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Bank Resolution and the Structure of Global Banks\*

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# Bank Resolution and the Structure of Global Banks \*

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## Abstract

We study the efficient resolution of global banks by national regulators. *Single-point-of-entry* (SPOE) resolution, where loss-absorbing capacity is shared across jurisdictions, is efficient in principle, but may not be implementable. First, when expected transfers across jurisdictions are too asymmetric, national regulators fail to set up an efficient SPOE resolution regime ex ante. Second, when required ex-post transfers across jurisdictions are too large, national regulators ring-fence local banking assets instead of cooperating in a planned SPOE resolution. In this case, *multiple-point-of-entry* (MPOE) resolution, where loss-absorbing capacity is pre-assigned to jurisdictions, is more efficient. Our analysis highlights a complementarity between bank resolution and the structure of global banks: the more decentralized a global bank's operations, the greater the relative efficiency of MPOE resolution.

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One of the main unresolved challenges emanating from the recent financial crisis is how to deal with global financial banks that are *too big to fail*. The collapse of Lehman Brothers demonstrated the immense costs of the failure of such an institution, with devastating repercussions for the financial system and the broader economy. Yet, bailouts and public guarantees that would prevent such failures also involve costs, stimulating moral hazard in the form of increased risk taking and incentives for financial institutions to grow ever larger and more complex. The proposed solution to this dilemma is bank resolution. Both the Dodd-Frank Act in the U.S. and the Bank Recovery and Resolution Directive (BRRD) in the E.U. call for novel but, as of yet, untested resolution mechanisms for global systemically important banks (G-SIBs). The aim of these proposals is to end too big to fail by providing a credible way to resolve and recapitalize failing G-SIBs with minimal disruption and without taxpayer support.

In this paper we analyze the key trade-offs that arise in global, cross-border resolutions, taking into account the political constraints faced by national regulators. We show that although conducting a single, global resolution for an entire multinational bank (a “single-point-of-entry” resolution) is efficient in principle, such a global resolution is not always compatible with the interests of national regulatory authorities, who may prefer to ring-fence their national banking industries. In that situation, conducting separate resolutions in different jurisdictions (a “multiple-point-of-entry” resolution) is more efficient. In general, our model highlights that credible G-SIB resolution must take into account a bank’s operational structure and complementarities across operations in different jurisdictions.

The challenge in designing resolution mechanisms for G-SIBs is to adapt existing resolution procedures that have worked well for smaller (i.e., national or regional) banks to be able to handle the resolution of much larger banks that operate across multiple jurisdictions. For example, resolution under Title II of the Dodd-Frank Act is partially modeled after the FDIC receivership procedure used

to resolve smaller and medium-sized banks. However, a central element of speedy FDIC resolution is Purchase and Assumption (P&A), by which a healthy bank purchases assets and assumes liabilities of the troubled bank. For a modest-sized bank, such a resolution and sale can usually be completed over a weekend. Operations of the troubled bank can then resume on the following Monday, as if nothing had happened, thereby protecting deposits, minimizing market disruptions, and reducing contagion risk. However, for a failing G-SIB such a swift transfer of assets and liabilities over the course of a weekend is typically not feasible. G-SIBs are simply too large, and their balance sheets too complicated for quick P&A to be an option. In addition, the resolution of G-SIBs has an inherent international (cross-jurisdictional) component that is not an issue when the FDIC resolves a small to medium-sized U.S. bank.

The proposed solution to this challenge is to perform a G-SIB resolution through a restructuring of pre-assigned liabilities of the failing institution (see [Federal Deposit Insurance and Bank of England \(2012\)](#), [Financial Stability Board \(FSB\) \(2014\)](#)). Specifically, troubled operating subsidiaries of a G-SIB are recapitalized by writing down long-term liabilities (typically equity and subordinated long-term debt) issued by a non-operating holding company. Crucially, recapitalization via a non-operating holding company allows the G-SIB's operating subsidiaries to remain open for business during the resolution and protects the operating subsidiaries' runnable short-term liabilities, thereby preventing destabilizing runs on the G-SIB's operations.

Among policymakers, there has been a lively debate about two specific resolution models, illustrated in [Figure 1](#): Under multiple-point-of-entry (MPOE) resolution, each national regulator performs a separate resolution (if necessary), drawing on loss-absorbing capital (in the form of long-term debt and equity) that is held separately by national holding companies in each jurisdiction. Loss-absorbing capacity is not shared across jurisdictions under this model. For example, a U.K. subsidiary would always be recapitalized by the associated U.K. holding company. In contrast,

under single-point-of-entry (SPOE) resolution, a global bank is recapitalized by writing off debt or equity issued by a single global holding company that owns banking subsidiaries in multiple jurisdictions. Under SPOE resolution, loss absorbing capacity is shared across jurisdictions. For example, a U.K. operating subsidiary could be recapitalized by a U.S. holding company.

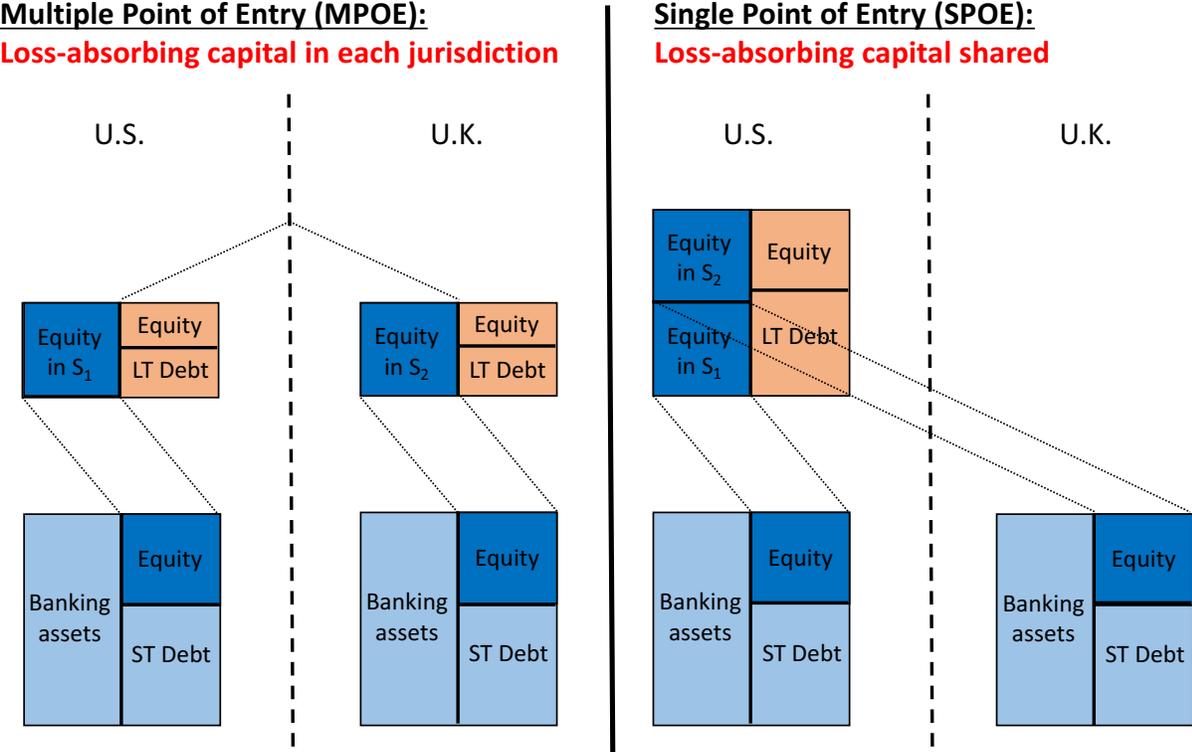


Figure 1: **MPOE and SPOE resolution.** The figure illustrates Multiple Point of Entry (MPOE) and Single Point of Entry (SPOE) resolution. Under MPOE, loss-absorbing capital (in the form of outside equity and long-term debt) is issued separately by national (intermediate) holding companies in each jurisdiction. Under SPOE, loss-absorbing capital is issued by a global holding company and is therefore shared across jurisdictions.

The contribution of our paper is to characterize the main trade-offs between MPOE and SPOE resolution in the context of a simple model of global banks and national regulators. Our analysis establishes four main results. First, we show that bank resolution that is conducted exclusively through an intervention on the liability side—by reducing the share of equity in proportion to

the loss, or writing down debt of the financial institution’s holding company—has to go hand in hand with a regulatory requirement for holding companies to issue a sufficient amount of equity or long-term debt so as to guarantee sufficient loss-absorbing capacity. In our model, as in [Bolton and Freixas \(2000, 2006\)](#), asymmetric information about long-term cash-flows makes equity and long-term debt expensive relative to short-term debt. Therefore, absent a requirement to issue long-term loss-absorbing securities, financial institutions may choose to rely mainly on short-term debt as a source of funding. Because this short-term debt is runnable, and therefore cannot credibly be written down, this makes an orderly resolution impossible—leaving a disorderly liquidation via a bank run or a tax-funded bailout as the only remaining options.

Second, we show that for global financial institutions that operate in multiple jurisdictions, SPOE is the efficient resolution mechanism in a benchmark setting in which regulators can fully commit to cooperating in the middle of a crisis, thereby emulating the actions of a benevolent supra-national regulator. Because SPOE resolution allows regulators to make transfers between operating subsidiaries in different jurisdictions, a successful SPOE resolution regime can be achieved with a lower amount of required loss-absorbing capacity than would be possible under separate national MPOE resolution schemes. As a result, for the same level of risk acceptable to regulators, SPOE resolution allows global financial institutions to provide more socially beneficial banking services than would be possible under MPOE resolution.

Third, even though SPOE resolution is efficient in principle, the regulatory status quo—in which global financial institutions are resolved by national regulators—may prevent the creation of an efficient SPOE resolution regime. In particular, whenever expected cross-jurisdictional transfers are sufficiently asymmetric, the national regulator that makes the larger expected transfer has an incentive to opt out of a globally efficient cross-jurisdiction SPOE resolution and to set up a national resolution scheme instead. From an ex-ante perspective, the creation of an efficient

SPOE resolution regime is therefore feasible only if the expected cross-jurisdictional transfers are sufficiently symmetric.

Fourth, even when regulators are willing to agree on an SPOE resolution regime ex ante, SPOE resolution may not be implementable ex post. When the resolution of multinational financial institutions is conducted by self-interested national regulatory authorities, a successful SPOE resolution requires that regulators cooperate and make the ex-post transfers that are necessary for a successful resolution. If regulators cannot firmly bind themselves to actually making these transfers, they may find it in their interest post hoc not to make the required transfers and to ring-fence domestic assets instead. Specifically, when the required transfer across jurisdictions is too large, the regulator's ex-post incentive constraints cannot be satisfied, leading to a breakdown of a planned SPOE resolution. This, in turn, will lead to either a disorderly liquidation or a tax-funded bailout. Our analysis further establishes that the possibility of such an ex-post breakdown of a planned SPOE resolution depends on the operational structure of the financial institution at hand. Incentive-compatible SPOE resolution depends on operational complementarities across national banking operations, such as those arising from joint cash management or other shared services. It is the prospect of losing these complementarities that incentivizes regulators not to ring-fence assets ex post.

When SPOE resolution is not ex-post incentive compatible, MPOE resolution, where loss-absorbing capacity is held by national holding companies in each jurisdiction, is preferable to a messy liquidation or a bailout. While this structure eliminates some of the coinsurance benefits that would be achievable under SPOE resolution, it is not subject to ex-post incentive compatibility constraints and can therefore support a well-ordered resolution in cases where SPOE resolution would break down. More generally, we show that the constrained optimal resolution mechanism in this situation follows a hybrid approach, with some loss-absorbing capacity shared across jurisdictions, and some loss-absorbing capacity pre-assigned to national jurisdictions.

Finally, in an extension of our model, we investigate the moral hazard consequences of shared loss-absorbing capacity under SPOE resolution. How are incentives of the operating affiliates affected by a resolution regime where they are certain to be made whole following an operating loss, no matter how large? We show that operating subsidiaries' incentives depend on the net effect of two forces under SPOE. On the one hand, SPOE dampens incentives relative to MPOE because cash flows generated in one jurisdiction can be transferred to plug a hole in the other jurisdiction. On the other hand, because it economizes on loss-absorbing capacity, SPOE resolution can allow shareholders to offer larger (inside) equity stakes to affiliate managers, providing stronger financial incentives to perform and to control risk.

Overall, our results highlight that the choice between SPOE and MPOE depends on the nature of the bank's underlying business risks, as well as the operational complementarities between banking units located in different jurisdictions. A one-size-fits-all approach to G-SIB resolution is therefore unlikely to be efficient. Rather, resolution procedures should be adapted to correspond to a particular G-SIB's business risks and cross-border complementarities in its operations. Our analysis also shows that the full benefits from SPOE resolution can only be realized in the presence of a supra-national bank regulator. Replacing national regulators with a multinational regulatory authority would eliminate both the ex-post and ex-ante incentive issues that can prevent efficient SPOE resolution. Of course, whether the creation of such a supra-national resolution authority is politically feasible is a separate question.

The simplicity of our model necessarily implies that there are some important aspects of bank resolution that are not addressed in our framework. For example, we follow most of the regulatory literature in assuming that it is always feasible to set aside sufficient loss absorbing capacity to recapitalize a troubled subsidiary. An interesting extension of our analysis would consider also cases in which this is not possible. Moreover, the two-period model proposed in this paper does

not capture some important dynamic issues, such as how banks rebuild loss-absorbing capacity over time after a resolution.

Despite the ongoing policy debate (see, in particular, [Tucker \(2014a,b\)](#)), there is almost no formal economic analysis of the trade-offs between MPOE and SPOE resolution. One exception is the recent paper by [Faia and Weder di Mauro \(2016\)](#), who analyze how the losses that regulators impose on domestic and foreign bondholders under MPOE and SPOE resolution depend on banks' mix between foreign and domestic assets and liabilities. Several recent papers investigate other aspects of bank resolution. [Jackson and Skeel \(2012\)](#) and [Skeel \(2014\)](#) compare resolution under OLA with the alternative of restructuring a failed G-SIB in bankruptcy court. [Duffie \(2014\)](#) discusses the resolution of failing central counterparties, which, like G-SIBs, are likely to be too big to fail. [Walther and White \(2015\)](#) provide a model of bank resolution in which regulators may be too soft during a resolution, for fear of spooking market participants. [Beck et al. \(2013\)](#) analyze how incentives for national regulators to intervene depend on foreign asset holdings and equity ownership of the bank in question. In addition, a number of recent papers explore the supervision (but not resolution) of multinational banks. [Dell'Ariccia and Marquez \(2006\)](#) show that supra-national capital regulation is more likely to emerge when jurisdictions are homogeneous. Similarly, [Beck and Wagner \(2013\)](#) find that the benefits from supra-national regulation increase with cross-border externalities but decrease with country heterogeneity. [Carletti et al. \(2015\)](#) show that some of the benefits of centralized supervision may be offset by inferior information collection by national regulators. [Calzolari and Lóránth \(2011\)](#), [Colliard \(2015\)](#), and [Calzolari et al. \(2015\)](#) study the incentives of regulators to monitor multinational banks and investigate how national or supra-national supervision interacts with banks' legal structures and their decisions to expand abroad. Our analysis complements these studies by exploring the supra-national aspects of bank resolution (as opposed to supervision). More generally, the idea of resolving banks and preventing bank runs

by imposing losses on long-term creditors is related to recapitalization via contingent convertible securities (CoCos). For a survey of this literature, see [Flannery \(2014\)](#). Finally, whereas our analysis focuses on loss-absorbing capital on the liability side, [Diamond and Kashyap \(2015\)](#) explore the role of liquidity requirements on the asset side in preventing bank runs.

## 1 Model

We consider a model with three dates,  $t = 0, 1, 2$ . There are two types of players: (1) a multinational financial institution that operates in two jurisdictions and (2) two national regulators with resolution authority in their respective jurisdiction.

### 1.1 The Global Bank

A multinational financial institution operates two subsidiaries, each located in a different jurisdiction,  $i = 1, 2$ , say, the U.S. and the U.K.<sup>1</sup> Each operating subsidiary runs its own stylized banking operation, which we model as follows. At date 0, each subsidiary raises a fixed amount  $F$ , which it invests in the provision of banking services. This investment is funded through a combination of short-term debt with face value  $R_1$  due at date 1 (for example, demand deposits, wholesale funding, certificates of deposit, short-term commercial paper), long-term subordinated debt with face value  $R_{LT}$  due at date 2, and an outside equity stake  $\alpha_0$  that is issued at date 0. We assume that outside equity and long-term subordinated debt are issued by a holding company, as is envisaged under OLA. Issuing these claims at the holding company level implies that they are structurally subordinated to the short-term debt claims that are issued by operating subsidiaries. During a resolution, when time is of the essence, it is then straightforward to determine which claims will absorb losses,

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<sup>1</sup>In practice, global banks usually also have multiple operating subsidiaries within the same jurisdiction. We abstract away from this consideration in order to focus on the international aspect of resolving global financial institutions.

allowing for a speedy resolution.<sup>2</sup> Moreover, issuing subordinated claims at the holding company level potentially allows for the sharing across jurisdictions of the loss-absorbing capacity that is provided by these securities.

To capture the social benefits of banking (e.g. the economy-wide benefits of liquidity provision and a seamless payment system) we assume that each dollar of the bank’s operations that is financed using safe short-term debt  $R_1$  yields a social benefit  $\gamma > 0$  over and above the cash flows that back the short-term debt claim.<sup>3</sup> In other words,  $\gamma$  represents the liquidity services and convenience yield obtained from safe, money-like securities issued by the bank.

Banking operations yield cash flows at dates 1 and 2. At date 1, there are two possible aggregate states. With probability  $p_1$  the high aggregate state realizes and both operating subsidiaries receive a high cash flow  $C_1^H$ . With probability  $1 - p_1$ , the low aggregate state realizes and both subsidiaries receive the low cash flow  $0 < C_1^L < C_1^H$ . The aggregate state captures undiversifiable cash-flow risk that both operating subsidiaries are exposed to. For simplicity, we assume that the two operating subsidiaries have the same exposure to the aggregate shock.

In addition to this aggregate cash-flow risk, the operating subsidiaries are also exposed to diversifiable cash-flow risk at date 1. Specifically, we assume that one of the two banking subsidiaries receives an additional cash flow of  $\Delta > 0$ . This additional cash flow  $\Delta$  is received by the operating subsidiary in jurisdiction  $i$  with probability  $\theta_i$ , where  $\theta_1 + \theta_2 = 1$ .<sup>4</sup> This representation captures diversifiable risk in the sense that, even though  $\Delta$  always realizes, it is not known which operating subsidiary will receive it. We assume that  $C_1^H$  is sufficiently high that both operating subsidiaries

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<sup>2</sup>In addition, to guarantee structural subordination, the holding company is generally required not to have any operations of its own (i.e., it is a non-operating or “clean” holding company).

<sup>3</sup>This can be seen as a way of capturing, in reduced form, the benefits alternately from maturity transformation as in (Diamond and Dybvig (1983)) or from the disciplining benefits of short-term debt as in (Calomiris and Kahn (1991) and Diamond and Rajan (2001)).

<sup>4</sup>One particularly simple case is  $\theta_1 = \theta_2 = 1/2$ , such that the additional cash flow  $\Delta$  realizes with equal probability in each of the two jurisdictions. However, as we will see below, allowing for asymmetry across jurisdictions ( $\theta_1 \neq \theta_2$ ) is instructive because it is a key consideration in whether regulators can mutually agree to set up an SPOE resolution scheme.

are solvent in the high cash-flow state, irrespective of who receives  $\Delta$ . When  $C_1^L$  realizes, on the other hand, the banking subsidiaries will not necessarily have sufficient funds to repay or roll over their short-term debt obligation  $R_1$ , thereby creating a need for bank resolution.

Date 2 summarizes the continuation (or franchise) value of the two subsidiaries. We assume that with probability  $p_2^i$  the operating subsidiary in jurisdiction  $i$  receives a continuation value of  $V$  at date 2.<sup>5</sup> With probability  $1 - p_2^i$  the continuation value at date 2 is zero. The probability  $p_2^i$  of receiving the continuation value  $V$  is private information of the operating subsidiary in jurisdiction  $i$ . For simplicity, we assume that  $p_2^i \in \{0, 1\}$  and that uninformed investors' prior belief that  $p_2^i = 1$  is given by  $\bar{p}_2$ . As in Bolton and Freixas (2000, 2006), the assumption that  $p_2^i$  is private information implies that it is expensive for a bank with high  $p_2^i$  to raise funds against the continuation cash flows at date 2. This is why long-term debt and equity are expensive funding sources relative to short-term debt.

In the event of a run on the bank's short-term liabilities, the bank is liquidated at date 1. We assume that that liquidation is inefficient, in the sense that the liquidation payoff  $L$  is strictly smaller than the market's expected value of the banking franchise:  $L < \bar{p}_2 V$ . Moreover, a run and ensuing liquidation in jurisdiction  $i$  has spillover costs of  $S > 0$  in the other jurisdiction  $j$ .<sup>6</sup> Jointly, these assumptions capture the cost of a disorderly liquidation in the wake of a run, creating a need for a more efficient resolution of a loss-making bank affiliate.

Finally, to capture the (potential) benefits of global banking, we assume that the continuation value  $V$  is contingent on the two operating subsidiaries continuing to operate within the same global bank after date 1. If the two subsidiaries are separated at date 1 (for example, because national regulators invoke separate resolution procedures or when one of the two subsidiaries is liquidated), this reduces the continuation value in each jurisdiction to  $\lambda V$ , where  $\lambda < 1$ . This assumption

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<sup>5</sup>Without much loss of generality and to reduce the number of subcases to consider we assume that the date-2 continuation values of the operating subsidiaries in each jurisdiction  $i$  are identical,  $V_i = V$ .

<sup>6</sup>Another way of introducing spillover costs to other market participants is to allow  $L$  to be negative.

captures the loss of economies of scale and scope across the two operating subsidiaries (for example, resulting from joint cash management, common IT systems, and other shared services). If the operating subsidiaries want to prevent the reduction in continuation value that results from a split-up of the global bank at date 1, they can do so by setting up redundant systems ex ante (for example, by making sure that each operating subsidiary has its own independent cash management system). Redundant systems require a higher setup cost  $\tilde{F} > F$ . However, when a split-up of the global bank is sufficiently likely, it may be preferable to incur this higher setup cost than losing economies of scope ex post. A key implication of this assumption is that it generates an interaction between the resolution model and the global bank's operational structure: SPOE may be better suited to a G-SIB with no redundant systems and high economies of scale and scope, while MPOE may be more apposite for a G-SIB with redundant systems in place.

## 1.2 National Bank Regulators

Whereas the bank is global, bank resolution is local and is carried out by national regulators in each jurisdiction. There are two instances in which a national regulator in jurisdiction  $i$  may invoke resolution. First, when the local operating subsidiary cannot meet its contractual date 1 repayment  $R_1$ , and second, when resolution has been invoked by the regulator in the other jurisdiction, so as to ring-fence domestic assets.

In Section 3, we first consider a benchmark case, in which the two national regulators jointly maximize global welfare and can credibly commit to a resolution plan ex ante, thereby emulating a supra-national regulatory authority. In Section 4 we contrast this benchmark with the more realistic scenario, in which regulators cannot credibly commit to a resolution plan and act according to the best interests of their own jurisdiction. This is the main part of our analysis and captures the regulatory status quo. To be sure, in the absence of an international treaty on bank resolution

(notwithstanding the efforts of the G-20, the Financial Stability Board (FSB) and the Basel Accords) it is impossible for regulators to credibly commit to cooperating with other regulators in a G-SIB resolution. The expectation should be that, when push comes to shove, regulators will act in their own national interest.<sup>7</sup> To capture national interests, we make the particularly simple assumption that each national regulator cares only about outcomes in its own jurisdiction. This extreme form of national interest is clearly not necessary; all of our results hold as long as the regulator in jurisdiction  $i$  applies a discount to cash flows in jurisdiction  $j$ .

## 2 The Need for Minimum Loss-Absorbing Capacity Requirements

The central presumption of the proposed resolution mechanism for G-SIBs is that the bank holding company will have a capital cushion—in the form of equity or subordinated long-term debt—that is large enough to absorb any potential losses of its operating subsidiaries. In other words, the resolution model is predicated on the requirement that the G-SIB will have sufficient total loss-absorbing capacity (TLAC) that the short-term liabilities of the operating subsidiaries will be safe—even if heavy losses reduce the value of operating subsidiary assets below its liabilities, the holding company will have sufficient capital to plug the hole. The whole point of the resolution model for G-SIBs is that TLAC will be so large that there will not be a risk of a disruptive creditor run on the operating subsidiaries' banking operations, even in a crisis, so that they can continue operating as usual.<sup>8</sup>

Because the proposed resolution mechanisms rely on sufficient loss-absorbing capital, the first key question is whether the owners of the bank holding company will, in fact, find it in their

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<sup>7</sup>In the absence of an international treaty, regulators and resolution authorities can issue Memorandums of Understanding or form Supervisory Colleges. However, because these are not legally binding, they generally do not solve the problem that regulators will ultimately act in their national interest.

<sup>8</sup>It is, of course, possible that an operating subsidiary's banking business can no longer generate profits. In this case, the assumption is that bank management at the holding company level will close down such unprofitable subsidiaries. In other words, both under SPOE and MPOE resolution, financial discipline is imposed by the management of the holding company, and not by credit markets.

interest to issue such a sufficient amount of long-term debt or outside equity. In this section, we show that this is generally not the case—asymmetric information about long-term cash flows (the continuation value  $V$ ) make equity and long-term debt expensive relative to short-term debt. Therefore, the equity holders of the holding company may prefer to rely excessively on short-term debt financing, even at the risk of default at date 1. It follows that a required minimum TLAC is an essential complement to the proposed SPOE and MPOE resolution approaches. Since this basic economic result does not depend on the presence of multiple operating subsidiaries, we focus the analysis for the remainder of this section on one operating subsidiary in isolation (and abstract away from complementarities across jurisdictions and redundant systems).

Thus, consider the financing choices of the owners of a single operating subsidiary. At date 0 the setup cost  $F$  can be funded via a combination of (i) short-term debt of face value  $R_1$  due at date 1; (ii) long-term subordinated debt with face value  $R_{LT}$  due at date 2; and, (iii) an equity stake  $\alpha_0$  issued to outside investors at date 0. In addition, at date 1 the operating subsidiary can issue further claims against date 2 cash flows thereby rolling over its (senior) short-term debt.

Financing choices are made by the informed owners of the operating subsidiary in a pooling equilibrium, as in Bolton and Freixas (2000, 2006). In the pooling equilibrium, the high type ( $p_2^i = 1$ ) moves first and makes the financing choices in its best interest, knowing that low type ( $p_2^i = 0$ ) will mimic these choices. The high type will seek to avoid issuing claims against the continuation value  $V$  that will be undervalued by uninformed investors in a pooling equilibrium with the low type. From the perspective of a high-type subsidiary, the true value of a unit claim on  $V$  is 1, but uninformed investors are willing to pay only  $\bar{p}_2 < 1$  for this claim.<sup>9</sup>

The underpricing of claims issued against the continuation value  $V$  (from the perspective of the high type) entails a pecking order in funding sources, by which the issuer strictly prefers to first sell

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<sup>9</sup>Separating equilibria do not exist because banks with low continuation values can always costlessly mimic high types.

short-term claims on date 1 cash flows before considering issuing long-term claims. Up to the face value  $C_1^L$  such short-term debt can always be repaid from the date 1 cash-flows and can therefore be issued without incurring any informational dilution costs. Up to the face value  $C_1^L + \bar{p}_2 V$ , the optimal strategy for the high type issuer is to issue short-term debt at date 0 and only issue claims against the continuation value  $V$  at date 1 in the event that the realized date 1 cash flow is smaller than the promised face value of the short-term debt. Such state-contingent issuance against  $V$  is optimal because it minimizes dilution costs.

Taking into account the convenience yield of safe short-term debt,  $\gamma$ , the owners of the operating subsidiary can therefore raise up to  $(1 + \gamma)(C_1^L + \bar{p}_2 V)$  without incurring any default risk at date 1. From a bank resolution analysis perspective, the interesting case is when  $F > (1 + \gamma)(C_1^L + \bar{p}_2 V)$ , because in this case, financing entirely by short-term debt exposes the banking subsidiary to default risk. In what follows, we therefore focus on this case.

**Assumption 1.** *Financing exclusively with short-term debt exposes the operating subsidiary to default risk. This requires that  $F > (1 + \gamma)(C_1^L + \bar{p}_2 V)$ .*

When  $F > (1 + \gamma)(C_1^L + \bar{p}_2 V)$  there are two relevant funding structures to compare, one where default is avoided at date 1 and one where it is not. To avoid default at date 1 the operating subsidiary must issue no more than  $R_1 = C_1^L + \bar{p}_2 V$  in short-term debt, the maximum that can be rolled over at date 1. The remaining funds must be raised through a combination of subordinated long-term debt and equity. Alternatively, the operating subsidiary may raise the entire amount  $F$  via short-term debt, without any long-term subordinated debt or equity issued by the holding company. Under this latter funding structure, the bank is exposed to default risk because it may be unable to roll over its short-term debt at date 1. In this case, the banking franchise is seized by creditors and liquidated for an amount  $L$ . Liquidation is inefficient because it yields less than the expected cash flows from continuing the banking franchise,  $L < \bar{p}_2 V$ .

We first consider the funding structure in which the holding company issues sufficient TLAC that the short-term debt issued by the subsidiary is safe. The composition of this TLAC is such that at least an amount  $\hat{R}_{LT}$  of long-term subordinated debt is issued so that all date 1 cash-flow that may be carried forward in the firm from date 1 to date 2 is pledged to investors. This is efficient from the perspective of the owners of the operating subsidiary, as it ensures that all fairly-priced cash flows are completely sold to investors. Once all fairly priced cash flows have been sold, the owners are indifferent between any combination of outside equity issuance  $\alpha_0$  and additional subordinated long-term debt  $R_{LT} \geq \hat{R}_{LT}$  as loss-absorbing capital. Without loss of generality, we can therefore calculate the payoff to equity holders by assuming that all external loss-absorbing capital is composed solely of long-term subordinated debt.

The maximum issuance of safe short-term debt  $R_1 = C_1^L + \bar{p}_2 V$  raises funds in the amount of  $(1+\gamma)(C_1^L + \bar{p}_2 V)$ . The remaining amount  $F - (1+\gamma)(C_1^L + \bar{p}_2 V)$  is raised via long-term subordinated debt, as explained above. The face value of long-term subordinated debt  $R_{LT}$  therefore must satisfy

$$p_1 \bar{p}_2 R_{LT} + p_1 (1 - \bar{p}_2) (C_1^H + \theta \Delta - C_1^L - \bar{p}_2 V) + (1 - p_1) \theta \Delta = F - (1 + \gamma) (C_1^L + \bar{p}_2 V). \quad (1)$$

This breakeven condition reflects the fact that  $R_{LT}$  is paid back in full at date 1 when the high cash flow  $C_1^H$  realizes and the operating subsidiary has a positive continuation value  $V$ , which occurs with probability  $p_1 \bar{p}_2$  from the perspective of uninformed investors. In all other cases, long-term subordinated debtholders receive whatever is left after short-term creditors have been paid. Based on this breakeven condition, the face value of long-term subordinated debt is given by

$$R_{LT} = \frac{F - (1 + \gamma) (C_1^L - \bar{p}_2 V) - p_1 (1 - \bar{p}_2) (C_1^H + \theta \Delta - C_1^L - \bar{p}_2 V) - (1 - p_1) \theta \Delta}{p_1 \bar{p}_2}, \quad (2)$$

and the payoff to the owners of the high-type operating subsidiary is

$$\begin{aligned}\Pi_{TLAC} &= p_1 [C_1^H + \theta\Delta + V - R_1 - R_{LT}] \\ &= \frac{1}{\bar{p}_2} [p_1 C_1^H + (1 - p_1)C_1^L + \theta\Delta + \bar{p}_2 V + \gamma(C_1^L + \bar{p}_2 V) - F].\end{aligned}\quad (3)$$

The main observation here is that  $d\Pi_{TLAC}/d\bar{p}_2$  is positive whenever sufficient loss-absorbing capital requires issuing claims against the continuation value  $V$  (i.e., when  $F > p_1 C_1^H + (1 - p_1)C_1^L + \gamma C_1^L + \theta\Delta$ ). Intuitively, the expected profits to the owners of a high-type banking operation are lower when  $\bar{p}_2$  is low, such that claims against  $V$  are sold at a larger discount.

Now consider the second funding structure, under which the entire amount  $F$  is funded with short-term debt. In this case the operating subsidiary will default whenever the low cash flow  $C_1^L$  realizes, irrespective of the realization of  $\Delta$ , provided that  $\Delta$  is not too large. We will focus on this case, but the alternative case (where receiving  $C_1^L + \Delta$  allows the operating subsidiary to service its short-term debt) can be treated in similar fashion.

**Assumption 2.** *If financing is exclusively in the form of short-term debt, the operating subsidiary defaults whenever  $C_1^L$  realizes, irrespective of whether the additional cash flow  $\Delta$  is received. This requires that  $R_1 > C_1^L + \Delta + \bar{p}_2 V$ , which holds as long as  $\Delta$  is not too large.*

By raising  $F$  solely with short-term debt, the face value of short-term debt has to satisfy the breakeven condition

$$p_1 R_1 + (1 - p_1)(C_1^L + \theta\Delta + L) = F. \quad (4)$$

Short-term debtholders are repaid in full when the high cash flow realizes. If the low cash flow realizes, they seize the cash flow  $C_1^L$  and liquidate the firm. This breakeven condition yields a face value of short-term debt of

$$R_1 = \frac{F - (1 - p_1)(C_1^L + \theta\Delta + L)}{p_1}. \quad (5)$$

When financing is exclusively in the form of short-term debt, under Assumption 2 the owners of the operating subsidiary receive a payoff only when the high cash flow realizes. Their expected profit is then given by

$$\Pi_{noTLAC} = p_1 [C_1^H + \theta\Delta - R_1 + V] = p_1 C_1^H + (1 - p_1)C_1^L + \theta\Delta + p_1 V - (1 - p_1)L - F. \quad (6)$$

Comparing expected profits with and without loss-absorbing capacity, equations (3) and (6), reveal that private incentives may be such that the owners of the banking operation do not issue securities that provide sufficient TLAC and instead rely exclusively on short-term debt. To see this, note first that financing with sufficient TLAC dominates when claims against long-term cash flows are fairly priced ( $\bar{p}_2 = 1$ ). In this case, TLAC does not involve any dilution costs and generates a social benefit of safe short-term debt of  $\gamma(C_1^L + \bar{p}_2 V)$  that is appropriated by the owners of the banking operation. Risky debt financing, on the other hand, is costly because it does not generate a convenience yield and it leads to inefficient liquidation in the low cash flow state. In contrast, when dilution costs on long-term cash flows are sufficiently high (when  $\bar{p}_2$  lies below a cutoff  $\bar{p}_2^* < 1$ ), risky debt financing is privately optimal, even though it leads to inefficient early liquidation and eliminates the social benefit of short-term debt. As a result of this conflict, SPOE and MPOE resolution schemes, both of which crucially rely on sufficient TLAC, must in general be complemented by a minimum TLAC requirement.

**Proposition 1. *Minimum TLAC requirement.*** *In the absence of a minimum amount of required TLAC, the equity holders of the holding company choose to rely exclusively on risky short-term debt financing when  $\bar{p}_2 < \bar{p}_2^*(\gamma, L)$ . Therefore, a minimum TLAC requirement is necessary as a complement to both SPOE and MPOE resolution.*

From a social perspective, the exclusive reliance on short-term debt when  $\bar{p}_2 < \bar{p}_2^*$  is inefficient. Risky short-term debt has no social benefit (whenever funding is possible with short-term debt, it is also possible with sufficient loss-absorbing capacity). Yet risky short-term debt has a cost, because it leads to inefficient liquidation in crisis states and eliminates the social value of safe short-term debt securities (as captured by  $\gamma$ ). It is also worth pointing out that the unwillingness of owners of the banking operation to issue securities that provide enough loss-absorbing capacity is not driven by an expectation of a bailout at date 1. Even if the government can commit not to bail out, the dilution cost associated with claims that provide loss-absorbing capacity implies that the owners of the banking operation may prefer to rely exclusively on short-term debt. Of course, if the government faces a commitment problem that could result in ex-post bailouts, the incentives to rely on short-term debt are even larger.

### 3 MPOE and SPOE Resolution under a Supra-National Regulator

In this section, we compare MPOE and SPOE resolution in a benchmark setting, in which the resolution is carried out by a benevolent supra-national regulator. This benevolent supra-national regulator chooses the resolution regime that maximizes the ex-ante expected value of the global bank (equivalent to ex-ante surplus) and can commit to implement the required ex-post transfers across jurisdictions under SPOE resolution. There are two main advantages of SPOE resolution: First, the ability to make transfers across subsidiaries in different jurisdictions generates coinsurance benefits, which translate into lower required TLAC for the global bank. This, in turn, increases the bank's capacity to provide banking services through short-term debt issuance. Second, under SPOE resolution, the two subsidiaries continue to operate as part of the same global bank even after a resolution, allowing the global bank to fully capture economies of scale and scope from shared services.

### 3.1 MPOE Resolution

MPOE involves a separate resolution in each jurisdiction, such that the global bank is split up during resolution in the low cash flow state  $C_1^L$ . In addition, TLAC for each subsidiary is held by the respective national holding company and is not shared across jurisdictions. Accordingly, TLAC in each jurisdiction must be set such that the operating subsidiary can meet its short-term liabilities  $R_1$  even when it generates only  $C_1^L$  at date 1 and the G-SIB is split up during resolution.

The amount of short-term debt that can be rolled over at date 1 depends on whether the G-SIB has redundant systems in place. Without redundant systems, splitting up the bank at date 1 leads to a reduction in expected franchise value to  $\lambda\bar{p}_2V$ , so that the maximum amount of safe short-term debt that can be issued is  $C_1^L + \lambda\bar{p}_2V$ . In the presence of redundant systems, the expected franchise value is unaffected by the organizational split resulting from MPOE resolution, so that the maximum safe short-term debt is  $C_1^L + \bar{p}_2V$ . It is efficient to set up redundant systems only if the benefits outweigh the additional ex-ante investment  $\tilde{F} - F$ . There are two benefits from such redundancy: 1) increased short-term debt issuance  $\gamma(1 - \lambda)\bar{p}_2V$  and 2) no expected separation costs from MPOE resolution  $(1 - p_1)(1 - \lambda)\bar{p}_2V$ .

Thus, depending on whether redundant systems are set up, the national holding company needs to raise TLAC in the amount of either  $[F - (1 + \gamma)(C_1^L + \lambda\bar{p}_2V)]$  or  $[\tilde{F} - (1 + \gamma)(C_1^L + \bar{p}_2V)]$ . As shown in the previous section, it is optimal for each national holding company to issue some TLAC in the form of subordinated long-term debt. More specifically, it is optimal for the face value of subordinated long-term debt to be at least as large as the maximum amount of cash that the bank

may carry forward from date 1 to date 2:  $R_{LT}^{MPOE} \geq C_1^H + \Delta - R_1 \equiv \hat{R}_{LT}^{MPOE}$ .<sup>10</sup> We summarize this discussion in the lemma below.

**Lemma 1. *Funding and TLAC under MPOE.***

(i) When  $\tilde{F} - F \geq (1 - p_1 + \gamma)(1 - \lambda)\bar{p}_2V$ , it is not efficient for subsidiaries to set up redundant systems. Each subsidiary issues safe short-term debt with face value  $R_1^{MPOE} = C_1^L + \lambda\bar{p}_2V$ . Required TLAC per subsidiary is given by  $F - (1 + \gamma)R_1^{MPOE} = F - (1 + \gamma)(C_1^L + \lambda\bar{p}_2V)$  and is raised by the national holding company via a combination of equity and subordinated long-term debt.

(ii) When  $\tilde{F} - F < (1 - p_1 + \gamma)(1 - \lambda)\bar{p}_2V$ , it is efficient for subsidiaries to set up redundant systems. Each subsidiary issues safe short-term debt with face value  $R_1^{MPOE} = C_1^L + \bar{p}_2V$ . Required TLAC per subsidiary is given by  $\tilde{F} - (1 + \gamma)R_1^{MPOE} = \tilde{F} - (1 + \gamma)(C_1^L + \bar{p}_2V)$  and is raised by the national holding company via a combination of equity and subordinated long-term debt.

(iii) In both cases, each subsidiary finds it privately optimal to raise at least  $\hat{R}_{LT}^{MPOE} = C_1^H + \Delta - R_1^{MPOE}$  of the required TLAC as subordinated long-term debt.

(iv) The subsidiaries are separated during resolution, so that each subsidiary bears an effective redundancy or separation cost of  $\min[\tilde{F} - F, (1 - p_1 + \gamma)(1 - \lambda)\bar{p}_2V]$ .

### 3.2 SPOE

SPOE resolution has two advantages relative to MPOE. First, the diversifiable cash flow  $\Delta$  can be transferred across the two subsidiaries, which generates diversification benefits. The ability to

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<sup>10</sup>Some commentators have argued that G-SIB resolution, TLAC, and the problem of determining the optimal composition of TLAC claims is all a wasteful distraction. To make G-SIBs safe, all that is needed is to impose sufficiently high equity-capital requirements. While, undoubtedly, a sufficiently high equity-capital requirement can guarantee the safety of a G-SIB, it may come at a cost of reducing socially valuable banking services. This is why the characterization of the constrained optimal funding structure and optimal G-SIB resolution is of interest.

share  $\Delta$  raises the minimum cash flow received by each subsidiary at date 1 from  $C_1^L$  to  $C_1^L + \Delta/2$ . Second, even without redundant systems each subsidiary can always roll over an amount  $\bar{p}_2 V$  of short-term debt at date 1, since the two subsidiaries are not separated under an SPOE resolution. Hence, under SPOE resolution each subsidiary can issue more safe short-term debt, generating larger benefits from the banking activity. The face value of safe short-term debt of each subsidiary under SPOE is:

$$R_1^{SPOE} = C_1^L + \Delta/2 + \bar{p}_2 V > R_1^{MPOE}. \quad (7)$$

TLAC is required if  $F > (1 + \gamma)(C_1^L + \Delta/2 + \bar{p}_2 V)$ , which we assume is the case, and is raised by the global holding company through a combination of subordinated long-term debt and equity. It is again privately optimal for the global holding company to issue subordinated long-term debt with a face value that is at least as large as the amount of cash that is carried forward by the two subsidiaries when they receive the high cash-flow:  $R_{LT}^{SPOE} \geq 2C_1^H + \Delta - 2R_1^{SPOE} \equiv \hat{R}_{LT}^{SPOE}$ . We summarize the above discussion in the following lemma.

**Lemma 2. *Funding and TLAC under SPOE.***

- (i) *Under SPOE resolution, each subsidiary issues short-term debt with face value  $R_1^{SPOE} = C_1^L + \Delta/2 + \bar{p}_2 V$ . Required TLAC per subsidiary is given by  $F - (1 + \gamma)R_1^{SPOE} = F - (1 + \gamma)(C_1^L + \Delta/2 + \bar{p}_2 V)$  and is raised by the global holding company via a combination of equity and subordinated long-term debt.*
- (ii) *The global holding company finds it privately optimal to raise at least  $\hat{R}_{LT}^{SPOE} = 2C_1^H + \Delta - 2R_1^{SPOE}$  of the required TLAC as subordinated long-term debt.*
- (iii) *Because the subsidiaries are not separated during resolution, there are no redundancy or separation costs.*

A comparison of Lemmas 1 and 2 establishes our second main result.

**Proposition 2. SPOE dominates under supra-national regulation.** *In the benchmark case with a supra-national regulator, SPOE resolution dominates MPOE resolution. SPOE resolution allows for more banking activity at the same level of risk and allows the two subsidiaries to capture the benefits from global banking, generating a net social benefit (relative to MPOE resolution) of*

$$\underbrace{\gamma\Delta}_{\text{additional banking services}} + \underbrace{2 \min[\tilde{F} - F, (1 - p_1 + \gamma)(1 - \lambda)\bar{p}_2 V]}_{\text{reduction in redundancy/separation costs}}. \quad (8)$$

*It is efficient to structure global banks as multi-national holding companies with shared services across jurisdictions, with national banking subsidiaries sharing TLAC issued by the global holding company.*

Proposition 2 highlights the appeal of SPOE resolution. If regulators can commit to cooperate in the middle of a crisis, then SPOE resolution dominates MPOE. The reason is twofold. First, the ability to make cross-jurisdictional transfers under SPOE resolution lowers the amount of required loss-absorbing capital. Under SPOE the G-SIB can increase the amount of socially beneficial banking services provided by each subsidiary by  $\Delta/2$ , leading to a total increase in banking services of  $\Delta$  and an increase in surplus of  $\gamma\Delta$ . Second, SPOE resolution allows the bank to fully harness economies of scale or scope that result from global banking, because SPOE resolution under supra-national regulation guarantees that the two subsidiaries remain part of the global bank even after a resolution. The subsidiaries can reap the benefits of shared services (such as joint cash management or IT systems) without risk of incurring separation costs or the need to set up redundant systems, resulting in an additional increase of surplus of  $2 \min[\tilde{F} - F, (1 - p_1 + \gamma)(1 - \lambda)\bar{p}_2 V]$ . This second channel again highlights the important correspondence between the adopted resolution scheme and a bank's operational structure. In particular, under SPOE resolution performed by a supra-national

regulator, it is efficient for G-SIBs to set up operations in a way that maximizes shared services to generate economies of scale and scope.

## 4 SPOE and MPOE with National Regulators

We now depart from the idealized setting of Section 3 and enrich the model to reflect the reality that bank resolution is conducted by self-interested national regulators. The main result of this section is that the ex-ante and ex-post incentive constraints that are required for successful bank resolution under SPOE limit the applicability of SPOE resolution, despite its conceptual appeal. First, we show that national regulators may not find it in their interest to set up a viable SPOE regime ex ante. When national regulators fail to set up an SPOE resolution mechanism ex ante, MPOE resolution is the only viable option. Second, we show that an SPOE resolution that is implemented by national regulators can fail ex post because regulators may prefer to ring-fence assets, rather than going along with the planned SPOE resolution. When this is the case, MPOE resolution is again the preferred option. Overall, the regulatory status quo, under which the resolution of multinational banks is carried out by national regulators, significantly limits the realizable benefits of SPOE resolution.

### 4.1 Ex-ante Incentive Compatibility

Self-interested national regulators will only agree to set up an SPOE resolution regime ex ante if the probabilities of making and receiving transfers are sufficiently symmetric. If one of the two jurisdictions is significantly more likely to make transfers under SPOE resolution, the regulator in this jurisdiction will not agree to put in place an SPOE resolution mechanism, even if this is efficient in the sense of maximizing overall surplus.

Recall that the additional cash flow  $\Delta$  appears in jurisdiction 1 with probability  $\theta_1$  and in jurisdiction 2 with probability  $\theta_2$ , where  $\theta_1 + \theta_2 = 1$ . We now show that the higher is  $\theta_i$ , the less likely it is that the regulator in jurisdiction  $i$  will agree to SPOE resolution across the two jurisdictions. To see this, consider first the expected benefits from entering an SPOE resolution scheme. A move from MPOE to SPOE resolution yields a benefit of  $\gamma\Delta/2$  in each jurisdiction in terms of greater provision of banking services. Also, SPOE resolution allows the bank to capture economies of scale and scope benefits from global banking, which per jurisdiction amount to the lesser of the cost of setting up redundant systems and expected separation costs,  $\min[\tilde{F} - F, (1 - p_1 + \gamma)(1 - \lambda)\bar{p}_2V]$ .

The cost of SPOE resolution is the expected net transfer that a jurisdiction has to make to the other jurisdiction in the low cash flow state. Even though this is a pure transfer when looking at the two subsidiaries as a whole, our assumption that regulators follow national objectives implies that in their eyes this transfer constitutes a loss for their jurisdiction.

Consider the regulator in jurisdiction 1. With probability  $(1 - p_1)\theta_1$ , jurisdiction 1 makes a transfer of  $\Delta/2$  to jurisdiction 2. With probability  $(1 - p_1)\theta_2$ , jurisdiction 1 receives a transfer of size  $\Delta/2$  from jurisdiction 2. The net expected transfer that jurisdiction 1 makes to jurisdiction 2 is therefore  $\frac{\Delta}{2}(1 - p_1)(\theta_1 - \theta_2)$ .

The regulator in jurisdiction 1 is willing to enter into an SPOE resolution regime if the benefits from increased banking activity and shared services outweigh the cost in the form of expected net transfers, which, based on the discussion above, requires that

$$\theta_1 - \theta_2 \leq \frac{\gamma}{1 - p_1} + \min \left[ \frac{\tilde{F} - F}{1 - p_1}, \left( 1 + \frac{\gamma}{1 - p_1} \right) (1 - \lambda)\bar{p}_2V \right]. \quad (9)$$

Because both regulators have to agree to set up an SPOE resolution regime, an analogous condition has to hold for the regulator in jurisdiction 2. Combining the ex-ante incentive constraints of both regulators, we arrive at the following proposition.

**Proposition 3. *Ex-ante incentive compatibility of SPOE resolution.*** *SPOE bank resolution is ex-ante incentive compatible only if the benefit from increased banking activity and the gains from global banking in each jurisdiction outweigh the expected net transfer payments to the other jurisdiction. This requires that cash flows in each jurisdiction are sufficiently symmetric:*

$$|\theta_1 - \theta_2| \leq \frac{\gamma}{1 - p_1} + \frac{2}{\Delta} \min \left[ \frac{\tilde{F} - F}{1 - p_1}, \left( 1 + \frac{\gamma}{1 - p_1} \right) (1 - \lambda) \bar{p}_2 V \right]. \quad (10)$$

Proposition 3 establishes that ex-ante implementation of SPOE requires sufficient symmetry in payoffs across jurisdictions. The left hand side of the ex ante IC constraint (10) states that the probabilities  $\theta_i$  of receiving the diversifiable cash flow  $\Delta$  must be sufficiently symmetric across the two jurisdictions. When one jurisdiction is significantly more likely to make a transfer under SPOE, the regulator of that jurisdiction does not find it in its interest to set up an SPOE resolution scheme. The right-hand side of the ex ante IC constraint (10) states that SPOE is more likely to be ex-ante incentive compatible when the incremental social benefit from banking activity  $\gamma$  is large, and when there are significant returns to scale and scope to global banking (in the form of saved redundancy and separation costs). A larger benefit from additional banking activity and from returns to scale and scope makes it more likely that nationally minded regulators agree to SPOE, even if for one of the jurisdictions this means making a net expected transfer to the other jurisdiction. Overall, the implication is therefore that when national regulators are in charge of designing a resolution scheme for multinational banks, they will choose a more efficient SPOE resolution mechanism only if the costs of SPOE resolution are shared sufficiently symmetrically across jurisdictions.

A few brief additional observations regarding Proposition 3 are in order. First, the conclusion that asymmetry across jurisdictions can prevent regulators from setting up an efficient resolution regime echoes the finding in [Dell’Ariccia and Marquez \(2006\)](#) that national regulators may not agree on a centralized supra-national capital regulation when jurisdictions are sufficiently heterogeneous.

Second, Proposition 3 implicitly rules out transfer payments between regulators (because they may not be politically feasible). If such transfer payments are possible, then the regulator in the jurisdiction that is more likely to receive a transfer under SPOE resolution could make an appropriate transfer payment to induce the other regulator to join the resolution mechanism. Third, when the probability of making instead of receiving a transfer under SPOE is large, ex-ante incentive compatibility can potentially be restored by also making the benefits from SPOE resolution asymmetric. Specifically, rather than allocating the additional amount of short-term debt that can be sustained under SPOE symmetrically across jurisdictions ( $\Delta/2$  per jurisdiction), the operating subsidiary in the jurisdiction that is more likely to receive  $\Delta$  could be allowed to issue more than  $\Delta/2$  in additional short-term debt, with the operating subsidiary in the other jurisdiction proportionally issuing less than  $\Delta/2$  in additional short-term debt. Even though this can help satisfy the ex-ante incentive constraint, however, asymmetric amounts of short-term debt make it harder to satisfy the ex-post incentive constraints discussed in the next subsection. Fourth, our analysis has focused exclusively on the direct costs and benefits of SPOE resolution. In addition, national regulators may prefer MPOE resolution if this protects a national champion, for example because it raises operating costs of foreign rivals.

## 4.2 Ex-post Incentive Compatibility

The main question ex post is whether the regulator in the jurisdiction in which the additional cash flow  $\Delta$  realizes has an incentive to make the required transfer of  $\Delta/2$  to the other jurisdiction. There are two ways in which SPOE can break down ex post. First, when the cash flow  $\Delta$  realizes in the jurisdiction in which the global holding company is located (the home jurisdiction), the home regulator may refuse to make the required transfer to the operating subsidiary in the other jurisdiction (the host jurisdiction). This happens when the transfer to the host institution  $\Delta/2$  is

larger than the home jurisdiction’s expected loss in case the subsidiary in the other jurisdiction faces a bank run and is liquidated. This cost consists of the loss of shared services  $(1 - \lambda)\bar{p}_2V$  and the direct spillover cost  $S$  that is incurred when the affiliate in the other jurisdiction defaults. Second, when the cash flow  $\Delta$  realizes in the host jurisdiction, the regulator in the host jurisdiction may prefer to ring-fence assets in response to an SPOE resolution in the home jurisdiction. Again, such ring-fencing is privately optimal when the transfer to the home subsidiary  $\Delta/2$  is larger than the expected loss of shared services  $(1 - \lambda)\bar{p}_2V$  and the direct spillover cost  $S$ . Given our assumption of equal continuation values  $V$  in the two jurisdictions, these two cases reduce to the same incentive constraint. Specifically, ex-post incentive compatibility in both jurisdictions requires that

$$\frac{\Delta}{2} \leq (1 - \lambda)\bar{p}_2V + S. \tag{11}$$

When this incentive constraint is violated, a planned SPOE resolution breaks down ex post. The low cash flow realization  $C_1^L$  coupled with the unwillingness of the relevant regulator to make the required transfer leads to the liquidation of at least one of the operating subsidiaries (or necessitates a bailout by the other regulator).

**Proposition 4. *Ex-post incentive compatibility of SPOE resolution.*** *In the presence of national regulators that cannot commit to ex-post transfers, SPOE resolution is not incentive compatible whenever the required ex-post transfer across jurisdictions is larger than the loss of shared services and the spillover costs that result from unilateral ring fencing*

$$\frac{\Delta}{2} > (1 - \lambda)\bar{p}_2V + S. \tag{12}$$

Proposition 4 has two main implications. First, when the cross-jurisdictional transfer that is required under SPOE is too large, the necessary incentive constraint (12) is not satisfied, leading

to a breakdown of the SPOE resolution scheme. Such an ex-post breakdown of a planned SPOE resolution is, of course, the worst possible outcome: Having planned for an SPOE resolution, the ex-post unwillingness of regulators to make required transfers leaves no other option than a disorderly liquidation following a bank run or a tax-funded bailout, precisely the scenarios that bank resolution is meant to prevent. Second, Proposition 4 shows that incentive compatible SPOE resolution is facilitated by operational complementarities across jurisdictions (as captured by a low  $\lambda$ ) as well as by direct spillover costs that result from ring fencing (as captured by the spillover cost  $S$ ). It is precisely the loss of complementarities across the two bank affiliates that incentivize regulators not to ring-fence assets ex post. Therefore, for relatively decentralized G-SIBs with small cross-jurisdictional complementarities, MPOE resolution is more likely to be appealing. This prediction is consistent with the observation that global banks that operate essentially independently across different jurisdictions (e.g., HSBC, Santander) typically have a preference for MPOE resolution. For example, in the HSBC 2015 annual report, it says that “[i]t is our view that a strategy by which the Group breaks up at a subsidiary bank level at the point of resolution (referred to as a Multiple Point of Entry) is the optimal approach, as it is aligned to our existing legal and business structure.”<sup>11</sup>

When the ex-post IC constraint is violated, a more robust MPOE resolution that does not require incentive compatibility across jurisdictions is preferable. However, because under MPOE resolution the two operating subsidiaries may be separated at date 1, it may then also be efficient to set up redundant systems, by paying the higher setup cost  $\tilde{F} > F$ , in order to avoid the separation costs  $(1 - p_1 + \gamma)(1 - \lambda)\bar{p}_2V$ . Combined with the ex-post incentive constraint for successful SPOE resolution by national regulators, this again points to the conformity of the bank resolution model

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<sup>11</sup>Proposition 4 also shows that an asymmetric allocation of short-term debt across jurisdictions to satisfy the ex-ante incentive constraint (as discussed in Section 4.1) makes it harder to satisfy the ex-post incentive constraint in all states. Specifically, successful resolution in all states is only possible when the ex-post IC is satisfied for the maximum realized transfer, which is now greater than  $\Delta/2$ .

with the operational structure of global banks. We summarize this discussion in the following proposition.

**Proposition 5. *Bank resolution and the structure of global banks.***

- (i) *SPOE resolution combined with a multinational holding company structure with shared services is efficient when  $\frac{\Delta}{2} \leq \bar{p}_2(1 - \lambda)V + S$ .*
- (ii) *MPOE resolution combined with separate national holding companies is efficient when  $\frac{\Delta}{2} > \bar{p}_2(1 - \lambda)V + S$ .*
- (iii) *Under MPOE resolution, setting up redundant systems that facilitate the separation of banking subsidiaries during a resolution is efficient when  $\tilde{F} - F < (1 - p_1 + \gamma)(1 - \lambda)\bar{p}_2V$ .*

According to Proposition 5, the efficient choice between SPOE and MPOE depends on the structure of a global bank’s business risks and the size of the complementarities between operating subsidiaries in different jurisdictions. In particular, the proposition shows that a one-size-fits-all approach to G-SIB resolution is unlikely to be efficient. Rather, whether a global bank is best resolved under SPOE or MPOE depends on the risks and the operational structure of that particular bank. Therefore, in general both options should be available, and an ex ante assessment has to be made whether a particular institution is resolved more efficiently under SPOE or MPOE. This correspondence between resolution, the bank’s cash flow risks, and operational structure is illustrated in Figure 2. For example, a multinational bank with significant diversifiable cash flow risk  $\Delta$ , for which the incentive constraint (12) cannot be satisfied, should be resolved under MPOE resolution. Moreover, under MPOE resolution it may then be efficient to set up redundant systems ex ante, in order to prevent the ex-post loss of value when operating subsidiaries are separated in a resolution. Consistent with this prediction, HSBC, which favors MPOE resolution, writes in

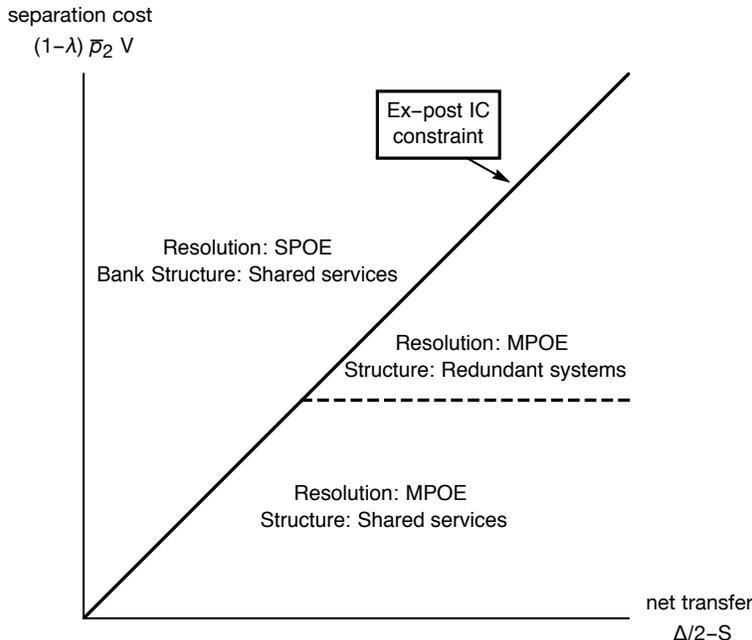


Figure 2: **Bank resolution (MPOE or SPOE) and bank structure.** The figure illustrates the correspondence between bank resolution and bank structure established in Proposition 5. The x-axis plots the required ex-post transfer under SPOE resolution  $\Delta/2$  net of direct spillover cost  $S$ . The y-axis plots the loss of franchise value that results when subsidiaries with shared services are separated as part of an MPOE resolution  $(1 - \lambda)\bar{p}_2V$ . The 45-degree line represents the ex-post incentive constraint for successful SPOE resolution (12). Whenever the ex-post incentive constraint is satisfied (i.e., to the left of the 45-degree line), SPOE resolution combined with a bank structure with shared services dominates MPOE resolution. When the ex-post incentive constraint is not satisfied (to the right of the 45-degree line) SPOE fails and therefore MPOE resolution is efficient. Under MPOE resolution, bank structure should respond through an ex-ante investment in redundant systems when the cost of such an investment is less than the expected separation cost (i.e.,  $\tilde{F} - F < (1 - p_1 + \gamma)(1 - \lambda)\bar{p}_2V$ ), as illustrated by the dashed line.

its 2015 annual report that “we are working with our regulators to mitigate or remove critical inter-dependencies between our subsidiaries to further facilitate the resolution of the Group.”

### 4.3 Optimal Ex-Post Incentive Compatible Resolution: A Hybrid Approach

Up to now our analysis focused on a comparison between a pure SPOE resolution (all loss-absorbing capacity is shared across jurisdictions) and a pure MPOE resolution (all loss-absorbing capacity is held separately at the national level). We now build on these results to show that, in general,

the constrained optimal resolution mechanism in the presence of national regulatory interests is a hybrid model, in which some loss-absorbing capacity is shared and some is pre-assigned to a particular jurisdiction.

The idea behind such a hybrid model is straightforward. As shown above, a pure SPOE resolution breaks down when the required ex-post transfer violates the incentive constraint of one of the regulators. In this case, a pure MPOE can still provide successful resolution, but gives up benefits from resource sharing across jurisdictions when resolution is triggered. The constrained optimal model lies somewhere in between: it reduces cross-jurisdictional transfers to an amount that just satisfies the required ex-post IC constraints. Of course, relative to SPOE, the smaller size of the cross-jurisdictional transfer has to be offset by an increase in loss-absorbing capacity that is pre-assigned to individual jurisdictions. The following proposition formalizes this intuition.

**Proposition 6. *Constrained optimal bank resolution.*** *Assume that  $\Delta/2 > \bar{p}_2(1 - \lambda)V + S$ , so that the ex-post incentive constraint for SPOE resolution (12) is violated. The constrained-optimal bank resolution scheme combines shared TLAC that is held at the international holding company level with TLAC that is pre-assigned at the jurisdiction level. Shared TLAC at the international holding company level is set such that the cross-jurisdiction transfer  $T$  just satisfies the ex-post IC constraint,*

$$T^* = \bar{p}_2(1 - \lambda)V + S, \tag{13}$$

where  $T^* \leq \Delta/2$ . The remaining TLAC is pre-assigned to national holding companies in each jurisdiction. This hybrid model allows for banking activity to be as high as  $C_1^L + \bar{p}_2V + T^* \leq C_1^L + \bar{p}_2V + \Delta/2$  for each operating subsidiary.

In the presence of national regulatory interests, resolution of globally systemically important banks should therefore generally rely on both shared and pre-assigned loss-absorbing capacity. Specifically, shared loss-absorbing capital at the global holding company level harnesses the diversi-

fication benefit of SPOE resolution, but only to the point where ex-post transfers of “contributable resources” (in our model these are the cash flow  $\Delta$ ) during a crisis are just incentive compatible. The reduction in the use of contributable resources in resolution is then offset through an increase in “prepositioned resources” in the form of TLAC pre-assigned to each jurisdiction. While this hybrid model does not generate the amount of socially valuable banking activity that would be possible under SPOE resolution and a single supra-national regulator (the benchmark case in Section 3), it exploits the advantages of shared loss-absorbing capacity to the extent possible given the regulatory status quo under which global financial institutions are resolved by national regulators.

## 5 Bank Incentives under MPOE and SPOE

Under a bank resolution model in which loss absorbing capacity is always sufficient to absorb operating losses, the usual disciplining role of debt is muted. This makes equity-based incentives for management particularly important. SPOE and MPOE resolution differ with respect to these incentive properties. In particular, the adopted resolution model affects the G-SIB’s capital structure, its ability to transfer resources, and cross-subsidize between affiliates. Accordingly, an important question is which resolution model results in better incentives for the management of operating subsidiaries.

In this section, we extend our model to analyze which resolution model is better able to provide equity-based incentives to managers of the G-SIB’s operating subsidiaries. To do so, we introduce a managerial effort problem into our model. Specifically, we assume that each subsidiary manager has to exert effort  $e \in \{0, 1\}$  to generate the cash flow  $\Delta$ . Subsidiary  $i$  receives  $\Delta$  with probability  $\theta_i$  if its manager exerts effort ( $e = 1$ ). Exerting effort is costly in the sense that it involves the loss of a private benefit  $B > 0$ . As before, we assume that  $\theta_1 + \theta_2 = 1$ , so that the cash flow  $\Delta$  is generated for sure (in one of the jurisdictions) if both subsidiaries exert effort. On the other hand,

if the manager of subsidiary  $i$  does not exert effort ( $e = 0$ ), this subsidiary only receives  $\Delta$  with probability  $\theta_i - \epsilon$ . Therefore,  $\Delta$  realizes with probability less than one if at least one subsidiary manager shirks. For simplicity, we focus on the case in which TLAC takes the form of an outside equity stake  $\alpha_0$ .<sup>12</sup>

## 5.1 Incentives under MPOE Resolution

Before comparing incentives under MPOE and SPOE resolution, it is worthwhile pointing out a key robustness property of MPOE resolution. Since TLAC for each subsidiary is set to cover the shortfall  $R_1^{MPOE} - C_1^L = \bar{p}_2 \lambda V$  under MPOE, a run on short-term debt can be avoided by writing down claims on the bank's continuation value, irrespective of whether  $\Delta$  materializes. Therefore, successful resolution under MPOE does not depend on the presence of adequate managerial incentives to produce  $\Delta$ . However, relative to SPOE, MPOE reduces the amount of liquidity services provided by the G-SIB and, as we will show below, MPOE may result in muted incentives for managers to produce the cash flow  $\Delta$ . In sum, MPOE resolution results in more resilient but potentially less efficient G-SIBs.

What then are the incentives for a subsidiary manager, acting in the interests of inside equity holders of operating subsidiary  $i$ , to exert effort to generate cash flow  $\Delta$  under MPOE? When the manager exerts effort ( $e = 1$ ), inside equityholders obtain the following expected payoff: With probability  $p_1$ , the high aggregate cash-flow state obtains and the expected payoff to inside equityholders is  $(1 - \alpha_0^{MPOE})(C_1^H + \theta_i \Delta - R_1^{MPOE} + p_2^i V)$ . With probability  $(1 - p_1)(1 - \theta_i)$ , the low aggregate cash-flow  $C_1^L$  is realized and  $\Delta$  is not produced. In this case, equityholders are completely wiped out in resolution and receive zero. Finally, with probability  $(1 - p_1)\theta_i$ , the subsidiary receives

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<sup>12</sup>If TLAC is composed of both equity and long-term subordinated debt, the resulting additional leverage may improve incentives relative to the case in which all TLAC is in the form of outside equity. However, the relative ranking of incentives under SPOE and MPOE will be unaffected by this generalization. For a model that examines the incentive and risk-shifting properties of debt and equity-based TLAC (but without our focus on MPOE vs. SPOE in the context of a global resolution), see [Mendicino et al. \(2016\)](#).

$C_1^L + \Delta$ . In this case, because  $\Delta$  is available to reduce outstanding short-term debt, equityholders are only partially wiped out in resolution. Specifically, the fraction  $x$  of equity that is wiped out must satisfy  $x\bar{p}_2\lambda V = \bar{p}_2\lambda V - \Delta$ , such that inside equityholders receive an expected date-2 payoff of  $(1-x)(1-\alpha_0^{MPOE})p_2^i\lambda V = (1-\alpha_0^{MPOE})\frac{p_2^i}{\bar{p}_2}\Delta$ .<sup>13</sup> When the manager does not exert effort ( $e = 0$ ), inside equityholders' payoffs are analogous except that  $\Delta$  realizes only with probability  $\theta_i - \epsilon$ . Exerting effort is individually optimal for the manager of subsidiary  $i$  if producing  $\Delta$  with probability  $\theta_i$  leads to a higher payoff for the manager than receiving  $\Delta$  with probability  $\theta_i - \epsilon$  and enjoying the private benefit  $B$ :

$$p_1(1-\alpha_0^{MPOE})(C_1^H + \theta_i\Delta - R_1^{MPOE} + p_2^iV) + (1-p_1)\theta_i(1-\alpha_0^{MPOE})\frac{p_2^i}{\bar{p}_2}\Delta \geq$$

$$p_1(1-\alpha_0^{MPOE})(C_1^H + (\theta_i - \epsilon)\Delta - R_1^{MPOE} + p_2^iV) + (1-p_1)(\theta_i - \epsilon)(1-\alpha_0^{MPOE})\frac{p_2^i}{\bar{p}_2}\Delta + B \quad (14)$$

Collecting terms and simplifying, exerting effort is optimal for the manager of subsidiary  $i$  if:

$$p_1(1-\alpha_0^{MPOE})\epsilon\Delta + (1-p_1)(1-\alpha_0^{MPOE})\frac{p_2^i}{\bar{p}_2}\epsilon\Delta \geq B. \quad (15)$$

Note that the relevant incentive constraint is that of the low type (i.e.,  $p_2^i = p_2^L$ ), who is less likely to receive the continuation value  $V$  at date 2.<sup>14</sup>

## 5.2 Incentives under SPOE Resolution

To gauge incentives under SPOE resolution, we need to make an assumption about how profits are divided between the national banking subsidiaries. The most natural assumption is that the

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<sup>13</sup>There are two reasons why  $\Delta$  is paid out to reduce short-term debt. First, the high-type bank strictly prefers to do so, because raising funds against future cash flows is costly as it occurs at a discount. As before, the low-type bank will mimic the high type. Second, legally it would be difficult for the bank to effectively pay out a dividend  $\Delta$  just before going into resolution.

<sup>14</sup>To fully capture the incentive effects implied by (15), in this section we do not normalize  $p_2^L$  to zero, but allow for  $p_2^L \geq 0$ .

global holding company pays out a share  $\alpha_0^{SPOE}$  of its global earnings to outside shareholders, and that national operating subsidiaries receive the remaining share  $1 - \alpha_0^{SPOE}$  of the profits that were generated in that particular jurisdiction. Assuming that managers' objectives are aligned with the inside equity holders of the national operating subsidiaries, it is incentive compatible for the manager of operating subsidiary  $i$  to exert effort under SPOE resolution if:

$$\begin{aligned}
& p_1(1 - \alpha_0^{SPOE}) [C_1^H + \theta_i \Delta - R_1^{SPOE} + p_2^i V] \geq \\
& p_1(1 - \alpha_0^{SPOE}) [C_1^H + (\theta_i - \epsilon) \Delta - R_1^{SPOE} + p_2^i V] + B.
\end{aligned} \tag{16}$$

Note that under SPOE, the cash flow  $\Delta$  never accrues to inside equity holders in the low cash-flow state. Instead,  $\Delta$  is used to repay short-term debt in each subsidiary (recall that face value of short-term debt is higher under SPOE:  $R_1^{SPOE} = R_1^{MPOE} + (1 - \lambda)\bar{p}_2 V + \Delta/2$ ). Collecting terms and simplifying, effort is privately optimal under SPOE if

$$p_1(1 - \alpha_0^{SPOE})\epsilon\Delta \geq B. \tag{17}$$

### 5.3 Are Incentives Stronger under MPOE or SPOE?

Comparing the incentive constraints (14) and (16) reveals that differences in incentives under MPOE and SPOE resolution are driven by two effects. First, incentives under SPOE are muted because the operating subsidiary never receives the cash flow  $\Delta$  in the low cash-flow state. Effectively, the higher amount of short-term debt under SPOE results in debt overhang. Second, the required outside equity stakes  $\alpha_0$  differ across MPOE and SPOE. To determine the net incentive effect of the adopted resolution regime, we therefore need to calculate the equilibrium outside equity stakes  $\alpha_0^{MPOE}$  and  $\alpha_0^{SPOE}$ .

Under MPOE resolution, the outside equity stake issued by each national holding company  $i$  must generate funds of at least  $F - R_1^{MPOE}$ , and therefore satisfies

$$\alpha_{0,i}^{MPOE} [p_1(C_1^H + \theta_i\Delta - R_1^{MPOE} + \bar{p}_2V) + (1 - p_1)\theta_i\Delta] \geq F - C_1^L - \lambda\bar{p}_2V, \quad (18)$$

where the payoff in the low cash-flow state is the outside equityholders' expectation of the diminished equity stake  $(1 - p_1)\theta_i(1 - x)\bar{p}_2\lambda V = (1 - p_1)\theta_i\Delta$ . Substituting in for  $R_1^{MPOE}$ , this yields a minimum required outside equity issue of:

$$\alpha_{0,i}^{MPOE} = \frac{F - C_1^L - \bar{p}_2\lambda V}{p_1[C_1^H - C_1^L + \bar{p}_2(1 - \lambda)V] + \theta_i\Delta}. \quad (19)$$

Note that the required outside equity stake that is issued in each jurisdiction under MPOE depends on  $\theta_i$ , the probability that the additional cash flow  $\Delta$  realizes in jurisdiction  $i$ . This means that, under MPOE resolution, incentives will be affected by asymmetries across jurisdictions.

Under SPOE resolution, the outside equity stake issued by the global holding company must generate  $2(F - R_1^{SPOE})$  and therefore satisfies:

$$\alpha_0^{SPOE} [p_1(2C_1^H + \Delta - 2R_1^{SPOE} + 2\bar{p}_2V)] \geq 2(F - C_1^L - \bar{p}_2V - \Delta/2), \quad (20)$$

which, Substituting in for  $R_1^{SPOE}$ , yields a minimum required outside equity stake of:

$$\alpha_0^{SPOE} = \frac{F - C_1^L - \bar{p}_2V - \Delta/2}{p_1(C_1^H - C_1^L)}. \quad (21)$$

The required outside equity stake that is issued by the global holding company under SPOE does not depend on  $\theta_i$ . The reason is that it is irrelevant from the perspective of the global holding company which jurisdiction receives  $\Delta$ .

Overall, incentives to exert effort are therefore better under SPOE when the inside equity stake that can be retained under SPOE is sufficiently large to the smaller of the inside equity stakes that can be retained under MPOE, as characterized in part (i) of Proposition 7 below.

To gain intuition for when the condition given in part (i) of Proposition 7, it is useful to first consider the symmetric case ( $\theta_1 = \theta_2 = 1/2$ ). It can be shown that in this case the required outside equity share under SPOE resolution is smaller than the required equity stakes under MPOE. Incentives to exert effort under MPOE and SPOE resolution are then affected by two countervailing forces. On the one hand, SPOE resolution dampens incentives for national banking operations to produce the cash flow  $\Delta$ , because  $\Delta$  never accrues to equity holders in the low cash-flow state. This makes effort harder to sustain under SPOE resolution. On the other hand, the outside equity stake that is required to guarantee sufficient TLAC is smaller under SPOE ( $\alpha_0^{SPOE} < \alpha_0^{MPOE}$ ), so that inside equity holders receive a larger share of profits under SPOE, which increases incentives to exert effort. The net effect depends on the relative size of these two forces. As shown in part (ii) of Proposition 7, incentives to exert effort are stronger under SPOE when  $\Delta$  is sufficiently large.

Consider next the asymmetric case ( $\theta_1 \neq \theta_2$ ). Whereas asymmetry does not affect incentives for operating subsidiaries under SPOE, it worsens incentives for one of the two operating subsidiaries under MPOE, because the operating subsidiary for which  $\theta_i < 1/2$  has to issue a larger outside equity stake. Because the incentive constraint has to be satisfied for both operating subsidiaries, asymmetry in the probabilities  $\theta_i$  therefore makes it harder to sustain effort provision under MPOE relative to SPOE, as stated in part (ii) of Proposition 7.<sup>15</sup>

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<sup>15</sup>In our analysis of moral hazard concerns, we focused on how operating subsidiary managers can be incentivized through equity participation to offset the lack of discipline from debt markets under both MPOE and SPOE resolution. Alternatively, moral hazard concerns could be addressed by monitoring subsidiary managers. The analysis above can be straightforwardly adapted to this alternative specification by focusing on the company's incentives to monitor, with  $e \in \{0, 1\}$  standing for monitoring effort as opposed to the effort needed to produce the cash flow  $\Delta$ .

**Proposition 7. Incentives under MPOE and SPOE.**

(i) *Incentives to exert effort are higher under SPOE than under MPOE when the retained inside equity stake under SPOE is sufficiently larger than the smaller of the inside equity stakes under MPOE,*

$$\frac{1 - \alpha_0^{SPOE}}{\min_i [1 - \alpha_{0,i}^{MPOE}]} > 1 + \frac{1 - p_1}{p_1} \frac{p_2^L}{\bar{p}_2}. \quad (22)$$

(ii) *When the probabilities of receiving the additional cash flow  $\Delta$  are symmetric across jurisdictions ( $\theta_1 = \theta_2 = \frac{1}{2}$ ), a sufficient condition for better incentives under SPOE is that*

$$\frac{\Delta}{2} > (1 - p_1)(C_1^H - C_1^L) \frac{p_2^L}{\bar{p}_2}. \quad (23)$$

(iii) *When the probabilities of receiving the additional cash flow  $\Delta$  are asymmetric across jurisdictions ( $\theta_1 \neq \theta_2$ ), it becomes easier to sustain incentives under SPOE, because incentives are reduced for one of the two subsidiaries under MPOE.*

## 6 Discussion

In this section, we link our analysis to the current policy discussion on bank resolution. In Section 6.1, we discuss how our results help illuminate the recent TLAC proposals put forward by the Financial Stability Board (FSB) and the Federal Reserve. In Section 6.2, we provide a more general perspective on some of the unresolved issues regarding G-SIB resolution.

### 6.1 Assessing the FSB and Fed TLAC Proposals

As highlighted by our analysis, a major challenge in G-SIB resolution under SPOE is ensuring that national regulators are willing to cooperate. Such cooperation cannot be taken for granted, and

national regulators may end up preferring to ring-fence domestic assets rather than exposing their country to a costly cross-border SPOE resolution, with potentially large transfers to recapitalize operations in another jurisdiction. The recent resolution proposals by the [Financial Stability Board \(FSB\) \(2015\)](#) and the [Federal Reserve \(2015\)](#) recognize this challenge. First, under the FSB proposal, minimum TLAC requirements are not imposed on a consolidated basis on a whole banking group, but rather on “each resolution entity within each G-SIB” [FSB (2015), p. 9]. Moreover, what counts as a resolution entity is flexible.<sup>16</sup> At least in principle this flexibility allows regulators to set resolution-entity boundaries such that cross-jurisdictional transfers do not violate ex-post incentive compatibility constraints.

Second, within resolution entities, both the FSB and the Federal Reserve envision that incentive compatibility could be ensured through “prepositioned resources”, essentially TLAC that is pre-assigned to a particular jurisdiction. For example, the Federal Reserve’s rules require U.S.-based intermediate holding companies of foreign G-SIBs to hold minimum levels of so-called “internal TLAC” in the form of convertible long-term debt that is issued to the foreign parent. The idea is that if the intermediate holding company (or U.S. regulator) holds the trigger for conversion of this convertible long-term debt, losses in the intermediate holding company can be pushed up unilaterally to the foreign parent holding company. This is effectively a pre-allocation of loss-absorbing capacity, so as to ensure incentive compatibility in the resolution of a US subsidiary of a foreign G-SIB.

Broadly speaking, the constrained-efficient resolution regime described in Proposition 6, under which loss-absorbing capacity that is shared across jurisdictions is supplemented by entity-specific national TLAC requirements, supports the view that loss-absorbing capacity may have to be pre-assigned to jurisdictions. At the same time, our results call into question whether internal TLAC is

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<sup>16</sup>“A resolution entity may be a parent company, an intermediate or ultimate holding company, or an operating subsidiary. A G-SIB may have one or more resolution entities.” [FSB (2015), p. 9]. Note that the FSB rules do not require the resolution entity to be a holding company.

the best way to implement the constrained optimal resolution regime. In particular, note that the diversifiable cash flow  $\Delta$  cannot be fully pre-assigned to a jurisdiction. Because  $\Delta$  is a cash flow that realizes at date 1, even in the presence of sufficient internal TLAC,  $\Delta$  can be ring-fenced and is therefore not necessarily available as loss-absorbing capacity. In fact, our model suggests that there may actually be a role for preassigned *external* TLAC at the intermediate holding company level. For example, by issuing some long-term debt as loss-absorbing capital to external investors, the intermediate holding company can limit the size of the losses that is passed up to the global holding company, thereby limiting cross-jurisdictional transfers and ensuring that the foreign regulator's ex-post incentive constraint is satisfied during a resolution. This form of a preassigned external TLAC requirement is not what is proposed by the Federal Reserve. On the contrary, the Fed's rules on internal TLAC require that all loss-absorbing capacity at the intermediate holding company level is issued directly to the foreign parent.

Third, the Federal Reserve's internal TLAC rules appear to go beyond simply ensuring incentive compatibility and efficient cooperation between regulators during a resolution. Our analysis suggests that it is efficient to set preassigned TLAC requirements to just satisfy ex-post incentive compatibility, thereby maximizing the diversification benefits from shared loss-absorbing capacity. However, the internal TLAC rules proposed by the Federal Reserve seem to go significantly beyond what is required for incentive compatibility: Out of the 21% TLAC requirement at the global holding company level, the proposed rules require that 18% be pre-positioned in the intermediate holding companies as internal TLAC. By pre-positioning almost all loss-absorbing capacity, this requirement essentially eliminates the sharing of loss-absorption across jurisdictions, thereby diminishing one of the key advantages of a global SPOE resolution.

Finally, according to our analysis, the Fed's proposed requirement that a certain amount of TLAC has to be in the form of long-term debt seems unnecessarily restrictive. While our model

suggests that an overall TLAC requirement is indeed necessary to facilitate an orderly resolution, it does not provide a justification for requiring that TLAC be in the form of long-term debt. From the regulator’s perspective all that matters is that there is sufficient TLAC to guarantee the safety of the operating affiliates’ short-term debt. In the absence of any further requirement on the composition of TLAC, the bank issuer may well prefer to issue long-term debt, but it does not follow from this preference that long-term debt should be required.

## 6.2 Unresolved Issues and Discussion of Assumptions

Notwithstanding the efforts of the FSB, the FDIC and the Federal Reserve, there remains significant uncertainty about how the resolution of a G-SIB will work ex post, and how national regulators would coordinate the intervention. In this section, we provide a broad discussion of some these issues and how they relate to our model.

First, in the U.S. there remains uncertainty as to whether G-SIBs will be resolved under OLA or under a Chapter 11 bankruptcy procedure, potentially augmented by recovery and resolution plans (living wills). Currently, OLA is seen by U.S. regulators as a backstop to bankruptcy, which would be activated only if the organizational complexity of the G-SIB is such that invoking Chapter 11 would pose a systemic threat (see [Gruenberg \(2015\)](#)). However, to be a viable alternative to OLA, resolution under the bankruptcy code probably requires a much more detailed and credible pre-planned workout than is currently provided in living wills.<sup>17,18</sup>

A second major issue is the treatment of qualified financial contracts (QFCs) under OLA and bankruptcy. The exemption of QFCs from the automatic stay under Chapter 11 was a major

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<sup>17</sup>Some reform attempts to make bankruptcy a more viable option are underway. Indeed, the financial-services budget bill passed by the House of Representatives on July 7 2016 includes bankruptcy reform provisions to make the bankruptcy procedure better able to handle the resolution of a G-SIB. See Bankruptcy Legislation For Big Banks Gains Steam by Ryan Tracy *Wall Street Journal* July 7 2016

<sup>18</sup>In the U.S., a significant fraction of the living wills that banks have put forward to facilitate a resolution under the bankruptcy code are currently deemed insufficient by the Federal Reserve. See “US rejects ‘living wills’ of five banks,” *Financial Times*, April 13, 2016; “Regulators reject ‘living wills’ of five big U.S. Banks,” *Wall Street Journal*, April 13, 2016; and “Living wills of 5 banks fail to pass muster,” *New York Times*, April 13, 2016.

source of inefficiency in the bankruptcy of Lehman Brothers (see [Bolton and Oehmke \(2015\)](#) for an analysis of the effects of the bankruptcy treatment of QFCs). In particular, the main objective of bank resolution, namely preventing a creditor run on the bank's operating subsidiaries, is difficult to achieve when derivative and repo counterparties are free to terminate their contracts. Whereas under OLA the resolution authority can put a stay on QFCs, there currently is no general stay on these contracts under Chapter 11. In the absence of a stay imposed by the bankruptcy code, G-SIB resolution under Chapter 11 then requires that banks privately amend the contractual terms of their derivative contracts to include the possibility of a stay. Moreover, even under OLA, which allows for a stay on QFCs, there remains uncertainty whether this stay would extend to QFCs written in other jurisdictions.

A third major issue is liquidity provision during resolution. In principle, sufficient TLAC at the holding company level should ensure that there is no impairment of short-term debt or QFCs issued by the operating affiliates. Therefore, in the presence of sufficient TLAC, there should be no reason for short-term creditors, depositors, or QFC counterparties to run. While our analysis assumes that sufficient TLAC can indeed rule out runs, a self-fulfilling panic run could nonetheless destabilize operating subsidiaries even in the presence of sufficient TLAC. In that event, a carefully designed liquidity-provision facility that can be tapped during resolution is another key component of successful resolution. Under OLA, such liquidity provision would be provided via the orderly liquidation fund.

## **7 Conclusion**

This paper studies the resolution of global, systemically important banks (G-SIBs). Credible resolution regimes for these institutions are a key component to ending too-big-to-fail, and regulators around the world have been working on proposals regarding the appropriate design of such a reso-

lution regimes ([Federal Deposit Insurance and Bank of England \(2012\)](#), [Financial Stability Board \(FSB\) \(2014\)](#)). We contribute to this discussion by providing a formal economic analysis of the resolution of global banks. Our analysis highlights that a key challenge in designing a successful resolution framework is that the banks in question are global, but are resolved by national regulators. Therefore, resolution mechanisms have to be designed with a careful eye on the incentives of both regulators and banks.

Our analysis yields four main results. First, resolution through a liability-side restructuring at the holding company level, as envisioned by the proposed SPOE and MPOE resolution models, has to go hand in hand with a requirement for holding companies to issue a sufficient amount of outside equity and subordinated long-term debt that provide loss-absorbing capacity in a crisis. Absent such a requirement, resolution exclusively through a liability side reconstruction becomes infeasible, leading to either a disorderly liquidation or a tax-funded bailout. Second, SPOE resolution is potentially more efficient than MPOE resolution because it permits cross-jurisdictional transfers. The resulting diversification implies that successful SPOE resolution can in principle be implemented with less loss-absorbing capital than MPOE resolution, allowing the financial institution to provide more socially valuable banking services.

Unfortunately, these benefits of SPOE resolution may be difficult or impossible to implement. Our third result shows that, from an ex-ante perspective, national regulators may not find it in their interest to set up SPOE resolution in the first place. Under these circumstances, MPOE resolution is the only viable option. Fourth, we show that, rather than cooperating in a planned SPOE resolution, national regulators may prefer to ring-fence assets ex post, leading to a breakdown of the SPOE resolution process. Under these circumstances, MPOE resolution, under which loss-absorbing capacity is not shared across jurisdictions, avoids an unplanned ex-post breakdown of the resolution process and is preferable. In fact, a hybrid model, in which a certain amount of loss-absorbing

capacity is pre-assigned to jurisdictions (while the remainder is shared across jurisdictions), is even better and is constrained optimal. Finally, we show that incentives for national banking subsidiaries may differ across MPOE and SPOE resolution. Here, our model identifies a tradeoff: SPOE resolution dampens incentives insofar as it involves an overhang of short-term debt and transfers of cash flow to the other jurisdiction. On the other hand, SPOE can allow for the retention of a larger inside equity stake, which has a positive effect on incentives.

Overall, a novelty of our analysis is that it highlights a close connection between successful bank resolution, operational complementarities across banking units held in different jurisdictions, and the organizational structures adopted by global banks. In particular, our analysis highlights that the more decentralized a global bank's activities, the greater the relative advantage of MPOE resolution. A one-size-fits-all approach to G-SIB resolution is therefore unlikely to be efficient.

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## Appendix

**Proof of Proposition 1:** We first show that  $d\Pi_{TLAC}/d\bar{p}_2 > 0$  whenever sufficient loss-absorbing capital requires issuing claims against the continuation value  $V$ , i.e., when  $F > p_1 C_1^H + (1-p_1)C_1^L + \gamma C_1^L + \theta\Delta$ . This can be seen directly from

$$\frac{d\Pi_{TLAC}}{d\bar{p}_2} = \frac{F - p_1 C_1^H - (1-p_1)C_1^L - \gamma C_1^L - \theta\Delta}{(\bar{p}_2)^2}. \quad (\text{A1})$$

Next, solving  $Pi_{TLAC} = \Pi_{noTLAC}$  for  $\bar{p}_2$  yields the cutoff

$$\bar{p}_2^*(\gamma, L) = \frac{F - p_1 C_1^H - (1-p_1 + \gamma)C_1^L - \theta\Delta}{F - p_1 C_1^H - (1-p_1 + \gamma)C_1^L - \theta\Delta + (1-p_1)(V-L) + \gamma(C_1^L + V)}. \quad (\text{A2})$$

Given that  $d\Pi_{TLAC}/d\bar{p}_2 > 0$ , risky short-term debt financing is chosen whenever  $\bar{p}_2 < \bar{p}_2^*(\gamma, L)$ .

**Proof of Proposition 7:** We first show that, as claimed in the text,  $\alpha_0^{SPOE} < \alpha_0^{MPOE}$  in the symmetric case when  $\theta_1 = \theta_2 = 1/2$ . For simplicity, we first consider the special case when  $\lambda = 1$ .

In this case,  $\alpha_0^{SPOE} < \alpha_0^{MPOE}$  requires that

$$\frac{\Delta [(1-p_1)C_1^L + p_1 C_1^H + \Delta/2 + \bar{p}_2 V - F]}{p_1(C_1^H - C_1^L) [p_1(C_1^H - C_1^L) + \Delta/2]} > 0, \quad (\text{A3})$$

which holds if and only if

$$(1-p_1)C_1^L + p_1 C_1^H + \Delta/2 + \bar{p}_2 V - F > 0. \quad (\text{A4})$$

Condition (A4) requires that the ex-ante setup cost  $F$  is smaller than total pledgeable cash flow, which must hold if the operating subsidiaries are able to raise financing. Noting that  $\frac{d\alpha_0^{MPOE}}{d\lambda} < 0$ , we see that in the symmetric case  $\alpha_0^{SPOE} < \alpha_0^{MPOE}$  continues to hold when  $\lambda < 1$ . To prove part

(i) of the proposition, note that incentives are better under SPOE resolution when

$$p_1(1 - \alpha_0^{SPOE}) > p_1(1 - \alpha_0^{MPOE}) + (1 - p_1)(1 - \alpha_0^{MPOE})\frac{p_2^L}{\bar{p}_2}. \quad (\text{A5})$$

To derive the sufficient condition, we set  $\lambda = 1$  and, substituting in (19) and (21), obtain

$$\frac{2 [F - p_1 C_1^H - (1 - p_1) C_1^L - \bar{p}_2 V - \Delta/2] [(1 - p_1)(C_1^H - C_1^L) p_2^L - \bar{p}_2 \Delta/2]}{(C_1^H - C_1^L) \bar{p}_2 [p_1(C_1^H - C_1^L) + \Delta/2]} > 0, \quad (\text{A6})$$

which holds when (23) is satisfied. Given that  $\frac{d\alpha_0^{MPOE}}{d\lambda} < 0$ , this condition is sufficient but not necessary. Part (ii) of the proposition then follows from the observation that asymmetry ( $\theta_1 \neq \theta_2$ ) reduces the inside equity stake of the subsidiary for which  $\theta_i < 1/2$ , thereby reducing incentives to produce  $\Delta$  under MPOE, while incentives under SPOE are not affected.