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Bank Resolution, Regulatory Arbitrage, and Systemic Risk

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Abstract

We analyze the effect of bank resolution reforms on the systemic risk of financial conglomerates. We find that in developed countries, parent banks in a stricter resolution regime to their foreign subsidiaries have lower systemic risk contributions. The opposite is true for parents from developing countries. We explain these results as conglomerates exploiting differences in resolution between parents and subsidiaries, especially in developing countries, where rule enforcement is weaker. These results suggest that a more comprehensive regime has heterogeneous effects depending on country development, which has important implications for policymakers.

JEL Classification: G01, G21, G28

Keywords: Regulatory arbitrage, Systemic risk, Bank Resolution, Internal capital markets

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1 Introduction

The 2008-2009 global financial crisis, caused in part by systemic failures in banking regulation (Levine, 2012), has shown the limitations of the current regulatory framework and the need for a stricter monitoring of the cross-border activities of global systemically important banks. Global systemically important banks (GSIBs) have large networks of subsidiaries and branches in many countries and thus confront multiple regulators and national resolution authorities. While this variation in regulation increases compliance costs and reporting complexity, it also provides ample opportunities for regulatory arbitrage, which may have undesired externalities for the banking system. The effect on systemic risk of regulatory arbitrage due to the global operations of multinational banks remains an empirical question, which this paper aims to address.

Karolyi and Taboada (2015) argue that there are two distinct views regarding the effects of regulatory arbitrage on bank performance and systemic risk. The first view is of a "benign" effect of regulatory arbitrage, where banks aim to maximize shareholder value through improved capital allocation to markets where investments are not constrained by the costly stricter regulation in the home country. These positive externalities do not benefit only the parent bank, but also the foreign subsidiary, which is now connected to the more comprehensive regulatory regime at the headquarters of the parent. Ultimately, the benign form of regulatory arbitrage may lead to better performance and lower risk of the banking group as a whole. The second, or "malignant", form of regulatory arbitrage is related to activities that destroy value and can harm the stability of the system, such as excessive risk taking in countries with laxer regulation that harms market competition and discipline, and leads to race-to-the-bottom equilibria (Acharya, 2003). In this paper, we shed light on the circumstances that motivate banks to engage in either type of regulatory arbitrage.

First, we conjecture that the effect of regulatory arbitrage depends on the degree of development of the country of the parent bank, when compared to the countries of its subsidiaries. Karolyi and Taboada (2015) find that bank shareholders reward cross-boarder acquisitions whose targets come from a better regulated banking sector (in terms of tougher prescriptions), but also from better developed countries. In the same spirit, we analyze the effect of regulatory arbitrage on the systematic risk of countries' banking sectors for parents located in developed and developing countries, respectively. Second, we analyze the contribution of each specific resolution tool to increasing or decreasing banks' systemic risk.

We focus on one particular branch of banking regulation, which saw a major redesign since 2008: Bank resolution legislation. Prior to 2008, most countries relied on courts to apply corporate insolvency laws in dealing with failing banks. Due to the specifics of banks and the vulnerability of the banking system to runs and contagion effects, general corporate insolvency proved inefficient in handling the crisis and governments around the world resorted to bank bailouts to limit the negative effects of failing banks (Acharya, 2009). To avoid the use of public funds in the future, many governments ventured to develop special bank resolution regimes that would be more suited to addressing bank failures. And while the direction of the reform was clear, countries implemented the different features of a comprehensive bank resolution regime with a different pace. We exploit these differences and the varying exposure of global banks to different jurisdictions via their corporate ownership structures to identify the effect of regulatory arbitrage on systemic risk.

To this end, we use the Bank Resolution Index introduced in Beck et al. (2020) that traces the implementation of bank resolution reforms in 22 member countries of the Financial Stability Board (FSB). We connect these country-level reforms with a hand-collected dataset that links global banks to their domestic and foreign subsidiaries. Concentrate on subsidiaries in the aforementioned 22 FSB jurisdictions allows us to devise a proxy for regulatory arbitrage: the difference between the bank resolution index of the country of the parent bank and the average resolution index in the jurisdictions of its subsidiaries. We then proceed to analyze how regulatory arbitrage affects systemic risk in developed and less developed countries, and which bank characteristics and resolution features drive the relationship.

Our results suggest that global banks indeed engage in regulatory arbitrage, but we find distinct differences in the effect of this practice on systemic risk between developed and less developed countries. Namely, regulatory arbitrage in developed countries reduces systemic risk when the resolution regime of the parent bank is stricter than the regimes of its subsidiaries. This result speaks to the findings of Karolyi and Taboada (2015) and suggest a "benign" form of regulatory arbitrage in that case. The results are driven by bank liquidity, better management quality and higher leverage. The effect of higher leverage through bank resolution is not new to the literature (see Beck et al., 2020). In terms of the specific resolution features that reduce systemic risk, it appears that stricter bail-in regulation and more resolution powers in the parent country jurisdiction tend to reduce systemic risk, while support measures, which may involve use of public funds or an increase in compliance costs, tend to increase it.

For parents in less developed countries, regulatory arbitrage takes a "malignant" form and tends to increase systemic risk. The results are insensitive to liquidity and managerial quality, while lower leverage is indicative of higher systemic risk through regulatory arbitrage. Regarding the most important resolution features, it is notable that resolution powers drive the main results, but only in developed countries, which has major implications for policymakers.

In summary, there are no tools that uniformly decrease system risk worldwide. We explain these results as financial conglomerates exploiting differences in resolution tools between parent and subsidiaries, in particular in developing countries where rules enforcement is weaker.

We address concerns about potential endogeneity and reverse causality in our analysis by employing an instrumental variables approach that uses past crises of the home parent country as a source of exogenous variation in regulatory arbitrage. Our key findings are robust to this specification. To provide cleaner identification and control for unobserved heterogeneity, we also use the announcement of the Volker Rule by president Barack Obama in January 2010 as an exogenous shock to the risk of the banking sector. The results from our quasi-natural experiment confirm the main finding that for parents in more developed countries, such as the US, regulatory arbitrage reduces systemic risk contributions.

For robustness purposes, we also test our hypotheses using an alternative measure of systemic risk, the marginal expected shortfall (MES) (Acharya et al., 2016), and find similar results. The main findings are also robust to different sub-periods, model specifications, and confounding factors, such as a possible simultaneity with the introduction of other macroprudential tools in our sample. Our results remain unchanged after controlling for the degree of diversification of the conglomerate (the coinsurance effect), and that banks with higher leverage but also higher liquidity benefit more from regulatory arbitrage.

Our paper speaks to several strands of literature. First, we contribute to the literature on bank regulation and regulatory arbitrage. Doidge et al. (2004) observe a significant valuation difference between foreign firms listed in the US and non-US-listed firms from the same country and hypothesize that controlling shareholders of US-listed firms cannot extract private benefits at the expense of minority shareholders. This aligned interest increases the demand for shares from a wider set of investors. Karolyi and Taboada (2015) analyze cross-border acquisitions and find that target firms in host countries with less stringent regulation improve the abnormal returns of the targets and overall. The authors explain this with a benign form of regulatory arbitrage.

Relating to the stability of the global financial system, Acharya (2003) and Acharya et al. (2009) argue that regulatory arbitrage may lead all jurisdictions around the world to suffer from excessive risk-taking activities. Ongena et al. (2013) find that EU banks lower their lending standards and give away riskier loans through their foreign operations in response to the stricter banking regulations in the EU. Frame et al. (2020) find that US bank holding companies tend to choose locations with weaker regulation for their foreign operations, which leads to higher individual and systemic risk. On the other hand, Karolyi et al. (2023) find that countries with weak regulation see a disproportionally larger improvement in systemic risk stemming from cross-border cash flows.

Third, we relate to the literature on the effects of regulation across borders and the wider literature on supranational regulation and cross-border resolution. The literature on cross-border resolution primarily discusses how bail-in of creditors is affected by the institutional setup and distribution of powers among regulators in the markets of operation of global banks. For example, Beck et al. (2020) gather data on bank resolution reforms in members of the Financial Stability Board and study how bank resolution regimes affect systemic risk of banks. Beck et al. (2023) discuss the economics of supranational regulation based on a large dataset of bilateral agreements and find that cooperation between supervisors improves banking stability, with higher improvements for small and less complex banks and in cases where supervisors are more stringent and have access to higher quality information. Our paper speaks in that direction as it shows that regulatory tools on their own do not prevent the increase in financial risk across different countries in terms of institutional background and financial development.

Our paper is further related to the literature on the drivers of systemic risk (see, e.g., Adrian and Brunnermeier, 2016 and Brunnermeier et al., 2020) and the wider literature on the role of internal capital markets in banking activity (see, e.g., Peek and Rosengren, 1997; Peek and Rosengren, 2000; Ivashina and Scharfstein, 2010; De Haas and van Lelyveld, 2010; De Haas and van Lelyveld, 2014; Cetorelli and Goldberg, 2009, 2010, 2012a,b). We find that internal capital markets reduce systemic risk contributions of parents in more developed countries, while more research is needed to explains the systemic risk prevention in less developed countries.

We also relate to the literature on the effect of economic development on bank risk and efficiency (see, e.g., Demirguc-Kunt and Huizinga (2000); Demirguc-Kunt and Levine (1999)). Consistent with earlier findings in that literature, we show that a stricter resolution regime is beneficial in countries where bank efficiency is high, but the opposite applies to parents located in developing countries, as they can exploit differences in resolution regimes across their subsidiaries to move their assets at the expense of both shareholders and depositors.

The two most related papers to ours are Beck et al. (2020) and Frame et al. (2020). Beck et al. (2020) analyze the effect of resolution reforms on banks' systemic risk in times of crisis, by looking at a set of banks in FSB countries. They find strong evidence that bank resolution regimes increase systemic risk during crisis periods. There are several key features in our approach that explain the differences in the results. We use the parent-subsidiary relationship as an important identification device and aim to understand how the exposure of parents to jurisdictions with weaker resolution regimes affect their systemic risk contributions. To this end, our focus is on regulatory arbitrage by taking the difference of the resolution indices of parents and subsidiaries, and we ignore standalone banks. In addition, we also examine whether a more comprehensive bank resolution legislation improves financial stability depending on the country's economic development.

Frame et al. (2020) investigate US holding banks only, and they find a detrimental impact of regulatory arbitrage on systemic risk for US bank holding companies. They correlate with risk the likelihood of banks to operate in countries with weaker overall regulatory environment. Our global sample allows us to identify cases where bank resolution regimes lead to a decrease in systemic risk and thus to examine the drivers of both views on the phenomenon. Frame et al. (2020) proxy for regulatory arbitrage by regressing systemic risk contributions on foreign rule and thus, again, differ from our more direct measure.

Our paper is also related to the ongoing policy discussions regarding the effectiveness of the new bank resolution legislation, and particularly of bail-in arrangements. Theoretically, the possibility for early intervention through bail-in may reduce moral hazard and improve ex-ante risk-taking incentives of global banks, lowering the probability of financial crises to occur (see, e.g., Farhi and Tirole, 2012 and Chari and Kehoe, 2016). It may also lead to uncertainty reduction and loss minimization once a crisis occurs (see, e.g., Klimek et al., 2015 and Berger et al., 2022). At the same time, under rule-based bail-in, direct interlinkages between bank balance sheets, information effects and sudden reassessment of bank risk may lead to bank panic and contagion during crises (see, e.g., Acharya and Yorulmazer, 2008 and Eisert and Eufinger, 2018). Our paper provides preliminary evidence that bail-in rules reduce systemic risk through the internal capital markets of global banks.

The paper is organized as follows. Section 2 presents the institutional details regarding bank resolution and our theoretical predictions and testable hypotheses. Section 3 describes our empirical model, data and variables, while Section 4 presents our empirical results. Section 5 provides robustness checks and Section 6 summarizes our findings and their policy implications. All variable definitions are in the Appendix.

2 Bank Resolution Framework

The shift to a special bank resolution framework has been the cornerstone of the overhaul of banking regulation since the global financial crisis of 2008-2009. The need for this framework arose from the inability of general corporate insolvency regimes to resolve failing banks quickly and efficiently, and without causing a deeper crisis within the banking system. General corporate insolvency involves court handling of the liquidation of a single bank and aims at satisfying the claims of creditors. This regime applies when it is already too late to restructure the bank and does not take into account the systemic repercussions of a failure of a bank, such as bank runs, domino effects and contagion within the financial system and to the real economy.

The lack of a special bank resolution legislation that does not involve lengthy court proceedings and is handled by a designated resolution authority forced governments to bailout banks with public funds at the peak of the financial crisis. In some instances, such as in Ireland in 2010, the government had taken up so much debt for expensive bailouts of banks that were considered "too big to fail" that it itself had to be bailed out by syndicates of international institutions. The bailouts (and the additional austerity measures in the case of Ireland) increased the pressure on governments to find a solution to avoid the excessive use of public funds in the future.

In 2009, the Basel Committee and the G20 entrusted the Financial Stability Board to devise guidelines for a comprehensive special bank resolution framework. This assignment resulted in the publication of 12 Key Attributes (KAs) of a successful bank resolution regime in 2011 (see FSB, 2011). The KAs took into account the good practices in the United States and other countries with special bank resolution regimes and provided a holistic view on the resolution process.[1] The KAs served as

[1] The United States had developed a special bank resolution regime already in the early 1990s to deal with the saving and loan crisis, while the implementation of Title II of Dodd-Frank Act in the US, the Banking Act in the United Kingdom in 2009 and the Bank Restructuring Act in Germany in 2010 added modern components to the resolution framework that took into account the lessons from the financial crisis.

a base for the development of the Bank Recovery and Resolution Directive (BRRD), which harmonized the resolution tools and proceedings in the European Union (EU).

In 2013, the FSB published a report that took stock of the state of the bank resolution framework in its member countries (see FSB, 2013). The report revealed a huge heterogeneity in the implementation of bank resolution features, with the US, Switzerland and some countries in the EU having a large lead over countries in Asia and Southern Europe. In Figure 1, we report the timeline of the implementation of the resolution framework for 15 out of 22 countries in our sample. The figure shows substantial differences in the implementation of resolution reforms in the cross-section of countries in our sample, where several subsidiaries are located in different countries with different resolution regimes.

Beck et al. (2020) exploit this heterogeneity to gauge the impact of bank resolution regimes on systemic risk during global and bank-specific crisis events. In contrast to their study investigate whether global banks benefit from their operations being in jurisdictions with varying levels of completeness of their resolution frameworks in the form of regulatory arbitrage. Therefore, in our paper, we build on the previous research and use the ownership structure of global banks to study whether global banks engage in regulatory arbitrage and how it affects their contribution to the systemic risk in their home countries.

2.1 Theoretical Predictions

Our main testable hypotheses aim at identifying whether global banks engage in regulatory arbitrage and at examining its effect on systemic risk. Karolyi and Taboada

(2015) find a positive impact on abnormal returns when the acquiring bank comes from a stricter regime, but also from a more developed country. The authors argue that their findings suggest a prevalent "benign" form of regulatory arbitrage. Frame et al. (2020) analyze the behavior of US bank holding corporations (BHCs) and find that these tend to enter countries with weaker regulation and supervisory institutions. Engaging in regulatory arbitrage in their sample is correlated with a higher individual risk and systemic risk contributions, measured by VaR and $\Delta CoVaR$, respectively. Based on these previous findings, we formulate our first hypothesis as:

Hypothesis 1. The stricter the parent resolution regime compared to its subsidiaries, the higher the contribution of the group to systemic risk, and vice versa.

Since the main goal of the recent banking regulation is to reduce the dependency on public funds and improve market discipline, bank resolution regimes have many different features that may reduce or increase systemic risk, depending on the circumstances. Beck et al. (2020) find that bail-in tools and resolution powers increase systemic risk in crisis times, while having a designated resolution authority tends to reduce it. To analyze the effect of regulatory arbitrage through specific elements of the resolution regime we formulate the following:

Corollary 1.1. The effect of regulatory arbitrage on systemic risk depends on the type of resolution features used.

Our sample of countries has a varying level of regulatory and economic development. Regulatory arbitrage may have a different effect on systemic risk for parents from more developed countries compared to less developed countries for many reasons. As shown by Demirguc-Kunt and Huizinga (2000), the greater the development of a country's banks, the tougher is the competition and the greater is the efficiency. It is therefore likely that the effect of the new resolution framework on bank risk depends on the economic and financial development of a country. Banks in less developed countries, where contract enforcement tends to be inefficient may exploit more easily the differences between parent and subsidiaries enforcement rules across countries than in developed countries, where banks are more efficient (Demirguc-Kunt and Levine, 1999). While it is difficult to capture the effect of resolution framework on efficiency, we investigate whether the contribution to risk of parents located in less developed countries differs when their subsidiaries are in different resolution regimes. To test this conjecture, we postulate that:

Hypothesis 2. Economic development influences the effect of regulatory arbitrage on systemic risk.

In our robustness section, we also delve deeper into what type of characteristics drive the effect of regulatory arbitrage on systemic risk. Brunnermeier (2009), Brunnermeier and Pedersen (2009), and Adrian and Brunnermeier (2016) find that systemic risk increases due to liquidity spirals and sudden droughts in market and funding liquidity. Frame et al. (2020) find that banks with a better risk management tend to enter markets with weaker regulation, while Beck et al. (2020) find that higher leverage tends to reduce systemic risk through bank resolution. In summary, we expect that stricter resolution regimes in the home country of the parent bank increase systemic risk, while better bank management reduces systemic risk through bank resolution and that different resolution features may have different, possibly opposing, effects on systemic risk.

The effect of differences in resolution regimes may not be due to regulatory arbitrage, but due to other reasons. Our results can be related to a coinsurance effect that differs across countries. Laeven and Levine (2007) show that there exist a diversification discount in financial conglomerates. Similar to the effect of diversification for corporations, they show that the diversification of activities across financial conglomerates generates a value discount. Therefore, if banks in developed countries co-insure more than in less developed countries, our results might be explained by a diversification effect. We investigate this possible alliterative channel in the robustness session.

3 Empirical Model, Data and Variables

In our paper, we exploit the resolution differences across parent and subsidiary banks to investigate the effect of these differences on the contribution to systemic risk of financial conglomerates. We start by employing the bank resolution index developed by Beck et al. (2020). The index tracks the development of resolution regimes in 22 members of the Financial Stability Board (FSB) along to several categories: i) general resolution framework; ii) powers of the resolution authority; iii) number of tools beyond bail-in available to the resolution authority; ; iii) whether the resolution regime allows for bail-in; iv) additional support measures to resolve a bank. The index is constructed by country and the details about its individual elements are available in Appendix A.2. Beck et al. (2020) compile the overall Bank Resolution Index by summing up the five categories per country and per year:

$$Resolution\ Index_{c,t} = \sum_{m=1}^{22} I_{m,c,t}, \tag{1}$$

where $I_{m,c,t}$ takes the value of one if a particular resolution measure m is implemented (or already exists) in country c at time t and zero otherwise. Because the index is assigned at the country level and we do know the location of parent and subsidiaries, we are able to construct our main measure of resolution arbitrage, which we label as $Resolution\ Diff$. We construct this new measure as the difference between parent resolution index and the asset-weighted average of the resolution indexes of all its subsidiaries, as follows:

$$Resolution\ Diff_{it(n)} = Resolution\ Index_{i,t} - \sum_{p=1}^{N}\sum_{q=1}^{N} w_{jit} \times Resolution\ Index_{i,t}, \tag{2}$$

where w_{it} are the weights (assets) of subsidiary j of parent bank i at time t. A positive value implies that parent banks are in a stricter resolution regime with respect to their subsidiaries, and vice versa.

At a later stage of the analysis, we subdivide the index into several subcategories as in Beck et al. (2020): General resolution, resolution powers, resolution tools, bail-in framework and support measures. We then calculate the respective difference measures for these subcategories in the same way as in Equation 2. Table A.1 contains the definitions of all resolution variables we use.

3.1 Empirical Model

We start our empirical analysis with a panel fixed effects estimation at the monthly level. Our main independent variable is the bank's contribution to the systemic risk of a country's banking sector, measured by $\Delta CoVaR$. As we would like to capture whether the differences in resolution within financial groups affect the contribution of parent banks to systemic risk, our main dependent variable is "Resolution Difference", which is the difference between the parent and the subsidiary resolution regimes, value-weighted by bank assets. The model reads as follows:

$$\begin{aligned} \Delta CoVaR_{i,c,t} = \alpha + \beta ResolutionDiff_{i,c,t-1} + \beta_1 ResolutionIndex_{c,t-1} + \\ + \lambda BankControls_{i,c,t-1} + \gamma MacroControls_{c,t-1} + \mu_i + \nu_t + \epsilon_{i,c,t}, \end{aligned} \tag{3}$$

where $\Delta CoVaR_{i,c,t}$ is the contribution to systemic risk of bank i in month t in country c, and μ_i and ν_t are bank fixed effects and time fixed effects, respectively.

$ResolutionDiff_{i,c,t-1}$ is the difference between the resolution indices in the home country c of parent bank i and the asset-weighted average resolution index in the countries of bank i's subsidiaries at time *t-1*. $ResolutionIndex_{c,t-1}$ is the level of the resolution index in the home country c of parent bank i at time *t-1*. The vector of bank controls includes total assets as a measure of size (the natural logarithm of total dollar-denominated bank assets), leverage (the ratio of total bank assets and total bank common equity), ROA, liquidity (total liquid assets over total deposits), and managerial quality (total operating profit over total operating income), lagged by one period. Following the standard approach in the literature, we cluster standard errors at the parent bank-month level. We also include monthly and bank fixed effects to control for all bank- and time-invariant characteristics that may affect our results. The macroeconomic variables comprise GDP growth, domestic credit to GDP and inflation, and control for country heterogeneity across financial and economic development. We estimate our model over two subsamples: developed and developing countries, according to the classification of Morgan Stanley Capital International (MSCI).

We expect a negative (positive) coefficient of the "Resolution Difference" variable if systemic risk decreases (increases) when the parent bank is subject to a stricter resolution regulation than its subsidiaries.

3.2 Data and Descriptive Statistics

Our sample selection starts with the pool of listed banks in Bureau van Dijk's Bankscope, from 2000 to 2015. We keep all banks with complete information on size, loans, deposits, return on assets (ROA), and leverage. Bankscope also contains information about the ownership structure of global banks. We are therefore able to identify if a bank has one or more subsidiaries, and in which country a subsidiary is located. This is key information for us as it allows us to construct indicators regarding the differences in the bank resolution frameworks in which a parent and its subsidiaries operate. This difference is equal to zero for all standalone banks (i.e., banks without subsidiaries). We also retrieve macroeconomic data from the World Bank's World Development Indicators database. The frequency of the balance sheet and macroeconomic data is annual.[2] The final sample covers 454 parent banks and 1,431 subsidiaries over 20 (out

[2] The details regarding variable construction are available in the Appendix.

of 22) countries covered by the dataset, for a total of 7,117 bank-year observations.

Similar to Beck et al. (2020), we use $\Delta CoVaR$ (Adrian and Brunnermeier, 2016) as a proxy that captures a single bank's contribution to systemic risk. $\Delta CoVaR$ is constructed as the difference between the value at risk (VaR) of the financial system conditional on a particular institution experiencing extreme losses and the value at risk of the financial system conditional on the same institution's asset returns being at their median level. By construction, it also captures whether a bank is an important part of the system because of its size (Adrian and Brunnermeier, 2016). We retrieve daily bank stock prices from 2000 to 2016 from Thompson Reuters Datastream.[3]

Based on the resolution index in Beck et al. (2020), we construct the variable "Resolution Difference", computed as the difference between the parent resolution index and the asset-weighted average of the resolution index of its subsidiaries. A negative value of this variable implies that parent banks tend to have subsidiaries in more comprehensive resolutions regimes, compared to their home country's resolution framework. Appendix A reports the details on the construction of these variables.

To keep most of the variation in CoVaR, we reduce the frequency from daily to monthly, instead of annual, similar to Barth and Schnabel (2013). After merging with the yearly balance-sheet information, we end up with a sample of 99,375 monthly observations between 2000 and 2016, of which 60,335 parent bank monthly observations, for a total of 5,087 parent bank-year observations. Table 1 presents the list of banks for which we have complete balance sheet and CoVaR information. In Panel A, we report the observations of parent banks in developed countries, following the definition

[3]Of the 1431 subsidiaries, only 122 are listed subsidiaries with stock price information, which we keep for our final sample of listed banks with CoVaR.

of the MSCI World Center. In Panel B, we report the number of annual observations for the developing countries. The Unites States have the largest number of banks, followed by India and Korea. As the table shows, there is little information about Chinese banks. We drop these in our robustness checks to make sure they do not drive the results.

Table 2 reports the summary statistics for all variables in the sample. Panel A of Table 2 shows the distribution of the main dependent variable, $\Delta CoVaR$, for all parent banks in our sample, together with their balance sheet information collapsed at the bank-year level. The descriptive statistics in Table 2 show that $\Delta CoVaR$ varies substantially across banks (from -0.95 to +17.5). The mean of $\Delta CoVaR$ equals 1.48, hence, on average, a distress at one institution is associated with an increase in the conditional value at risk of the respective country's banking system by 1.48 daily percentage points (averaged over a month). The plots in Figure 2 show the evolution of CoVaR over time across several dimensions. The spikes in CoVaR tend to coincide with events that significantly affect the systemic risk of the banking sector. Panel A of Table 2 also shows that banks vary substantially in size, from 0.003% to 44% (like Lloyds in UK) of the GDP of their own country.

In Panel B, we report the characteristics of parent banks in developed countries, for which we have at least one subsidiary in the BvD dataset. Financial groups represent the majority of the sample, with the number of subsidiaries varying from 1 to 3500 for the biggest financial groups, with a median of 16 subsidiary banks per group. Among these, 8% have a subsidiary abroad, representing however 60% of total assets of big banks. We also report the average resolution framework in the home country of parent banks: 32% have the bail-in tool, and the average resolution index is 2.64 for parent banks.

The bottom part of Panel B of Table 2 shows the differences between parent and subsidiary resolution regimes when the parent bank is in a developed country. The sign of the coefficient of variable "Resolution Difference" is positive, which implies that parent banks in developed countries tend to have subsidiaries in countries with less comprehensive resolution frameworks compared to the parent's resolution framework. Overall, the resolution framework appears to be tighter for the parent banks in developed countries when compared to their non-domestic subsidiaries.

Panel C of Table 2 reports the characteristics of parent banks in developing countries. The number of companies in a financial group varies from 2 to 372 for the biggest financial groups, with a median of 36 companies by group, which is higher compared to the median of 16 companies of financial groups in developed countries. This confirms past findings of banks being family-controlled and often organized in pyramids (see, e.g., Caprio et al., 2007). Among those, 42% are subsidiaries abroad. None of the parent banks in this sample have a pure bail-in tool, and the sign of the coefficient of the difference in bail-in tools between parents and subsidiaries is negative. This is driven by subsidiaries that are in countries with tighter resolution framework compared to their parent bank.

It is important to note that none of the parent banks in the developing countries had implemented the bail-in tool, and for this reason, we cannot investigate the heterogeneous effect of the bail-in between developed and developing countries. However, some countries (India, Indonesia, and Turkey) had implemented some additional tools, which include the possibility of splitting failing banks into good and bad banks, or of establishing of a bridge institution. Despite the percentage of parents having foreign subsidiaries being about 10%, these banks cover 62% of the overall bank assets in the economy, both in developed and in developing countries.

To illustrate the evolution of the difference across parents and subsidiaries over time, Figure 3 reports the average resolution index and the average difference of the resolution index between parent and subsidiaries by year, for both developing and developed countries. Both developed and developing countries increase the sophistication of their bank resolution regimes over time. However, while the difference in resolution strength between parents and subsidiaries have turned positive for developed countries, which implies a tighter resolution regime of parent companies, the opposite applies to developing countries. This opens up possible regulatory arbitrage opportunities across the members of the same financial group that are located in different jurisdictions.

4 Empirical Results

In a first step, we aim at investigating the contribution of parent banks to systemic risk in case they have subsidiaries located in different regimes, both for parents in developed and in developing countries. We then employ a quasi-natural experiment to address the concern that some unobserved heterogeneity drives our results.

4.1 Developed versus Developing Countries

We start our analysis by looking at the effect of resolution arbitrage on bank systemic risk when parent banks are located in a developed country. We estimate Equation 3 on the sub-sample of countries reported in Table 1, Panel A. The results are in Table 3. Column (1) of Table 3 shows that the higher the difference in resolution regimes between the parent and its subsidiaries, the lower the systemic risk in the *developed* country where the parent bank is located.

Specifically, a one-step increase in the difference in resolution strength between parents and subsidiaries implies a 5% decrease of the contribution of the bank to the systemic risk of its own country. Column (2) adds the level of the resolution index as a control variable and the result remains unchanged. Adding bank and macroeconomic controls in Models (3) and (4), respectively, does not change the main result substantially. The signs of the control variables are as expected. A better management quality and higher liquidity reduce systemic risk. At the same time, larger bank size reduces systemic risk, which may signal the presence of a too-big-to-fail phenomenon in our bank sample.

In Panel B, we also analyze which characteristics of the resolution framework play a larger role by looking separately at differences between parent and subsidiaries in terms of the powers assigned to resolution authorities, the available tools in the resolution kit that exclude the bail-in tool, whether there is a separate bail-in framework, as well as the differences in additional support measures when resolving a bank. To interpret the direction and the magnitude of the coefficient more intuitively, we define an indicator variable equal to one when the tools in the parent bank country are stricter with respect to the resolution powers in the country of the subsidiary.

Columns (2) to (5) of Panel B of Table 3 show the results. The results indicate that a positive difference in resolution powers between parents and subsidiaries reduces systemic risk contribution of the parent company by 11%. We confirm that resolution powers play a major role in explaining the main effect of the resolution regime differences across parents and subsidiaries. This result confirms the findings of Beck et al. (2020) for resolution regime levels during major crisis events around the globe.

Despite the fact that the effect of the bail-in tool is not statistically significant, as bail-in is still not fully operational across countries and leading to a lower statistical power in the sample, the coefficient is economically relevant: a more stringent bail-in framework at the parent bank level decreases the systemic risk by 7%, which is the highest value in our sample for a single tool. This suggests that a comprehensive adoption of bail-in may be the most effective resolution tool in reducing the systemic risk of the banking sector.

Finally, additional support measures increases the systemic risk of the country the bank is in. This result can be explained by the additional compliance costs and resolution fund fees banks in more advanced resolution environments have to face, and these costs are even higher for banks with international operations (see, e.g., Acharya, 2003).

In a second step, we answer the question whether banks from developed countries have a different strategy to banks in other regions. We therefore estimate an additional model that includes the interaction between the resolution difference index and an indicator variable equal to one if the parent bank is in a developed country (according to MSCI). The results are in Table 4.

Columns (1) - (3) of Table 4 show the results. A larger difference in resolution regimes between a parent and its subsidiaries implies a higher systemic risk for the developing country where the parent bank is located. Specifically, a one-step increase in the difference in resolution strength between parents and subsidiaries implies a 21% increase of the contribution of the bank to the systemic risk of its own country. This is economically relevant and suggests that differences in resolution regimes are less likely to have positive spillovers when the parent is located in a developing country.

We delve deeper into the mechanisms of transmission and investigate which bank balance sheet characteristics drive the effect of regulatory arbitrage on systemic risk that we find. To this end, we split our sample along the medians to several bank characteristics that are important for policy and supervision, such as leverage, bank liquidity, and managerial quality.

We first perform the analysis on developed countries and report the results in Table 5. The table shows that the main effect is driven by banks with higher leverage ratios and lower liquidity. The result that lower liquidity (total liquid assets over total deposits) increases systemic risk is in line with the findings of Brunnermeier (2009), Brunnermeier and Pedersen (2009), and Adrian and Brunnermeier (2016). The outcome that higher leverage reduces systemic risk through resolution regimes is previously documented by Beck et al. (2020). The authors explain it by the deleveraging that occurs after resolution reforms are enforced, as well as during economic and financial crises. We do not find a statistically significant differential impact of resolution differences through managerial quality.

We also perform a similar analysis for developing countries. Table 6 shows that the effect is concentrated in banks with lower leverage ratios, and thus in less financially constrained banks. These banks have more financial flexibility to move assets across subsidiaries. Overall, these findings confirm the baseline results on the effect of resolution arbitrage on banks systemic risk.

4.2 Addressing Endogeneity

In this section, we address concerns about potential reverse causality and omitted variables problems affecting our baseline results. To control for some unobserved characteristics that might drive both the differences in resolution and bank CoVaR, we exploit President Obama's endorsement of the Volcker Rule[4] during a speech on January 21, 2010 that aimed at eliminating the too-big-to fail problem in the US.[5] More specifically, we compare US banks before and after the announcement, with or without subsidiaries abroad. Our conjecture is that banks with subsidiaries in different resolution regimes would have been affected differently by the announcement compared to banks with only domestic subsidiaries.

Because the parent bank acknowledges that it will move to a stricter regulatory regime, it would benefit from having subsidiaries countries with laxer regulation. In

[4]The Volker Rule is a major feature of the Dodd-Frank Act that prohibits proprietary trading by US commercial banks and, together with the similar recommendation in the Vickers Report in the UK, is considered to be a major step towards reducing the too-big-to-fail problem in banking through ring-fencing of investment activities (see USHR, 2010 and ICB, 2011).

[5]As the FED had pointed out, JP Morgan Chase, Bank of America, Citigroup, Wells Fargo, and Goldman Sachs collectively held $8.5 trillion in assets at the end of 2011, equivalent to 56 percent of U.S. GDP.

other words, having foreign subsidiaries in less strict resolution regimes reduces the exposure to the home rule. We therefore expect a stronger decrease in the risk of these banks after the announcement, compared to the pure domestic banks, in line with our baseline results. Provided that these banks share a similar organizational structure, and that we use bank fixed effects to control for any heterogeneous difference across banks, we expect that the resolution difference would play a stronger role in the aftermath of the announcement.

We perform our analysis in several steps. First, we keep only US banks and we construct an indicator variable equal to one when the parent bank has a positive difference in the resolution framework with respect to its subsidiaries before Obama's announcement. Second, we keep a window of 2 years before and after the reform, therefore from 2008 to 2011. We estimate the following model:

$$\begin{aligned}\Delta CoVaR_{i,c,t} = \alpha + \beta ResolutionDiff_{i,c,t-1} + \\ \beta_1 ResolutionDiff_{i,c,t-1} \times after + \lambda BankControls_{i,c,t-1} \\ + \gamma MacroControls_{c,t-1} + \mu_i + \nu_t + \epsilon_{i,c,t}\end{aligned} \tag{4}$$

where $\Delta CoVaR_{i,t,c}$ is the contribution to systemic risk of bank i in month t in country c, $ResolutionDiff_{i,c,t-1} \times after$ captures the effect of parent-to-subsidiary difference in resolution regimes after the announcement affecting US parent banks, and the variable $after$ is an indicator variable equal to one after January 2010, and zero before. The vector of bank and country controls includes all variables used so far, one period lagged. We also include monthly fixed effects ν_t, while μ_i is a vector of bank fixed effects.

The results are reported in Table 7. The coefficient of $ResolutionDiff_{i,c,t} \times after$ holds economically and statistically significant, which confirms our expectations about banks with a US parent in a stricter resolution regime and centralized resolution framework being more affected by the announcement, compared to the US banks with only domestic subsidiaries. Specifically, these banks experience a decrease in the CoVaR by 60% compared to the years before the announcement. These results are in line with our baseline findings and confirm that financial conglomerates exposed to different resolution frameworks contribute to the country systemic risk in a heterogeneous way, depending on where their subsidiaries are located.

In our second test, we address the possible reverse causality between systemic risk and resolution reforms by performing instrumental variables analysis. To this end, we follow Frame et al., 2020 and Beck et al. (2020), who use the variation in regulation explained by financial crises. We argue that both the resolution differences and the level of the resolution index should be instrumented, as both reflect resolution reforms that may be affected by systemic risk. Therefore, we need at least two instruments (ideally, more than two) for the model to be statistically identified. To instrument the variables *Resolution Difference* and *Resolution Index*, we use three indicators at the country level based on the banking crisis database of Laeven and Valencia (2018): Output Loss to GDP, Fiscal Costs to Output Loss and Number of Crises.[6]

Past financial crises lead to strengthening of banking regulation in general and bank resolution in particular, as shown before by Beck et al. (2020), but are not expected to have a first-order effect on the dynamics of systemic risk in the future. The exclusion restriction condition in our setting also requires that there is no relationship

[6]For complete definitions of the instrumental variables, see Table A.3.

between past crises in the home country of the parent and its expansion in the foreign market, where the subsidiary is located. Some papers show that the pattern of bank internationalization is related to some geographical diversification of risk (Berger et al., 2022), and also with regulatory restrictions or the characteristics of the banking sector of the host countries (Barth et al., 2006). None of these studies on cross-border expansion of the banking sector provides evidence of past bank crises affecting the decision to have subsidiaries in particular resolution regimes.

In our setup, we control for time fixed effects to take into account all possible period-related variations in bank resolutions differences and systemic risk. Any residual influence of financial crises at home most likely affects systemic risk at the parent level via regulatory arbitrage through the internal capital markets of global banks. In our setting, this arbitrage effect occurs through host market resolution rules – either in the form of bail-in or a bailout.

Table 8 presents the results from our IV estimation. Models (1) through (3) replicate columns (2), (3) and (4) of Table 3 for developed countries, respectively, and Model (4) replicates Panel B of Table 3 for developing countries. The results confirm our baseline findings of a heterogeneous effect of resolution regimes on multinational banks depending on the degree of development of the domestic country of the parent bank. Using the exogenous variation in the level of the bank resolution index yields a positive and significant coefficient, which is also found by Beck et al. (2020).

The instruments are very strong throughout our estimations and fail the Hansen J-test at the 5% level only in the case of developing countries. This could be explained by the lack of variation in the IVs for developing countries in our sample period, which means that they are captured by the bank fixed effects. Therefore, in that case we drop these fixed effects and show the results for reference purposes but they should be interpreted with caution.

While none of these solutions can completely eliminate concerns that locating subsidiaries abroad can endogenously respond to some past variation in the systemic risk, our results provide support for the benign view on regulatory arbitrage for developed countries and the malignant form for developing countries, found in the previous sections.

5 Robustness

In this section, we perform a set of robustness checks to validate our findings. First, we use an alternative measure of systemic risk as our main dependent variable: the Marginal expected Shortfall (MES), introduced in Acharya et al. (2016). We rerun Equation 3 and report the results in Table 9, both over the sample of developed (Panel A) and developing countries (Panel B). The main results remain qualitatively the same after this change.

Because our sample period covers the financial crisis, we expect that the effects are stronger after the crisis, when regulation is strengthened. We therefore split our samples of developed and developing countries into two sub-periods, before and after the 2008 financial crisis, and estimate again Equation 3. The results in Table 10 present significant coefficients for resolution differences after the crisis, with a substantial strengthening of the relationship between resolution arbitrage and systemic risk both for developed and developing countries.

Third, we test whether our results partially capture different bank or country effects. First, we test for the existance of a diversification effect. Laeven and Levine (2007) show that the diversification of activities across financial conglomerates generate a value discount, because insiders are able to extract private benefits at the expense of minority shareholders. On the other side, there might be a coinsurance effect that can be different between developed and developing countries.

We therefore follow Laeven and Levine (2007) and construct a measure of diversity at the group level, based on the bank's specialization on loan activity, proxied by the asset-weighted average of loans - at the group level - over the total assets. A very low value of this variable implies that the bank does not specialize in lending, and vice versa. We add this variable to the set of our control variables and estimate the model for developed (Columns (1)-(2)) and developing countries (columns (3)-(4)) in Table 11. The table shows that our effect stays stable after controlling for group diversification. Consistent with Laeven and Levine (2007), a higher bank specialization (low diversity), decreases the bank risk and its contribution to the systemic risk, in particular in developing countries.

Another confounding factor is the introduction throughout the sample period of various macro-prudential policies at the parent/subsidiary level that might drive our results. We therefore retrieve from the IMF's integrated Macroprudential Policy (iMaPP) Database several indicators for the introduction of alternative macroprudential policies at the country level, originally constructed by Alam et al. (2019). Specifically, we control for the average loan-to-value limits at the country level, as differences between parent and subsidiaries can be driven by more aggressive policies at the loan portfolio level. Additionally, we construct a Policy Action indicator (SUM17) that proxies for all capital and liquidity policies introduced at the country level that might affects the systemic risk of parents and subsidiaries. Table 12 shows that our main effects remain economically and statistically significant after controlling for these alternative policies.

Furthermore, we rerun the the specification in Equation 3 by two-way clustering our standard errors at the bank and month level (Table 13), and drop the US from our sample (Table 14). The results remain across both of these robustness tests.

Our next robustness check is related to the organizational form of the resolution regime. More specifically, we investigate whether the results are driven by the parent being in a Multiple-point-of-entry or in a Single-point-of-entry jurisdiction. In order to promote collaborative SPOE resolution and joint supervision, burden sharing (also known as loss allocation) is necessary. A joint backstop or a backstop from the home country facilitates single point of entry (SPOE), while countries that support only the part of global banks that operates within their borders support multiple point of entry (MPOE; Schoenmaker, 2017). Under MPOE, loss-absorbing capital (outside equity and long-term debt) is issued separately by national holding companies in each jurisdiction. Under SPOE, loss-absorbing capital is issued by a global holding company and is therefore shared across jurisdictions.

Bolton and Oehmke (2019) focus on the single-point-of-entry and multiple-point-of-entry dichotomy and make a link between bank resolution and the operational structures, risks and incentives of global banks. The results from their theoretic setup show that SPOE (championed by the United States) is more efficient but time-inconsistent. If *ex post* transfers are too large, national regulators will ring-fence subsidiary bank assets instead of allowing SPOE resolution. Moreover, if the expected transfers of assets across countries is overly asymmetric, SPOE fail *ex ante*.

Without burden sharing, the home country would bear the full weight of a possible bank recapitalization under SPOE, which may prove challenging given limited fiscal capacity of certain countries. To address this issue, we take into account the size of the country, as small and medium-sized countries are unable to offer a credible fiscal backstop to large global banks without joint burden sharing. The hypothesis is that banks in small and medium-sized countries are less likely to take advantage of the laxer resolution regimes and move riskier assets abroad, as they are more likely to be subject to MPOE.

We therefore identify six countries that are below the 1,000 trillion of GDP (which represent the 10% percentile of the GDP distribution): Australia, Hong Kong, Indonesia, South Africa, Switzerland, and Turkey. We run the same model as before by dropping these countries, and we report the results in Table 15.

The table confirms that our findings are not driven by an organizational form effect. Specifically, the coefficient on resolution differences stays negative and significant, and it accounts for a reduction in the bank contribution to country risk by 26 to 30% for banks having a more comprehensive resolution regime at the parent level. It is interesting to note that the resolution index turns negative and significant, consistent with the idea that only a country with a credible fiscal backstop can take advantage of the resolution framework. Overall, the test confirms the role of resolution arbitrage across big banks in reducing/increasing the systemic risk of a country bank sector.

6 Conclusion

This paper investigates whether global banks engage in regulatory arbitrage, taking advantage of their presence in jurisdictions with various degrees of regulatory strength and how it affects their systemic risk.

Previous research identifies two types of regulatory arbitrage with respect to its effect on systemic risk: a benign form of regulatory arbitrage that improves capital allocation and reduces systemic risk, or a destructive form of regulatory arbitrage that induces excessive risk-taking and increases systemic risk (see Frame et al., 2020). We find evidence for the existence of both types of regulatory arbitrage depending on the country's degree of development. Our results show the prevalence of the benign form of regulatory arbitrage in developed countries as opposed to a more "malignant" form in less-developed countries.

The reduction of systemic risk for developed countries is mainly through better liquidity, while in developing countries it goes through a lower leverage ratio. Better resolution powers and more resolution tools at home reduce systemic risk in developed countries and increase it in developing countries. The benign form of regulatory arbitrage in developed countries is supported by a natural experiment and a number of robustness checks.

Our findings have policy implications for the ongoing debates regarding the effectiveness of bank resolution regimes in reducing systemic risk – one of the main reasons these reforms were implemented in the first place. Our preliminary results suggest that bail-in, the new and highly contested feature of the overhaul of banking regulation since 2008, appears to work as intended in cross-border context, but we also find that resolutions tools have heterogeneous effects depending to the home country's degree of development. The existence of the destructive type of regulatory arbitrage in some cases signals that more effort is required by policymakers and regulators to improve bank business models, strategies and incentives.

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Table 1: Sample of banks

The table reports the complete sample of banks in developed (Panel A) and developing countries (Panel B), for which we are able to compute $\Delta CoVaR$ over the period January 2000 - December 2016. The sample is retrieved from the intersection of the Bureau van Dijk Bankscope and the Thompson Reuters Datastream databases. The data are reported at the parent bank-year level.

Panel A: Developed	France	Germany	Italy	Netherlands	Spain	Switzerland	UK	US	Canada	Australia
2000	2	2	9	2	4	3	6	7	182	6
2001	2	2	9	2	4	4	6	7	197	6
2002	2	2	9	2	5	5	7	7	186	6
2003	2	3	9	2	5	6	7	8	234	6
2004	2	3	10	2	5	6	8	8	248	6
2005	2	3	10	2	5	6	7	8	259	6
2006	2	4	11	1	5	6	9	8	262	6
2007	2	4	11	1	5	6	11	8	238	6
2008	4	4	10	1	5	6	11	8	247	7
2009	4	4	10	1	5	6	11	8	253	7
2010	4	4	10	1	5	7	11	8	262	8
2011	4	4	10	1	5	7	11	7	266	8
2012	4	4	10	1	5	6	11	9	271	8
2013	4	4	10	1	5	8	11	10	279	8
2014	4	4	10	1	6	8	11	10	286	8
2015	4	4	9	1	6	9	12	10	286	8
2016	3	4	9	1	6	8	12	9	234	8
Total	**51**	**59**	**166**	**23**	**86**	**107**	**162**	**140**	**4,190**	**118**
Panel B: Developing	China	Hong Kong	India	Indonesia	Korea	Russia	Turkey	South Africa	Brazil	Mexico
2000	0	3	17	7	13	1	4	15	5	3
2001	0	3	17	6	13	1	5	15	6	3
2002	1	4	20	7	15	1	5	14	6	3
2003	1	4	23	7	17	1	6	11	6	2
2004	1	5	23	6	17	2	6	8	5	4
2005	1	6	20	6	22	4	6	6	6	5
2006	1	9	21	6	26	7	5	6	5	5
2007	3	10	20	6	22	8	6	6	8	4
2008	3	8	21	6	19	10	5	6	8	4
2009	4	8	21	5	18	10	6	6	5	5
2010	3	8	21	5	20	11	7	6	4	6
2011	4	8	21	5	22	10	6	6	4	8
2012	5	8	21	5	24	11	6	6	4	8
2013	6	8	22	5	26	8	6	6	4	9
2014	7	9	22	5	28	8	7	6	4	9
2015	7	9	22	5	27	7	7	5	4	9
2016	4	9	21	5	25	7	6	5	3	8
Total	**51**	**119**	**353**	**97**	**354**	**107**	**99**	**133**	**87**	**95**

Table 2: Statistics

The table reports the summary statistics for all the variables used in the analysis. In Panel A, we report the summary statistics for the complete sample of banks for which we are able to compute $\Delta CoVaR$ over the period January 2000 - December 2016. In Panel B, we report the characteristics of parent banks with at least one subsidiary in the Bankscope sample in the same period. In Panel C, we report the (weighted average) characteristics of the subsidiaries. The sample is retrieved from the intersection of the Bureau van Dijk Bankscope and the Thompson Reuters Datastream databases. All variables are defined in detail in Appendix A.

Panel A: All sample	mean	median	sd	min	max	N
DeltaCoVaR (Parents)	1.48	1.25	1.22	-.095	17.4	60,355
Firm-Year						
Leverage	12.9	11.1	10.6	1	105	5,087
ManQuality	.265	.301	.343	-1.67	1	5,087
ROAA	1.16	.92	2.67	-7.63	16.5	5,087
Liquidity	.302	.0761	1.04	.00436	10.1	5,087
Size (% GDP)	2.53	.0242	8.25	.000308	44.7	5,087
Panel B: Parents (developed)	mean	median	sd	min	max	N
Number of companies	114	16	370	0	350	4,761
ForSub	.08	0	.271	0	1	4,761
Resolution Index	2.67	2.56	.421	.693	3.09	4,761
Bailin(Y)	.341	0	.474	0	1	4,761
Res. framework	1.86	1	.989	1	3	4,761
Additional Support	2.15	2	.803	0	4	4,761
Tools (no bailin)	2.79	3	.701	0	3	4,761
Resolution Diff. (Par/subs)	.0116	0	.354	-2.06	2.3	4,761
Res. framework diff.(Par/subs)	-.0151	0	.216	-2	2	4,761
Tools with bailin diff.(Par/subs)	.0219	0	.302	-2.5	3	4,761
Tools (no bailin)	2.79	3	.701	0	3	4,761
Bailin(Y) diff.(Par/subs)	-.0729	0	.259	-1	1	4,761
Additional Support diff.(Par/subs)	.0117	0	.171	-2.44	3	4,761
Panel C: Parents (developing)	mean	median	sd	min	max	N
Number of companies	76	36	95.7	2	372	326
ForSub	.429	0	.496	0	1	326
Resolution Index	2.47	2.56	.284	.693	2.83	326
Bailin(Y)	0	0	0	0	0	326
Res. framework	2.82	3	.57	1	3	326
Additional Support	1.13	1	.556	0	2	326
Tools (no bailin)	1.67	2	1.14	0	3	326
Resolution Diff. (Par/subs)	.0709	0	.599	-1.61	1.79	326
Res. framework diff.(Par/subs)	.193	0	.694	-2	2	326
Tools sans bailin diff.(Par/subs)	-.0807	0	.494	-2	1	326
Additional Support diff.(Par/subs)	.0422	0	.335	-1	1	326

Table 3: Group Resolution Differences and Systemic Risk in Developed Countries

Panel A of the table reports the estimates of Equation 3, where the dependent variable is $\Delta CoVaR$ for each parent bank i for each monthly t over the period January 2000 - December 2016, for parents in developed countries. The variable "ResolutionDiff" is computed as the difference between the parent country resolution index and the asset-weighted average of the resolution indexes of its subsidiaries. Panel B reports the estimates of Equation 3, where we replace the Resolution difference with the vector Y_{it} that includes differences in resolution tools. The latter are computed as the difference between a parent country's resolution subcategory and the asset-weighted average of the respective resolution subcategory of its subsidiaries. To illustrate, the variable Tools sans Bail-in difference (>0) is an indicator variable equal to 1 if the difference between the number of tools that exclude bail-in in the parent bank country and the asset-weighted average of the number of tools that exclude bail-in in the countries of its subsidiaries is greater than zero. The model controls for a vector of bank characteristics and includes time (month) and bank fixed effects. The sample is retrieved from the intersection of the Bureau-van-Dijk Bankscope and the Thompson Reuters Datastream databases. Macroeconomic variables (GDP, GDP growth, inflation) are retrieved from the World Banks' Development indicators. All standard errors are clustered at the bank level.

Panel A: Resolution Framework	(1)	(2)	(3)	(4)
Resolution Diff. (Par/subs)	-0.048**	-0.052**	-0.051**	-0.051**
	(0.021)	(0.024)	(0.024)	(0.024)
Resolution Index		0.018	0.048	0.024
		(0.038)	(0.032)	(0.037)
NumSub			0.006	0.006
			(0.004)	(0.004)
ForSub			-0.055	-0.054
			(0.133)	(0.135)
Leverage			0.001	0.001
			(0.001)	(0.001)
ManQuality			-0.107***	-0.112***
			(0.026)	(0.027)
ROAA			-0.004	-0.004
			(0.004)	(0.004)
Liquidity			-0.034***	-0.034***
			(0.012)	(0.012)
Size			-0.454*	-0.587**
			(0.247)	(0.247)
GDP				0.153**
				(0.075)
GDPgrowth				0.003
				(0.014)
Inflation				0.038**
				(0.015)
Observations	56,496	56,496	56,496	56,496
R-squared	0.860	0.860	0.861	0.861
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Table 3: Group Resolution Differences and Systemic Risk - continued

Panel B: Resolution Tools	(1)	(2)	(3)	(4)
Bailin difference (> 0)	-0.073			
	(0.065)			
Bailin(Y)	0.005			
	(0.030)			
Powers difference (> 0)		-0.116**		
		(0.054)		
Powers		0.001		
		(0.011)		
Tools sans bailin difference (> 0)			-0.128	
			(0.110)	
Tools (no bailin)			0.023	
			(0.023)	
Additional Support difference (> 0)				-0.063
				(0.043)
Additional Support				0.057***
				(0.016)
Observations	56,496	56,496	56,496	56,496
R-squared	0.861	0.861	0.861	0.861
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Bank Var	Yes	Yes	Yes	Yes
Country Var	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Group Resolution Differences and Systemic Risk across Countries

The table reports the estimates of Equation 3, where the dependent variable is $\Delta CoVaR$ for each parent bank i for each monthly t over the period January 2000 - December 2016, for parents in both developed and developing countries. We take the entire sample and report the estimates of interactions effects, where we interact the variable “ResolutionDiff” with an indicator variable equal to one for developed countries (MSCI classification). The variable “ResolutionDiff” is computed as the difference between the parent country resolution index and the asset-weighted average of the resolution indexes of its subsidiaries. The model controls for a vector of bank characteristics and includes time (month) and bank fixed effects, and their interaction with the main variable of interest. The sample is retrieved from the intersection of the Bureau-van-Dijk Bankscope and the Thompson Reuters Datastream databases. Macroeconomic variables (GDP, GDP growth, inflation) are retrieved from the World Banks' Development indicators. All standard errors are clustered at the bank level.

	(1)	(2)	(3)
Resolution Diff. × Developed Country	-0.298***	-0.278***	-0.289***
	(0.064)	(0.059)	(0.092)
Resolution Diff. (Par/subs)	0.226***	0.210***	0.218**
	(0.058)	(0.053)	(0.088)
Resolution Index	-0.070	-0.078	0.451***
	(0.215)	(0.200)	(0.161)
NumSub		-0.078*	-0.060
		(0.041)	(0.042)
ForSub		0.166	0.087
		(0.152)	(0.152)
ROAA			0.048*
			(0.025)
ManQuality			-0.147
			(0.174)
Size			-0.385
			(0.910)
Liquidity			-0.008
			(0.032)
Leverage			0.015
			(0.010)
GDP			0.194
			(0.126)
GDPgrowth			-0.016
			(0.015)
Inflation			0.034***
			(0.010)
pvalue (developed/developing)	0.0000***	0.0001***	0.0000***
Observations	60,355	60,355	60,355
R-squared	0.885	0.885	0.887
Bank FE	Yes	Yes	Yes
Bank FE*Developed	Yes	Yes	Yes
Control Var*Developed	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Group Resolution Differences and Bank Characteristics: Developed Countries

The table reports the estimates of Equation 3, where the dependent variable is $\Delta CoVaR$ for each parent bank i for each monthly t over the period January 2000 - December 2016, for parents in developed countries. The variable "Resolution Difference" is computed as the difference between the parent country resolution index and the asset-weighted average of the resolution indexes of its subsidiaries. The cutoff for the sample splits are determined, for each date, by splitting the sample into banks with a high (above the median) and low (below the median) level of the characteristics in the top row of the respective column: bank leverage, liquidity, and managerial quality. The model controls for a vector of bank characteristics and includes time (month) and bank fixed effects. The sample is retrieved from the intersection of the Bureau-van-Dijk Bankscope and the Thompson Reuters Datastream databases. Macroeconomic variables (GDP, GDP growth, inflation) are retrieved from the World Banks' Development indicators. All standard errors are clustered at the bank level.

	Leverage		Liquidity		Man. Quality	
	(1)	(2)	(3)	(4)	(5)	(6)
	High	Low	High	Low	High	Low
Resolution Diff. (Par/subs)	-0.063**	-0.057	-0.053**	-0.436*	-0.059*	-0.051*
	(0.025)	(0.060)	(0.023)	(0.263)	(0.032)	(0.027)
Resolution Index	0.047	0.052	0.026	0.829*	0.028	0.031
	(0.041)	(0.081)	(0.042)	(0.438)	(0.051)	(0.054)
Leverage	0.002	0.004	0.001	0.005**	-0.004	0.002**
	(0.001)	(0.005)	(0.001)	(0.002)	(0.006)	(0.001)
ManQuality	-0.103**	-0.111***	-0.093***	-0.128***	-0.088	-0.040
	(0.050)	(0.040)	(0.035)	(0.040)	(0.159)	(0.041)
ROAA	-0.007	-0.006	-0.004	-0.014	-0.003	-0.023**
	(0.017)	(0.004)	(0.004)	(0.010)	(0.004)	(0.011)
Liquidity	0.088	-0.057**	-0.037***	0.788	-0.037***	-0.002
	(0.084)	(0.029)	(0.012)	(0.581)	(0.014)	(0.044)
Size	-0.462	-12.635***	-0.528**	-21.963*	-1.516*	-0.315
	(0.356)	(3.021)	(0.243)	(11.843)	(0.818)	(0.423)
pvalue	0.7763		0.0000***		0.3198	
Observations	27,835	28,660	26,943	29,553	28,295	28,201
R-squared	0.877	0.864	0.875	0.856	0.872	0.869
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Macro Variables	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Group Resolution Differences and Bank Characteristics: Developing Countries

The table reports the estimates of Equation 3, where the dependent variable is $\Delta CoVaR$ for each parent bank i for each monthly t over the period January 2000 - December 2016, for parents in developing countries. The model controls for a vector of bank characteristics and includes time (month) and bank fixed effects. The sample is retrieved from the intersection of the Bureau-van-Dijk Bankscope and the Thompson Reuters Datastream databases. Macroeconomic variables (GDP, GDP growth, inflation) are retrieved from the World Banks' Development indicators. All standard errors are clustered at the bank level.

	Leverage		Liquidity		Man. Quality	
	(1)	(2)	(3)	(4)	(5)	(6)
	High	Low	High	Low	High	Low
Resolution Diff. (Par/subs)	0.078	0.608***	0.064	-0.032	0.050	0.116
	(0.090)	(0.158)	(0.193)	(0.145)	(0.179)	(0.000)
Resolution Index	0.091	0.416	0.713***	0.696***	0.095	0.364
	(0.250)	(0.350)	(0.242)	(0.234)	(0.615)	(0.000)
Leverage	0.003	-0.020	0.030**	-0.004	0.007	0.013
	(0.007)	(0.047)	(0.013)	(0.009)	(0.015)	(0.000)
ManQuality	-1.038*	0.000	0.039	-0.120	0.251	-0.312
	(0.558)	(0.312)	(0.179)	(0.768)	(0.801)	(0.000)
ROAA	0.375**	0.022	0.028*	0.083	0.048*	-0.029
	(0.177)	(0.023)	(0.015)	(0.070)	(0.025)	(0.000)
Liquidity	0.023	-0.170***	-0.007	1.226	0.042	-0.173
	(0.026)	(0.037)	(0.030)	(0.978)	(0.048)	(0.000)
Size	1.084	-17.643**	-2.447	-0.126	1.712	0.332
	(0.861)	(7.070)	(2.002)	(0.999)	(1.971)	(0.000)
pvalue	0.0000***		0.0103**		0.4916	
Observations	2,106	1,753	1,681	2,178	2,055	1,803
R-squared	0.931	0.887	0.910	0.920	0.890	0.932
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Macro Variables	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Too-Big-to-Fail and Regulatory Arbitrage

This table reports a event study where our treated group are US parent banks with subsidiaries in tighter resolution regimes before President Obama's announcement of the Volker Rule in January 2010, compared to parent US banks with only domestic subsidiaries. We take two years before and after the announcement as our timeline window. We interact the indicator variable "after" with an indicator variable equal to 1 for parent banks with a resolution index greater than the index of their subsidiaries before the US president announcement. The model controls for a vector of bank characteristics and includes time (month) and bank fixed effects. The sample is retrieved from the intersection of the Bureau-van-Dijk Bankscope and the Thompson Reuters Datastream databases. Macroeconomic variables (GDP, GDP growth, inflation) are retrieved from the World Banks' Development indicators. All standard errors are clustered at the bank level.

	(1)	(2)	(3)	(4)
Resolution Diff(Par/subs) × after	-0.698***	-0.719***	-0.533***	-0.653***
	(0.153)	(0.154)	(0.197)	(0.157)
Resolution Diff. (Par/subs)	0.107	0.049	0.054	-0.014
	(0.190)	(0.199)	(0.201)	(0.188)
Resolution Index		-0.260***	-0.195*	-5.099
		(0.057)	(0.111)	(3.187)
NumSub		0.073	0.060	0.068
		(0.077)	(0.071)	(0.066)
Leverage			0.008***	0.008***
			(0.002)	(0.002)
ManQuality			-0.083**	-0.058
			(0.040)	(0.037)
ROAA			0.002	-0.006
			(0.013)	(0.012)
Liquidity			-0.046*	-0.045
			(0.027)	(0.028)
Size			-3.669	-7.778*
			(5.501)	(4.635)
GDP				-24.423
				(15.953)
GDPgrowth				0.520
				(0.472)
after	-0.614***			
	(0.028)			
Observations	11,866	11,866	11,866	11,866
R-squared	0.610	0.855	0.857	0.857
Bank FE	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Instrumental Variables Estimation

The table reports the estimates of Equation 3 where we instrument both ResolutionDiff and Resolution Index, for developed and developing countries. The dependent variable is $\Delta CoVaR$ for each parent bank i for each monthly t over the period January 2000 - December 2016, for parents in developed and developing countries for Models (1)-(3) and Model (4), respectively. The instruments include Number of Crises, Fiscal Costs to GDP and Fiscal Costs to Output loss in the respective parent country, derived from Laeven and Valencia (2018) and defined in Table A.3. The variable "ResolutionDiff" is computed as the difference between the parent country resolution index and the asset-weighted average of the resolution indexes of its subsidiaries. The model controls for a vector of bank characteristics and includes time (month) and bank fixed effects. The sample is retrieved from the intersection of the Bureau-van-Dijk Bankscope and the Thompson Reuters Datastream databases. Macroeconomic variables (GDP, GDP growth, inflation) are retrieved from the World Banks' Development indicators. All standard errors are clustered at the bank level.

	(1) developed	(2) developed	(3) developed	(4) developing
Resolution Diff. (Par/subs)	-0.4551***	-0.3743***	-0.5202***	1.8593***
	(0.070)	(0.080)	(0.099)	(0.604)
Resolution Index	0.3590***	0.3690***	0.3271***	11.8926***
	(0.044)	(0.044)	(0.051)	(0.775)
NumSub		0.0009	-0.0037	-0.4727***
		(0.003)	(0.003)	(0.063)
ForSub		0.1582**	0.2584***	1.2130***
		(0.073)	(0.082)	(0.169)
Leverage		-0.0003	-0.0013**	0.0020
		(0.001)	(0.001)	(0.020)
ManQuality		-0.1164***	-0.1140***	-0.4032**
		(0.010)	(0.010)	(0.167)
ROAA		-0.0063***	-0.0103***	0.0324
		(0.002)	(0.002)	(0.025)
Liquidity		-0.0417***	-0.0394***	-0.0946
		(0.005)	(0.005)	(0.066)
Size		-0.4728***	-0.5539***	4.5608***
		(0.101)	(0.107)	(0.556)
GDP			0.3034***	-1.4409***
			(0.053)	(0.235)
GDPgrowth			-0.0013	0.1905***
			(0.004)	(0.034)
Inflation			0.0310***	0.4451***
			(0.009)	(0.026)
Constant				9.0680*
				(5.238)
Observations	56,496	56,496	56,496	3859
Bank FE	Yes	Yes	Yes	No
Time FE	Yes	Yes	Yes	Yes
Nr of Instruments	3	3	3	3
F-Statistic (1st Stage)	192.775	148.116	128.687	30.514
J-Statistic (2nd Stage)	1.5775	0.1377	3.2164	163.9962
p-value (J-Statistic)	0.209	0.711	0.073	0.000

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: Group Resolution Differences and Systemic Risk: Marginal Expected Shortfall

The table reports the estimates of:

$$MES_{i,t} = \alpha + \beta ResolutionDifference_{it} * Deveoped + \Gamma X_{i,t-1} + \varepsilon_t\ ,$$

in columns (1)-(3), where the dependent variable is $MarginalExpectedShortfall$ (MES), as computed in Acharya et al. (2016) for each parent bank i for each monthly t over the period January 2000 - December 2016, for parents in developed and developing countries. The variable "ResolutionDiff" is computed as the difference between the parent country resolution index and the asset-weighted average of the resolution indexes of its subsidiaries. "Developed" is an indicator variable for developed countries (MSCI). In Columns (4)-(7), we estimate the same regression as in Table 3, where we analyze the effect of the different resolution tools. For simplicity, we do not report the coefficients of the level variables. The vector of resolution tools includes several measures computed as the difference between a parent country's resolution subcategory and the asset-weighted average of the respective resolution subcategory of its subsidiaries. To illustrate, the variable Tools sans Bail-in difference is computed as the difference between the number of tools that include the bail-in in the parent bank country and the asset-weighted average of the number of tools that include bail-in in the countries of its subsidiaries. The model controls for a vector of bank characteristics and includes time (month) and bank fixed effects. The sample is retrieved from the intersection of the Bureau-van-Dijk Bankscope and the Thompson Reuters Datastream databases. Macroeconomic variables (GDP, GDP growth, inflation) are retrieved from the World Banks' Development indicators. All standard errors are clustered at the bank level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			6				
Resolution Diff. (Par/subs)	0.327**	0.340**	0.302***				
	(0.165)	(0.167)	(0.116)				
ResolutionDiff×Developed	-0.446**	-0.450**	-0.460***				
	(0.182)	(0.184)	(0.137)				
Powers diff×Developed				-0.214**			
				(0.092)			
Powersdiff				0.161**			
				(0.072)			
Tools with bailin diff×Developed					-0.588		
					(0.420)		
Tools (bailin) diff.					0.417		
					(0.409)		
Tools sans bailin diff×Developed						-0.542	
						(0.429)	
Tools (no bailin) diff.						0.416	
						(0.410)	
Additional Support diff×Developed							-0.542
							(0.429)
Additional Support diff							0.338
							(0.358)
Resolution Index	-1.143**	-1.141**	0.019	-1.026*	-3.098***	-3.059***	0.281
	(0.545)	(0.569)	(0.266)	(0.559)	(0.983)	(1.011)	(0.306)
pvalue (inter)	0.0149**	0.0148***	0.0008***	0.0203**	0.1618	0.2073	0.3544
pvalue (inter+level)	0.1315	0.1638	0.0368**	0.4037	0.0671**	0.3074	0.9086
Observations	60,148	60,148	60,148	60,148	60,148	60,148	60,148
R-squared	0.658	0.658	0.661	0.661	0.661	0.662	0.661
Bank Var	No	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE*Developed	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Var	No	No	Yes	Yes	Yes	Yes	Yes
Control Var*Developed	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 10: Group Resolution Differences and Systemic Risk: Before and After the 2008 Financial Crisis

Thetable reports the estimates of Equation 3, where the dependent variable is $\Delta CoVaR$ for each parent bank i for each monthly t over the period January 2000 - December 2016, for parents in developed countries and developing countries, before and after the financial crisis of 2008. The variable “ResolutionDiff” is computed as the difference between the parent country resolution index and the asset-weighted average of the resolution indexes of its subsidiaries. The model controls for a vector of bank characteristics and includes time (month) and bank fixed effects. The sample is retrieved from the intersection of the Bureau-van-Dijk Bankscope and the Thompson Reuters Datastream databases. Macroeconomic variables (GDP, GDP growth, inflation) are retrieved from the World Banks’ Development indicators. All standard errors are clustered at the bank level.

	Developed Countries		Developing Countries	
	before	after	before	after
	(1)	(2)	(3)	(4)
Resolution Diff. (Par/subs)	-0.019	-0.052*	0.170	0.500***
	(0.026)	(0.027)	(0.114)	(0.145)
Resolution Index	-0.017	0.048	0.394*	6.047**
	(0.045)	(0.049)	(0.191)	(2.524)
NumSub	-0.005	0.017**	0.107	-0.077
	(0.006)	(0.007)	(0.128)	(0.075)
ForSub	-0.007	-0.050	-0.297	0.179
	(0.126)	(0.173)	(0.213)	(0.335)
Leverage	0.006**	0.003***	-0.008	0.009
	(0.002)	(0.001)	(0.005)	(0.032)
ManQuality	-0.126*	-0.159***	-0.293*	-0.166
	(0.065)	(0.032)	(0.166)	(0.423)
ROAA	0.005	-0.003	0.048***	0.019
	(0.003)	(0.005)	(0.015)	(0.061)
Liquidity	-0.045*	-0.039	0.107	-0.064
	(0.024)	(0.030)	(0.064)	(0.058)
Size	-0.502**	-0.840***	0.039	-0.723
	(0.251)	(0.257)	(1.253)	(2.610)
GDP	-0.065	0.330**	1.384**	2.744***
	(0.123)	(0.154)	(0.606)	(0.781)
GDPgrowth	-0.000	-0.011	0.012	-0.033**
	(0.011)	(0.014)	(0.025)	(0.013)
Inflation	0.011	0.023*	0.049***	0.047*
	(0.014)	(0.014)	(0.009)	(0.027)
pvalue	0.0000***		0.0039***	
Observations	28,241	35,036	1,144	2,715
R-squared	0.892	0.863	0.931	0.900
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11: Group Resolution and the Diversification Effect

The table reports the estimates of 3 where we add the variable 'Diversity' to our main specification, computed as the asset weighted average of loans - at the group level - over the total assets (Laeven and Levine (2007)), for developed and developing countries. The dependent variable is $\Delta CoVaR$ for each parent bank i for each monthly t over the period January 2000 - December 2016, for parents in developed countries. The variable "ResolutionDiff" is computed as the difference between the parent country resolution index and the asset-weighted average of the resolution indexes of its subsidiaries. The model controls for a vector of bank characteristics and includes time (month) and bank fixed effects. The sample is retrieved from the intersection of the Bureau-van-Dijk Bankscope and the Thompson Reuters Datastream databases. Macroeconomic variables (GDP, GDP growth, inflation) are retrieved from the World Banks' Development indicators. All standard errors are clustered at the bank level.

	(1)	(2)	(3)
Resolution Diff. (Par/subs)	0.226***	0.226***	0.294***
	(0.087)	(0.078)	(0.090)
ResolutionDiff × Developed Country	-0.264***	-0.263***	-0.317***
	(0.078)	(0.073)	(0.093)
Resolution ×Bank Specialization	-0.081	-0.081	-0.123*
	(0.078)	(0.076)	(0.069)
Bank Specialization	-0.155	-0.157	-0.128
	(0.103)	(0.103)	(0.095)
Observations	60,091	60,091	60,091
R-squared	0.885	0.885	0.886
Bank FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 12: Controlling for Contemporaneous Macro-prudential Policies

The table reports the estimates of Equation 3, where the dependent variable is $\Delta CoVaR$ for each parent bank i for each monthly t over the period January 2000 - December 2016, where we add indicators for contemporaneous macroprudential policies at the country level, other than bank resolution. We retrieve the variables from the IMF's integrated Macroprudential Policy (iMaPP) Database, originally constructed by Alam et al. (2019). We control for the average LTV limit, which is a numerical indicator of regulatory limits to loan-to-value (LTV) ratios, and for its difference across parent and subsidiaries (Average LTV limit diff.). We also add the Policy Action indicator (SUM17), which takes the sum of policy action indicators of all 17 instruments of macroprudential policy. Each tightening event is coded as a +1, each loosening event is coded as a -1, and no or neutral action is coded as a 0. Details are in the Appendix. The model controls for a vector of bank characteristics and includes time (month) and bank fixed effects. The sample is retrieved from the intersection of the Bureau-van-Dijk Bankscope and the Thompson Reuters Datastream databases. Macroeconomic variables (GDP, GDP growth, inflation) are retrieved from the World Banks' Development indicators. All standard errors are clustered at the bank level.

	(1)	(2)	(3)	(4)	(5)	(6)
Resolution Diff×Developed Country	-0.371***	-0.315***		-0.314***	-0.327***	-0.325***
	(0.080)	(0.089)		(0.086)	(0.085)	(0.108)
Resolution Diff. (Par/subs) Par/subs)	0.300***	0.249***	0.313***	0.252***	0.265***	0.255**
	(0.075)	(0.085)	(0.100)	(0.082)	(0.081)	(0.104)
Average diff LTV limit			-0.043***	-0.016*	-0.017*	-0.017*
			(0.013)	(0.009)	(0.009)	(0.010)
Average LTV limit		0.021**	0.044***	0.025***	0.025***	0.025***
		(0.008)	(0.011)	(0.009)	(0.009)	(0.009)
Policy-actions Indicator (sum 17)				0.041	0.060	0.054
				(0.033)	(0.041)	(0.041)
Difference Policy-actions Indicator					-0.065*	-0.065
					(0.038)	(0.041)
GDP	0.152*	0.213**	0.237**	0.235**	0.228**	0.295**
	(0.090)	(0.103)	(0.107)	(0.106)	(0.105)	(0.147)
GDP growth	-0.002	-0.003	-0.004	-0.005	-0.005	-0.005
	(0.010)	(0.011)	(0.011)	(0.011)	(0.010)	(0.011)
Inflation	0.022***	0.021***	0.022***	0.022***	0.022***	0.026***
	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
GDP diff	-0.097	-0.095	-0.097	-0.097	-0.099	-0.136
	(0.066)	(0.065)	(0.062)	(0.062)	(0.063)	(0.084)
Stock Mkt to GDP						-0.001
						(0.000)
Stock Mkt to GDP diff						0.001
						(0.000)
Inflation diff.						-0.012**
						(0.006)
Regulatory Quality						0.007
						(0.268)
pvalue	0.0000***	0.000***	0.000***	0.000***	0.000***	0.000***
Observations	60,355	60,355	60,355	60,355	60,355	60,007
R-squared	0.886	0.886	0.886	0.886	0.886	0.886
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13: Group Resolution Differences and Systemic Risk: Alternative Standard Error Clustering

The table reports the estimates of Equation 3, where the dependent variable is $\Delta CoVaR$ for each parent bank i for each monthly t over the period January 2000 - December 2016, for parents in developed countries. The variable "ResolutionDiff" is computed as the difference between the parent country resolution index and the asset-weighted average of the resolution indexes of its subsidiaries. The model controls for a vector of bank characteristics and includes time (month) and bank fixed effects. The sample is retrieved from the intersection of the Bureau-van-Dijk Bankscope and the Thompson Reuters Datastream databases. Macroeconomic variables (GDP, GDP growth, inflation) are retrieved from the World Banks' Development indicators. All standard errors are clustered at the bank and month levels.

VARIABLES	(1)	(2)	(3)	(4)
Resolution Diff. (Par/subs)	0.202**	0.249**	0.243**	0.243**
	(0.088)	(0.099)	(0.097)	(0.097)
ResolutionDiffdev	-0.270***	-0.326***	-0.320***	-0.320***
	(0.097)	(0.111)	(0.108)	(0.108)
Developed	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Resolution Index	0.095*	0.119*	0.155**	0.155**
	(0.056)	(0.063)	(0.060)	(0.060)
NumSub		-0.000	0.002	0.002
		(0.005)	(0.005)	(0.005)
ForSub		-0.007	-0.007	-0.007
		(0.089)	(0.089)	(0.089)
Observations	60,355	60,355	60,355	60,355
R-squared	0.885	0.885	0.886	0.886
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 14: Dropping United States

The table reports the estimates of Equation 3, where the dependent variable is $\Delta CoVaR$ for each parent bank i for each monthly t over the period January 2000 - December 2016, for parents in developed countries. The variable "ResolutionDiff" is computed as the difference between the parent country resolution index and the asset-weighted average of the resolution indexes of its subsidiaries. The model controls for a vector of bank characteristics and includes time (month) and bank fixed effects. The sample is retrieved from the intersection of the Bureau-van-Dijk Bankscope and the Thompson Reuters Datastream databases. Macroeconomic variables (GDP, GDP growth, inflation) are retrieved from the World Banks' Development indicators. All standard errors are clustered at the bank level.

VARIABLES	(1)	(2)	(3)
ResolutionDiff×Developed	-0.253***	-0.246***	-0.253**
	(0.065)	(0.060)	(0.097)
Resolution Diff. (Par/subs)	0.202***	0.195***	0.191**
	(0.061)	(0.055)	(0.092)
Resolution Index	-0.034	-0.042	0.357**
	(0.219)	(0.208)	(0.153)
NumSub		-0.063	-0.040
		(0.040)	(0.045)
ForSub		0.117	0.057
		(0.141)	(0.147)
ROAA			0.038
			(0.024)
ManQuality			-0.129
			(0.207)
Size			-0.071
			(0.805)
Liquidity			-0.001
			(0.034)
Leverage			0.011
			(0.009)
GDP			0.421*
			(0.213)
GDPgrowth			-0.043***
			(0.016)
Inflation			0.026***
			(0.010)
Observations	10,641	10,641	10,641
R-squared	0.901	0.901	0.906
Bank FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 15: Group Resolution Differences and Systemic Risk across Big Countries

Thetable reports the estimates of Equation 3, where the dependent variable is $\Delta CoVaR$ for each parent bank i for each monthly t over the period January 2000 - December 2016, for parents in both developed and developing countries. We identify six countries that are below USD 1,000 trillion of GDP (which represent the 10% percentile of the GDP distribution): Australia, Hong Kong, Indonesia, South Africa, Switzerland, and Turkey. We drop these countries and report the estimates of interactions effects, where we interact the variable "ResolutionDiff' with an indicator variable equal to 1 for developed countries (MSCI classification). The variable "ResolutionDiff" is computed as the difference between the parent country resolution index and the asset-weighted average of the resolution indexes of its subsidiaries. The model controls for a vector of bank characteristics (listed in the table), and includes time (month) and bank fixed effects, and their interaction with theindicator for developed countries. The sample is retrieved from the intersection of the Bureau-van-Dijk Bankscope and the Thompson Reuters Datastream databases. Macroeconomic variables (GDP, GDP growth, inflation) are retrieved from the World Banks' Development indicators. All standard errors are clustered at the bank level.

	(1)	(2)	(3)
Resolution Diff. × Developed Country	-0.267***	-0.265***	-0.325***
	(0.058)	(0.063)	(0.089)
Resolution Diff. (Par/subs)	0.206***	0.215***	0.270***
	(0.053)	(0.058)	(0.086)
Resolution Index	-0.484*	-0.422	-1.420**
	(0.291)	(0.312)	(0.613)
NumSub		-0.131***	-0.129*
		(0.043)	(0.077)
ForSub		-0.001	-0.155
		(0.154)	(0.220)
ROAA			-0.009
			(0.032)
ManQuality			-0.274**
			(0.114)
Size			-1.601
			(1.401)
Liquidity			-0.039
			(0.035)
Leverage			-0.012
			(0.011)
GDP			0.268
			(0.192)
GDPgrowth			0.037
			(0.025)
Inflation			-0.010
			(0.020)
pvalue (developed/developing)			0.0000***
Observations	56,623	56,623	56,623
R-squared	0.868	0.868	0.869
Bank FE	Yes	Yes	Yes
Bank FE*Developed	Yes	Yes	Yes
Control Var*Developed	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Figure 1: Resolution Framework Implementation Scheme by Country

The table reports the timeline of the resolution framework implementation for the countries in our sample. The information is retrieved from ECB's and FED's documentation on the implementation of resolution regulation.

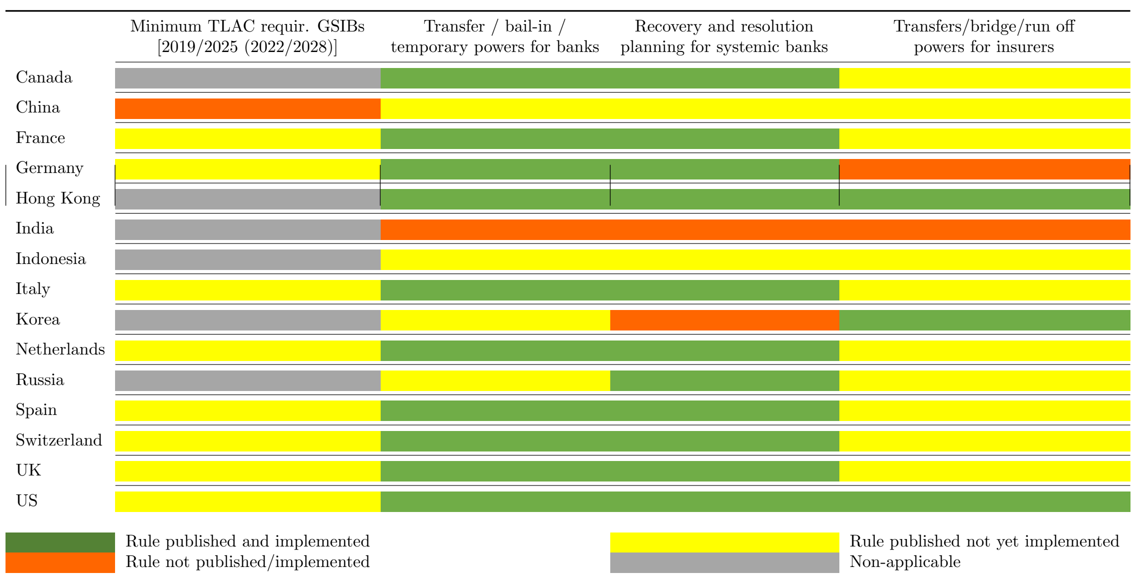


Figure 2: Resolution Differences and Systemic Risk

This figure reports $\Delta CoVaR$ of parent banks between 2000 and 2016. The left panel reports the average CoVaR of the overall sample, while in the right panel we compare CoVaR of parent banks with at least one subsidiary in a different resolution regime setting, and (parent) banks that have no subsidiaries located in different resolution regimes. The details on the construction of $\Delta CoVaR$ are in the Appendix. The sample is retrieved from the intersection of the Bureau-van-Dijk Bankscope and the Thompson Reuters Datastream databases.

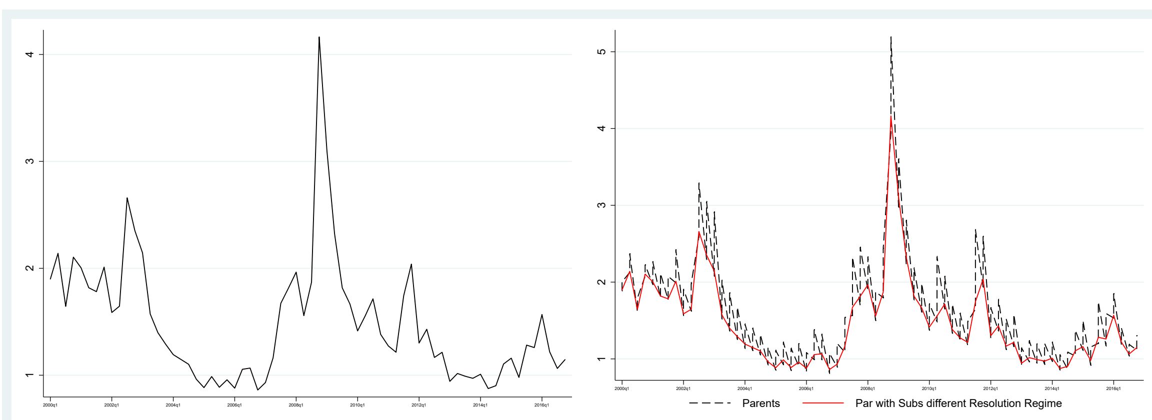
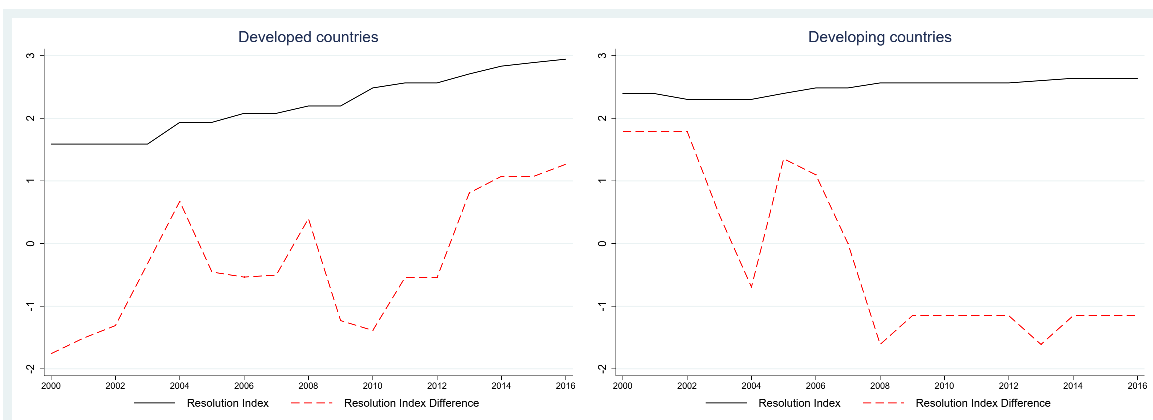


Figure 3: Resolution Regimes Differences (Par/subs)

This figure reports plots of the resolution indexes, and the differences between parent and subsidiaries resolution index (dotted line), by year, for developed (left panel) and developing countries (right panel). The details regarding the construction of the resolution index are in the Appendix. The variable "ResolutionDiff" is computed as the difference between the parent country resolution index and the asset-weighted average of the resolution indexes of its subsidiaries. The sample is retrieved from the intersection of the Bureau-van-Dijk Bankscope and the Thompson Reuters Datastream databases over the period January 2000 - December 2015.



A Appendix: Variables

A.1 Dependent Variable

$\Delta CoVaR$: the variable is constructed in several steps. We first estimate the value at risk for each bank, VaR_{it}, by identifying the q-quintile for each this expression holds true:[7]

$$Pr(X^i \leq VaR_q^i | X^i) = q\%,$$

where X^i is the growth rate of the market value of bank i's assets. In a second step, we derive *CoVaR* with a quantile regression as in Koenker and Bassett (1978) built on equity prices (details provided in the Appendix). $CoVaR_q^{j|i}|X^i$ is the VaR of institution j, conditional on $X^i = VaR_q^i$ of institution$i$:

$$Pr(X^j \leq CoVaR_q^{j|i} | X^i = VaR_q^i) = q\%,$$

Hence, the *CoVaR* of the *system*,which comprises all banks operating within a country, conditional on $X^i = VaR_q^i$ of bank i, is:

$$CoVaR_q^{system|X^i=VaR^i} = Pr(X^{system} \leq CoVaR_q^{system|i} | X^i = VaR_q^i) = q\%.$$

We then construct the bank's contribution to *systemic* bank risk as follows:

$$\Delta CoVaR_q^{system|i} = CoVaR_q^{system|X^i=VaR^i} - CoVaR_q^{system|X^i=median^i}$$

[7]Similar to Koenker and Bassett (1978), we apply a stress level of q = 99% in our regressions.

which captures the difference between the value at risk of a country's banking system when bank i is in distress, compared to the value at risk of the system when the bank is at its median level of returns. The variable is estimated for each bank at the daily frequency and then averaged at the monthly level.

A.2 Resolution Variables

Bank Resolution Index and Subindices: this section presents the individual reforms and categories that comprise the bank resolution index in Beck et al. (2020).

Subindex 1. General framework

1.1. Specific bank resolution framework

1.2. Specifically designated bank resolution authority

1.3. Another authority has powers to restructure/resolve banks

Subindex 2. The resolution authority has the power to...

2.1. Remove and replace management

2.2. Appoint an administrator

2.3. Operate and resolve the firm

2.4. Ensure continuity of essential services and functions

2.5. Override rights of shareholders when applying resolution powers

2.6. Temporarily stay the exercise of early termination rights

2.7. Impose a moratorium with a suspension of payments to unsecured, creditors and customers plus creditor stay

2.8. Liquidate the bank without the need of court decision

Subindex 3. Resolution tools available to the resolution authority

3.1. Transfer or sell assets and liabilities, legal rights and obligations

3.2. Establishment of a bridge institution

3.3. Establishment of an asset management vehicle

3.4. Bail-in tool

Subindex 4. The bail-in framework includes...

4.1. A minimum requirement of eligible liabilities (i.e. bail-inable debt)

4.2. Provisions to respect the hierarchy of claims while providing flexibility to depart from the general principle of equal (pari passu) treatment of creditors of the same class

4.3. Provisions constituting that public resources may only be used if private ones are not available and a bail-in was conducted

Subindex 5. The following supporting measures/features exist:

5.1. Implementation of Basel III

5.2. Resolution powers/tools can be used fast and flexibly. Proxy: court decision needed or not? (1 = No court decision needed)

5.3. Mandatory development of resolution and recovery plans

5.4. Resolution fund (publicly and privately financed)

A.3 Macroprudential and country development indicators

The macroprudential variables are retrieved from the IMF's integrated Macroprudential Policy (iMaPP) Database, originally constructed by Alam et al. (2019), while country development variables are retrieved from the World Bank.

Average LTV limit: Simple average of the regulatory LTV limits in each country and month (LTVaverage). It focuses on LTV limits on real estate mortgage loans (both residential and commercial), while the dummy-type indicators and text information may cover other types of loans (e.g., auto loans). When a country does not have any LTV limits, in principle, we set the value at 100—i.e., you can borrow the full amount against the collateral value. For more details, please see Alam et al. (2019).

Policy Indicator (SUM17): Sum of indicators for each instrument of macroprudential policy. Each tightening event is coded as a +1, each loosening event is coded as a -1, and no or neutral action is coded as a zero. SUM17 takes the sum of policy action indicators of all 17 instruments. For more details, please see Table A.2 retrieved from Alam et al. (2019).

Stock Market to GDP: Ratio of the stock market and the GDP, retrieved from the World Bank.

Regulatory Quality Index: Captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.

Table A.1: **Resolution Variables.** This table presents a list of the resolution variables used in the empirical analysis. All level variables are retrieved from Beck et al. (2020), while the variables in differences are own calculations based on the level variables differences between parents and their subsidiaries.

Variable	Definition
Resolution index	Aggregate resolution index. Varies from 0 to 22.
Resolution Diff	Difference between the resolution index of the parent banks and the asset-weighted average resolution indexes of its subsidiaries.
Framework	General resolution framework (e.g. bespoke bank resolution regime, different than corporate resolution). Varies from 0 to 3.
Powers	Powers of resolution authority (e.g. to replace management). Varies from 0 to 8.
Tools with bailin	Resolution tools including bail-in options (e.g. splitting in good and bad bank; bailin tool). Varies from 0 to 4.
Tools sans bailin	Resolution tools without the bail-in tool. Varies from 0 to 3.
Bailin	Dummy that takes the value of 1 if the bail-in tool is implemented, 0 otherwise.
Bailin framework	Features of the bailin framework (e.g. a minimum requirement of eligible liabilities). Varies from 0 to 3.
Support	Additional support measures (living wills, resolution fund). Varies from 0 to 4.
FrameworkDiff	Difference between the resolution framework of the parent banks and the asset-weighted average framework of its subsidiaries and own calculations.
PowersDiff	Difference between the resolution powers of the parent banks and the asset-weighted average resolution powers of its subsidiaries and own calculations.
ToolsBailinDiff	Difference between the tools with bail-in of the parent bank and of the parent banks and the asset-weighted average tools with bail-in of its subsidiaries and own calculations.
SupportDiff	Difference between the support measure of the parent bank and of the parent banks and the asset-weighted average level of support measures of its subsidiaries.

Table A.2: **Composition of SUM17 Index** This table presents a list of all 17 tools that compose our composite Policy Action indicator (SUM17). SUM17 takes the sum of all 17 policy action instruments. All variables are retrieved from Alam et al. (2019).

Variable	Definition
C1.CCB	A requirement for banks to maintain a countercyclical capital buffer.
C2.Conservation	Requirements for banks to maintain a capital conservation buffer.
C3.Capital	Capital requirements for banks, which include risk weights, systemic risk buffers, and minimum capital requirements.
C4.LVR	A limit on leverage of banks, calculated by dividing a measure of capital by the bank's non-risk-weighted exposures.
C5.LLP	Loan loss provision requirements for macroprudential purposes, which include dynamic and sectoral provisions.
C6.LCG	Limits on growth or the volume of aggregate credit, the household-sector credit, or the corporate-sector credit.
C7.LoanR	Loan restrictions, include loan limits and prohibitions, lender characteristics, and other factors.
C8.LFC	Limits on foreign currency (FC) lending, and rules or recommendations on FC loans.
C9.LTV	Limits to the loan-to-value ratios, applied to residential and commercial mortgages, but also applicable to other secured loans.
C10.DSTI	Limits to the debt-service-to-income ratio and the loan-to-income ratio.
C11.Tax	Taxes and levies applied to specified transactions, assets, or liabilities.
C12.Liquidity	Measures taken to mitigate systemic liquidity and funding risks, minimum requirements for liquidity coverage ratios, liquid asset ratios, net stable funding ratios, core funding ratios and external debt restrictions.
C13.LTD	Limits to the loan-to-deposit (LTD) ratio and penalties for high LTD ratios.
C14.LFX	Limits on net or gross open foreign exchange (FX) positions, limits on FX exposures and FX funding, and currency mismatch regulations.
C15.RR	Reserve requirements (domestic or foreign currency) for macroprudential purposes.
C16.SIFI	Measures taken to mitigate risks from global and domestic systemically important financial institutions (SIFIs).
C17.Other	Macroprudential measures not captured in the above categories.

Table A.3: **Independent Variables** This table presents a list of the independent variables used in the empirical analysis. Firm variables are retrieved from Bankscope, while country variables (Output Loss to GDP, and Fiscal Costs to Output Loss) are retrieved from Laeven and Valencia (2018). Finally, the number of crises are retrieved from Beck et al. (2020).

Variable	Definition
Parent Bank	A dummy equal to one if the bank has subsidiaries.
Number subsidiaries	Number of subsidiaries for each parent.
For(eign) Sub	A dummy equal to one if the Parent has a foreign subsidiary.
ROAA	Profitability (data4024) winsorized at 1%-99%.
Liquidity	Total liquid assets (data2075)/Total deposits (data2030) winsorized at 1%-99%.
Size	Data2025 converted in dollars/US GDP winsorized at 1%-99%.
Management quality	Total operating profit/Total operating income (data10220/data2190), winsorized at 1%-99%.
Output Loss to GDP	Output loss to GDP of past crises in a country, computed as the cumulative sum of the differences between actual and trend real GDP over the period [T, T+3], expressed as a percentage of trend real GDP, with T the starting year of the crisis.
Fiscal Costs to Output Loss	Fiscal Costs to GDP to Output loss to GDP of past crises in a country. Fiscal costs are defined as the component of gross fiscal outlays related to the restructuring of the financial sector. They include fiscal costs associated with bank recapitalization, but exclude asset purchases and direct liquidity assistance from the treasury. Output losses are computed as defined above.
Number of Crises	Number of past banking crises in a country.

Table A.4: **Pairwise Correlations**

The table reports pairwise correlations for the main variables in our analysis. The sample is retrieved from the intersection of the Bureau-van-Dijk Bankscope and the Thompson Reuters Datastream databases over the period January 2000 – December 2015. The symbol * denotes statistical significance at the 1% level.

	$\Delta CoVaR$ (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Leverage	0.0657*												
ManQuality	0.0377*	-0.2891*											
ROAA	0.0601*	-0.3657*	0.7452*										
Liquidity	0.1753*	0.1124*	-0.0632*	0.1369*									
Size	0.2554*	0.4171*	-0.0204*	-0.0770*	0.3308*								
NumSub	0.2702*	0.3139*	0.0031	-0.0445*	0.2466*	0.7582*							
ForSub	0.2893*	0.3445*	-0.0015	-0.0013	0.4410*	0.6610*	0.5290*						
Resolution Index	-0.1957*	-0.2513*	-0.0713*	-0.1140*	-0.1891*	-0.3181*	-0.2824*	-0.3214*					
Resolution Diff.	-0.0363*	-0.1672*	-0.0063	0.0289*	0.0752*	-0.2743*	-0.2146*	-0.0195*	0.3325*				
Framework Diff.	-0.0723*	-0.1364*	0.0194*	0.0258*	0.0042	-0.1371*	-0.2221*	-0.1242*	0.2178*	0.4899*			
Tools_with bailin Diff.	-0.0422*	-0.0982*	-0.0129*	0.0099*	0.1068*	-0.2244*	-0.1933*	0.0303*	0.2825*	0.8816*	0.4348*		
Support Diff.	0.0514*	-0.0966*	-0.0200*	0.0194*	0.0928*	-0.1082*	-0.0525*	0.1331*	0.1875*	0.6478*	0.0866*	0.2509*	
Powers Diff.	-0.0564*	-0.1683*	-0.0031	0.0338*	0.0074	-0.2996*	-0.2049*	-0.1183*	0.3368*	0.8987*	0.4500*	0.2923*	0.5473*