

# Bank Resolution and the Structure of Global Banks \*

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## Abstract

We study the efficient resolution of global banks in the presence of national regulators. *Single-point-of-entry* (SPOE) resolution, where loss-absorbing capacity is shared across jurisdictions, is efficient but may not be implementable. First, when expected cross-jurisdiction transfers are too asymmetric, national regulators will not agree to set up an efficient SPOE resolution regime ex ante. Second, when ex-post required transfers across jurisdictions are too large, national regulators choose to ring-fence local banking assets, leading to a breakdown of a planned SPOE resolution. In this case, constrained efficient resolution is achieved through *multiple-point-of-entry* (MPOE) resolution, where some loss-absorbing capacity is assigned ex ante to national holding companies in each jurisdiction. Our analysis highlights a complementarity between bank resolution and the organizational structure of global banks—the more decentralized a global bank’s operations, the greater the relative efficiency of MPOE resolution.

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In an attempt to end “too big to fail” and to avoid a repeat of the disorderly bankruptcy of Lehman Brothers, Title II of the Dodd-Frank Act calls for a new resolution mechanism for systemically important financial institutions, the orderly liquidation authority (OLA). Resolution under OLA is partially modeled after the FDIC receivership procedure used to resolve traditional banks. However, a central element of FDIC resolution is Purchase and Assumption (P&A), in which a healthy bank purchases assets and assumes liabilities of the troubled bank. For a modest-sized troubled bank, such a sale can usually be completed over a weekend, so that the resolved bank can continue operations on the following Monday, thereby minimizing market disruptions and contagion as well as protecting the deposit insurance fund. In contrast, for a global systemically important financial institution (G-SIFI), a transfer of assets and liabilities over a weekend, as envisioned by P&A, is typically not possible. Systemically important financial institutions are simply too large, and their assets too complicated, for P&A to work.

The central challenge posed by Title II of the Dodd-Frank Act is therefore to adapt the FDIC receivership model for small and medium-sized banks to the resolution of global systemically important financial institutions. The proposed solution ([Federal Deposit Insurance and Bank of England \(2012\)](#), [Financial Stability Board \(2014\)](#)) is to perform G-SIFI resolution entirely through an intervention on the liability side of the failing institution, thereby avoiding disruptions in the G-SIFI’s banking operations. Specifically, the troubled G-SIFI is recapitalized by writing down long-term liabilities (typically equity and subordinated debt) of a non-operating holding company, thereby plugging the hole opened up by operating losses. Struggling operating subsidiaries can remain open for business during this process. Therefore, a simple liability-side recapitalization through a non-operating holding company replaces P&A, so that G-SIFI resolution can be performed without touching any of the runnable short-term liabilities of the G-SIFI’s operating subsidiaries. Resolution

happens entirely at the level of non-operating holding companies of G-SIFIs, which will assume the losses and allow the necessary recapitalization of troubled operating subsidiaries.

Among policymakers, there has been a lively debate about two specific resolution models: 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. In contrast, under multiple-point-of-entry (MPOE) resolution, each national regulator performs a separate resolution (if necessary), drawing on loss-absorbing capacity that is held separately by national holding companies. Under this proposal, not all loss-absorbing capacity is shared; a U.K. subsidiary would be recapitalized at least partially by the associated U.K. holding company. Despite this ongoing policy debate, the advantages and disadvantages of SPOE and MPOE resolution are currently not well understood.

The aim of this paper is to develop a theoretical framework that characterizes the relevant trade-offs between SPOE and MPOE resolution. Our analysis establishes four main results. First, we show that bank resolution that is conducted exclusively through an intervention on the liability side—by writing down debt or equity of the financial institution’s holding company—has to go hand in hand with a requirement for holding companies to issue a sufficient amount of equity or long-term debt in order to guarantee sufficient loss-absorbing capacity. 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 a minimum amount of these securities, financial institutions may find it individually optimal to rely exclusively on short-term debt. This makes an orderly resolution by intervening on the liability side impossible.

Because short-term debt cannot be written down during a crisis, a bank run and ensuing disorderly liquidation or a tax-funded bailout would be 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 that operate 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, under the regulatory status quo, where multinational financial institutions are resolved by national regulators, national regulators may fail to set up an efficient SPOE resolution scheme. 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 cross-jurisdictional SPOE resolution and set up a national resolution scheme instead. From an ex-ante perspective, SPOE resolution is therefore feasible only when expected cross-jurisdictional transfers are sufficiently symmetric.

Fourth, even when regulators are willing to agree on an SPOE resolution mechanism ex ante, SPOE may not be implementable ex post when the resolution of multinational financial institutions is conducted by self-interested national regulatory authorities. Specifically, a successful SPOE resolution requires that national regulators be willing to cooperate in the middle of a crisis and make ex-post transfers across jurisdictions. If regulators cannot firmly bind themselves to actually making these transfers, ex post they may find it privately optimal not to make the required transfers

and to ring-fence assets instead. In particular, when the required transfers are sufficiently large, the necessary ex-post incentive constraints are not satisfied, leading to a breakdown of the SPOE resolution scheme. This, in turn, leaves a disorderly liquidation or a tax-funded bailout as the only remaining options. Our model shows that the likelihood of such an ex-post breakdown of a planned SPOE resolution depends on the operational structure of the financial institution at hand. Specifically, incentive-compatible SPOE resolution requires operational complementarities (such as those arising from joint cash management or other shared services) across national banking operations—it is the loss of these complementarities that incentivizes regulators not to ring-fence assets ex post.

When SPOE resolution is not ex-post incentive compatible, successful resolution requires an MPOE approach, with at least some loss-absorbing capacity held by national holding companies in each jurisdiction. While this structure eliminates some of the coinsurance benefits that would be achievable under SPOE resolution, it is preferable to a failed SPOE resolution that leads to liquidation or necessitates a bailout funded by taxpayers. The 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, we provide an extension of our model, in which the national operating subsidiaries are subject to a moral hazard problem. Whether incentives to produce cash flows are dampened under SPOE depends on the net effect of two forces. On the one hand, because cash flows are sometimes transferred to the other jurisdiction, SPOE dampens incentives relative to MPOE. On the other hand, because SPOE economizes on loss-absorbing capacity, under certain conditions the owners of the national banking operations retain a larger inside equity share under SPOE, leading to an improvement in incentives.

Overall, our model characterizes the conditions under which SPOE or MPOE resolution are optimal when multinational financial institutions are resolved by national regulators. For a specific G-SIFI, the efficient choice between these regimes depends on the nature of the underlying business risks and the complementarities between operational subsidiaries in different jurisdictions. A novel aspect of our approach is therefore 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. Successful bank resolution is therefore both a question of sufficient loss absorbing capacity and of an appropriate corporate structure. Finally, our analysis highlights 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 prevent efficient SPOE when required ex-post transfers are too large or anticipated ex-ante transfers too asymmetric.

This simplicity of our model necessarily implies that there are some important aspects of bank resolution that are not captured 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.

Our model formalizes and extends the existing policy discussion on bank resolution, in particular the thoughts on SPOE and MPOE resolution in an international context given in [Tucker \(2014a,b\)](#). Several other recent papers investigate different aspects of bank resolution. [Jackson and Skeel \(2012\)](#) and [Skeel \(2014\)](#) compare resolution under OLA with the alternative of restructuring failed

G-SIFIs under the bankruptcy code. Whereas our focus is on G-SIFIs, [Duffie \(2014\)](#) discusses the resolution of failing central counterparties, which, like G-SIFIs, may be too big to fail. [Walther and White \(2015\)](#) provide a model of national bank resolution in which regulators may be too soft during a resolution, for fear of spooking market participants. Finally, bank resolution through an intervention on the liability side shares certain aspects with balance sheet reconstruction via contingent convertible securities. For a survey of that literature, see [Flannery \(2014\)](#).

## 1 Model Setup

We consider a model with three dates,  $t = 0, 1, 2$ . A multinational financial institution operates two subsidiaries located in different jurisdictions,  $i = 1, 2$ . This captures, in a simple way, the structure of a global bank with operating subsidiaries in, say, the U.S. and the U.K.<sup>1</sup>

Each operating subsidiary runs its own stylized banking operation. 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 the date-0 issuance of an outside equity stake  $\alpha_0$ . We assume that outside equity and long-term subordinated debt are issued by the holding company, as is foreseen under OLA. Issuing these claims at the holding company level guarantees that the long-term claims that provide loss-absorbing capacity 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 are subordinated, allowing a

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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.

speedy resolution.<sup>2</sup> Moreover, issuing subordinated claims at the holding company level provides a particularly simple way to share loss absorbing capacity across jurisdictions, if so desired.

Bank resolution becomes relevant only if the banking operations that generate the fragility that bank resolution addresses generate benefits for society and are therefore worthwhile protecting. Accordingly, to capture the social benefits of banking activity, such as those arising from maturity transformation, we assume that each dollar of the bank's operations that is financed using safe short-term debt  $R_1$  yields a social benefit of  $\gamma$  over and above the cash flows that are generated by the bank's investments. This assumption captures, in reduced form, benefits from maturity transformation such as the provision of liquidity services (Diamond and Dybvig (1983)) and the disciplining benefits of short-term debt (Calomiris and Kahn (1991) and Diamond and Rajan (2001)). Alternatively, this assumption can be interpreted as stemming from a convenience yield of completely safe, money-like securities.

Banking operations yield cash flow 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  $C_1^L$ . With probability  $1 - p_1$ , the low aggregate state realizes and both subsidiaries receive the low cash flow  $C_1^L < C_1^H$ . The aggregate state captures 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 exposed to idiosyncratic cash flow risk at date 1. Specifically, we assume that one of the two banking subsidiaries receives an additional cash flow of  $\Delta$ . 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>3</sup> This assumption captures id-

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<sup>2</sup>In addition, to guarantee such structural subordination the holding company generally has no operations of its own; it is a non-operating holding company.

<sup>3</sup>One particularly simple case is  $\theta_1 = \theta_2 = 1/2$ , such that  $\Delta$  realizes with equal probability in each of the two jurisdictions. However, as we will see below, allowing for  $\theta_1 \neq \theta_2$  is interesting because it matters for regulators' incentives to agree to an SPOE resolution scheme.

iosyncratic 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 such that both operating subsidiaries 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 role for bank resolution at date 1.

Date 2 summarizes the continuation (or franchise) value of the two subsidiaries, both on their own and in combination. Specifically, we assume that with probability  $p_2^i$  the operating subsidiary in jurisdiction  $i$  receives a cash flow of  $V$  at date 2. With probability  $1 - p_2^i$ , the cash flow at date 2 is zero. The probability  $p_2^i$  of receiving the continuation cash flow is private information of the operating subsidiary in jurisdiction  $i$ . For simplicity, we assume that the probability of receiving the continuation value  $V$  is given by  $p_2^i \in \{0, 1\}$ . 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 the probability of the realization of the continuation value is private information implies that it is expensive for a banking operation with high  $p_2^i$  to raise funds against cash flows at date 2. Therefore, long-term debt and equity are expensive funding sources relative to short-term debt. If instead of continuing to date 2 the banking operation is liquidated at date 1, this yields a liquidation payoff of  $L$ . We assume that liquidation is inefficient, in the sense that it yields less than the market's expected cash flows from continuing the banking franchise,  $L < \bar{p}_2 V$ . This assumption captures the cost of a disorderly liquidation, possibly in the wake of a run on the banking operation.

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 split up at date 1, for example because national regulators invoke separate resolution procedures in each jurisdiction, this reduces the continuation value in jurisdiction  $i$  to  $\lambda V$ , where  $\lambda < 1$ . This assumption captures the loss of

economies of scope and shared services, such as cash management, across the the two operating subsidiaries. If the operating subsidiaries want to prevent the reduction in continuation value that results from splitting the global bank at date 1, they can do so by setting up redundant systems (e.g., each operating subsidiary has its own independent cash management system) at date 0. This requires paying a higher setup cost  $\tilde{F} > F$ . The operating subsidiaries may find it optimal to incur this cost, rather than losing economies of scope ex post, when a split of the global banking at date 1 is sufficiently likely.

Finally, each jurisdiction has its own national banking regulator. The regulator in jurisdiction  $i$  has the power to invoke bank resolution in its jurisdiction. We assume that each of the national regulators triggers resolution in its jurisdiction when the local operating subsidiary cannot meet its contractual date 1 repayment  $R_1$ . Moreover, the regulator in jurisdiction  $i$  can trigger its own resolution (and ring-fence assets) when a resolution process is started in the other jurisdiction.

Under the frictionless benchmark in Section 3, we assume that the regulators jointly maximize global welfare. However, in practice regulators in each jurisdiction generally concentrate on the best interests of their own jurisdiction. Accordingly, the key friction in our model, analyzed in Section 4 is that national regulators are self-interested, in the sense that they care more about their own jurisdiction. Notwithstanding the efforts of the G-20, the Financial Stability Board (FSB) and the Basel accords, the assumption that banks operate internationally but regulators pursue national interests reflects the status quo of bank regulation. For simplicity, we make the extreme assumption that each national regulator follows purely national objectives and cares only about cash flows in its own jurisdiction. However, this extreme form of national regulatory interest is not necessary. More generally, all of our insights apply as long as the regulator in jurisdiction  $i$  applies a discount to cash flows in jurisdiction  $j$ .

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

Irrespective of the specific approach (i.e., SPOE or MPOE), the central assumption of the proposed resolution mechanisms is that the bank holding company has a capital cushion—in the form of equity or subordinated debt—that is large enough to absorb potential losses of its operating subsidiaries. This loss-absorbing capital (LAC) makes sure that the short-term liabilities of the operating subsidiaries are safe—even if heavy losses reduce the value of operating subsidiary assets below its liabilities, the holding company has sufficient capital to plug the hole. Because of this, the operating subsidiary’s banking operations will not be disrupted by a creditor run, even in a crisis.<sup>4</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 interest to issue a sufficient amount of long-term debt or outside equity to guarantee sufficient loss-absorbing capacity. 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 exclusively on short-term debt financing, even at the risk of default at date 1. Therefore, a required minimum amount of loss-absorbing capital is an essential complement to the proposed SPOE and MPOE resolution approaches. Because this insight does not rely on multiple operating subsidiaries, this section focuses on one operating subsidiary in isolation.

Consider the financing choices of the owners of a single operating subsidiary. At date 0, the setup cost  $F$  can be raised 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

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<sup>4</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.

$\alpha_0$  issued to outside investors at date 0. In addition, at date 1 the operating subsidiary can issue further claims against date 2 cash flows by rolling over its (senior) short-term debt.<sup>5</sup>

In our framework, 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 ( $p_2^i = 1$ ) then makes the financing choices in its best interest, knowing that low type ( $p_2^i = 0$ ) will mimic these choices. Because of pooling with the low type, the high type will seek to avoid issuing claims against the continuation value  $V$ : 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>6</sup>

The discount on claims issued against the continuation value  $V$  implies a pecking order, under which the owners of the operating subsidiary first sell claims on the date 1 cash flows by issuing short-term debt. Up to a face value of  $C_1^L$  such short-term debt can always be repaid from the date 1 cash flow and can therefore be issued without incurring any dilution costs. Up to a face value of  $C_1^L + \bar{p}_2 V$ , the optimal strategy for the owners of the banking subsidiary is to issue short-term debt at date 0 and issue claims against the continuation value  $V$  at date 1 if the realized cash flow is smaller than the promised face value of short-term debt. Such state-contingent issuance against  $V$  is optimal because it minimizes dilution costs.

Taking into account the additional benefit 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 default risk. From a bank resolution perspective, the interesting case is therefore 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.

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<sup>5</sup>Although in principle the bank could also issue more equity at date 1, we do not consider this possibility for simplicity.

<sup>6</sup>Note that a separating equilibrium cannot exist because low types can always costlessly mimic high types.

**Assumption 1.** *Financing exclusively by short-term debt exposes the operating subsidiary to default risk. This requires that  $F > (1 + \gamma)(C_1^L + \bar{p}_2V)$ .*

When  $F > (1 + \gamma)(C_1^L + \bar{p}_2V)$ , there are two relevant funding structures to compare. One possibility is a funding structure that avoids default at date 1. To do so, the operating subsidiary issues the maximum amount of short-term debt that can always be rolled over at date 1,  $R_1 = C_1^L + \bar{p}_2V$ . The remaining funds are raised through a combination of subordinated long-term debt and equity issued by the holding company. 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 operating subsidiary defaults when the low cash flow  $C_1^L$  realizes 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,  $L < \bar{p}_2V$ .

We first consider the funding structure in which the holding company issues sufficient LAC such that the short-term debt issued by the subsidiary is safe. From the perspective of the owners of the operating subsidiary, it is always efficient to issue at least a minimum amount  $\tilde{R}_{LT}$  of long-term subordinated debt to make sure that all cash that may be carried forward in the firm from date 1 to date 2 is sold to investors. This ensures that 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 subordinated long-term debt  $R_{LT} \geq \tilde{R}_{LT}$  as loss-absorbing capital. Without loss of generality, we can therefore calculate the payoff to equity holders assuming that loss-absorbing capital is based solely on long-term subordinated debt.

Issuing the maximum amount of safe short-term debt, by setting the face value of short-term debt to  $R_1 = C_1^L + \bar{p}_2V$ , raises an amount  $(1 + \gamma)(C_1^L + \bar{p}_2V)$ , where  $\gamma$  captures the social value of safe short-term debt. Given this, a remaining amount  $F - (1 + \gamma)(C_1^L + \bar{p}_2V)$  has to be raised with

long-term subordinated debt. The face value of long-term subordinated debt  $R_{LT}$  must therefore satisfy

$$p_1\bar{p}_2R_{LT} + p_1(1 - \bar{p}_2)(C_1^H + \theta\Delta - C_1^L - \bar{p}_2V) + (1 - p_1)\theta\Delta = F - (1 + \gamma)(C_1^L + \bar{p}_2V). \quad (1)$$

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

$$R_{LT} = \frac{F - (1 + \gamma)(C_1^L - \bar{p}_2V) - p_1(1 - \bar{p}_2)(C_1^H + \theta\Delta - C_1^L - \bar{p}_2V) - (1 - p_1)\theta\Delta}{p_1\bar{p}_2}, \quad (2)$$

and the profit to the owners of the high-type operating subsidiary is given by

$$\begin{aligned} \Pi_{LAC} &= p_1 [C_1^H + \theta\Delta + V - R_1 - R_{LT}] \\ &= \frac{1}{\bar{p}_2} [p_1C_1^H + (1 - p_1)C_1^L + \theta\Delta + \bar{p}_2V + \gamma(C_1^L + \bar{p}_2V) - F]. \end{aligned} \quad (3)$$

The main observation here is that when sufficient loss-absorbing capital requires issuing claims against the continuation value  $V$  (i.e., when  $F > p_1C_1^H + (1 - p_1)C_1^L + \gamma C_1^L + \theta\Delta$ ), then the expected profit to the owners of an operating subsidiary of high type is lower when  $\bar{p}_2$  is low because claims against  $V$  are subject to a larger discount from fair value.

Now consider the second funding structure, where the entire amount  $F$  is funded by short-term debt issued by the operating subsidiary. In this case, as long as  $\Delta$  is not too large, the operating

subsidiary will default whenever the low cash flow  $C_1^L$  realizes, irrespective of the realization of  $\Delta$ . We will focus on this case, but the alternative case can be treated in very similar fashion.

**Assumption 2.** *If financing is exclusively in the form of short-term debt, the operating subsidiary defaults whenever  $C_1^L$  realizes. This requires that  $\bar{p}_2 V > \Delta$ .*

In order to raise  $F$  solely from short-term debt, the face value of short-term debt then has to satisfy

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

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, the owners of the operating subsidiary receive a payoff only when the high cash flow realizes. Their expected profit is given by

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

Comparing expected profits with and without loss-absorbing capacity, equations (3) and (6), shows that private incentives may be such that the owners of the banking operation do not issue securities that provide sufficient LAC and instead rely exclusively on short-term debt. To see this, note that financing with sufficient LAC dominates when claims against long-term cash flows are fairly priced ( $\bar{p}_2 = 1$ ). In this case, LAC 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 leads to inefficient liquidation in the low cash flow state. In contrast, when dilution costs on long-term cash flows are sufficiently high (i.e.,  $\bar{p}_2 < \bar{p}_2^* < 1$ ), risky debt financing is privately optimal, even though it leads to inefficient early liquidation and eliminates the social benefit of short-term debt. Because of this, SPOE and MPOE resolution schemes, both of which crucially rely on sufficient LAC, must in general be complemented by a minimum LAC requirement.

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

From a social perspective, the 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 leads to inefficient liquidation after low cash flow realizations and eliminates the social value of safe short-term debt securities (as captured by  $\gamma$ ). It is also worthwhile pointing out is 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. To the extent that, in addition, the government faces a commitment problem that leads to 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 with a benevolent supra-national regulator. This benevolent supra-national regulator will choose the resolution regime that maximizes the ex-ante expected value of the global bank and can commit to implement the required ex-post transfers across jurisdictions under SPOE resolution. After analyzing this benchmark case, we turn to the status quo of self-interested national regulators in Section 4. There we will see that national regulators may choose not to set up an efficient resolution regime ex ante and, even if they did, may fail to cooperate ex post.

The benchmark case in this section highlights the main advantage of SPOE resolution: The ability to make transfers across subsidiaries in different jurisdictions generates coinsurance benefits, which translate into lower required LAC for the global bank than under SPOE resolution. As a result, relative to MPOE resolution, SPOE resolution allows for a higher level of banking services  $R_1$ , generating a net social benefit of  $\gamma (R_1^{SPOE} - R_1^{MPOE})$ .

#### 3.1 MPOE

We first consider MPOE resolution. Under MPOE resolution, LAC is held separately in each jurisdiction. This means that we can consider each jurisdiction separately.

LAC in each jurisdiction must be set such that even after the lowest possible cash flow realization at date 1, the operating subsidiary can repay  $R_1$ . Given the worst possible cash flow realization  $C_1^L$ , the maximum amount that the subsidiary in jurisdiction  $i$  can repay at date 1 is given by  $C_1^L + \bar{p}_2 V$ : In the low cash-flow state, the subsidiary can repay  $C_1^L$  and can raise an additional  $\bar{p}_2 V$  against expected cash flows at date 2. Therefore, whenever  $F > C_1^L + \bar{p}_2 V$ , some LAC is required to guarantee that the subsidiary can continue to operate at date 1. Specifically, to maximize the benefits from banking activity, the subsidiary sets  $R_1$  to its maximum value  $R_1^{MPOE} = C_1^L + \bar{p}_2 V$

and then raises the remainder  $F - (1 + \gamma)R_1$  using subordinated debt or equity, which functions as LAC.

Privately, the subsidiary prefers to issue at least some subordinated long-term debt. The reason is that this allows the subsidiary to sell all fairly-valued date 1 cash flows. This requires that the face value of subordinated long-term debt is weakly larger than the maximum amount of cash that the firm may carry forward from date 1 to date 2:

$$R_{LT}^{MPOE} \geq C_1^H + \Delta - R_1 = C_1^H + \Delta - C_1^L - \bar{p}_2 V \equiv \tilde{R}_{LT}^{MPOE}. \quad (7)$$

The subsidiary is indifferent between all combinations of subordinated debt and equity for which  $R_{LT}^{MPOE} \geq \tilde{R}_{LT}^{MPOE}$ .

**Lemma 1.** *Under MPOE resolution, the subsidiary in jurisdiction  $i$  issues  $R_1^{MPOE} = C_1^L + \bar{p}_2 V$ . Required LAC is given by  $F - R_1^{MPOE} = F - (1 + \gamma)(C_1^L + \bar{p}_2 V)$  and is raised via a combination of equity and subordinated long-term debt. The subsidiary finds it privately optimal to raise at least  $\tilde{R}_{LT}^{MPOE} = C_1^H + \Delta - C_1^L - \bar{p}_2 V$  of the required LAC as subordinated long-term debt.*

### 3.2 SPOE

We now consider SPOE resolution. The advantage of SPOE resolution is that the idiosyncratic cash flow  $\Delta$  can be transferred across the two subsidiaries. Compared to MPOE, this raises the minimum cash flow received by each subsidiary at date 1 from  $C_1^L$  to  $C_1^L + \Delta/2$ , such that the maximum amount of short-term debt  $R_1$  that can always be repaid at date 1 is given by  $C_1^L + \Delta/2 + \bar{p}_2 V$  (i.e.,  $\Delta/2$  higher than under MPOE). Therefore, SPOE allows more banking activity than MPOE: Each subsidiary sets

$$R_1^{SPOE} = C_1^L + \Delta/2 + \bar{p}_2 V \geq R_1^{MPOE}. \quad (8)$$

LAC is needed if  $F > (1 + \gamma)(C_1^L + \Delta/2 + \bar{p}_2V)$ , which we assume is the case.<sup>7</sup> Then both operating subsidiaries set  $R_1 = C_1^L + \Delta/2 + \bar{p}_2V$  and the holding company raises the the shortfall by issuing subordinated debt or equity.

As under MPOE, it is privately optimal for the holding company to issue some 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 after they receive the high cash flow:

$$R_{LT}^{SPOE} \geq 2C_1^H + \Delta - 2R_1^{SPOE} = 2C_1^H + \Delta - 2(C_1^L + \Delta/2 + \bar{p}_2V) \equiv \tilde{R}_{LT}^{SPOE}. \quad (9)$$

The holding company is indifferent between all combinations of subordinated debt and equity for which  $R_{LT}^{SPOE} \geq \tilde{R}_{LT}^{SPOE}$ .

**Lemma 2.** *Under SPOE resolution, the subsidiary in each jurisdiction issues  $R_1^{SPOE} = C_1^L + \Delta/2 + \bar{p}_2V$ . Required LAC per subsidiary is given by  $F - (1 + \gamma)R_1^{SPOE} = F - (1 + \gamma)(C_1^L + \Delta/2 + \bar{p}_2V)$  and is raised via a combination of equity and subordinated long-term debt. The holding company finds it privately optimal to raise at least  $\tilde{R}_{LT}^{SPOE} = 2(C_1^H - C_1^L - \bar{p}_2V)$  of the required total LAC as subordinated long-term debt.*

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

**Proposition 2.** *In the benchmark case of a supra-national regulator, SPOE resolution dominates MPOE resolution because it allows for more banking activity at the same level of risk, generating a net social benefit (relative to MPOE resolution) of  $\gamma\Delta$ . Banks should be structured as multi-national holding companies, in which national banking subsidiaries share LAC that is held at the global holding company level.*

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<sup>7</sup>Note that transitioning from MPOE to SPOE completely eliminates the need for LAC when  $(1 + \gamma)(C_1^L + \bar{p}_2V) < F \leq (1 + \gamma)(C_1^L + \Delta/2 + \bar{p}_2V)$ .

Proposition 2 states that if regulators can commit to cooperate in the middle of a crisis and can bind themselves to actually making required transfers ex post, then SPOE resolution dominates MPOE. The reason is that the ability to make cross-jurisdictional transfers lowers the amount of loss-absorbing capital that is required to guarantee a successful resolution via a liability side reconstruction. This allows the G-SIFI to 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  $\gamma\Delta$ .

In addition, Proposition 2 highlights a correspondence between the adopted resolution scheme and organizational structure. When regulators can commit to making the ex-post transfers that are required under SPOE resolution, then even after a resolution at date 1 the two operating subsidiaries continue to provide banking services as part of the same multinational holding company structure. This allows subsidiaries to capitalize on economies of scope from shared services, as captured by the lower setup cost  $F < \tilde{F}$  when some functions (such as joint cash management) can be shared across subsidiaries. In short, under supranational regulation, SPOE resolution dominates MPOE and G-SIFIs would organize as multinational holding companies that rely as much as possible on shared services to generate economies of scope.

## 4 SPOE and MPOE with National Regulators

We now depart from the idealized framework of Section 3 and enrich the model to reflect that, in practice, bank resolution is conducted by self-interested national regulators. The main result 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 the preferred option. Overall, the regulatory status quo, under which the resolution of multinational banks is carried out by national regulators, therefore significantly limits the realizable benefits of SPOE resolution.

#### 4.1 Ex-ante Incentive Compatibility

We first consider the regulators' ex-ante incentives to agree in SPOE resolution. Specifically, we will show that regulators will only agree to set up an SPOE resolution regime 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  $\theta_i$ , the less likely it is that the regulator in jurisdiction  $i$  agrees to SPOE resolution across the two jurisdictions.

To see this, we consider first the benefit from entering an SPOE resolution scheme. Under a functioning resolution scheme, each bank can raise the amount of short term debt from  $R_1^{MPOE} = C_1^L + \bar{p}_2 V$  to  $R_1^{SPOE} = C_1^L + \bar{p}_2 V + \Delta/2$ . Given the net benefit of  $\gamma$  per dollar of short-term debt, a move from MPOE to SPOE resolution therefore yields a benefit of  $\gamma\Delta/2$  in each jurisdiction. Given that both subsidiaries issue  $\Delta/2$  of additional debt, this benefit accrues equally across the two jurisdiction. Moreover, note that this benefit does not depend on the probability  $\theta_i$  of receiving the cash flow  $\Delta$ .

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 activities outweigh the cost in the form of expected net transfers, which, based on the discussion above, requires that

$$\theta_1 - \theta_2 \leq \frac{\gamma}{1 - p_1}. \tag{10}$$

Analogously, the regulator in jurisdiction 2 is willing to enter an SPOE resolution regime ex ante when  $\theta_2 - \theta_1 \leq \frac{\gamma}{1 - p_1}$ . Putting together these two constraints (both regulators have to agree to SPOE), we arrive at the following proposition.

**Proposition 3.** *SPOE bank resolution is ex-ante incentive compatible only if for the regulator in each jurisdiction the benefit from increased banking activity outweighs the expected net transfer payments to the other jurisdiction. This requires that cash flows are sufficiently symmetric:*

$$|\theta_1 - \theta_2| \leq \frac{\gamma}{1 - p_1}. \tag{11}$$

Proposition 3 shows that successful ex-ante implementation of SPOE resolution depends on three factors. First, the probabilities  $\theta_i$  of receiving the additional cash flow  $\Delta$  must be sufficiently symmetric across the two jurisdictions. When one jurisdiction is significantly more likely than the

other to have 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. Second, SPOE is more likely to be ex-ante incentive compatible when benefit from banking activity  $\gamma$  is large. A larger benefit from banking activity makes it more likely that the regulator who is more likely to receive the cash flow  $\Delta$  is willing to make a net expected transfer to the other jurisdiction. Third, SPOE is more likely to be ex-ante incentive compatible the lower the probability  $1 - p_1$  that a transfer has to be made. 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. If costs and benefits are asymmetric, SPOE resolution will not be set up, despite its advantages over MPOE.

## 4.2 Ex-post Incentive Compatibility

We now consider the regulators' ex-post incentive constraints. The main question there 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 write off debt or equity to recapitalize 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 of shared services if the host subsidiary defaults  $\bar{p}_2(1 - \lambda)V$ . Second, when the cash flow  $\Delta$  realizes in the host jurisdiction, the regulator in the host jurisdiction may prefer to ring fence assets when the home regulator invokes SPOE resolution. Ring fencing is privately optimal when the transfer to the home subsidiary  $\Delta/2$  is larger than the expected loss of shared services for the host subsidiary in the case of ring fencing,  $\bar{p}_2(1 - \lambda)V$ . Given

our assumption of equal continuation values  $V$  in the two jurisdictions, these two conditions reduce to the same incentive constraint. Therefore, ex-post incentive compatibility in both jurisdictions therefore requires that

$$\frac{\Delta}{2} \leq \bar{p}_2(1 - \lambda)V. \quad (12)$$

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). Clearly, in these cases, the more robust MPOE resolution is preferable.

**Proposition 4.** *Ex-post incentive compatibility under MPOE and SPOE* In the presence of national regulators that cannot commit to ex-post transfers,

(i) *SPOE resolution combined with a multinational holding company structure is efficient if the required ex-post transfer is smaller than the loss of shared services that results from ring fencing,  $\frac{\Delta}{2} \leq \bar{p}_2(1 - \lambda)V$ .*

(ii) *MPOE resolution combined with separate national holding companies is efficient if the ex-post transfer required under SPOE exceeds the loss of shared services that results from ring fencing,  $\frac{\Delta}{2} > \bar{p}_2(1 - \lambda)V$ .*

Proposition 4 has two major implications. First, the proposition shows that when the transfers that are required under SPOE are too large, the necessary incentive constraint (12) is not satisfied, leading to a breakdown of the SPOE resolution scheme. Note that an ex-post breakdown of a planned SPOE resolution is the worst possible outcome: Having planned for an SPOE resolution,

the ex-post unwillingness of a regulator to make the required transfer leaves only a disorderly liquidation or a tax-funded bailout as viable options.

Second, Proposition 4 shows that incentive compatible SPOE resolution requires that there be operational complementarities (such as those arising from joint cash management or other shared services) across national banking operations: It is precisely the loss of these complementarities that incentivizes regulators not to ring-fence assets ex post. Note that this prediction is consistent with the observation that global banks that operate essentially independently across different jurisdictions (e.g., Santander) typically have a preference for MPOE resolution—the more decentralized a global financial institution, the greater the relative efficiency of MPOE resolution.

Taken together, these two observations highlight that 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. Therefore, a one-size-fits all approach to G-SIFI resolution is unlikely to be efficient—whether a global bank is resolved according to SPOE or MPOE should depend on the risks and the structure of that particular bank. For example, a multinational bank with significant idiosyncratic cash flow risk  $\Delta$  across jurisdictions, for which the incentive constraint (12) cannot be satisfied, should be resolved under MPOE resolution. Because of this, the operating subsidiaries are split during a resolution, such that setting up redundant systems for shared services at a higher initial setup cost  $\tilde{F} > F$  is likely to be efficient.

### 4.3 Optimal Ex-Post Incentive Compatible Bank 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 the above 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 assigned to a particular jurisdiction.

The idea behind such a hybrid model is simple. As shown above, a pure SPOE resolution breaks down when the required ex-post transfer violates the incentive constraint of one of the regulators. The optimal hybrid model reduces the cross-jurisdictional transfer to an amount that just satisfies both regulators' ex-post IC constraints. Given this smaller cross-jurisdictional transfer, some loss-absorbing capacity has to be held at the national level. The following proposition formalizes this intuition.

**Proposition 5. *Constrained optimal bank resolution.*** *The constrained-optimal bank resolution scheme combines LAC that is held at the international holding company level with local LAC in each jurisdiction. LAC at the international holding company level is set such that the cross-jurisdiction transfer  $T$  just satisfies the ex-post IC constraint,*

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

where  $T^* \leq \Delta/2$ . The remaining LAC is held by the national holding company in each jurisdiction. This allows banking activity of  $C_1^L + \bar{p}_2V + T^* \leq C_1^L + \bar{p}_2V + \Delta/2$  for each operating subsidiary.

In the presence of national regulatory interests, resolution of globally systemically important banks should therefore generally rely on both national and supra-national loss-absorbing capacity. A multinational holding company provides shared loss-absorbing capacity up to an amount that makes ex post transfers during a crisis just incentive compatible. The remaining required loss-absorbing capacity is held in the national holding companies in each jurisdiction. This loss-absorbing capacity is not shared, it is pre-assigned to a particular operating subsidiary. While this hybrid model does not generate the amount of socially valuable banking activity that would be possible under SPOE

resolution and a single multinational regulator (the benchmark case in Section 3), it exploits the advantages of cross-jurisdictionally shared loss-absorbing capacity to the extent possible under the status quo of national regulation of multinational financial institutions.

## 5 Bank Incentives under MPOE and SPOE

Under both MPOE and SPOE resolution, operating subsidiaries are left intact and only liabilities of the holding company are written down to bring the distressed G-SIFI back to solvency. An important concern is that this approach exacerbates moral hazard problems at the operating subsidiaries and, therefore, requires an organizational response by the bank to monitor and discipline subsidiary management. Under SPOE, this monitoring responsibility lies with the global holding company, whereas under MPOE it lies with each national holding company. Therefore, the resolution regime determines how the bank is organized and run internally. In this section, we analyze which implied organizational structure is more efficient at disciplining moral hazard at the operating subsidiary level.

The incentive problem induced by the bank resolution mechanism takes both the form of monitoring incentives for the holding company as well as incentives for management of the operating subsidiaries. For simplicity we only explicitly consider the latter in our model. To do so, we assume that each subsidiary has to exert effort to generate the idiosyncratic cash flow  $\Delta$ . Specifically, subsidiary  $i$  receives  $\Delta$  with probability  $\theta_i$  if it exerts effort. As before, we assume that  $\theta_1 + \theta_2 = 1$ , such that  $\Delta$  realizes for sure if both subsidiaries exert effort. On the other hand, if subsidiary  $i$  does not exert effort, it receives  $\Delta$  with probability  $\theta_i - \epsilon$ , but receives a private benefit  $B$ . Therefore,  $\Delta$  realizes with probability less than one if at least one subsidiary shirks. For simplicity, we assume in this section that LAC is held in the form of an outside equity stake  $\alpha_0$ .

## 5.1 Incentives under MPOE

We first consider the incentives to exert effort under MPOE resolution. A key simplification under the assumptions of our model is that under MPOE required LAC is not affected by the subsidiaries' effort choices because, for each subsidiary, LAC is set to cover a shortfall of  $R_1^{MPOE} - C_1^L$ , which is sufficient to avoid default irrespective of whether  $\Delta$  realizes.

What are the incentives for the owner of operating subsidiary  $i$  to exert effort in order to generate  $\Delta$  under MPOE? Effort is individually optimal for the owner of subsidiary  $i$  if exerting effort and producing  $\Delta$  for sure leads to a higher payoff than not exerting effort, generating  $\Delta$  with probability  $\theta_i - \epsilon$ , and receiving the private benefit  $B$ . Incentive compatibility therefore requires that

$$\begin{aligned} & (1 - \alpha_0^{MPOE}) [p_1(C_1^H + \theta_i\Delta - R_1^{MPOE} + p_2^iV) + (1 - p_1)\theta\Delta] > \\ & (1 - \alpha_0^{MPOE}) [p_1(C_1^H + (\theta_i - \epsilon)\Delta - R_1^{MPOE} + p_2^iV) + (1 - p_1)(\theta_i - \epsilon)\Delta] + B. \end{aligned} \quad (14)$$

Rewriting this condition, we find that exerting effort is individually optimal if

$$1 - \alpha_0^{MPOE} > \frac{B}{\epsilon\Delta}. \quad (15)$$

## 5.2 Incentives under SPOE

We now turn to the incentives to exert effort under SPOE. To do so, we have to make an assumption about how profits are divided up among the national banking operations. We assume that after the global holding company has paid out a share  $\alpha_0^{SPOE}$  to outside shareholders, it rebates the remaining profits to national operating subsidiaries in a pro rata fashion based on generated cash flows (i.e., each operating subsidiary receives a share  $1 - \alpha_0^{SPOE}$  of the profits it generated). Under

SPOE it is then individually optimal for operating subsidiary  $i$  to exert effort if

$$(1 - \alpha_0^{SPOE}) [p_1(C_1^H + \theta_i \Delta - R_1^{SPOE} + p_2^i V)] > (1 - \alpha_0^{SPOE}) [p_1(C_1^H + (\theta_i - \epsilon) \Delta - R_1^{SPOE} + p_2^i V)] + B. \quad (16)$$

Comparing the incentive constraints (16) and (14), we observe that there is a difference in the low cash flow state: Under SPOE, the idiosyncratic cash flow  $\Delta$  no longer accrues to the inside equity holder. Instead,  $\Delta/2$  is used to repay the higher face value of short-term debt (recall that  $R_1^{SPOE} = R_1^{MPOE} + \Delta/2$ ), while the remaining  $\Delta/2$  is transferred to the other operating subsidiary. This dampens the inside equity holder's incentives, such that effort is now privately optimal if

$$(1 - \alpha_0^{SPOE}) p_1 > \frac{B}{\epsilon \Delta}. \quad (17)$$

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

The preceding analysis shows that differences in incentives under MPOE and SPOE are driven by two effects. First, because the operating subsidiary does not receive  $\Delta$  in the low cash flow state under SPOE, the incentive constraint under SPOE is multiplied by the probability of the high cash flow,  $p_1$ . Second, the required outside equity stake  $\alpha_0$  differs across MPOE and SPOE resolution schemes. To determine the net incentive effect, we therefore need to calculate the outside equity stakes  $\alpha_0^{MPOE}$  and  $\alpha_0^{SPOE}$ . Under MPOE resolution, the outside equity stake issued by each national holding company must raise at least  $F - R_1^{MPOE}$  and therefore satisfies

$$\alpha_0^{MPOE} [p_1(C_1^H + \theta_i \Delta - R_1^{MPOE} + \bar{p}_2 V) + (1 - p_1) \theta \Delta] \geq F - C_1^L - \bar{p}_2 V, \quad (18)$$

which yields

$$\alpha_0^{MPOE} \geq \frac{F - C_1^L - \bar{p}_2 V}{p_1(C_1^H - C_1^L) + \theta_i \Delta}. \quad (19)$$

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 raise  $2(F - R_1^{SPOE})$  and therefore satisfies

$$\alpha_0^{SPOE} [p_1(2C_1^H + \Delta - 2R_1^{SPOE} + 2\bar{p}_2 V)] \geq 2(F - C_1^L - \Delta/2 - \bar{p}_2 V), \quad (20)$$

which yields

$$\alpha_0^{SPOE} \geq \frac{F - C_1^L - \bar{p}_2 V - \Delta/2}{p_1(C_1^H - C_1^L)}. \quad (21)$$

The required outside equity stake that is issued by the global holding company under SPOE does not depend on  $\theta_1$  or  $\theta_2$ . This is the case because the global holding company receives  $\Delta$  with probability one, such that it does not matter in which jurisdiction  $\Delta$  materializes.

Equations (19) and (21) yield an intuitive interpretation of the difference in the required outside equity shares under MPOE and SPOE resolution. Under SPOE, a smaller remaining amount has to be raised via outside equity, as revealed by a comparison of the numerators in (19) and (21). However, because under SPOE  $\Delta$  has already been pledged to short-term debt holders, the outside equity stake is issued against a smaller amount of remaining cash flows, as shown by a comparison of the denominators in (19) and (21). It can be shown that in the symmetric case ( $\theta_1 = \theta_2 = 1/2$ ),

the required outside equity share under SPOE resolution is smaller than the required equity stakes under MPOE. When  $\theta_1 \neq \theta_2$ , on the other hand, it is possible that  $\alpha_0^{SPOE} > \alpha_0^{MPOE}$  for the operating subsidiary that is more likely to receive the idiosyncratic cash flow  $\Delta$  (and therefore has the lower  $\alpha_0^{MPOE}$  between the two subsidiaries).

We start by considering the incentive differences between the two regimes in the symmetric case ( $\theta_1 = \theta_2 = 1/2$ ). In this case, a comparison of the incentive constraints (15) and (17) shows that the incentives to exert effort under MPOE and SPOE resolution are affected by two countervailing forces. On the one hand, SPOE resolution dampens incentives for national banking operations to produce the cash flow  $\Delta$ , because  $\Delta$  does not always accrue to equity holders because it is used to pay off short-term debt and is partially transferred to the operating subsidiary in the other jurisdiction. This makes effort harder to sustain under SPOE resolution. On the other hand, the lower required LAC under SPOE implies that  $\alpha_0^{SPOE} < \alpha_0^{MPOE}$ , such that equity holders receive a larger share of profits under SPOE, which increases the incentives for national banking operations to exert effort. The net effect depends on the relative size of these two effects. In the asymmetric case ( $\theta_1 \neq \theta_2$ ), an additional effect arises: While the required equity stake under SPOE resolution is not affected by asymmetry, incentives now become harder to sustain for one of the operating subsidiaries under MPOE. This makes it harder to satisfy the required incentive constraints under MPOE resolution, making it more likely that incentives are stronger under SPOE. The following proposition summarizes these results.

**Proposition 6. *Incentives under MPOE and SPOE.***

- (i) *When the probabilities of receiving the idiosyncratic cash flow  $\Delta$  are symmetric across jurisdictions ( $\theta_1 = \theta_2 = \frac{1}{2}$ ), SPOE resolution leads to reduced incentives relative to MPOE when*

$$\frac{\Delta}{2} < (1 - p_1)(C_1^H - C_1^L). \quad (22)$$

(ii) *When the probabilities of receiving the idiosyncratic cash flow  $\Delta$  are asymmetric across jurisdictions ( $\theta_1 \neq \theta_2$ ), it becomes easier to sustain incentives under SPOE relative to MPOE the larger the asymmetry of probabilities  $|\theta_1 - \theta_2|$ .*

The first part of Proposition 6 follows from the observation that in order to improve incentives relative to MPOE, the outside equity stake under SPOE must be sufficiently small, which requires that  $\Delta/2$ , the additional amount raised via short-term debt in each jurisdiction under SPOE, is sufficiently large. Therefore, when  $\Delta/2$  is below a threshold, incentives are harder to sustain under SPOE. The second part of Proposition 6 follows from the observation that asymmetry does not affect incentives for operating subsidiaries under SPOE, but worsens incentives for one of the two operating subsidiaries under MPOE. Because the relevant incentive constraints have to be satisfied at both operating subsidiaries, incentives become easier to sustain under SPOE relative to MPOE as asymmetry across the two subsidiaries increases. In sum, when benefits from the mutualization of liquidity across jurisdictions are relatively small, then MPOE is the preferred resolution mechanism in terms of addressing moral hazard concerns at the operating subsidiary level.

## 6 Conclusion

This paper proposes a model to study the resolution of global systemically financial institutions via an intervention on the liability side, as proposed by the Dodd-Frank Act and recent European bank resolution proposals ([Federal Deposit Insurance and Bank of England \(2012\)](#), [Financial Stability Board \(2014\)](#)). Our framework highlights that resolution regimes for multinational financial institution have to be designed with an eye on both the incentives of financial institutions and those of national regulators.

Our analysis yields four main results. First, resolution through a liability-side intervention 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 through a liability side reconstruction becomes infeasible, leading to either a disorderly liquidation or a tax-funded bailout. Second, SPOE resolution is more efficient than MPOE resolution because it allows cross-jurisdictional transfers. Therefore, successful SPOE resolution can in principle be implemented with less loss-absorbing capacity, allowing the financial institution to provide more socially valuable banking services. However, the 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. Second, 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, which avoids an unplanned ex-post breakdown of the planned resolution process, is preferable. In this case, a hybrid model, in which at least some loss-absorbing capacity is pre-assigned to jurisdictions, is optimal. Finally, incentives for national banking subsidiaries to produce cash flows may differ across MPOE and SPOE resolution. Here, our model identifies a tradeoff: SPOE resolution dampens incentives insofar as national banking operations internalize that some of the cash flows produced may be transferred 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. For example, the more decentralized a global bank's activities, the greater the relative advantage of MPOE resolution.

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## Appendix

**Comparing  $\alpha_0^{SPOE}$  and  $\alpha_0^{MPOE}$ .** This appendix provides additional detail for the comparison of  $\alpha_0^{SPOE}$  and  $\alpha_0^{MPOE}$  in Section 5.3. We first consider the symmetric case ( $\theta_1 = \theta_2 = 1/2$ ). In this case,  $\alpha_0^{SPOE} < \alpha_0^{MPOE}$  requires that

$$\frac{\Delta [(1 - p_1)C_1^L + p_1C_1^H + \Delta/2 + \bar{p}_2V - F]}{p_1(C_1^H - C_1^L) [p_1(C_1^H - C_1^L) + \Delta/2]} > 0, \quad (\text{A1})$$

which holds if and only if

$$(1 - p_1)C_1^L + p_1C_1^H + \Delta/2 + \bar{p}_2V - F > 0. \quad (\text{A2})$$

Condition (A2) 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.

We now show that in the asymmetric case ( $\theta_1 \neq \theta_2$ ) it is possible that for one of the two operating subsidiaries  $\alpha_0^{SPOE} > \alpha_0^{MPOE}$ . To see this, note that  $\alpha_0^{MPOE}$  is monotonically increasing in  $\theta_i$ . There is therefore a critical value  $\tilde{\theta}$  such that  $\alpha_0^{SPOE} = \alpha_0^{MPOE}$ . From (19) and (21), we can determine this critical value as

$$\tilde{\theta} = \frac{1}{2} \frac{p_1(C_1^H - C_1^L)}{F - C_1^L - \Delta/2 - \bar{p}_2}. \quad (\text{A3})$$

Given that  $\theta_i \in [0, 1]$ , we now check whether it is possible that  $\tilde{\theta} < 1$ , which requires that

$$F > \underbrace{(1 - p_1)C_1^L + p_1C_1^H + \bar{p}_2V + \Delta/2}_{\text{total pledgeable CF}} - p_1(C_1^H - C_1^L)/2, \quad (\text{A4})$$

which cannot be ruled out.