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, 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 national holding companies, is efficient. 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.

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 costs of the failure of such an institution, with sweeping repercussions for the financial system and the broader economy. Yet, implicit public guarantees that would prevent such failures are equally costly, creating moral hazard in the form of increased risk taking and incentives for financial institutions to become larger and more complex.

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 global systemically important banks (G-SIBs), the orderly liquidation authority (OLA). Resolution under OLA is partially modeled after the FDIC receivership procedure used to resolve smaller and medium-sized 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 bank, such a sale can usually be completed over a weekend. The resolved bank can therefore resume operations on the following Monday, thereby minimizing market disruptions and contagion. In contrast, for a G-SIB, 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 assets too complicated, for P&A too work. In addition, the resolution of G-SIBs has an inherent international (i.e., cross-jurisdictional) component that is not generally an issue when the FDIC resolve a small to medium-sized bank.

The central challenge posed by Title II of the Dodd-Frank Act is therefore to adapt the FDIC receivership model so that it can handle the resolution of a G-SIB. The proposed solution is to perform G-SIB resolution entirely through an intervention on the liability side 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 remain open for business during 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. Therefore, loss-absorbing capacity is not shared across jurisdictions. 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 therefore shared across jurisdictions. For example, a U.K. operating subsidiary could be recapitalized by a U.S. holding company.

This paper develops a theoretical framework that characterizes the relevant trade-offs between MPOE and SPOE resolution, which, despite the ongoing policy debate, are currently not well understood. 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. 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 loss-absorbing securities, financial institutions may choose to rely mainly on short-term debt as a source of funding. Because this short-term debt
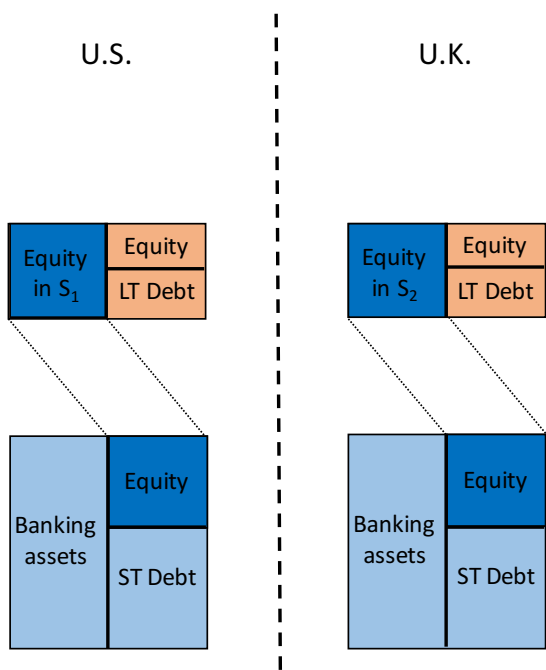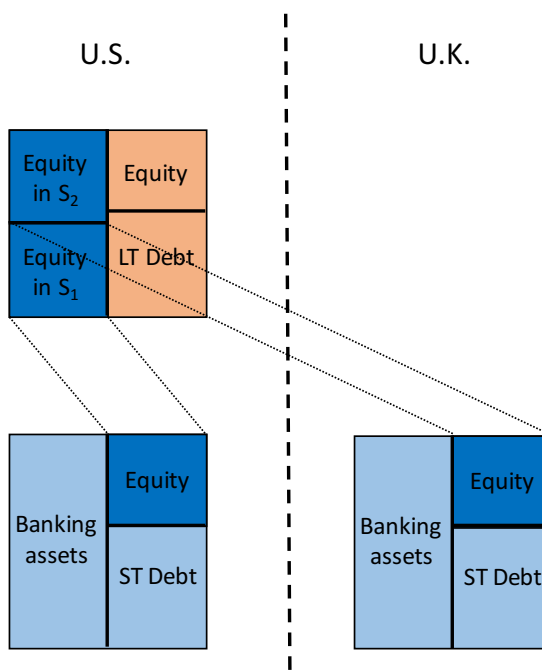
Figure 1: **MPOE and SPOE resolution.** The figure illustrates Multiple Point of Entry (MPOE) and Single Point of Entry (SPOE) resolution. Under MPOE, loss-absorbing capital (in the form of outside equity and long-term debt) is issued separately by national holding companies in each jurisdiction. Under SPOE, loss-absorbing capital is issued by a global holding company and is therefore shared across jurisdictions.

is runnable, and therefore cannot 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 supranational 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 an efficient cross-jurisdiction SPOE resolution and sets 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, ex post they may find it in their interest not to make the required transfers and ring-fence 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, 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. 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, MPOE resolution, where loss-absorbing capacity is held by national holding companies in each jurisdiction, is more efficient. 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 provide for a successful resolution even 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 baseline model, we investigate the moral hazard consequences of shared loss-absorbing capacity under SPOE resolution. Whether the operating subsidiaries' incentives to produce cash flow are dampened under SPOE depends on the net effect of two forces. On the one hand, because cash flows generated in one jurisdiction are sometimes transferred to the other jurisdiction, SPOE dampens incentives relative to MPOE. On the other hand, because it economizes on loss-absorbing capacity, SPOE resolution can allow owners of the national banking operations to retain larger (inside) equity stakes, leading to an improvement in incentives.

Overall, our model characterizes the conditions under which SPOE or MPOE resolution are more efficient, given the regulatory status quo under which multinational financial institutions are resolved by national regulators. Our results highlight that this trade-off 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

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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 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.

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 failed G-SIBs under the bankruptcy code. 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 foreign asset and equity shares 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. Related, Beck and Wagner (2013) find

that the benefits from supra-national regulation increase in cross-border externalities but decrease in 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 papers by exploring the supra-national aspects of bank resolution. Finally, the idea of conducting bank resolution through an intervention on the liability side is related to recapitalization (outside of resolution) via contingent convertible securities (CoCos). For a survey of this literature, see Flannery (2014).

1 Model Setup

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

There is a multinational financial institution that operates two subsidiaries located in different jurisdictions, $i = 1, 2$. This assumption captures, in a simple way, the structure of a global bank with operating subsidiaries in, say, the U.S. and the U.K.[1]

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

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[1]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.

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 α_0 that is issued at date 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 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, allowing a speedy resolution.[2] Moreover, issuing subordinated claims at the holding company level allows for the loss-absorbing capacity that is provided by these securities to be shared 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 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 γ 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, these benefits from banking can be interpreted as stemming from a convenience yield of safe, money-like securities issued by the bank.

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

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[2]In addition, to guarantee structural subordination, the holding company is generally required not to have any operations of its own; it is a non-operating holding company.

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 diversifiable cash flow risk at date 1. Specifically, we assume that one of the two banking subsidiaries receives an additional cash flow of Δ. This additional cash flow Δ is received by the operating subsidiary in jurisdiction i with probability θ_i, where $\theta_1 + \theta_2 = 1$.[3] This assumption captures diversifiable risk in the sense that, even though Δ 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 Δ. 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.

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 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 bank 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. In the case 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

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[3]One particularly simple case is $\theta_1 = \theta_2 = 1/2$, such that the additional cash flow Δ 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.

the market's expected cash flows from continuing the banking franchise, $L < \bar{p}_2 V$. Moreover, a run and ensuing liquidation in jurisdiction i has s spillover cost of S in the other jurisdiction j. Jointly, these assumptions capture the cost of a disorderly liquidation in the wake of a run on the banking operation, generating a role for resolution.

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 λV, where $\lambda < 1$. This assumption 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 $\widetilde{F} > F$. However, when a split-up of the global bank is sufficiently likely, it may be optimal to incur this higher setup cost, rather than losing economies of scope ex post. A key implication of this assumption is that it generates a link between the resolution method adopted for a bank and its operational structure (i.e., heavy reliance on shared services or the creation of redundant systems).

1.2 National Bank Regulators

Whereas the bank is global (i.e., it operates across the two jurisdiction), bank resolution is carried out by national regulators in each jurisdiction. There are two instances under which the regulator in jurisdiction i can invoke resolution. First, each of the national regulators triggers resolution in its

jurisdiction when the local operating subsidiary cannot meet its contractual date 1 repayment R_1.

Second, the regulator in jurisdiction i can trigger its own resolution (and ring-fence assets) when resolution has been invoked by the regulator in the other jurisdiction.

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 then contrast this benchmark with the more realistic case, 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. In particular, 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) makes it impossible for regulators to credibly commit to cooperating with other regulators during a resolution, so that regulators will ultimately act in their own national interest.[4] 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 interests 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 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. A sufficient amount of total loss-absorbing capital (TLAC) makes sure that the short-term liabilities

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[4]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.

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.[5]

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. This implies that 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 that operate in different jurisdictions, for the remainder of this section we focus on one operating subsidiary in isolation (and abstract away from complementarities across jurisdictions and the decision to rely on shared services or set up redundant systems).

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 α_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.

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[5]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.

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.[6]

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 γ, 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.

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

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[6]Separating equilibria do not exist because banks with low continuation values can always costlessly mimic high types.

When $F > (1 + \gamma)(C_1^L + \overline{p}_2 V)$, 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, $R_1 = C_1^L + \overline{p}_2 V$. 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 bank is exposed to default risk because it may fail to roll over 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, $L < \overline{p}_2 V$.

We first consider the funding structure in which the holding company issues sufficient TLAC 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 $\hat{R}_{LT}$ 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 α_0 and 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 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 $R_1 = C_1^L + \overline{p}_2 V$, raises an amount $(1 + \gamma)(C_1^L + \overline{p}_2 V)$, where γ captures the social value of safe short-term debt. Given this, a remaining amount $F - (1 + \gamma)(C_1^L + \overline{p}_2 V)$ has to be raised via

long-term subordinated debt. The face value of long-term subordinated debt R_{LT} therefore satisfies

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

This breakeven condition captures that R_{LT} is paid back in full when the high cash flow C_1^H 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

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

and the profit to the owners of the high-type operating subsidiary can be written as

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\begin{aligned}
\Pi_{TLAC} &= p_1 \left[C_1^H + \theta\Delta + V - R_1 - R_{LT} \right] \\
&= \frac{1}{\bar{p}_2} \left[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 \right]. \qquad (3)
\end{aligned}
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The main observation here is that when having sufficient loss-absorbing capital requires issuing claims against the continuation value V (i.e., when $F > p_1 C_1^H + (1-p_1)C_1^L + \gamma C_1^L + \theta\Delta$), then the expected profit to the owners of a high-type banking operation is lower when $\bar{p}_2$ is low, because claims against V are sold at a larger discount.

Now consider the second funding structure, under which the entire amount F is funded by short-term debt. In this case, as long as Δ is not too large, the operating subsidiary will default whenever the low cash flow C_1^L realizes, irrespective of the realization of Δ. We will focus on this

case, but the alternative case (where receiving Δ allow the operating subsidiary to continue) 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, irrespective of whether the additional cash flow Δ is received. This requires that $\Delta < \frac{F - C_1^L - (1-p_1)L - p_1\bar{p}_2 V}{p_1 + (1-p_1)\theta}$.*

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

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

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

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

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

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

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 TLAC and instead rely exclusively on short-term debt. To see

this, note 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 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., 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. Because of this, 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 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 γ). 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, 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. After analyzing this benchmark case, we then turn to the regulatory status quo, under which the resolution is carried out by self-interested national regulators in Section 4. There we will see that national regulators may choose not to set up and efficient resolution regime ex ante and, even if they did, may fail to cooperate ex post.

The benchmark case discussed in this section highlights 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 than under MPOE resolution. This, in turn, implies that SPOE resolution allows for a higher level of banking services generated by the safe short-term liabilities R_1, generating a net social benefit (relative to MPOE resolution) of $\gamma \left(R_1^{SPOE} - R_1^{MPOE} \right)$. 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 capture economies of scale and scope from shared services.

3.1 MPOE Resolution

We first consider MPOE resolution. When resolution is necessary, MPOE involves a separate resolution in each jurisdiction, such that the global bank is split up during resolution in the low cash flow state. TLAC for each subsidiary is held by the respective national holding company and is not shared across jurisdictions.

TLAC in each jurisdiction must be set such that, even after the lowest possible cash flow realization at date 1 and a potential split of the global bank during resolution, the operating subsidiary can meet its short-term liabilities R_1. The maximum face value such that short-term debt is safe is given by the low cash flow realization C_1^L plus funds that the subsidiary can raise against cash flows at date 2. How much can be raised against date 2 depends on whether the subsidiaries have redundant systems in place. Without redundant systems, splitting up the bank at date 1 leads to a reduction in expected cash flows to $\lambda \overline{p}_2 V$, such that the maximum amount of safe short-term debt is $C_1^L + \lambda \overline{p}_2 V$. In the presence of redundant systems, expected date 2 cash flows are equal to $\overline{p}_2 V$, thereby supporting a maximum of $C_1^L + \overline{p}_2 V$ of short-term debt. However, recall that setting up redundant systems has a cost; it requires raising $\widetilde{F} > F$ at date 0. Therefore, it is efficient to set up redundant systems only if the benefits from increased short-term debt $\gamma(1 - \lambda)\overline{p}_2 V$ and the elimination of expected separation costs $(1 - p_1)(1 - \lambda)\overline{p}_2 V$ outweigh the additional ex-ante investment $\widetilde{F} - F$, resulting in effective redundancy or separation costs of $\min[\widetilde{F} - F, (1 - p_1 + \gamma)(1 - \lambda)\overline{p}_2 V]$.

TLAC is required whenever the setup cost exceeds the amount that can be raised with safe short-term debt. Specifically, depending on whether redundant systems are are set up, the national holding company raises either $F - (1+\gamma)(C_1^L + \lambda \overline{p}_2 V)$ or $\widetilde{F} - (1+\gamma)(C_1^L + \overline{p}_2 V)$ through a combination of subordinated long-term debt and equity. Privately, the bank finds it optimal for each national holding company to issue some subordinated long-term debt, rather than relying solely on TLAC in the form of equity. The reason is the presence of some long-term debt allows the bank to sell all fairly-valued date 1 cash flows. Specifically, 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: $R_{LT}^{MPOE} \geq C_1^H + \Delta - R_1 \equiv \hat{R}_{LT}^{MPOE}$. The bank is indifferent between all combinations of subordinated debt and equity for which $R_{LT}^{MPOE} \geq \hat{R}_{LT}^{MPOE}$.

Lemma 1. *Funding and TLAC under MPOE.*

(i) When $\widetilde{F} - F \geq (1 - p_1 + \gamma)(1 - \lambda)\overline{p}_2 V$, it is not efficient for subsidiaries to set up redundant systems. Each subsidiary issues safe short-term debt with face value $R_1^{MPOE} = C_1^L + \lambda \overline{p}_2 V$. Required TLAC per subsidiary is given by $F - (1 + \gamma)R_1^{MPOE} = F - (1 + \gamma)(C_1^L + \lambda \overline{p}_2 V)$ and is raised by the national holding company via a combination of equity and subordinated long-term debt.

(ii) When $\widetilde{F} - F < (1 - p_1 + \gamma)(1 - \lambda)\overline{p}_2 V$, it is efficient for subsidiaries to set up redundant systems. Each subsidiary issues safe short-term debt with face value $R_1^{MPOE} = C_1^L + \overline{p}_2 V$. Required TLAC per subsidiary is given by $\widetilde{F} - (1 + \gamma)R_1^{MPOE} = \widetilde{F} - (1 + \gamma)(C_1^L + \overline{p}_2 V)$ 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) Because the subsidiaries are separated during resolution, each subsidiary bears an effective redundancy or separation cost of $\min[\widetilde{F} - F, (1 - p_1 + \gamma)(1 - \lambda)\overline{p}_2 V]$.

3.2 SPOE

We now consider SPOE resolution. SPOE resolution has two key advantages relative to MPOE. First, the diversifiable cash flow Δ can be transferred across the two subsidiaries, which generates diversification benefits. Specifically, compared to MPOE resolution, the ability to share Δ raises the minimum cash flow received by each subsidiary at date 1 from C_1^L to $C_1^L + \Delta/2$. Second, because the two subsidiaries are not separated under SPOE, even without redundant systems each subsidiary can always roll over an amount $\overline{p}_2 V$ of short-term debt at date 1. Therefore, under SPOE resolution, each subsidiary can issue more safe short-term debt than would be possible under MPOE, thereby

generating larger benefits from banking activity. Specifically, under SPOE each subsidiary sets the face value of safe short-term debt to

$$R_1^{SPOE} = C_1^L + \Delta/2 + \overline{p}_2 V \geq R_1^{MPOE}. \tag{7}$$

TLAC is then required if $F > (1 + \gamma)(C_1^L + \Delta/2 + \overline{p}_2 V)$, which we assume is the case, and is raised by the global holding company through a combination of subordinated long-term debt and equity. As under MPOE, it is privately optimal for the global 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: $R_{LT}^{SPOE} \geq 2C_1^H + \Delta - 2R_1^{SPOE} \equiv \hat{R}_{LT}^{SPOE}$. The holding company is indifferent between all combinations of subordinated debt and equity for which $R_{LT}^{SPOE} \geq \hat{R}_{LT}^{SPOE}$.

Note that in contrast to MPOE, under SPOE resolution the two subsidiaries continue to operate as part of a single global bank even after a resolution. Therefore, SPOE resolution involves no risk of separation and consequently allows the global bank to rely on shared services, thereby harnessing scale and scope benefits of global banking.

Lemma 2. *Funding and TLAC under SPOE.*

(i) *Under SPOE resolution, each subsidiary issues short-term debt with face value $R_1^{SPOE} = C_1^L + \Delta/2 + \overline{p}_2 V$. Required TLAC per subsidiary is given by $F - (1 + \gamma)R_1^{SPOE} = F - (1 + \gamma)(C_1^L + \Delta/2 + \overline{p}_2 V)$ 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.*

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(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*

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

In this case, it is efficient to structure global banks as multi-national holding companies with shared services across jurisdictions, in which national banking subsidiaries share 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 loss-absorbing capital that is required to guarantee a successful resolution via a liability side reconstruction. This allows the G-SIB 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 Δ and an increase in surplus of $\gamma\Delta$. Second, SPOE resolution allows the bank to 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 $2\min[\widetilde{F} - F, (1 - p_1 + \gamma)(1 - \lambda)\overline{p}_2 V]$. This second channel highlights an 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 that, in practice, 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 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 Δ appears in jurisdiction 1 with probability θ_1 and in jurisdiction 2 with probability θ_2, where $\theta_1 + \theta_2 = 1$. We now show that the higher θ_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 expected benefits from entering an SPOE resolution scheme. First, the ability to share the diversifiable cash flow Δ across jurisdictions implies that each banking subsidiary can increase the amount of safe short term debt by $\Delta/2$. Given a net benefit of γ per dollar of safe short-term debt, a move from MPOE to SPOE resolution therefore yields a benefit of $\gamma\Delta/2$ in each jurisdiction. SPOE resolution allows the bank to capture benefits from global banking, which per jurisdiction amount to the lesser of the cost of setting up redundant systems and expected separation costs, $\min[\widetilde{F} - F, (1 - p_1 + \gamma)(1 - \lambda)\bar{p}_2 V]$.

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

$$\theta_1 - \theta_2 \leq \frac{\gamma}{1 - p_1} + \min\left[\frac{\widetilde{F} - F}{1 - p_1}, \left(1 + \frac{\gamma}{1 - p_1}\right)(1 - \lambda)\overline{p}_2 V\right]. \tag{9}$$

Because both regulators have to agree to setting up an SPOE resolution regime, an analogous condition has to hold for the regulator in jurisdiction 2. Therefore, 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 for the regulator in each jurisdiction the benefit from increased banking activity and the gains from global banking outweigh the expected net transfer payments to the other jurisdiction. This requires that cash flows are sufficiently symmetric:*

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

Proposition 3 shows that the successful ex-ante implementation of SPOE resolution requires sufficient symmetry across jurisdictions. The left hand side of the ex ante IC constraint (10) shoes that the probabilities θ_i of receiving the diversifiable cash flow Δ must be sufficiently symmetric across the two jurisdictions. When one jurisdiction is significantly more likely 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. The right-hand side of the ex ante IC constraint (10) shows that SPOE is more likely to be ex-ante incentive compatible when the benefit from banking activity γ is large and when there are significant gains to global banking (in the form of saved redundancy and separation costs). A larger benefit from additional banking activity and gains from global banking that are possible under SPOE make it more likely that regulators both regulators agree to SPOE, even though for one of them 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.

Let us make three brief observations regarding Proposition 3. First, the result that asymmetry across jurisdictions can prevent regulators from setting up an efficient resolution regime echoes the finding in Dell'Ariccia and Marquez (2006), where 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 (for example, because they are politically infeasible). 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 versus receiving a transfer under SPOE is asymmetric, 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 Δ could be allowed to issue more than $\Delta/2$ in additional short-term debt, with the operating subsidiary in the other jurisdiction accordingly issuing less than $\Delta/2$ in additional short-term debt. However, even though this can help satisfying the ex-ante incentive constraint, asymmetric amounts of short-term debt make it harder to satisfy the ex-post incentive constraints discussed in the following subsection.

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 Δ 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 Δ 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 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 $\bar{p}_2(1 - \lambda)V$ and the direct spillover cost of default of the subsidiary in the other jurisdiction $S.$. Second, when the cash flow Δ realizes in the host jurisdiction, the regulator in the host jurisdiction may prefer to ring-fence assets when the home regulator invokes SPOE resolution. Such ring-fencing is privately optimal when the transfer to the home subsidiary $\Delta/2$ is larger than the expected loss of shared services $\bar{p}_2(1 - \lambda)V$ and the direct spillover cost S that results from a default in the home jurisdiction. 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

$$\frac{\Delta}{2} \leq \bar{p}_2(1 - \lambda)V + S. \tag{11}$$

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 the 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*

$$\frac{\Delta}{2} > \bar{p}_2(1 - \lambda)V + S. \tag{12}$$

Proposition 4 has two main implications. First, when the cross-jurisdictional transfer that is required under SPOE is too large, the necessary incentive constraint (11) 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 low λ) 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 and cross-jurisdictional spillovers that incentivize regulators not to ring-fence assets ex post. Therefore, MPOE resolution is more likely to be efficient the more decentralized a global financial institution. 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 its 2015 annual report, HSBC writes 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."[7]

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 $\widetilde{F} > F$, in order to prevent the separation costs of $(1 - p_1 + \gamma)(1 - \lambda)\overline{p}_2 V$ that results from the loss of shared services in each jurisdiction. Combined with the ex-post incentive constraint for successful SPOE resolution by national regulators, this generates a link between bank resolution and the operational structure of global banks, summarized 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 $\frac{\Delta}{2} \leq \overline{p}_2(1 - \lambda)V + S$.*

(ii) *MPOE resolution combined with separate national holding companies is efficient when $\frac{\Delta}{2} > \overline{p}_2(1 - \lambda)V + S$.*

(iii) *Under MPOE resolution, setting up redundant systems that facilitate the separation of banking subsidiaries during a resolution is efficient when $\widetilde{F} - F < (1 - p_1 + \gamma)(1 - \lambda)\overline{p}_2 V$.*

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

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[7]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 $\Delta/2$.
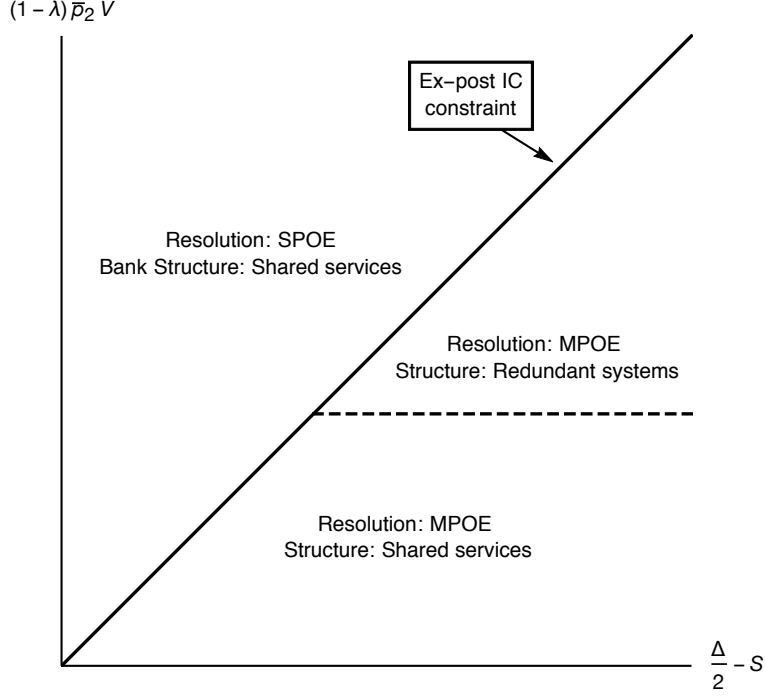
Figure 2: **Bank resolution (MPOE or SPOE) and bank structure.** The figure illustrates the correspondence between bank resolution and bank structure established in Proposition 5. The x-axis plots the required ex-post transfer under SPOE resolution $\Delta/2$ net of direct spillover cost S. The y-axis plots the loss of franchise value that results when subsidiaries with shared services are separated as part of an MPOE resolution $(1 - \lambda)\overline{p}_2 V$. The 45-degree line represents the ex-post incentive constraint for successful SPOE resolution (11). 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., $\widetilde{F} - F < (1 - p_1 + \gamma)(1 - \lambda)\overline{p}_2 V$), as illustrated by the dashed line.

resolved according to SPOE or MPOE should depend on the risks and the operational structure

of that particular bank. 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 Δ across jurisdictions, for which the incentive constraint (11) cannot be

satisfied, should be resolved under MPOE resolution. Moreover, under MPOE resolution it may

then be efficient to set up redundant system ex ante, in order to prevent the ex-post loss of value

when operating subsidiaries are separated in a resolution. As illustrated in the figure, setting up redundant systems under MPOE is efficient when $\widetilde{F} - F < (1 - p_1 + \gamma)(1 - \lambda)\overline{p}_2 V$. Consistent with this prediction, HSBC, which favors MPOE resolution, writes in 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 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 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 all potential benefits from resource sharing across jurisdictions in resolution. 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 capital in the form of equity or long-term debt that is pre-assigned to individual jurisdictions. The following proposition formalizes this intuition.

Proposition 6. *Constrained optimal bank resolution.* *Assume that* $\Delta/2 > \overline{p}_2(1 - \lambda)V + S$, *such that the ex-post incentive constraint for SPOE resolution (11) 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 to jurisdiction. 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 not shared but pre-assigned to national holding companies in each jurisdiction. This hybrid model allows banking activity of $C_1^L + \bar{p}_2 V + T^* \leq C_1^L + \bar{p}_2 V + \Delta/2$ 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 diversification benefit of SPOE resolution, but only to the point where ex-post transfers of "contributable resources" (i.e., the cash flow Δ) during a crisis are just incentive compatible. The reduction of 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 jursdiction. 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 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-SIB back to solvency. An important

concern is that this approach may exacerbate 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 involves both a monitoring incentive problem for the holding company and an effort incentive problem for the 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 $e \in \{0, 1\}$ to generate the cash flow Δ. Specifically, subsidiary i receives Δ with probability θ_i if it exerts effort ($e = 1$). Effort is costly in the sense that it involves the loss of a private benefit $B > 0$ when $e = 1$. As before, we assume that $\theta_1 + \theta_2 = 1$, such that Δ realizes for sure if both subsidiaries exert effort. On the other hand, if subsidiary i does not exert effort ($e = 0$), it only receives Δ with probability $\theta_i - \epsilon$. In other words, Δ realizes with probability less than one if at least one subsidiary shirks. For simplicity, we assume in this section that TLAC is held in the form of an outside equity stake α_0.

5.1 Incentives under MPOE Resolution

We first consider the incentives to exert effort under MPOE resolution. A key simplification in our model is that under MPOE required TLAC is not affected by the subsidiaries' effort choices. The reason is that for each subsidiary, TLAC is set to cover the shortfall $R_1^{MPOE} - C_1^L$, which is sufficient to avoid default irrespective of whether Δ materializes.

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

$$(1 - \alpha_0^{MPOE}) \left[p_1(C_1^H + \theta_i \Delta - R_1^{MPOE} + p_2^i V) + (1 - p_1)\theta \Delta \right] >$$

$$(1 - \alpha_0^{MPOE}) \left[p_1(C_1^H + (\theta_i - \epsilon)\Delta - R_1^{MPOE} + p_2^i V) + (1 - p_1)(\theta_i - \epsilon)\Delta \right] + B \qquad (14)$$

Or, collecting terms and simplifying, exerting effort is individually optimal for the manager of subsidiary i if:

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

5.2 Incentives under SPOE Resolution

We now turn to the incentives to exert effort under SPOE resolution. To do so, we need to be more specific about how profits are divided among the national banking operations. We assume that the global holding company pays out a share α_0^{SPOE} of its global earnings to outside shareholders and that the managers of the national operating subsidiaries receive the remaining share of profits from their subsidiaries. That is, each operating subsidiary manager receives the share $1 - \alpha_0^{SPOE}$ of the profits it generated. Accordingly, under SPOE resolution it is then individually optimal for the manager of operating subsidiary i to exert effort if:

$$(1 - \alpha_0^{SPOE}) \left[p_1(C_1^H + \theta_i \Delta - R_1^{SPOE} + p_2^i V) \right] >$$

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

Comparing the incentive constraints (16) and (14), we observe that there is a difference in the low cash flow state: Under SPOE, the cash flow Δ no longer accrues to the operating subsidiary managers. 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:

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

5.3   Are Incentives Better under MPOE or SPOE?

The preceding analysis shows that differences in incentives under MPOE and SPOE resolution are driven by two effects. First, because the operating subsidiary does not receive Δ in the low cash flow state under SPOE, the incentive constraint under SPOE is multiplied by the probability of the high cash-flow state p_1. Second, the required outside equity stake α_0 differs across MPOE and SPOE resolution schemes. To determine the net incentive effect, we need to calculate the outside equity stakes α_0^{MPOE} and α_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:

$$\alpha_{0,i}^{MPOE} \left[p_1(C_1^H + \theta_i \Delta - R_1^{MPOE} + \bar{p}_2 V) + (1 - p_1)\theta \Delta \right] \geq F - C_1^L - \bar{p}_2 V, \tag{18}$$

which yields:

$$\alpha_{0,i}^{MPOE} \geq \frac{F - C_1^L - \bar{p}_2 V}{p_1(C_1^H - C_1^L) + \theta_i \Delta}. \tag{19}$$

The required outside equity stake that is issued in each jurisdiction under MPOE therefore depends on θ_i, the probability that the additional cash flow Δ 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:

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

which yields:

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

The required outside equity stake that is issued by the global holding company under SPOE does not depend on either θ_1 or θ_2. The reason is that the global holding company receives Δ with probability one, such that it does not matter in which jurisdiction Δ 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 amount has to be raised via outside equity, as revealed by a comparison of the numerators in (19) and (21). However, because under SPOE Δ 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 $\alpha_0^{SPOE} > \alpha_{i0}^{MPOE}$ for the operating subsidiary i that is more likely to receive the cash flow Δ (and therefore has the lower $\alpha_{0,i}^{MPOE}$ of 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 (14) and (16) 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

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to produce the cash flow Δ, because Δ does not always accrue to equity holders, as 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 TLAC 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 7. *Incentives under MPOE and SPOE.*

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

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

(ii) *When the probabilities of receiving the additional cash flow Δ 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 7 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 7 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   Discussion

In this section, we provide a brief discussion of our results in the light of the current policy discussion on bank resolution. In Section 6.1, we discuss how our results help illuminate the recent resolution proposals put forward by the Financial Stability Board (FSB) and the Federal Reserve. In Section 6.2, we then provide a more general discussion of some of the key aspects of successful bank resolution and how these relate to the assumptions of our model.

6.1   Assessing the FSB and Fed Resolution Proposals

Our results highlight that the main challenge in guaranteeing efficient resolution of global banks under SPOE is ensuring that national regulators cooperate during the resolution. Such cooperation cannot be taken for granted, because national regulators may prefer to ring-fence assets rather than participating in a cross-border SPOE resolution that requires transfer payments to the other jurisdiction.

The recent policy proposals by the Financial Stability Board (FSB) (2015) and the Federal Reserve (2015) recognize this challenge. First, under the FSB proposal, minimum requirements for total loss-absorbing capital (TLAC) are not imposed on a consolidated basis on a whole banking

group, but rather to "each resolution entity within each G-SIB" [FSB (2015), p. 9]. Moreover, what constitutes a resolution entity is rather flexible.[8] This flexibility allows regulators, at least in principle, to set resolution-entity boundaries such that cross-jurisdictional transfers do not violate ex-post incentive compatibility constraints.

Second, within resolution entities, the proposals by the FSB and the Federal Reserve envision that incentive compatibility can be ensured through *internal* TLAC. For example, the Federal Reserve's internal TLAC rules require US-based intermediate holding companies of foreign G-SIBs to hold minimum levels of 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 US regulator) holds the trigger for conversion, losses in the intermediate holding company can be pushed up unilaterally to the global holding company. This results in an effective pre-allocation of loss-absorbing capacity, in the hope that this can ensure incentive compatibility of a cross-border resolution. 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 sufficient to implement the constrained optimal resolution regime. In particular, note that the diversifiable cash flow Δ cannot be fully pre-assigned to a jurisdiction. Because Δ is a cash flow that realizes at date 1, even in the presence of sufficient internal TLAC, Δ can be ring-fenced and is therefore not necessarily available as loss-absorbing capacity. In fact, our model suggests that there may be role for *external* TLAC even 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 amount of losses that is passed up to the global holding company, thereby limiting

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[8] "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].

cross-jurisdictional transfers such that the foreign regulator's ex-post incentive constraint is satisfied during a resolution. This is at odds with the requirement, proposed by the Federal Reserve, that all loss-absorbing capacity at the intermediate holding company level should be in the form of internal TLAC (i.e., issued directly to the parent).

Third, some of the proposed rules appear to go beyond ensuring incentive compatibility and efficient cooperation between regulators during a resolution. Our analysis suggests that it is efficient to set internal TLAC requirements so as to just satisfy ex-post incentive compatibility, thereby maximizing the diversification benefits from shared loss-absorbing capacity. In contrast, the internal TLAC rules proposed by the Federal Reserve may 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 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 eliminating one of the key advantages of a global SPOE resolution.

Finally, according to our analysis, the requirement in the Fed proposal 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 justification for requiring whether TLAC is in the form of long-term debt or equity. It may therefore be prudent to allow banks more flexibility in how they meet their overall TLAC requirement.

6.2   Unresolved Issues and Discussion of Assumptions

Notwithstanding the efforts of the FSB 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.[9]

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 the main 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 with the bank. Whereas under OLA, the resolution authority can put a stay on QFCs, there is no general stay on these contracts under Chapter 11. Therefore, G-SIB resolution under Chapter 11 can only work if banks privately amend the contractual terms of their derivative contracts to include a temporary stay also under Chapter 11. 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

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[9]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.

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 rules 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 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 (FSB) (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. 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. 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. 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

Comparing α_0^{SPOE} and α_0^{MPOE}. This appendix provides additional detail for the comparison of α_0^{SPOE} and α_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

$$\frac{\Delta \left[(1-p_1)C_1^L + p_1 C_1^H + \Delta/2 + \overline{p}_2 V - F \right]}{p_1(C_1^H - C_1^L)\left[p_1(C_1^H - C_1^L) + \Delta/2 \right]} > 0, \tag{A1}$$

which holds if and only if

$$(1-p_1)C_1^L + p_1 C_1^H + \Delta/2 + \overline{p}_2 V - F > 0. \tag{A2}$$

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 α_0^{MPOE} is monotonically increasing in θ_i. There is therefore a critical value $\widetilde{\theta}$ such that $\alpha_0^{SPOE} = \alpha_0^{MPOE}$. From (19) and (21), we can determine this critical value as

$$\widetilde{\theta} = \frac{1}{2} \frac{p_1(C_1^H - C_1^L)}{F - C_1^L - \Delta/2 - \overline{p}_2}. \tag{A3}$$

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

$$F > \underbrace{(1-p_1)C_1^L + p_1 C_1^H + \overline{p}_2 V + \Delta/2}_{\text{total pledgeable CF}} - p_1(C_1^H - C_1^L)/2, \tag{A4}$$

which cannot be ruled out.