooperation differ across countries, and actual agreements may already reflect this. Policy makers, in their effort to improve the international financial architecture, should be aware of cross-country differences in cooperation gains.

This paper relates to a small but rapidly expanding literature on cross border cooperation between bank regulators and supervisors– which up to now has been almost exclusively of theoretical nature. First, several papers have analyzed the design of the financial safety net in the presence of cross border banks. Dell'Arricia and Marquez (2006) show that competition between national regulators can lower capital adequacy standards, since national regulators do not take into account the external

[4]See 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).

benefits of higher capital adequacy standards in terms of higher stability in other countries, making cooperation more desirable when external benefits are higher, and when the preferences of regulators are homogenous. Our analysis of actual cooperation can be viewed as a test of their theory, as applied to supervision. Acharya (2003) argues that coordinating capital adequacy ratios across countries without coordinating on other dimensions of the regulatory framework, such as resolution policies, can have detrimental effects for stability. Lóránth and Morrison (2007) show that capital requirements set at a level to offset the safety net subsidy of deposit insurance result in too little risk-taking in the case of multinational banks. Freixas (2003) and Goodhart and Schoenmaker (2009) show that relying on ex-post arrangements for the recapitalization of failing cross border banks leads to underprovision of resources; ex-ante burden sharing agreements are needed to overcome coordination problems between supervisors. Our paper relates to this mostly theoretical literature by providing evidence that when distortions from uncoordinated domestic policies are high (because of externalities), countries are more likely to implement supranational solutions.

Second, several papers have discussed the incentives of national supervisors vis-a-vis cross border banks and possible cross border cooperation forms. Niepmann and Schmidt-Eisenlohr (2013) show that decisions of national governments on recapitalizing failing banks are inefficient if banking systems are linked through interbank markets. Calzolari and Lóránth (2011) show that organization of foreign presence through branches leads to higher incentives to intervene as the home country regulator can draw on all assets, while it reduces intervention incentives if the regulator is responsible for repaying all deposits, including in foreign branches. Beck et al. (2013a) analyze interventions into banks during the Global Financial Crisis, showing that cross border linkages lead to distortions in national decisions, consistent with the presence of externalities. Carletti, Dell'Ariccia, and Marquez (2020) examine the interaction between centralized supervision, and information collection by local regulators. Calzolari et al. (2018) show that there is a coordination problem among

national supervisors, and that hence supranational supervisors can implement more efficient monitoring. Our paper contributes to this literature by showing that cross border supervisory cooperation can be effective in increasing bank stability, but is not necessarily optimal for all country pairs.

Finally, this paper also relates to the literature examining the effects of the regulation of 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, Calomiris, Hooley, Korniyenko, and Wieladek (2014a), Forbes, Reinhardt and Wiedalek (2017)) and domestic credit (Aiyar, Calomiris and Wiedalek (2014b)). Ongena, Popov and Udell (2013) also show that tighter regulation in home countries lowers lending standards in subsidiaries, increasing lending to riskier firms. We contribute to this literature by examining whether cooperation between host and home countries affects bank stability. More broadly, our paper relates to debates in other areas of financial sector regulation, including international standards such as Basel and cooperation between securities market supervisors (Silvers, 2019). We regard both as complementary to our focus on supervisory cooperation in banking.

The remainder of the paper is structured as follows. The next section describes our cooperation data. Section III uses bank level analysis to examine the relationship between supervisory cooperation and stability. Section IV contains the analysis of the determinants of cooperation agreements. Section V concludes.

II. Cooperation Data

We have hand collected data on supervisory cooperation at the country pair level. The information was gathered from the supervisory bodies' websites and official documents available online. Because of data availability, we focus our search on countries in Europe, the Americas, Africa, and the Trans-Tasman Union. Within these regions, we focus on 93 countries that are covered in the database of Claessens and Van Horen (2014). We look for agreements that have been signed by these countries up and until 2013. We describe in this section the sample of country pairs

formed among the 93 countries searched, which comprises 4,278 country pairs, covering the years from 1995 until 2013.

Supervisory cooperation can take many different forms. Based on guidelines of the Basel committee, we distinguish four (and increasingly intensive) forms of cooperation: 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. More information on these agreements is provided in the online appendix.[5] We first construct a dummy variable COOPERATION indicating that any form of the four levels of cooperation is present. If we do not find any information about agreements for a given country pair, we assume that no cooperation exists (this is the case for 880 country pairs; in a robustness test we exclude such cases). Second, we construct an ordinal variable, COOPERATION_INTENSITY, which ranges from zero to four (zero referring to no cooperation being present, while four referring to the existence of a supranational regulator). If a country pair has signed several agreements that correspond to different levels of cooperation intensity, we code this variable with the highest level.

Its important to note that, even though cooperation agreements mostly follow the guidelines of the Basel committee, there is still considerable variation in intensity within each class of agreements. Our coding of the cooperation intensity thus necessarily comes with measurement errors; for this reason we primarily rely in our study on the dummy variable indicating the existence of cooperation.

By the last year of our sample period (2013), 522 country pairs have signed a cooperation agreement (about 12% of all possible pairs). Of the country pairs that have signed an agreement, 70% are part of a multilateral arrangement and 58% are part of a bilateral agreement (some country pairs have both types of agreements in place). Out of the 522 cooperation agreements signed, we have information about the type of the agreement for 441 country pairs. Among these 441 pairs, 142 have a Memorandum of Understanding for information sharing and on site inspection, 220

[5]In the online appendix we also provide examples of these agreements (for a MOU for information sharing, a College of Supervisors and a MOU on crisis management and resolution).

have a College of Supervisors, 51 have a Memorandum of Understanding on crisis management and resolution, and 28 have a supranational supervisor.[6] Interestingly, there is quite some variation in the number of countries involved in an agreement, ranging from 2 (bilateral agreement) to 16, with a median of 2.

There is also significant variation across countries in terms of the number of agreements signed, as shown in Figure 1. This figure shows the fraction of other countries a country cooperates with by the end of 2013 (see the online appendix for the underlying data). Many countries, most of them from Africa, have not signed any agreement, whereas some other countries, mostly in Europe, actively cooperate internationally in bank supervision. For example, Germany and France have agreements with 40% and 38% of the other sample countries, respectively. Figure 2 depicts the evolution of the outstanding cooperation agreements in each region. Most of the agreements were signed after 2000. In addition, Europe has, for all the years considered, the largest number of outstanding agreements. As can be seen in the figure, there has been a steady increase in cross border arrangements in both Latin America and the European Union, with a jump in 2007 and 2009, respectively. In Africa, on the other hand, the evidence points at cross border cooperation only starting in 2009, but then rapidly increasing over the past years.

III. Effectiveness of Cooperation

In this section we study whether supervisory cooperation is effective. Starting with country pair cooperation data we construct bank specific indices of supervisory cooperation. These indices measure the extent to which the parent-subsidiary structure of a cross border bank is covered by supervisory cooperation. We then relate these indices of supervisory cooperation to different proxies of bank risk and stability.

[6]This includes the West African Monetary Union, but not the Eurozone (the Single Supervisory Mechanism became only effective in 2014).

A. Data and Methodology

We consider cross border banks headquartered in one of the 93 countries. We focus on the consolidated level to abstract from potential risk shifting within the bank (for example, following cooperation with a specific subsidiary country, a bank may simply shift risk into another subsidiary not covered by global cooperation). To construct bank level cooperation indices, we require information on their (foreign) subsidiaries (which may be located outside the 93 countries). For this we match the subsidiaries in the Claessens and Van Horen (2014) database with parents, defined by a 50% ownership threshold.[7] As the 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. We match with Bankscope (using consolidated data for the parents and the unconsolidated for the subsidiaries) to obtain balance sheet variables. We also include macroeconomic data from the World Bank database to construct country level controls. The final sample comprises 197 parent banks in 52 home countries and 116 host countries, between 1995 and 2013. The subsidiaries of these parent banks span 401 home-host country pairs.

Our regressions take the following form

$$y_{b,j,t} = \beta_1 COOPERATION_{b,t} + \beta_2 X_{b,t} + \beta_3 Z_{j,t} + \gamma_b + \delta_t + \epsilon_{b,j,t}, \tag{1}$$

where y is a measure of the stability of parent bank b in country j in year t. The variable of interest, COOPERATION, is the share of host supervisors (i.e., supervisors of the parent bank's subsidiaries) with whom the home (parent bank) supervisor has a cooperation agreement. To calculate the share we weigh by the importance of each subsidiary, measured as the subsidiary's share in the parent bank's total foreign assets. X is a set of bank level control variables and Z a set of home country control variables. For the bank level variables we include the Log(ASSETS) as size indicator,

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

the ratio of foreign to total assets to measure the importance of foreign operations for the parent bank FOREIGN_TA/TA, LIABILITIES/TA as an (inverse) measure of bank capitalization, LOAN_LOSS_PROVISIONS/TOTAL_LOANS as indicator of lending quality, and NON INTEREST_INCOME/TOTAL_INCOME to proxy for the business model. This follows the literature that has explored the relationship between bank characteristics and bank stability (see, e.g., Anginer, Demirguc-Kunt, and Zhu(2014), Brunnermeier, Dong and Palia (2020)). To account for time varying differences at the country level that may affect banks' stability, we include the home country's Log(GDP_PER_CAPITA, the volatility of GDP growth (measured over a five year rolling window), VOL_GROWTH and its trade openness, measured as exports plus imports, relative to GDP, TRADE/GDP.[8] Furthermore, we include bank and year fixed effects γ_b and δ_t, so that β_1 captures the relationship between supervisory cooperation and a bank's stability relative to the bank's average stability over the sample period. Bank fixed effects control for time invariant unobserved bank characteristics and year fixed effects control for global trends in bank stability that might co vary with cooperation agreements. We report robust standard errors clustered at the bank level in all regressions.

In our main analysis, we use the natural logarithm of the Z_SCORE (as in e.g. Houston, Lin, Lin and Ma (2010), Demirguc-Kunt and Huizinga (2010), Laeven and Levine (2009), and many others) as a measure of bank stability. The Z-score measures the distance from insolvency (Roy (1952)) and is calculated as

$$Z_{b,t} = \frac{ROA_{b,t} + E/A_{b,t}}{\sigma(ROA)_{b,t}}, \tag{2}$$

where ROA is return on assets, E/A denotes the equity to asset ratio and $\sigma(ROA)$ is the standard deviation of return on assets. Arguably, lowering default risk is a primary objective of supervisory cooperation. We use a three year rolling time

[8]We do not include country year fixed effects instead in our model, since there would be too many fixed effects relative to the number of observations, and the variation we exploit would be dramatically reduced. However, the main result remains mostly unchanged when estimating this model including country year fixed effects. The coefficient remains positive and of similar magnitude, but its significance drops to 10%.

window from years $t-2$ to t to compute the standard deviation of ROA (rather than the full sample period) to allow for time variation in the denominator of the Z-score. In separate regressions, we also split the Z-score into the numerator and denominator. In a further robustness test, we use the Marginal Expected Shortfall (MES) (Acharya, Pedersen, Philippon, and Richardson (2017)), which measures a bank's average return when the market experiences stress, thus capturing systemic risk exposure. We follow common practice and compute the MES for each bank-year observation by looking at the average daily stock return of the bank on days where the country's local banking sector index (MSCI banking sector index) experiences one of its 5% lowest returns. Doing so, the MES of bank b in year t corresponds to bank b's expected equity loss per dollar in year t conditional on the local banking sector experiencing severe stress. We take the negative value of this measure for ease of interpretation.

Table 1 presents the descriptive statistics for our sample of cross border banks. Panel A in this table shows statistics of the cross border banks' subsidiary structure. The average bank has operations in 3 host countries and has 3 foreign subsidiaries. The minimum number of host countries and foreign subsidiaries is 1, while the maximum number is 33 and 36, respectively. Panel B summarizes the statistics of the variables in our bank level analysis. The natural log of the Z-score varies between -7.44 and 12.3. The MES varies between -0.016 and 0.134. The weighted supervisory cooperation index varies between 0 and 1, with a mean of 0.6. This implies that there was a cooperation agreement in place in 60% of home-host relationships in our sample (weighted by subsidiaries' assets). The standard deviation of the cooperation index is 0.445, indicating that there is substantial variation in the extent to which the foreign subsidiaries of different banks are covered by supervisory cooperation. Our empirical analysis exploits within bank variation in cooperation. Such variation arises either when the country of the parent bank signs new cooperation agreements or if the subsidiary structure changes. In our data, variation is predominantly due to the first source (about 70%).[9] A full description of these variables and their sources are given

[9]This figure corresponds to the R^2 of a regression of the weighted cooperation indicator on the same weighted cooperation indicator, but using the subsidiary structure fixed at the beginning of the

in the online appendix.

B. Evidence

Table 2 shows that higher cooperation between a bank's home and host supervisors is associated with lower bank risk, as measured by a higher distance from default of the consolidated bank. We regress (annual) Z-scores for the 197 cross border banks on their cooperation index and a series of bank and country level control variables. The cooperation index enters positively and significantly in both columns (1) and (2). The coefficient estimate of 0.54 in both columns suggests that a one standard deviation increase in cooperation share (0.445) is associated with a 24% increase in distance from default of the consolidated bank, thus a meaningful economic effect. Among the control variables, in line with previous literature (e.g. Beck, De Jonghe and Schepens (2013b)), we find that larger banks have higher Z-scores and that less capitalized banks have lower Z-scores. Banks with higher loan loss provisions as a share of total loans have lower Z-scores, reflecting their higher credit risk, while banks with a higher fraction of non interest income have higher Z-scores, which could be explained by their higher diversification levels. In column (2), where we include several home country variables that might co-vary with cooperation, we find that banks in richer and more open (to trade) home countries have higher Z-scores.[10]

There is a general belief that regulation and supervision is less effective at large banks (see for example Hovakimian and Kane (2000), Acharya and Richardson (2009), Carbó-Valverde, Kane and Rodriguez-Fernandez (2013)), as these banks benefit from their *Too Big To Fail* status and because their regulation and supervision is more difficult due to higher complexity. The results in columns (3) and (4) confirm this, showing that our findings are driven by the smaller banks in our sample. We split the sample at the 50th percentile according to total assets and find that cooperation only enters positively and significantly in the sample of smaller banks (column 4). The

sample period.

[10]Two of our control variables (lLIABILITIES/TA and LOAN_LOSS_PROVISIONS) capture also bank risk as reflected in the dependent variable (the Z_SCORE). We thus re-estimate the model excluding these variables. The results are unchanged.

coefficient estimate for the smaller banks (1.19) is more than twice as high as the corresponding coefficient in the entire sample, suggesting fairly effective supervision at smaller banks (a standard deviation increase in cooperation now increases the Z-score by 53%).[11] Given that there is only a positive and significant relationship for smaller banks, we focus in the following on the subset of these banks. It is important to note that, given our sample comprises large multinational parent banks, these "small" banks still involve large systemically important banks, located both in developing countries (e.g., Banco do Brasil and Barclays Africa Group), as well as developed countries (e.g., Nordea Bank AB and Raiffeisen Zentralbank Oesterreich).[12]

The results so far do not answer the question through which channel supervisory cooperation lowers bank default risk. In column (5) and (6) we investigate the numerator and denominator of the Z-score separately, and find that cooperation is effective through reducing volatility (of profits), rather than by increasing profitability or forcing higher capital. In principle, banks can decide to become riskier along two dimensions. First, they can engage in riskier activities, increasing the variance of returns and thus increasing the likelihood of default. Alternatively, they can increase leverage or take on less profitable activities, which reduces the buffer they have before they reach default. We would expect supervisory cooperation to be mainly operative along the first dimension. This is because asset risk is more difficult to observe and control at arms length; intensive cooperation and information exchange should hence have a pronounced effect. The second dimension, by contrast, is already well covered by existing (international) regulations, such as capital adequacy standards; we would hence expect the (incremental) effect of supervisory cooperation to be more limited. We split the Z-score into the capital equity ratio and ROA (numerator) and the standard deviation of ROA over a rolling three year window (denominator). While

[11] We have investigated different channels for why supervision is less effective for the larger banks, such as business complexity or complexity in subsidiary structure. However proxies for such channels turned out to be highly correlated with bank size (and each other); we hence cannot empirically distinguish among them.

[12] Our sample cut off for a "small" bank is 93 billion USD; the threshold for systemic importance applied by the Federal Reserve is 50 billion USD, wheras the ECB applies a threshold of 30 billion EUR.

cooperation does not enter significantly in the regression of capital asset ratio and ROA, it enters negatively and significantly in the regression of profit volatility.[13]

In column (7) we use the Marginal Expected Shortfall (MES) as alternative stability measure. The MES offers two potential advantages over the Z-score. First, it is based on market prices and thus captures different information than balance sheet based measures. Second, as a measure of systemic risk, it relates more closely to policymakers' objectives of maintaining financial stability.[14] A disadvantage is that this measure can only be calculated for listed banks, reducing our sample by two thirds. The results in column (7) confirm the findings obtained from the balance sheet based risk measure, showing a negative and significant coefficient for the supervisory cooperation index. This suggests that systemic risk exposure of the parent bank is lowered as cross border cooperation increases.

1. Robustness

The results continue to hold under a number of robustness tests.[15] First, there are several concerns about endogeneity of the bank level cooperation index. Such endogeneity can arise with respect to supervisory cooperation, but also the subsidiary structure (which is an input into the cooperation index). We employ a variety of tests to alleviate concerns about endogeneity, including an examination of the parallel trend assumption and an instrumental variable analysis.

Second, we investigate whether cooperation is still effective during a crisis period, thus periods when it matters the most. The robustness analysis suggests that the effectiveness of cooperation does not change in crisis period (in other words: it remains effective). Finally, cooperation may only become effective once it covers a substantial part of a bank's subsidiaries. We thus investigate the possibility of

[13]Lower profit volatility is not necessarily desirable when low risk activities also come with lower profits (in which case the ROA in the numerator of the Z-score would decrease). However, this does not seem to be the case here: when we use ROA itself as dependent variable, the cooperation index does not enter significantly.

[14]In the case of small banks, systemic risk arises due to correlated failures (Acharya and Yorulmazer (2007) and Gong and Wagner (2019)).

[15]The full details of the robustness analysis are contained in the online appendix.

increasing returns to cooperation. The results suggest that cooperation is effective at all levels. However, there is also (weak) evidence for the presence of increasing returns.

2. Effectiveness and Regulation

The results in Table 3 show that the effectiveness of supervisory cooperation is a function of the regulatory framework of home and host countries, thus also shedding light on the channels through which cross border supervisory cooperation increases bank stability. Here we interact the cooperation index with a number of regulatory indicators.[16] These indicators are overall SUPERVISORY_ STRINGENCY, where higher values of this variable indicate greater stringency; a dummy variable indicating whether financial statements at the parent level have to be audited by a licensed or certified EXTERNAL_ AUDITOR; and limits to FOREIGN_ENTRY, where higher values of this variable indicate more freedom to entry. A detailed description of these variables is provided in the online appendix. Regulatory data is obtained from Barth, Caprio and Levine (1999, 2003, 2007, and 2011).[17]

Effective supervisory cooperation requires that supervisors can act swiftly if needed. We would expect both the home and host supervisor's stringency to matter, as interventions may require actions in either the parent or the subsidiary. In column (1) we find that both coefficients on the interaction terms of the cooperation index with supervisory stringency are positive and significant, suggesting the importance of supervisors' stringency in facilitating the stability enhancing role of cross border supervisory cooperation.

The results in column (2) suggest that the positive relationship between supervisory cooperation and bank stability is more than twice as high if financial statements at the parent level have to be audited by a licensed or certified external auditor. Effective supervision relies on credible information that can be exchanged with other parties, thus we would expect the quality of information availability to

[16]To construct a host country indicator, we weigh each country's indicator by the importance of each subsidiary, measured as the subsidiary's share in the parent bank's total foreign assets.

[17]The data are available for the years 1999, 2003, 2007, and 2011. For the missing years we take the values of the last available survey.

improve supervision. The interaction term between cooperation and the external audit dummy for both home and host country enters positively, but only significantly for the home country (weakly significant for the host country).

The results in column (3) suggest that supervisory cooperation has a stronger relationship with bank stability if there are fewer limits on foreign bank entry in the host countries. When foreign bank entry is easier, we would expect there to be more foreign banks in the subsidiary country. Given a higher importance of foreign activities, the supervisor may thus focus more on such activities, increasing effectiveness. While a similar argument also applies to home country supervision, we may expect the relationship to be weaker as for the home country (with possibly many parent banks) the presence of subsidiaries from other countries may matter less for overall financial stability. The results in column (3) are consistent with this, suggesting that supervisory cooperation has a stronger relationship with bank stability if there are fewer limitations on foreign bank entry in the host countries, whereas there is no significant relationship for the home country.

IV. Determinants of Cooperation

The previous section has shown that cooperation is effective in improving bank stability. However, this does not necessarily imply that countries should cooperate as there are also costs to cooperation. Cooperation is only optimal for a country pair when their gains from cooperation outweigh the costs. In this section we examine whether actual cooperation across country pairs can be explained by differences in benefits and costs, as suggested by the externality-heterogeneity trade off.[18]

[18]To be sure, even if this is the case, this does not imply that the cooperation is a direct consequence of the benefits and costs. For example, cooperation may also be the result of a wider process of financial integration, which in turn is linked to net benefits (the Eurozone is a point in case here). Our analysis does not speak to how cooperation is actually brought about; we only examine whether the ultimate outcome is consistent with net benefits to cooperation.

A. Data and Methodology

We first describe our empirical measures of cooperation benefits and costs, arising from externalities and heterogeneities.[19] A full description of the variables and their sources is given in the online appendix. Our analysis now includes all 4,278 country pairs formed among the 93 countries searched in our cooperation data (whereas in the preceeding analysis we only made use of country pairs spanned by parent-subsidiary relationships in our bank sample).

Externalities (of cross border nature) increase the benefits from supranational cooperation as individual country supervisors will fail to take effects outside their regulatory perimeter into account. Cross border externalities most directly arise from international activities of financial institutions. For example, the failure of a bank that has foreign assets will incur costs abroad, among others by leading to lower credit availability to foreign firms and losses imposed on depositors (or taxpayers). Such costs will not be taken into account by a domestic supervisor, leading to inefficient decisions.[20] A case in point is Iceland (whose banks from the perspective of the Icelandic supervisor had substantial foreign assets and deposits) where it can be argued that supervisors had insufficient incentives to control bank risk. As a first proxy we hence compute the share of the assets of banks from country j operating in country i and vice versa. We take the average of the two shares to construct a country pair measure of cross border activity, AVG_FOREIGN_SHARE. This measure directly captures the cross border externalities arising from the failures of banks in one country on financial stability of the pair's other country. Contagion effects are arguably intensified in the presence of systemically important banks. We thus include as a second proxy a dummy variable G SIB that indicates whether both countries share a common Global Systemically Important Bank, identified by the Financial

[19] Dell'Arricia and Marquez (2006) and Beck and Wagner (2016) provide the theoretical background for how cross border externalities and country heterogeneity affect supervisory and regulatory cooperation. They show that the gains from delegating decisions to a supranational agency i) increase in cross border externalities, and ii) decrease in preference heterogeneity across countries.

[20] Beck et al (2013a) analyse interventions in cross border banks during the crisis of 2007-2009 and show that they are distorted in the presence of foreign operations. In particular, regulators intervene at a later stage (that is, when bank health has already deteriorated significantly) when a bank has more foreign investments and debt funding.

Stability Board in their 2013 update.

In a financially integrated world, there are various other channels through which a shock arising from the failure of one bank can spill over to other countries. This includes fire sale externalities (e.g., Stein (2009)), informational contagion or panics. For such effects to materialize, no direct cross border links have to exist between two banking systems as these spillovers can arise through capital markets. We expect such spillovers to be more pronounced when countries have integrated capital markets. We thus employ as a proxy the average CORRELATION between country *i's* and *j's* stock market index when each country's index experiences the 5% lowest returns (we use the Datastream index to proxy a country's stock market; when this is not available we use the MSCI Market Index). By conditioning correlations on the left tail, we capture that fire sale externalities materialize in bad states.

Externalities are also more pronounced in a monetary union. First, in a monetary union it is more difficult for governments to deal with spillovers from other countries. As the fiscal capacity of sovereigns is more limited (they cannot print their own money), it is more difficult to backstop troubled banks, resulting in more failures and higher costs. This mechanism was at play during the European Sovereign Debt Crisis. Second, the presence of a common lender of last resort in a monetary union might result in a tragedy of commons problem, as it is in the interest of every member government to share the burden arising from troubles at its own banks with the other members. We capture higher costs of cross border spill overs in the presence of a common currency (or fixed exchange rates) by including a dummy variable CURRENCY that indicates whether country i and country j have the same currency or their currency is fixed with respect to the other. We expect higher benefits from supranational cooperation when this dummy takes the value of one. A point in case is the Eurozone, where it has been argued that the presence of a monetary union has increased the need for having a banking union as well.

In our empirical analysis, we use the four proxies separately but also construct an index. We calculate the index from the average of the four externality measures (in

case of a missing input, this input is dropped from the calculation of the average), where each measure is normalized to lie between zero and one. Figure 3a shows the development of the (averaged) index during the sample period; we can see a clear increase in cross border externalities over time.

We next discuss our measures for costs of integration arising due to heterogeneity. If countries were identical ex ante, they would agree on the type of supranational supervision they want to implement (and the implementation would not be particularly burdensome). However, countries differ in practice along various dimensions. This increases the cost of cooperation, in particular as common policies may then not be optimal for either country (or both of them).

First, we include a measure of preference heterogeneity. Since cooperation typically comes with uniform standards, it is less desirable for countries that disagree. Specifically, the costs to cooperation have been shown to be higher when regulators have different preferences (Dell'Ariccia and Marquez (2006)) and when countries perceive different costs to letting banks fail (Beck and Wagner (2016)). Similarly, gains from centralized decision making are also lower when countries differ in their fiscal preferences (Oates (1972)), which in our context may take the form of differences in the willingness to use public founds to bail out banks. We construct our preference heterogeneity measure based on differences in voting patterns in the U.N. General Assembly (see, e.g., Signorino and Ritter (1999)). Specifically, we construct a variable PREFERENCES defined as preference affinity (described in more detail in appendices D and E of the online appendix) times -1, normalized to the $[0, 1]$ range.

Heterogeneity can also result from incentive asymmetries. Such asymmetries arise when the importance of the foreign country's subsidiaries in the host banking system is large compared to the importance of these subsidiaries for the home country's banking system.[21] We hence also include a proxy for the asymmetry with respect to cross border activity, FOREIGN_SHARE. For this, we consider the

[21] For example, many West European banks have subsidiaries in small South East European countries. While these subsidiaries have larger market share in the host countries, the operation in these host countries makes up a minuscule part of the parent bank's balance sheet. See Ahmad, Beck, d'Hulster, Lintner, and Unsal (2019), for specific examples.

difference between the banks' foreign assets of one country in the other over the total assets of the other country's banking system and over the total assets of the home country's banking system, and vice versa and compute the absolute value of the average.

Similar to preferences, we conjecture that differences in geographic, institutional, and linguistic proximity makes cooperation more costly as they increase differences in failure and resolution costs. We capture this with several variables. First, we include the country's LEGAL_ORIGIN, indicating whether legal tradition of a given country is English, French, German, Socialist or Scandinavian (La Porta, Lopez-de-Slianes and Shleifer (2008)). We also consider the LANGUAGE spoken in the country. Finally, we include each country's LATITUDE and LONGITUDE. We construct differences in these variables for each country pair.

Furthermore, countries may also differ in their ability to address bank failures swiftly. The literature has shown that rapid and decisive political action during systemic banking distress relies on fiscal space. We therefore include the difference between countries' GOVERNMENT_DEBT/GDP ratio as an (inverse) measure of fiscal capacity. Finally, we expect countries with different levels of economic development to face differences in the cost of bank failure, given the different role of banks in these economies. We therefore include the difference in gross domestic product divided by population, GDP_PER_CAPITA.

Similar to the externality index, we can construct a HETEROGENEITY_INDEX from the average of the (non missing) normalized individual heterogeneity measures. Figure 3b shows the average heterogeneity between country pairs over time. Unlike in the case of externalities, we do not see a clear time trend. A possible reason for the persistence of the heterogeneity index is that many of the variables are time invariant. Figure 3c depicts next the heterogeneity index including only time varying variables. There is now significant variation over the 20 years of our sample – but still no clear time trend.

B. Evidence

In this section we examine whether actual cooperation agreements are consistent with our measures of economic benefits and costs. We present first a cross sectional analysis of the existence of cooperation agreements. Following this, we explore the time dimension employing duration analysis. Finally, we use a sub sample to study the intensity of supervisory cooperation.

1. Cross Sectional Analysis

We examine whether higher externalities between two countries increase the probability that there is a supervisory cooperation agreement among them, and whether higher heterogeneity reduces this probability. We carry out a logit analysis at the country pair level. We estimate this model with two way clustering at each country of the pair.[22] We do not include country fixed effects in the main model to avoid biases arising from the incidental parameters problem in non linear panel data models with fixed effects (Neyman and Scott (1948)). Table 4 shows the descriptive statistics for our externality and heterogeneity variables for the cross sectional sample in 2013. We see considerable variation across country pairs in externality and heterogeneity that we will exploit in the following regression analysis. Table 5 contains the results for logit analysis for the last year of our sample (2013), showing the marginal effects.

The results in Table 5 provide evidence for the importance of externalities and heterogeneity in explaining the likelihood of countries cooperating in bank supervision. Column (1) shows that the externality index enters positively and significantly while the index of heterogeneity between two countries enters negatively and significantly. This is consistent with theory in that externalities increase the benefits from cooperation, while heterogeneity reduces it. The effects are economically significant. One standard deviation increase in the externality index increases the

[22]This controls for the possibility that a country's propensity to cooperate is correlated across potential cooperation target countries (e.g., a high propensity of country A to cooperate may show up in both cooperation with B and cooperation with C).

probability of cooperation by 9 percentage points, whereas one standard deviation increase in the heterogeneity index decreases the probability of cooperation by 6 percentage points (recall that the average propensity to cooperate is 12% in the sample). It is often implied that supranational cooperation is largely an outcome of political considerations and other non economic constraints, such as legal factors. Our analysis, in contrast, suggests that economic factors are highly relevant for determining cooperation.

Column (2) shows that all four dimensions of externalities matter individually; each of them is significantly and positively related with the probability of having a supervisory agreement; i.e., country pairs with higher cross border activities, country pairs that share a G SIB and either a common currency or a fixed exchange rate, and country pairs with a higher stock market correlation are more likely to have a supervisory cooperation agreement. The results in this column also show that some but not all dimensions of our heterogeneity measure are significantly correlated with the probability of a supervisory cooperation agreement. Specifically, country pairs that have different preferences, have asymmetric bank linkages, and are more distant from each other are less likely to have a supervisory cooperation agreement as do country pairs that do not share the same language. Informed by the results of column (2), we re-estimate the model in column (1) using for the construction of the heterogeneity index only those subcomponents that enter significantly. The results remain unchanged, both measures display the correct sign and are significant at 1% (results available on request).

We consider several variations of the baseline model to examine robustness. First, we include fixed effects for each country in the pair to account for potential time invariant unobserved heterogeneity at each country level. The results of this model in column (3) show that both variables remain significant and with the expected sign (we estimate a linear model to avoid the incidental parameter problem in this regression). Second, we estimate our model using principal component indicators for externality and heterogeneity (column 4). While we lose two thirds of

our sample (given that we now need all externality and heterogeneity variables to be available), both variables remain significant and with the expected sign.

Third, we restrict our sample to only include those countries that have published an exhaustive list of international cooperation agreements or on country pairs for which there is explicit information whether or not an agreement is present. In other words, we do not assume that country pairs did not engage in an agreement when we do not find any information on an agreement, but rather treat these country pair observations as missing. In this model, reported in column (5), both coefficients remain significant at the 1% level. We also note that in each case the (absolute) value of the estimated coefficients increases, confirming the idea that there is some measurement error in the baseline sample.

Fourth, we limit our sample to bilateral agreements. It can be argued that for multilateral arrangements, also the characteristics of the other countries that join the agreement will determine the cooperation. The results in column (6) show that both indices remain highly significant and with the expected sign.

Fifth, we control for trade links. One possible bias arises from omitted variables that are correlated both with our externality and heterogeneity measures, and the propensity to cooperate. Two such variables may be bilateral trade and trade agreements between the two countries. We control for these variables in column (7) of Table 5, using the sum of imports and exports between the two countries relative to their combined GDP and a dummy variable that indicates whether a preferential trade agreement exists between the two countries. Bilateral trade data is taken from Barbieri and Omar (2012) and trade agreements data is from the World Bank. The externality and heterogeneity variables remain significant and with the expected sign. Both bilateral trade and trade agreements enters with a positive and significant coefficient.

Sixth, we mitigate issues arising from reverse causation. Supervisory cooperation may lead to more monitoring of banks and cause retrenchment (Calzolari et al. (2018)), affecting market integration (Colliard (2020)) and result in lower

externalities. We address this issue in column (8), where we include our two indices (heterogeneity and externality) calculated for the year 2000. Most of the agreements were signed after this date. The results remain unchanged.

Finally, the online availability of the data on cooperation agreements might be endogenous. Less developed countries may be less likely to publish cooperation data online. Since our data strategy is internet based, we will miss any agreements published in other forms.[23] To account for potential sample selection bias, we employ a Heckman estimation. We use internet use in both countries as selection variable. We argue that when internet usage is widespread, it is more likely that countries will make information on cooperation agreements available online. This is consistent with findings in the public policy literature, which has shown a positive relationship between IT services in a country and transparency of governments and firms (see e.g., Rose (2005) and Perez, Rodriguez Bolivar and Lopez Hernandez (2008) for governments and Debreceny, Gray and Rahman (2002) for firms). Column (9) reports the first stage of this estimation, showing that higher internet usage indeed increases the probability of observing data on cooperation agreements online for a country pair. The second stage results in column (10) confirm our previous results; the externality measure remains positive and highly significant, while the heterogeneity measure becomes more negative (taking a value of -0.75) and stays significant at 1%.

We provide two goodness of fit measures alongside the pseudo R2 (the latter may not be the most appropriate measure as the dependent variable is binary). Both measures provide information on the fraction of correctly predicted outcomes. First, overall we predict 61% to 86% of all outcomes correctly across the specifications in Table 5. Second, according to McIntosh and Dorfman (1992) the sum of the fraction of zeroes correctly predicted plus the fraction of ones correctly predicted should exceed 100% if the prediction method is of value. In our case the sum of these fractions vary between 144% and 165%.

[23]Note that since we are investigating official international agreements, it is very unlikely that they are not available at all, it is just that we (as researchers) may not find them.

2. Duration Analysis

While so far we have studied variation across country pairs, we now also exploit variation across time. Because of the specific time structure in the dependent variable, a (logit) panel approach is not appropriate in our context. In particular, since in our data countries never move from cooperation to no cooperation, the process for the dependent variable can be characterized by a single jump (or absence of a jump) over the sample period. This is precisely the setting used in duration (and survival) analysis.

In this subsection we use duration analysis to estimate the likelihood of two countries cooperating, given that up to now they have not cooperated (we estimate models using the proportional hazard metric, for more details see the online appendix). We do not include country or country pair fixed effects, as this would bias our coefficient results upwards (Greene (2004)), though our findings are robust to the inclusion of country fixed effects. The sample now covers 4,138 country pairs over the years 1995-2013 (in 140 cases there was already cooperation prior to 1995; these observations are dropped). The duration variable varies from $t = 1$ if cooperation occurred in the first year of our sample, to $t = 18$ if no cooperation occurred up to 2013 (in the latter case, the data is said to be right censored). Consistent with the assumption of the duration analysis there are no cases where countries ceased cooperation, that is, move from cooperation to no cooperation.

The results in column (1) of Table 6 show that higher cross border externalities increase the hazard rate of a cooperation arrangement, while higher heterogeneity between countries is associated with a decrease of the probability of cooperation. In economic terms, one standard deviation in cross border externalities increases the probability of moving towards cooperation in a given year by 60%, while one standard deviation in heterogeneity decreases this probability by 49%. In column (2) we control for a post crisis effect; specifically, we include a dummy CRISIS that takes on the value one starting in 2008. Our results continue to hold. We can see that the crisis increases the likelihood that a cooperation arrangement will be adopted – as to be

expected. Finally, we control for the share of joint cooperation partners (that is, the share of third countries that have cooperation agreements with both countries). This captures the idea that when two countries have cooperation agreements outstanding with the same (other) countries, there most likely has already been some form of standardization that will make cooperation between the specific country pair less costly. In column (3) we find indeed that a higher share of common cooperation partners increases the probability of the adoption of cooperation arrangement. Finally, in column (4) we estimate a linear panel model; this allows for two way clustering and the inclusion of country fixed effects. We confirm that higher externalities (heterogeneity) reduce (increases) the likelihood of cooperation, with both coefficients significant at the 1% level.

3. Intensity of Cooperation

While so far we have focused on whether there is any form of cooperation present, we study next whether the externality-heterogeneity trade off can also explain the intensity of cooperation.

Table 7 presents the results using an ordered probit model with data from 2013. The sample size drops from 3,828 to 3,762 because for 66 country pairs we do not have information on the form of cooperation. The first column in Table 7 shows the estimates of the main model, while columns (2)-(6) break down the (marginal) effect on the likelihood of each of the five cooperation levels.

The results show that higher externalities and lower heterogeneity increase the expected intensity of cooperation, as they increase the likelihood of each (positive) cooperation level. The coefficient estimates for the main model in column (1) have the same sign and are highly significant as in the previous analyses. Column (2) contains the results for a cooperation intensity of zero (no cooperation); the marginal effect on the externality measure takes the value of -0.44, significant at the 1% level, whereas the coefficient on the heterogeneity measure takes the value of 0.39, also significant at the 1% level. Thus lower externalities and higher heterogeneity increase the likelihood

of no cooperation. This is consistent with the results in Table 5 where we have effectively examined the opposite question. In column (3) (Memorandum of Understanding on information sharing) the coefficients take the opposite sign (significant at the 1% level). This tells us that higher externalities and lower heterogeneity make it more likely that a pair of countries chooses a Memorandum of Understanding on information sharing as the form of cooperation. Similarly, in all other columns (column (4)-(6)), the externality variable takes a positive sign while the heterogeneity variables takes a negative sign. Thus higher net (economic) benefits increase the likelihood of all levels of cooperation.

It is informative to compare the size of the coefficients in the various regressions for (non zero) cooperation. From columns (3)-(6) we can see that the externality coefficients decrease in magnitude, from 0.104 for MoU to 0.039 for a supranational supervisor, with the exception of a College of Supervisors, which has a marginal effect of 0.221. We see the same ordering for the heterogeneity index, but with a negative sign. An increase in the net benefits has thus has a higher impact on lower cooperation stages than higher ones, with the exception of the College of Supervisors. An interpretation of this is that subsequent cooperation stages are more difficult to implement, and hence require a higher increase in net benefits to make them worthwhile. The higher sensitivity for the College of Supervisors may reflect that such colleges can be implemented for a specific bank only, and are hence less burdensome than country wide agreements.

In unreported robustness tests, we rerun the regression with a linear model, as such a model allows for two way clustering and the inclusion of country fixed effects, unlike the ordered probit model. We confirm that higher externalities (heterogeneity) increase (reduces) the intensity of cooperation, with both coefficients significant at the 1% level. To further gauge the sensitivity of our findings, we undertake three additional (unreported) robustness tests. First, we exclude the Eurozone countries from the sample. Second, we calculate the intensity variable weighing each intermediate cooperation degree equally (specifically, a common supervisor gets a "2"

and all other degrees of cooperation are coded with "1"). Finally, we also test our results excluding intermediate cooperation degrees (thus we only include country pairs that have either zero of full cooperation (common supervisor). Our two variables remain significant in all specifications, and with the expected signs.

V. Conclusion

The question of how to design the supranational financial architecture is an important one. Following the Global Financial Crisis, which saw significant international spillovers, several countries intensified cooperation in the supervision of their banks. This raises the question whether cooperation is effective in improving the stability of cross border banks. There is also large variation in countries' propensity to cooperate, raising in addition the question of why some countries cooperate while others not. Economic theory suggests that cooperation should be driven by two, opposing, factors. On the one hand, cross border externalities imply that uncoordinated domestic policies will result in inefficient supranational outcomes. Their presence suggests benefits to cooperation, as the latter allows internalizing international spillovers. On the other hand, heterogeneity across countries posits a cost to cooperation as it limits the set of policies that are mutually beneficial, as well as making the implementation of common policies costly.

Using bank level analysis we have shown that higher cooperation is associated with improved bank stability. We have also shown that actual cooperation arrangements among countries are consistent with benefits and costs predicted by externalities and heterogeneity across countries. This suggests that the varied and rich cooperation patterns found in the data may reflect differences in cooperation gains. Taken together, our results provide both a cautionary background for a global move towards uniformly more supervisory cooperation. Even though such cooperation can be expected to improve banking stability, it may not be necessarily be beneficial as cooperation gains vary across countries.

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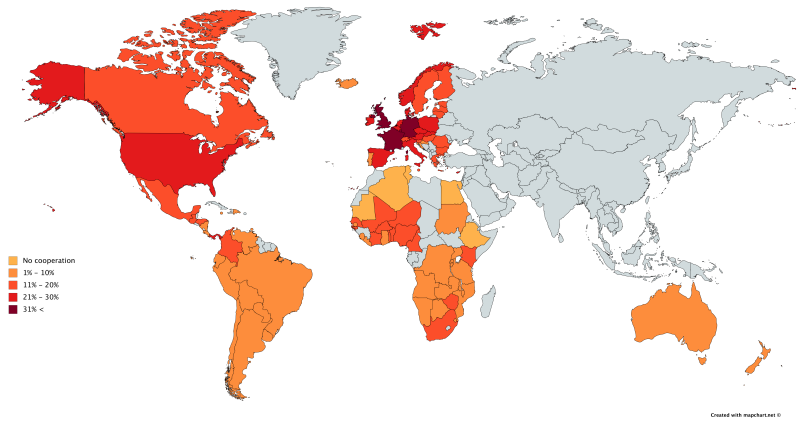
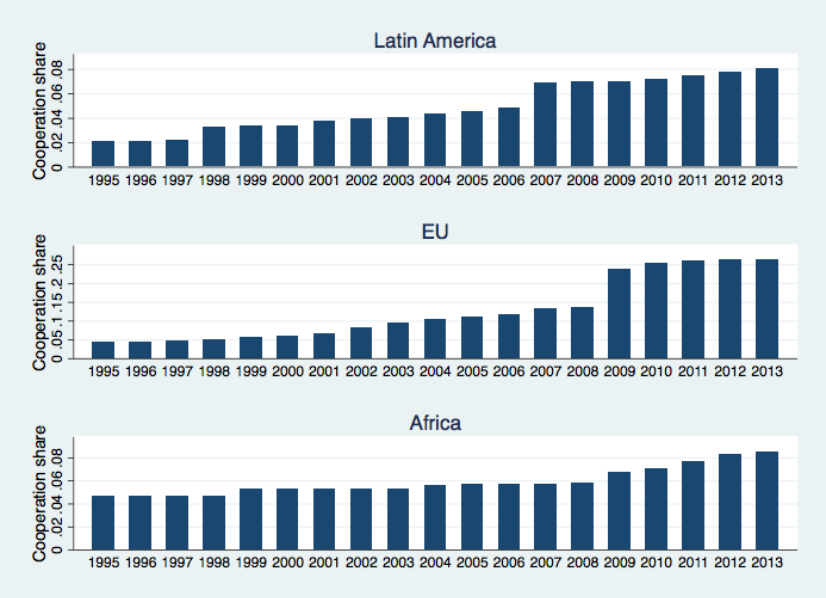
Figures

Figure 1. Geographic Distribution of Cooperation Agreements



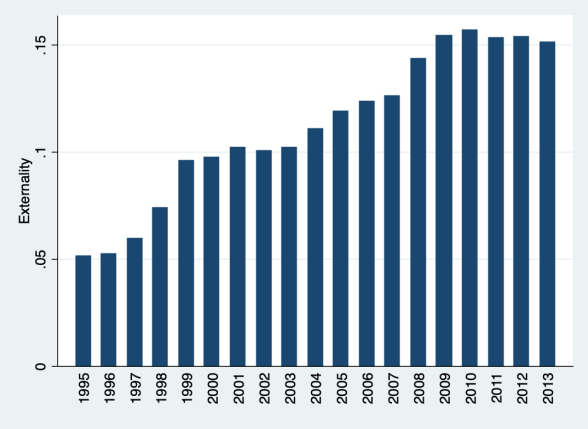
The figure shows the cooperation intensities of individual countries at the end of 2013. Darker red areas represent higher cooperation intensities, measured as the percentage of other countries a country cooperates with.

Figure 2. Evolution of Cooperation Agreements



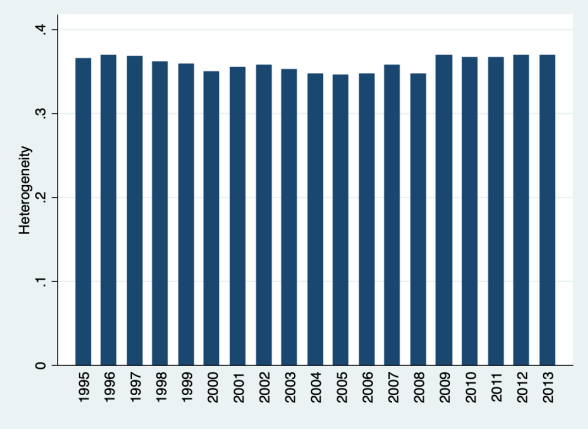
The figure shows the share of country pairs cooperating, relative to the total possible number of cooperation pairs within the region for each year.

Figure 3a. Evolution of Externalities



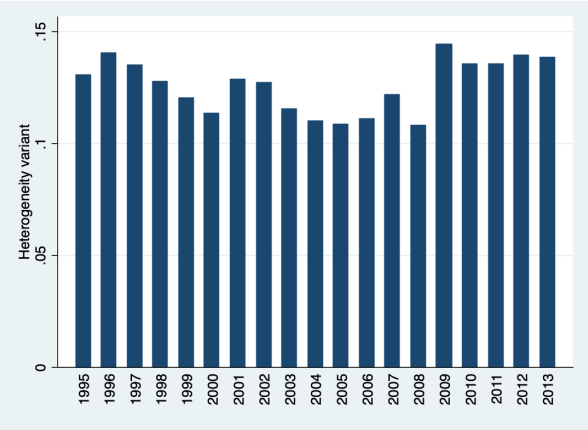
The figure shows the average externality index across all country pairs.

Figure 3b. Evolution of Heterogeneity



The figure shows the average heterogeneity across all country pairs for each year.

Figure 3c. Evolution of Heterogeneity (Time Variant)



The figure shows the average heterogeneity across all country pairs for each year including only the time variant components.

Tables

Table 1: Descriptive Statistics Cross Border Banks

Variable	Mean	Med.	Std. Dev.	Min.	Max.	N
Panel A: Subsidiary Structure						
Host countries	2.960	1	3.879	1	33	1661
Foreign subsidiaries	3.073	1	4.107	1	36	1661
Panel B: Bank Level Analysis' Variables						
Log(Z-Score)	3.752	3.625	1.647	-7.44	12.298	1105
Log(ROA+Equity/TA)	-2.595	-2.602	0.741	-11.139	0.134	1618
Log(SD(ROA))	-6.311	-6.176	1.703	-14.388	-1.755	1128
MES	0.038	0.033	0.026	-0.016	0.134	508
Loan growth	0.064	0.001	0.334	-4.910	4.464	1330
NPL/TL	0.050	0.028	0.069	0	0.409	1193
Cooperation	0.6	0.872	0.445	0	1	1661
Foreign TA/TA	0.16	0.065	0.237	0.005	0.942	1661
Log(assets)	10.364	10.824	1.975	2.333	12.358	1661
Liabilities/TA	0.906	0.930	0.12	0.069	0.992	1661
Loss prov./TL	0.014	0.007	0.021	-0.017	0.142	1540
Non interest income/Income	0.257	0.299	0.208	-0.147	1	1177
Liquid/TA	0.248	0.212	0.166	0.0002	0.911	1658
Income/cost	1.768	1.582	1.026	0.473	8.896	1627
Capital ratio	13.61	12.48	4.713	6.7	66.3	1132
Log(GDP per cap.)	9.822	10.434	1.167	5.48	11.322	1650
Vol(GDP growth)	0.093	0.081	0.061	0.004	0.566	1661
Trade/GDP	69.117	61.751	34.937	15.636	341.862	1657

This table reports summary statistics for our sample of cross border banks. The statistics are based on annual data for the years 1995-2013. Definition and sources of variables are listed in the online appendix.

Table 2: Effectiveness of Cooperation

				Small banks			
	Log(Z-Score)	Log(Z-Score)	Log(Z-Score) Large	Log(Z-Score) Small	Log(ROA+Equity/TA)	Log(SD(ROA))	MES
	1	2	3	4	5	6	7
Cooperation	0.540**	0.541**	0.184	1.187***	0.0286	-1.159***	-0.023***
	(0.258)	(0.234)	(0.196)	(0.369)	(0.0844)	(0.341)	(0.007)
Foreign TA/TA	-0.708	-1.003	0.251	-1.000	0.0251	1.025	-0.024
	(1.117)	(1.092)	(1.716)	(1.190)	(0.172)	(1.103)	(0.029)
Log(assets)	0.704***	0.527**	1.753**	0.431	0.0754	-0.356	-0.005
	(0.268)	(0.253)	(0.688)	(0.350)	(0.147)	(0.330)	(0.017)
Liabilities/TA	-4.319*	-4.631**	-30.44***	-3.075	-6.946***	-3.872	-0.026
	(2.238)	(1.980)	(7.189)	(2.733)	(1.114)	(2.669)	(0.131)
Loss prov./TL	-14.83**	-11.36**	-22.07***	-5.546	-6.094**	-0.548	0.013
	(6.329)	(5.465)	(4.565)	(6.331)	(2.419)	(5.434)	(0.123)
Non interest income/Income	2.298***	2.127***	1.960***	1.044	0.491	-0.554	0.035
	(0.521)	(0.448)	(0.421)	(0.784)	(0.413)	(0.696)	(0.021)
Log(GDP per cap.)		8.811***	8.094***	9.179*	4.859	-4.319*	0.0076
		(1.524)	(1.448)	(4.956)	(3.779)	(2.258)	(0.086)
Vol(GDP growth)		0.398	3.541	0.333	1.431	1.098	-0.025
		(1.248)	(2.945)	(1.642)	(1.182)	(0.875)	(0.063)
Trade/GDP		0.0217**	-0.00633	0.0308**	0.00597	-0.0248**	0.0005
		(0.00968)	(0.0140)	(0.0125)	(0.00509)	(0.0116)	(0.0003)
Bank FE	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y
Observations	804	804	402	402	402	402	137
R-squared	0.21	0.28	0.47	0.21	0.35	0.26	0.62

This table presents the results of regressions of bank risk and its components on cooperation. The dependent variables are bank's *Log(Z-Score)* in columns (1) - (4), *Log(ROA+Equity/TA)* in column (5), *Log(SD(ROA))* in column (6), and a bank's MES in column (7). *Cooperation* equals the asset weighted cooperation dummy between the parent bank country and its subsidiaries' countries. The sample is split at the 50th percentile according to total assets (columns (3) and (4)). Regressions in columns (4) - (7) contain the sample of small banks only. The sample period spans from 1995-2013. Definitions and sources of control variables are listed in the online appendix. All regressions are estimated including bank and year fixed effects, and robust standard errors clustered at the bank level (in parentheses). ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 3: Regulation and Effectiveness

	Log(Z-Score)	Log(Z-Score)	Log(Z-Score)
	1	2	3
Cooperation	0.552*	1.050**	0.967
	(0.318)	(0.414)	(0.582)
Supervisory stringency$_S$	0.045		
	(0.154)		
Cooperation*Supervisory stringency$_S$	0.476**		
	(0.215)		
Supervisory stringency$_P$	-0.078		
	(0.054)		
Cooperation*Supervisory stringency$_P$	0.268**		
	(0.134)		
External audit$_S$		0.156	
		(0.871)	
Cooperation*External audit$_S$		2.758*	
		(1.583)	
External audit$_P$		-0.584	
		(0.404)	
Cooperation*External audit$_P$		2.555**	
		(1.081)	
Foreign entry$_S$			0.705
			(0.836)
Cooperation*Foreign entry$_S$			1.926**
			(0.936)
Foreign entry$_P$			0.162
			(0.296)
Cooperation*Foreign entry$_P$			0.062
			(0.598)
All controls	Y	Y	Y
Bank FE	Y	Y	Y
Year FE	Y	Y	Y
Observations	320	359	319
R-squared	0.324	0.254	0.281

This table presents the results of regressions of bank risk on cooperation. The dependent variable is bank's *Log(Z-Score)*. *Cooperation* equals the asset weighted cooperation dummy between the parent bank country and its subsidiaries' countries. *Supervisory stringency* corresponds to an index that indicates capital stringency. *External audit* is a dummy equal to one if there is a compulsory licensed or certified external audit. *Foreign entry* is an index that indicates whether there are limits to foreign entities from entering the country. S and P stands for subsidiaries and parent, respectively. Subsidiaries' country data is aggregated at the parent bank level using the subsidiaries' assets as weights. All variables included in the interaction terms are mean centered. All regressions contain the sample of small banks only. The sample period spans from 1995-2013. Definitions and sources of control variables are listed in the online appendix. All regressions are estimated including bank and year fixed effects, and robust standard errors clustered at the bank level (in parentheses). ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 4: Descriptive Statistics Country Pair Analysis (Logit)

Variable	Mean	Std. Dev.	Min.	Max.	N
Cooperation	0.122	0.327	0	1	4278
Intensity	0.201	0.646	0	4	4206
Externality	0.151	0.188	0	0.832	3828
Heterogeneity	0.366	0.140	0.006	0.669	4278
Avg. foreign share	0.003	0.024	0	0.5	3828
Correlation	0.276	0.328	-0.695	0.956	1219
Currency	0.173	0.378	0	1	4278
G-SIB	0.168	0.374	0	1	3828
ΔPreferences	0.238	0.197	0	1	4278
ΔForeign share	0.002	0.022	0	1	3828
ΔLegal origin	0.625	0.484	0	1	4278
ΔLatitude	0.189	0.169	0	1	4278
ΔLongitude	0.308	0.222	0	1	4278
ΔLanguage	0.833	0.373	0	1	4278
ΔDebt/GDP	0.204	0.175	0	1	4186
ΔGDP per cap.	0.219	0.226	0	1	4186

This table reports summary statistics of the main regression variables in logit models. Definitions and sources of variables are listed in the online appendix. The sample consists of 4278 country pairs in 2013.

Table 5: Cross Sectional Analysis

	Indices	Components	Fixed effects	Principal components	Conservative sample	Bilateral agreements	Trade	Lagged indices	Heckman 1st stage	Heckman 2nd stage
	1	2	3	4	5	6	7	8	9	10
Externality	0.485***		0.433***		0.568***	0.328***	0.266***			0.566***
	(0.0617)		(0.0458)		(0.0621)	(0.0498)	(0.0409)			(0.0332)
Heterogeneity	-0.427***		-0.990***		-0.550***	-0.339***	-0.282***			-0.746***
	(0.0624)		(0.104)		(0.0723)	(0.0618)	(0.0547)			(0.0405)
Externality_{PCA}				0.0831***						
				(0.0185)						
$\text{Heterogeneity}_{PCA}$				-0.112***						
				(0.0111)						
$\text{Externality}_{2000}$								0.488***		
								(0.0575)		
$\text{Heterogeneity}_{2000}$								-0.443***		
								(0.0583)		
Avg. foreign share		2.132*								
		(1.116)								
Correlation		0.251***								
		(0.0590)								
Currency		0.0812**								
		(0.0356)								
G-SIB		0.114***								
		(0.0303)								
ΔPreferences		-0.249**								
		(0.119)								
ΔForeign share		-0.438***								
		(0.156)								
ΔLegal origin		-0.00951								
		(0.0222)								
ΔLatitude		-0.298***								
		(0.109)								
ΔLongitude		-0.415***								
		(0.106)								
ΔLanguage		-0.0841**								
		(0.0422)								
ΔDebt/GDP		0.0393								
		(0.0759)								
ΔGDP per cap.		0.0926								
		(0.0639)								
Trade							26.29***			
							(4.925)			
PTA							0.0988***			
							(0.0159)			
Internet use									0.004***	
									(0.0004)	
Observations	3,828	1,177	3,826	1,177	2,948	3,625	3,620	3,733	3,828	3,828
Pseudo-R^2	0.26	0.40	0.40	0.35	0.28	0.27	0.41	0.24		
%-Predicted	74.8	72.4	61.1	70.4	72.5	85.5	84.1	74.5		
M-D test	152.3	157.8	143.5	154.4	153.2	152.6	164.9	148.4		

This table presents the results of logit regressions of a cooperation indicator on the externality and heterogeneity indexes. The dependent variable is a country pair dummy equal to one if any form of cooperation is present between the two countries. $Externality_{PCA}$ is an index constructed using the first component of a principal component analysis of the variables included in the baseline externality index. $Heterogeneity_{PCA,ij}$ is an index constructed using the first component of a principal component analysis of the variables included in the baseline heterogeneity index. $Trade$ is the sum of exports and imports between the two countries over the sum of both countries' GDP. PTA is a dummy equal to one if a preferential trade agreement exists between the two countries. $\text{Externality}_{2000}$ is the externality index constructed using data from year 2000. $\text{Heterogeneity}_{2000}$ is the heterogeneity index constructed using data from year 2000. *Internet use* is the sum of both countries' individuals use of the internet as a percentage of each country's population. Definitions and sources of variables are listed in the online appendix. The sample consists of 4278 country pairs in 2013. All regressions report marginal effects. Model (3) includes fixed effects for each country in the pair and is estimated as a linear model. Models (1)-(8) are estimated with two way clustered standard errors at each country of the pair and model (9) and (10) are estimated with robust standard errors (in parentheses). ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 6: Hazard Rate Cooperation

	1	2	3	4
Externality$_{t-1}$	3.622***	3.452***	2.746***	0.027***
	(0.179)	(0.185)	(0.212)	(0.0051)
Heterogeneity$_{t-1}$	-4.096***	-4.284***	-4.214***	-0.062***
	(0.348)	(0.357)	(0.363)	(0.0080)
Crisis$_t$		0.832***		
		(0.104)		
Common share$_{t-1}$			21.95***	
			(1.286)	
Observations	63,257	63,257	63,257	63,257

Models in column (1)-(3) in this table present the results of duration model regressions of the hazard rate on the externality and heterogeneity indexes. The dependent variable in these models is the hazard rate of cooperation between a given country pair. $Crisis_t$ is a dummy variable equal to one starting in 2008. $Common\ share_{t-1}$ is the number of third countries with which both countries have a cooperation arrangement over the total possible number of joint countries that the two can cooperate with. Column (4) presents the results of a linear model of the probability of cooperation on the externality and heterogeneity indices. The sample consists of 4138 country pairs during the period 1995-2013 (country pairs with agreements before 1995 are dropped). Regressions (1)-(3) report coefficients from the proportional hazard metric of duration models and are estimated with robust standard errors (in parentheses). Regression (4) is estimated as a linear panel data model including country fixed effects and two way clustering at each country of the pair. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 7: Cooperation Intensity

	Model estimates	Average marginal effects				
		No cooperation	MoU info. sharing	CoS	MoU crisis management	Supranational supervisor
	1	2	3	4	5	6
Externality	3.17***	-0.438***	0.104***	0.221***	0.073***	0.039***
	(0.145)	(0.019)	(0.009)	(0.015)	(0.009)	(0.006)
Heterogeneity	-2.822***	0.389***	-0.093***	-0.196***	-0.065***	-0.035***
	(0.205)	(0.029)	(0.010)	(0.014)	(0.009)	(0.007)
Observations	3,762	3,762	3,762	3,762	3,762	3,762
Pseudo-R^2	0.21	0.21	0.21	0.21	0.21	0.21

This table presents the results of ordered probit regressions of the cooperation intensity on the externality and heterogeneity indexes. The dependent variable in these models is the intensity of cooperation between a given country pair. Intensity of cooperation ranges from zero to four if (i) the countries do not cooperate, (ii) have a Memorandum of Understanding for information sharing and on site inspection, (iii) have a College of Supervisors, (iv) have a Memorandum of Understand on crisis management and resolution and (v) have a supranational supervisor. The sample consists of 4206 country pairs in 2013. Column (1) reports the ordered probit coefficients. Columns (2)-(6) report marginal effects. All models are estimated with robust standard errors (in parentheses). ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.