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Understanding Living Wills

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During the recent financial crisis of 2007–08, several large financial institutions came close to failing. This led to a number of publicly supported rescues and other interventions involving taxpayer money.[1] In almost all of these instances, not intervening to lessen the impact of the failures on the market seemed (to some policymakers, at least) too costly. In other words, the crisis put into use the safety net for financial institutions. Ever since, fixing the so-called "too big to fail" (TBTF) problem has been a priority for policymakers.

The TBTF problem arises when a large financial institution is in financial distress: Policymakers are not generally able to commit not to rescue it from failing, mainly because of the fear of a sizeable disruption for financial markets and the economy as a whole if such a firm fails. This "ex-post" intervention of policymakers to prevent the failure, which effectively allows creditors of the firm in distress to avoid losses on their loans, implies perverse incentives for all large financial firms "ex ante": Because creditors anticipate no losses even in the event of failure, they do not make the price of their debt reflect the level of risk taken by the financial institutions. This may lead to excessive risk-taking by the firms, which in turn will mean more frequent failures, as well as more redistribution in the form of bailouts financed by taxpayers.[2]

In this article we will study how the requirement for large financial institutions to file resolution plans, or "living wills," with their regulators may help mitigate this commitment problem and, while doing

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[1] See White and Yorulmazer (2014) for a detailed list of these interventions.

[2] Grochulski (2011) presents a clear exposition of this commitment problem and shows how the lack of commitment may decrease welfare.

so, decrease both the frequency of failures and their negative consequences for the economy when they do happen. A living will (LW) is a document that describes how a firm would be wound down through an unassisted bankruptcy procedure in the event of financial distress in an orderly fashion and with minimal impact to the rest of the economy. Living wills are a new requirement put in place as part of the 2010 Wall Street Reform Act, also known as the Dodd-Frank Act (DFA). The DFA was crafted with the objective of preventing financial crises like the recent one from happening in the future. As part of a wide reform of financial firm regulation, DFA prescribed a range of both new and strengthened requirements and procedures that added to the portfolio of tools with which the financial firms' supervisors work to ensure a strong financial system. Two prominent examples of existing tools that were reinforced in DFA are capital and liquidity requirements. Two important examples of new tools, which we will analyze in this article, are the requirement for systemically important financial institutions (SIFIs) to file living wills annually with their regulators and the provisions for the Orderly Liquidation Authority (OLA).

The OLA provisions, described in Title II of the Act, authorize the Federal Deposit Insurance Corporation (FDIC) to manage the winding down of certain troubled financial firms. The possibility of resolution under OLA was created by DFA as an alternative to bankruptcy, in recognition of the difficulties that may arise when using bankruptcy to resolve these very large, complex, and interconnected SIFIs. Before 2010, if a financial firm was deemed insolvent or undercapitalized and was not able to attract new capital, negotiate a bail-in by its creditors, or find a buyer in the market, it had to resort to bankruptcy. If debtor-in-possession (DIP) financing for a reorganization under Chapter 11 was not available in the market, the firm was forced into liquidation under Chapter 7. If policymakers viewed bankruptcy as too costly an alternative for society, they had options to provide public support through a purchase and acquisition of selected assets of the troubled institution (usually mediated by the FDIC if they involved depository institutions, possibly with explicit assistance in the form of asset guarantees), or a taxpayer-funded bailout that injected capital or guaranteed a loan with favorable terms. OLA constitutes a new alternative in which the firm does get reorganized and liquidated, but in a more orderly and efficient manner than through bankruptcy.

Although the details of resolution through OLA are still not clear (it has never been used so far), it has been pointed out that this alternative may be convenient in times of aggregate financial distress: It allows the FDIC to borrow from the Orderly Liquidation Fund (OLF), a dedicated account at the Treasury, at low interest rates to finance the operations

of the firm in distress for at least some time. The availability of these cheap funds is likely to increase the liquidation value of the firm and possibly decrease the disruptions to the market, even in situations in which otherwise necessary DIP financing would not be available. If the liquidation of the distressed firm does not provide enough resources to repay the loans from the Treasury, DFA gives authority to charge fees on the solvent SIFIs to cover the difference, so no taxpayer money is used in OLA. However, it has also been pointed out that the availability of interim funding may benefit creditors that would otherwise get hurt from a sudden liquidation, hence leaving at least some of the perverse incentives of the TBTF problem in place.[3]

Despite the creation of the OLA, DFA still establishes bankruptcy as the preferred option for resolving a SIFI that is in financial difficulties. In order to make bankruptcy a more viable and orderly alternative, DFA requires firms designated as SIFIs to file an LW annually. Resolution through bankruptcy will be more orderly, for example, if it is easy to sell subsidiaries that are in good financial health to interested third parties. This is easiest when legal hurdles are minimal and these subsidiaries do not strongly depend on services (such as IT support) provided by other parts of the firm. As another example, resolution is easier when the failing firm has access to interim financing to keep its core operations working, which adds value to the firm. These examples suggest that a good LW should, among other things, describe the complementarities between assets and economies of scope across subsidiaries and provide a clear description of financing needs. This information would be helpful in maximizing the value of the company in bankruptcy.

Regulators review these LWs and require them to be useful and realistic. Moreover, if the plan for resolution makes apparent that certain characteristics of the firm complicate its liquidation, making the plan for liquidation "noncredible," regulators can require changes to those characteristics.

Living wills are a new tool, and regulators are still in the initial stages of implementing this requirement. Over the last few years, supervisors have been learning together with the firms about the key information that needs to be included in these documents. In this article, rather than providing a detailed description of the provisions in DFA relating to LWs and resolution, we want to lay down a *framework* that will help us understand LWs. Our objective is to study the potential benefits that LWs could bring to the regulation of financial firms,

[3] See Pellerin and Walter (2012) and Jarque and Price (2015).

and the most useful ways in which the recently installed LW review process should evolve.

In our analysis, we will emphasize the two channels through which LWs should be useful. The first channel is their annual review process, which takes place in the ex-ante world. During this review process regulators are allowed to demand changes in the way that firms are conducting business (such as their size, or the number and level of interconnectedness of their subsidiaries) if they assess that these changes would make their potential resolution less disruptive for the economy. The second channel is through their role as "road maps" for resolution authorities (bankruptcy judges but also regulators if OLA is invoked) in the event of failure. That is, in the ex-post world, LWs indicate the most efficient way to resolve the firm with minimal impact on the market.

We will illustrate in the context of a simple model of the TBTF problem how regulating living wills (rejecting noncredible plans and, importantly, mandating changes that make them realistic) may change the ex-ante versus ex-post tension that leads to the TBTF problem, and hence change the severity of the moral hazard problem. We will ask the following questions: What are the properties of living wills that make them most useful as a commitment device and improve ex-ante welfare? Under what conditions are they more likely to bring about this improvement? What are the potential costs that regulators should consider?

Our work here complements recent work in DeYoung, Kowalik, and Reidhill (2013) and in White and Yorulmazer (2014). These articles also explicitly consider how different alternatives (or "technologies") for resolution affect welfare. White and Yorulmazer (2014) use a simple static model to present a review of the different interventions during the 2007–08 financial crisis. DeYoung, Kowalik, and Reidhill (2013) focus instead on the dynamic properties of the too-big-to-fail problem. They highlight that, as regulators get better at resolution, they can let large firms fail at less cost to society (i.e., they are willing to implement harsher punishments to these firms in equilibrium), which translates into less risk taken by firms, and hence less failures, being sustained in a Markov equilibrium of the repeated game.

1. FRAMEWORK

The time inconsistency problem that underlines the TBTF problem is best described by looking at the diagram in Figure 1. The diagram describes the three-period game between three players: (1) a financial firm that maximizes the expected profits of its shareholders, (2) the

creditors of the firm who set the interest rate on their loans to the firm as to equate the expected return of debt and risk-free bonds, and (3) a benevolent policymaker, or "planner," who maximizes the welfare of society (i.e., the joint payoffs to the shareholders, the creditors, and the rest of society). The planner has a large budget funded by tax revenues to use in potential bailouts, as well as funds in the OLF from fees collected from financial institutions that can be used by the OLA to provide funding to wind down SIFIs in distress.

The characteristics of a firm will be summarized in a vector X, partitioned into a subset of characteristics ω over which the policymaker has control, and a subset x that is chosen freely by the firm:

$$X = (\omega, x)\,.$$

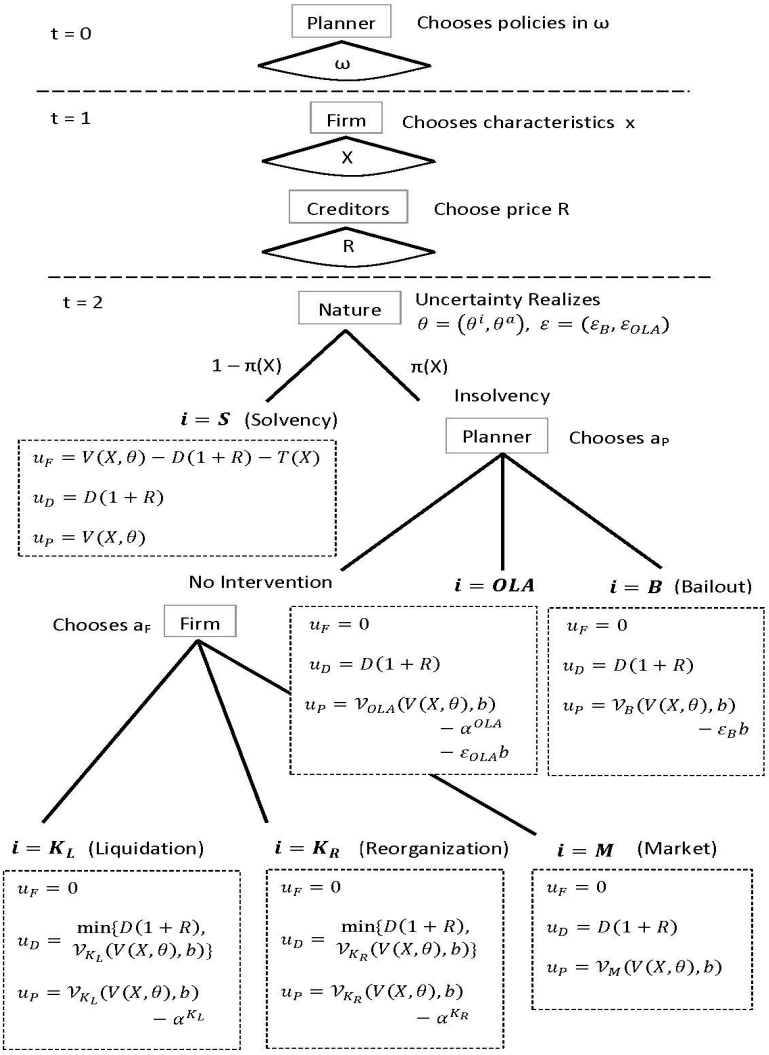
Timing and Strategies

In period 0, the planner moves first and sets regulation, which will determine the constraints on a subset ω of the vector of characteristics X of the firm. This regulation includes capital and liquidity requirements, and the obligation to file LWs that meet the planner's standards. Choices of the firm such as size and complexity will only be in ω if LWs are regulated; that is, we model the increased regulatory powers given by the DFA with the LW review process as an expansion of the choices $\omega \subset X$ over which supervisors have control.

In period 1, the firm chooses a subset of its characteristics, x, given that creditors choose a price R for loans that makes them indifferent between lending to the firm or buying riskless bonds, which pay an interest $\bar{R}_1$.

In period 2, nature determines the realization of an economic shock, $\theta \in \Theta$, according to the density function h, and a political shock, $\varepsilon \in \epsilon$, according to the density function g. The economic shock realization contains two elements, $\theta = \left(\theta^i, \theta^a\right)$, where θ^i represents the idiosyncratic state of the individual firm, which affects the value and/or liquidity of its assets, and θ^a represents the aggregate state of the economy, which affects the cost of funding that the firm will face in case of distress in period 2, $\bar{R}_2\left(\theta^a\right)$. The political shock, $\varepsilon = \left(\varepsilon_B, \varepsilon_{OLA}\right)$, summarizes society's utility cost of providing bailouts with taxpayer money, ε_B, and with OLF funds, ε_{OLA}. The first may be influenced by factors such as the level of disagreement of voters with the transfer of taxpayer money to banks, which may partly reflect the "type" or political views of the policymaker, as well as the opportunity cost of those funds, which

Figure 1 Game Tree



may depend on the state of public finances.[4] The second one may be influenced by factors such as the intensity of lobbying done by the banking sector against fees levied to fund the OLF, or by the opportunity cost of those funds if used to produce in the financial sector. Denoting the amount of funds devoted to help a firm in distress as b, the cost to society of providing a bailout with public funds will be $\varepsilon_B b$, while the cost of injecting funds in an OLA resolution will be $\varepsilon_{OLA} b$.

Given a realization of θ, the choices that the firm previously made, as contained in X, will determine the profit the firm makes, and hence whether it remains solvent. Denoting the gross value of the firm by $V(X, \theta)$, the amount of taxes owed by $T(X)$, the amount of debt borrowed by D, and the interest on this debt by R, we can define the set of states in which a firm with characteristics X fails, $\Theta^f(X)$, as

$$\Theta^f(X) = \{\theta \in \Theta : V(X, \theta) - T(X) - D(1 + R) < 0\},$$

that is, the states in which there is not enough profit to cover tax obligations and repay creditors. The set of states in which the firm is solvent, $\Theta^s(X)$, is simply the complement of Θ^f. Using the density function over states of nature, we can calculate the probability of failure as a function of the characteristics of the firm, X :

$$\pi(X) = \int_{\Theta^f(X)} h(\theta)\, d\theta.$$

In the event that the firm is insolvent, both the planner and the firm may make choices about its resolution. First, after observing a realization θ in $\Theta^f(X)$, and the realization of ε, the planner decides whether or not to intervene. If he intervenes, he chooses whether to resolve the firm through OLA or to bail it out. If OLA is chosen, the wind down of the firm can be financed using a transfer b funded by fees levied on other financial institutions through the OLF. If a bailout is chosen instead, any funding of operations or transfers will come from taxpayer money. Second, and only if the planner chooses not to intervene, the firm chooses whether to file for liquidation or reorganization under bankruptcy, or to "go to the market." Without modeling a market for troubled financial firms explicitly, with this last

[4] This shock could also be interpreted as a reduced-form summary or future utility cost of providing a bailout today. In particular, it could correspond to the net present expected value of the cost of future bailouts in a repeated game where the type of the policymaker has a persistent unobserved component and the market is trying to learn about it in order to correctly anticipate the policymaker's decisions in the future. This repeated game is complicated to analyze, so we do not explicitly study it here. For a simple model of this commitment problem without learning in a repeated game, see DeYoung, Kowalik, and Reidhill (2013).

option we capture the possibility that the firm can find an interested third party to purchase its assets or bargain a merge.

These available strategies imply six final nodes of the game. One is solvency, which we denote by $i = S$. The other five nodes represent the possible outcomes after the firm is insolvent: market resolution ($i = M$), bailout ($i = B$), bankruptcy liquidation ($i = K_L$), bankruptcy reorganization ($i = K_R$), and resolution through OLA ($i = OLA$).

The strategies of the three players in the game can be summarized as follows:

- The planner's strategy consists of a set of regulations, ω, as well as an action contingent on the realization of uncertainty, $a_P(X, \theta, \varepsilon)$: the decision to not intervene ($a_P = NI$), intervene by providing a bailout ($a_P = B$), or intervene by triggering OLA ($a_P = OLA$). We denote the strategy as $\sigma_P = (\omega, a_P(X, \theta, \varepsilon))$;
- The firm's strategy consists of a set of firm characteristics that are not controlled by supervisory requirements, x, and a contingent decision of whether to look for a market buyer ($a_F = M$), file for liquidation through bankruptcy ($a_F = K_L$), or file for reorganization through bankruptcy ($a_F = K_R$). We denote this strategy as $\sigma_F = (x, a_F(X, \theta))$;
- The creditors's strategy is an interest rate: $\sigma_D = R(X)$.

Payoffs

The six end nodes of the game in Figure 1 contain the payoffs to the three players, contingent on the node i as well as X, θ, and ε. We denote them as $u_i^F(X, \theta)$ for the firm, $u_i^D(X, \theta)$ for the creditors, and $u_i^P(X, \theta, \varepsilon)$ for the planner.

In states of insolvency, $\Theta^f(X)$, the net value of the firm, $V(X, \theta) - T(X)$, is not enough to repay the debt in full. Once the firm acknowledges its insolvency situation, its value may differ from the actual valuation of its assets, due to deadweight loss of different methods of resolution or to reputational effects even in the event of a bailout that prevents a liquidation. To make this explicit, we denote the value of the firm in states of insolvency as $\mathcal{V}_i(V(X, \theta))$ for any node $i \neq S$, with $\mathcal{V}_i(V(X, \theta)) \leq V(X, \theta)$. The dependence on i captures the fact that the ex-post value of the firm after resolution, $\mathcal{V}_i$, may be different depending on the method to resolve it. Payoffs in each node may depend as well on the method of resolution of the failing firm, as described below.

In the three nodes that correspond to resolution through OLA or liquidation or reorganization in bankruptcy, we consider the possibility that there may be negative externalities to society from the firm's failure. There is considerable debate in the academic and policy world about the existence, and importance, of these externalities. They are usually thought to originate from "spillover effects" or from "firesales." The label spillovers refers typically to credit disruptions: The inability of the failing firm to meet its debt obligations or perform functions that are essential to financial markets, such as being a broker-dealer (a "utility"), may negatively affect the ability to do business as usual for the firm's counterparties or clients. These externalities from spillovers, hence, are more likely to be important if the firm is a financial utility. The label firesales refers to the hurried sale of the assets of one large firm in distress at a price lower than its "fundamental" value—the price the firm could obtain if it had the time to find the right buyer. The externality would come from this sale unexpectedly lowering the market price of assets of certain types (those for which the failing firm had a significant market share). This could have the effect of decreasing the value of *other* institutions' balance sheets if they contain significant quantities of these undervalued assets. These externalities from firesales, hence, are more likely to be important in the market if the firm in distress is very large, or has a high market share for a particular asset.

Without taking a stand on whether these externalities are important, we include them in the model in order to study the implications that—were they shown to be significant—they would have in the process of financial firm resolution. We denote these potential externalities as $\alpha^i(X)$, for $i \in \{K_L, K_R, OLA\}$, with explicit dependence on the characteristics of the firm. Hence, we assume no externalities when the firm is solvent, receives a bailout, or is sold to a third party.

Next, we describe payoffs to each party in each of the six final nodes, as summarized in Figure 1. For each node, we also discuss the effect that having a regulated LW in place may have on the total value of the firm and on payoffs in that node.

Solvency $(i = S)$

First, we describe payoffs in the set of states when the firm is solvent, $\Theta^s(X)$, which correspond to the node $i = S$. In these states the value of the firm, net of taxes, $T(X)$, is larger than the value of debt, and thus creditors get repaid in full: $u_S^D(X, \theta) = D(1 + R)$. Welfare (the payoff to the planner) is $u_S^P(X, \theta) = u_i^F + u_i^D$, which equals the gross value of the firm, $V(X, \theta)$.

Crafting a good LW that conforms with regulatory requirements takes resources from the firm and limits its activities, decreasing its value. However, the control over more characteristics of the firm $\omega \subset X$ due to the LW review process may imply lower price of debt, which increases value. Hence, the overall effect of LWs on V in equilibrium is ambiguous.

Bailout $(i = B)$

If the firm fails, it may receive a bailout. The bailout is a transfer in the amount b from taxpayers to creditors and shareholders that allows the firm to repay its creditors in full and stay solvent. We denote the value of the firm after a bailout as $\mathcal{V}_B\left(V\left(X,\theta\right),b\right)$, to indicate that the transfer b will affect the final valuation of the firm; to keep the company solvent, the amount b will be such that

$$\mathcal{V}_B\left(V\left(X,\theta\right),b\right) - T\left(X\right) = D\left(1+R\right).$$

With this generic functional form, we recognize that the bailout allows the firm to continue its business, but the financial troubles revealed by the intervention could decrease the value of the firm. That is, we may have $\mathcal{V}_B\left(V\left(X,\theta\right),b\right)$ be lower than $V\left(X,\theta\right)+b$. The planner payoff is $u_i^P = u_i^F + u_i^D - \varepsilon_B b$, which equals $\mathcal{V}_B\left(V\left(X,\theta\right),b\right) - \varepsilon_B b$.

Because the firm is not liquidated in this node, having a regulated LW in place does not directly affect $\mathcal{V}_B$. The ambiguous effect on V, however, remains as described in the previous node.

Market Resolution $(i = M)$

A firm in distress may also be sold to the best buyer in the market for a value of $\mathcal{V}_M\left(V\left(X,\theta\right)\right)$. *A* scenario in which $\mathcal{V}_M\left(V\left(X,\theta\right)\right)$ is greater than the value of other methods of resolution corresponds to a situation in which the buyer may have a high valuation for the firm's assets, perhaps due to complementarities with the buyer's own assets. In this node, creditors get repaid in full. The value to society is $u_i^P = u_i^F + u_i^D$, which equals $\mathcal{V}_M\left(V\left(X,\theta\right)\right)$.

A regulated LW can serve as a road map for interested buyers to calculate the full potential of the firm. Moreover, LWs imply that the set of choices x is more limited, which translates into a firm that is simpler to evaluate. Hence, having regulated LWs may increase $\mathcal{V}_M$ for a given $V\left(X,\theta\right)$.

Bankruptcy for Reorganization $(i = K_R)$

If the firm files for bankruptcy, shareholders receive a 0 payoff, and debtholders get the value of the firm after reorganization, $\mathcal{V}_{K_R}(V(X,\theta))$ (they become the new shareholders).[5] The payoff to the planner takes into account potential externalities: $u^P_{K_R} = u^F_{K_R} + u^D_{K_R} - \alpha^{K_R}$, which equals $\mathcal{V}_{K_R}(V(X,\theta)) - \alpha^{K_R}$. The aggregate shock, θ^a, will affect the cost of DIP financing, $\bar{R}_2$, and hence the profitability of reorganizing the firm (Chapter 11) versus simply liquidating it (Chapter 7).

A regulated LW is crafted to include information that enhances the value of the firm in a bankruptcy procedure. It can also be valuable to external providers of DIP financing, since it makes the operations of the firm clearer, and supervision on ω gives a guarantee that the firm has desirable characteristics. Hence, a regulated LW increases $\mathcal{V}_{K_R}$.

Bankruptcy for Liquidation $(i = K_L)$

Shareholders again receive a 0 payoff, and debtholders get the liquidation value of the firm, $\mathcal{V}_{K_L}(V(X,\theta))$. The payoff to the planner takes into account potential externalities: $u^P_{K_L} = u^F_{K_L} + u^D_{K_L} - \alpha^{K_L}$, which equals $\mathcal{V}_{K_L}(V(X,\theta)) - \alpha^{K_L}$. Choosing liquidation over reorganization because of the absence of cheap DIP financing could imply some inefficiencies, since in reorganization the firm could continue to operate for a time after failure. This could avoid the inefficient liquidation of specific assets and the termination of otherwise valuable derivatives contracts. However, whether $\mathcal{V}_{K_R} > \mathcal{V}_{K_L}$ will also depend on the realization of θ^a through the price for DIP financing. In the same spirit, assuming that reorganization would call for fewer contracts terminated suddenly, and hence less disruption in the market, we assume externalities are less important under reorganization: $\alpha^{K_L} > \alpha^{K_R}$.

For the same reasons listed for the node of bankruptcy for reorganization, a regulated LW increases $\mathcal{V}_{K_L}$. Possibly, however, the positive effect in $\mathcal{V}_{K_R}$ for a given $V(X,\theta)$ is larger than the positive effect in $\mathcal{V}_{K_L}$: With an LW the price of DIP financing may be lower, but under bankruptcy for liquidation the firm does not look for financing, so this relative advantage of the LW is irrelevant.

[5] It is possible that after a firm files for bankruptcy (or even under other methods of resolution) shareholders get positive value after liquidating the firm and repaying debtholders. However, this depends on further resolution of uncertainty about the actual price that the market pays for the assets of the liquidating firm, which we are not modelling here. For the purpose of our analysis, the relevant value is $\mathcal{V}$, which can be interpreted as the expected value after resolving the firm, calculated at the moment when the planner or shareholders need to choose the method of resolution. By the definition of insolvency, $\mathcal{V} \leq V$.

OLA $(i = OLA)$

If OLA is used instead of bankruptcy to resolve the firm, shareholders again receive a 0 payoff, and debtholders get the liquidation value of the firm, denoted $\mathcal{V}_{OLA}\left(V\left(X,\theta\right),b\right)$. The payoff to the planner takes into account potential externalities, as well as the cost of injecting funds b to finance the wind down of the firm: $u^{P}_{OLA} = u^{F}_{OLA} + u^{D}_{OLA} - \alpha^{OLA} - \varepsilon_{OLA}b$, which equals $\mathcal{V}_{OLA}\left(V\left(X,\theta\right),b\right) - \alpha^{OLA} - \varepsilon_{OLA}b$. The value of a firm resolved through OLA may be different than $\mathcal{V}_{K_L}\left(V\left(X,\theta\right)\right)$ or $\mathcal{V}_{K_R}\left(V\left(X,\theta\right)\right)$. We assume $\mathcal{V}_{OLA} > \mathcal{V}_{K_L}$ in bad aggregate states of the economy to capture the possibility that cheap interim financing is available from the OLF, rather than having to depend on the availability of DIP financing in the market. We also assume that $\alpha^{OLA} < \alpha^{K_R}$ (less externalities under OLA than under bankruptcy) to reflect the fact that institutional advantages of OLA such as the ability to impose two business days of automatic stay even to qualified financial contracts (QFCs) may prevent some of the firesale effects on other firms.[6]

A regulated LW will help increase $\mathcal{V}_{OLA}$ in the same way as in bankruptcy, providing useful information. However, the increase in value will be more limited than for reorganization, since the interim financing needed to efficiently wind down the firm is not DIP financing (the price of which would be sensitive to that information), but rather funds provided by the OLF.

The payoffs to the players in each of the nodes can be summarized as follows:

- The payoff to the shareholders of the firm, u_F, will be the value of the firm, contingent on solvency, net of repayment of the debt and tax obligations:

$$u_F = \begin{cases} V\left(X,\theta\right) - D\left(1+R\right) - T\left(X\right) & \text{for } i = S. \\ 0 & \text{for } i \neq S; \end{cases}$$

- The payoff to creditors, u_D, will be the principal of the debt, D, plus interest, whenever the firm is solvent; if the firm is insolvent, they will get the resolution value of the firm, which will depend on the alternative chosen to resolve it:

$$u_D = \begin{cases} D\left(1+R\right) & \text{for } i = S \\ \min\left\{D\left(1+R\right), \mathcal{V}_i\left(V\left(X,\theta\right),b\right)\right\} & \text{for } i \neq S. \end{cases}$$

[6] In December 2014, in recognition of the inefficiency of the early termination of swap contracts at the moment when insolvency is determined, 18 major global banks agreed to a protocol developed by the International Swaps and Derivatives Association to include temporary stays on termination rights. The objective of the agreement was to give bankruptcy judges or regulators in charge of resolution time to conduct an orderly liquidation, since most commentators agreed that even two extra business days under OLA would not be enough to prevent inefficient liquidations. See Gruenberg (2015).

- The payoff to the social planner, u_P, will consist of the value of the firm, which will vary depending on whether it is solvent or, if insolvent, the method of resolution. If the firm is resolved through bankruptcy or OLA, externalities may decrease the payoff. If there is a transfer of taxpayer funds or from the OLF, there will be a cost determined by a realization according to $g(\varepsilon)$:

$$u_P = \begin{cases} V(X,\theta) & \text{for } i = S \\ \mathcal{V}_i\left(V(X,\theta), b\right) - \alpha^i(X) - \varepsilon_i b, & \text{for } i \neq S, \end{cases}$$

where

$$\alpha^i(X) \begin{cases} > 0 \text{ for } i \in \{K_L, K_R, OLA\} \\ = 0 \text{ otherwise,} \end{cases}$$

and

$$\varepsilon_i \begin{cases} > 0 \text{ for } i \in \{B, OLA\} \\ = 0 \text{ otherwise.} \end{cases}$$

It is worth pointing to two assumptions we are making in the set up of the game. First, we assume that the firm cannot misrepresent its choices in X, i.e., regulators get in the LW a truthful and accurate description of the firm and its potential resolution strategy. Second, we are assuming that all players know the value of all the final payoffs of the game, including the potential externalities and the different values that can be achieved depending on the method of resolution of a firm in financial distress. These are not realistic assumptions. We make them here to present the simplest environment that allows us to highlight the main economic forces behind the commitment problem in financial firm resolution. Relaxing them will certainly complicate the analysis of the problem, but we believe that the spirit of our conclusions in this article will remain valid in a more realistic environment with asymmetric information and uncertainty about payoffs.

It is our objective to understand the value that LWs bring to the problem of SIFI regulation, in particular how they may help to provide commitment to the policymaker not to choose a bailout in the event of insolvency. To that end, in the next subsection we characterize the outcome of the game, and in Section 2 we discuss how this outcome will differ with and without regulated LWs.

Outcomes

Given the sequential moves in the game, we look for a subgame perfect Nash equilibrium. The set of equilibrium strategies $(\sigma_F^*, \sigma_D^*, \sigma_P^*)$

are such that, at any decision node, agents are maximizing their expected value of the corresponding subgame. The first relevant subgame, working backward from the end nodes, is that of the firm choosing $a_F \in \{M, K_L, K_R\}$ if the planner has chosen not to intervene; that is, the firm chooses between selling to the market, liquidation, or reorganization. In this case, for each given vector of possible firm characteristics, (ω, x, R, a_P), and uncertainty realization up to that node, (θ, ε), the firm simply chooses the strategy that maximizes the value of the firm:

$$\max_{a_F \in \{M, K_L, K_R\}} \mathcal{V}_{a_F}\left(V\left(X, \theta\right)\right).$$

This subgame is then substituted by the final payoffs corresponding to this optimal choice of the firm, denoted $a_F^*\left(\omega, x, R, a_P; \theta, \varepsilon\right)$. This creates a new final subgame in which the planner chooses $a_P \in \{NI, B, OLA\}$; that is, it chooses from no intervention, an intervention in the form of a bailout, or resolution through OLA. To make this choice, it compares the value under each feasible method of resolution, for each realization of θ, taking a_F^* as given:

$$\max \left\{ \begin{array}{c} \mathcal{V}_{a_F^*}\left(V\left(X, \theta\right)\right) - \alpha^{a_F^*}\left(X\right), \mathcal{V}_B\left(V\left(X, \theta\right), b\right) - \varepsilon_B b, \\ \mathcal{V}_{OLA}\left(V\left(X, \theta\right), b\right) - \alpha^{OLA}\left(X\right) - \varepsilon_{OLA} b \end{array} \right\}.$$

This optimal choice is denoted $a_P^*\left(\omega, x, R; \theta, \varepsilon\right)$. In the next relevant subgame, creditors choose R anticipating the subsequent choices of intervention and resolution (that is, a_F^* and a_P^*), and using the probability of failure contingent on a choice of the firm, $\pi\left(X\right)$, to calculate their expected payoffs. That is, they set $R^*\left(X\right)$ given a_F^*, a_P^*, to solve

$$E_{\theta,\varepsilon}\left[u_D\left(R, a_P^*, a_F^*\right); X\right] = D\left(1 + \bar{R}_1\right), \tag{1}$$

where $E_{\theta,\varepsilon}$ denotes the expectation taken with respect to the densities $h\left(\theta\right)$ and $g\left(\varepsilon\right)$. In the next relevant subgame, the firm chooses its strategy $x^*\left(\omega\right)$ anticipating the interest R^* and the choices of intervention and resolution a_F^* and a_P^*, and again using $\pi\left(X\right)$ to calculate their expected payoffs:

$$\max_x E_{\theta,\varepsilon}\left[u_F\left(x, R^*, a_P^*, a_F^*; \omega\right)\right];$$

that is, the firm chooses x, the elements of the firm characteristic vector that are not subject to the constraints imposed by supervisors according to safety and soundness measures, or the LW review process. Finally, in the last subgame, at the initial node, the planner chooses regulation ω^* (the limits on the regulated characteristics of the firm) anticipating the choices at subsequent nodes, x^*, R^*, a_P^*, and a_F^*, as well as the corresponding $\pi\left(X^*\right)$:

$$\max_\omega E_{\theta,\varepsilon}\left[u_P\left(\omega, x^*, R^*, a_P^*, a_F^*\right)\right].$$

2. THE TIME INCONSISTENCY PROBLEM

We are now ready to formally describe the time inconsistency problem behind the TBTF problem. If commitment was available, the planner would like to choose, at time zero, both regulation, ω^*, and resolution policy, a_P^*, to maximize expected payoff

$$\max_{\omega, a_P} E_{\theta,\varepsilon} \left[u_P \left(\omega, x^*, R^*, a_P, a_F^* \right) \right].$$

Note that in the equilibrium we just described, since commitment is not available, at time zero the planner chooses only ω, taking as given his future subgame perfect choice a_P^*. Most importantly, x and R are chosen by the firm and the creditors also using a_P^*.

It is easy to see from the game tree that the solutions with and without commitment will not coincide. From the payoffs of the debtholders, we see that they only take losses if the firm is insolvent and resolved through bankruptcy or OLA. That is, bailouts guarantee debtholders get repaid in full. Because of this, a firm will find that it can minimize the interest rate on its debt, R^*, if it chooses a set of characteristics in x that make it profitable when solvent but likely to fail (i.e., "risky"), provided these characteristics also make it hard to resolve through bankruptcy or OLA. This is the moral hazard problem (i.e., choosing an x that implies too much risk of insolvency given the costs to society of a failure) that is triggered by TBTF (i.e., the firm being too hard to resolve). Excessive risk-taking of the firm is optimal because debtholders will not demand a higher interest rate, R, to compensate for it, since their payment is likely to be guaranteed by a bailout.

Instead, implementing a policy that prohibits bailouts (i.e., committing ex ante to never choosing $a_P = B$ for any X and θ) lowers the probability of financial distress because debtholders stand to lose from firm failure and hence demand a high R for x choices that make the firm likely to fail (see equation 1). This sensitivity of R to x choices implies that the firm finds it profitable to choose an x that makes it less likely to fail.

The time inconsistency problem arises because it is not credible for the planner to commit to never choosing $a_p = B$, since this is the optimal ex-post choice for some combinations of X and θ—for example, when the aggregate state of the economy is bad and DIP financing is so expensive that it makes the firm fail or when externalities are high. Because of this, the planner would need some external commitment mechanism in order to not choose to bailout in the relevant subgame. This issue of commitment arises because bailout policy is only implemented at the time of financial distress (that is, after observing the realization of θ). Since at that point (in that subgame) the characteristics of the firm, X, have already been determined, the planner finds it

profitable to bail out the firm whenever the payoff to society is higher with intervention than without it. This implies $a_P = B$ in a larger set of states θ than it would result under commitment. That is, denoting with b_B and b_{OLA} the amount of funds needed to bail out the firm or resolve it through OLA, respectively, a bailout will be chosen by the policymaker whenever

$$\mathcal{V}_B\left(V\left(X,\theta\right),b_B\right)-\varepsilon_B b_B > \max\left\{\begin{array}{c}\left\{\mathcal{V}_i-\alpha^i\left(X\right)\right\}_{i\in\{K_L,K_R,M\}},\\ \mathcal{V}_{OLA}-\alpha^{OLA}\left(X\right)-\varepsilon_{OLA}b_{OLA}\end{array}\right\}. \tag{2}$$

This behavior is anticipated by the firm in equilibrium, making the announcement of no bailouts at time 0 irrelevant. That is, $a_P\left(X,\theta\right)\neq B$ for all X,θ is a time-inconsistent strategy. This inability of the planner to commit will make the firm more likely to choose certain x characteristics that will imply more frequent failure. The reason is that for some of these failures creditors will be bailed out, and hence R for those x choices will be lower than it would be under commitment, according to the equilibrium interest rate condition in equation 1. Unless externalities are very large, the equilibrium under commitment would result in higher expected welfare by eliminating moral hazard in the choices of x. In the next section, we discuss specific examples of the manifestation of this moral hazard problem in the choices of the firm.

How can LWs help provide commitment not to bail out? Because the existence of a regulated LW implies higher values for the firm on the right-hand side of equation 2 but not on the left-hand side, the set of states for which the inequality will be satisfied will be smaller when the LW is in place. That is, by controlling certain firm characteristics that are mostly relevant for ease of resolvability, such as size and complexity, and by spelling out strategies to maximize the value of the firm in the event of liquidation, LWs make the alternative of unassisted resolution more attractive to the planner when compared to a bailout in the ex-post event of firm insolvency.

3. FIRM CHOICES AND MORAL HAZARD

To understand the implications of the design of regulation and resolution methods on outcomes, it is useful to be more specific in describing firm choices. In what follows, we provide a (nonexhaustive) list of salient firm choices that we had summarized in X in the description of the game above. We also discuss how each may influence the payoffs and probabilities of failure in the game. We consider choices over the following characteristics: the firm's size, its production and legal structure, its risk choices, the liquidity of its asset portfolio, its leverage,

and the degree of maturity transformation and other characteristics of its financing through debt. We discuss each of these in detail next.

Size

We denote the size of the firm by A. The firm benefits from increasing its size because of economies of scale, that is, $V(X, \theta)$ increases with A. The larger the firm, however, the more difficult it is to have an orderly liquidation in the event of financial distress. That is, the loss in value from resolution, $V - \mathcal{V}_i$, is increasing in A for $i = M, K_R, K_L, OLA$. It is plausible that this loss is greatest for K_L, which implies the fastest liquidation. Similarly, the externality cost, $\alpha^i(X)$, is increasing in A for $i = K_R, K_L, OLA$, and we expect it to be the largest for K_L and the lowest for OLA, since this institution can impose a two-business-day stay on qualified financial contracts, preventing some firesales of assets. This means that the failure of a larger firm may be more likely to trigger intervention (i.e., the planner prefers B to OLA, and OLA to NI), since it has the potential to impose larger externalities on the economy if it fails. In summary, an increase in size lowers the expected repayment of creditors in the nodes K_L, K_R, M, and, to a lesser extent, in OLA, but it increases it in the nodes of S, B; moreover, the node of bailout, B, in which creditors get repaid, happens with higher probability.

Complexity in Production

We denote the level of complexity due to production complementarities as C^p. This captures the number and interconnectedness of subsidiaries. The firm benefits from increasing C^p because of economies of scope if it stays solvent, i.e., V is increasing in C^P. However, if the firm fails, more complexity will make assessments of the value of the assets difficult unless the firm is bailed out and it continues to operate as usual, i.e., $V - \mathcal{V}_i$ is increasing in C^P for $i = M, K_R, K_L, OLA$.

For a firm of high complexity, and all else equal, OLA and bankruptcy may be at a disadvantage with respect to the market (other financial institutions may be more experienced at doing due diligence, and they may even be counterparties of the failing firm, who are better able to evaluate its portfolio). The OLA may be better than a bankruptcy judge, since the regulators have a good deal of information about the firm that may help them liquidate the firm, preserving some of the economies of scope. The value of bankruptcy through liquidation may also be higher than in reorganization, since complexity will again interfere with due diligence necessary to obtain DIP financing, making

it expensive. Hence, a plausible ranking of payoffs for a firm of very high C^P would be

$$\mathcal{V}_B > \mathcal{V}_M > \mathcal{V}_{OLA} > \mathcal{V}_{K_L} > \mathcal{V}_{K_R}.$$

Complexity Due to Regulatory Arbitrage

We denote the level of complexity due to regulatory arbitrage as C^b. It represents the complexity in firm structure due to having subsidiaries in different countries or even simply having legal entities that do not coincide with business units. Even though it may be convenient for the firm to exploit different tax regimes across different borders, this implies it is subject to different regulatory environments and legal systems that would handle bankruptcy in potentially different manners. This implies that maximizing the value of the firm in resolution would require a level of coordination across jurisdictions that seems difficult to attain. Hence, it is likely that in states of failure without a bailout, the effects of this type of complexity on payoffs are similar to the ones we just described for C^P, i.e., we have that $V - \mathcal{V}_i$ is increasing in C^b for $i \neq B, S$. However, the effect on welfare from an increase in C^b when the firm is not resolved is different than that of an increase in C^P. In contrast with savings that arise with economies of scale or scope, tax savings for the firm are simply a transfer between the rest of the economy and the stakeholders of the firm, so the planner does not value them. Moreover, they may actually distort the decisions of the firm, making its value—before taxes—actually lower for society. This is easily seen by comparing the payoff to shareholders in states of solvency, $V(X,\theta) - D(1+R) - T(X)$, with the payoff of the planner, $V(X,\theta)$. Clearly, because of the dependence of the tax bill on X through C^b, the level of complexity that maximizes the expectation over the value of the firm net of taxes may not coincide with the one that maximizes the expectation over the gross value of the firm, which is what the planner cares about.

Balance Sheet Risk

To explain the risk-shifting problem that arises in the financial system due to explicit and implicit government guarantees, we consider the firm's choice of risk in its balance sheet. For this, we assume that financial assets can be classified into "risky" and "safe," and the firm choices in X include the proportion of risky assets in the balance sheet

of the firm, denoted as $\rho \in [0,1]$. Assuming that the returns of both assets are stochastic and equal to r_R and r_S, correspondingly, they imply a return on the balance sheet that depends on ρ:

$$\rho r_R + (1-\rho) r_S.$$

A risk-shifting problem arises when the risky project is not efficient to undertake for society or creditors. A sufficient condition for that situation would be $E[r_R] < E[r_s]$. Under this assumption, despite it being inefficient, limited liability may still make it attractive for shareholders: Given that shareholders are not liable for losses in the event that the realized return is lower than the cost of the assets, we have that for them

$$E[\max(r_R, 0)] > E[\max(r_S, 0)].$$

Lenders, on the other hand, suffer losses but do not get an upside when risky projects pay off. Hence, after they observe the choice of ρ of the firm, they adjust the price of funding for the assets, R, to break even given the choice of risk of the firm.[7] Through this mechanism, debt monitoring implies that risk-taking is costly for the firm, and hence it does not choose only risky projects. Importantly, though, the payoffs to creditors are guaranteed to be $D(1+R)$ whenever there is a bailout. This implies that the sensitivity of the price of debt, R, to the risk choices of the firm is decreased if lenders believe that financial distress is likely to lead to the planner's intervention through a bailout. In turn, this means a higher risk chosen by the firm, which translates into higher probability of financial distress, $\pi(X)$.

Note that, short of the complete guarantee of debt that follows from a bailout in our simple model, anything that increases the value of an insolvent firm will increase the expected payoff to creditors. For example, if resolution through OLA is likely to enhance the liquidation value of the firm because of institutional advantages such as the ability to impose a two-day stay on qualified financial assets, or because of the availability of interim financing provided by the OLF, this will have the effect of decreasing the sensitivity of R to risk choices.

Liquidity

We denote the fraction of the portfolio that is invested in liquid assets as $\lambda \in [0,1]$. A high λ has several (and potentially opposing)

[7] In reality, lenders are likely to observe risk choices of the firm they lend to only imperfectly. As long as they have a (possibly costly) way of gathering some signal about this choice, the intuition conveyed in our simple model would still hold.

effects. First, it decreases the probability that the firm gets in financial distress because of liquidity needs: If, due to market frictions, the financing ability of the firm deteriorates (for example, it is unable to roll over short-term debt or unable to access repo markets), the firm can easily deplete its stock of liquid assets, remaining solvent along the way. However, this comes at a cost: Liquid assets, such as Treasury securities, have a liquidity premium, which means their return is lower. This means that a second effect is lower margins, which makes the firm less resilient to shocks and more likely to fail. High liquidity, however, has value in the event that resolution becomes necessary, since assets that are liquid are typically valued by a large number of agents in the economy, and their value is independent from the rest of the portfolio of the firm that holds them. Hence, a third effect is that a high λ is likely to imply a high liquidation value irrespective of the method of resolution. A fourth effect follows: A high resolution value implies that the creditors of the firm expect to recover a larger amount in the event that the firm goes into bankruptcy, and hence the price of debt decreases. If these savings are large enough, they may compensate the liquidity premium paid to achieve a higher λ. Finally, from the perspective of the policymaker, a fifth effect may arise: If the firm holds a large quantity of liquid assets, which are likely to be also in the balance sheets of other financial institutions, this may trigger a concern about firesale effects in the event of liquidation. Hence, indirectly, a higher liquidity requirement may make methods of resolution that are believed to prevent firesales, such as a bailout or OLA, more attractive.

Leverage

We denote the proportion of assets that are financed with equity capital instead of debt as κ. Leverage is $\frac{D}{V} = 1 - \kappa$. If κ is larger, the asset value realizations for which the firm is insolvent decreases. Capital requirements of the form $\kappa \geq \underline{\kappa}$, hence, decrease the probability of failure π. Tax advantages will, for the same cost of capital and debt, make the firm prefer leveraging. Only a high price of debt will make the firm choose $\kappa > \underline{\kappa}$ in the absence of regulatory constraints. However, a firm with a high κ should face a lower probability of failure, which will in turn lower its cost of debt, increasing V.

In the event that the firm does go into failure, higher κ will imply less disruptions for the economy in the form of contagion through counterparty risk, making $\alpha^{K_L} - \alpha^{OLA}$ smaller. Also, less reliance on debt will probably mean less fragile debt, implying less need for DIP financing. This will make the difference $\mathcal{V}^{OLA} - \mathcal{V}^{K_L}$ smaller. Hence, higher

capital requirements will undermine OLA's advantage with respect to bankruptcy.

Fragile Debt and Maturity Transformation

We denote as δ a measure of the reliance of the firm on "fragile" debt and the degree of maturity transformation that it engages in.[8] Fragile debt includes both run-prone debt financing (short-term debt like commercial paper and unsecured deposits) and repos and other QFCs.

Standard priority rules in bankruptcy—given by deposit insurance, bankruptcy law, exemption from the automatic stay for QFCs, as well as private arrangements between creditors and SIFIs (i.e., senior and junior debt denominations)—determine the probability that fragile-type debt gets repaid in the event of liquidation. For example, deposit insurance implies that depositors always get repaid. This implies that such depositors will only demand the risk-free rate of return, and hence the price of these loans will remain unchanged with changes in the firm's choices of X. Less explicit arrangements, such as the safety net implied by the existence of a policymaker with funds available to finance a firm in trouble, imply that short-term debt that is believed to be a mechanism for the contagion of financial weakness will be more likely to be first in line for repayment in a liquidation. Moreover, short maturity means that when information first starts to appear about financial trouble for a firm, its short-term lenders are simply able to not roll over their loans. These reasons imply that the lenders who own the fragile debt expect to get repaid with high probability, and hence this type of debt has a lower cost for the firm.

Relying on short-term debt has two important negative effects on the strength of the firm. First, for a given capital structure, more fragile debt (higher δ) implies a higher probability of financial distress. Because of its short maturity, this debt needs to be refinanced frequently and hence is more likely to become unavailable when financial weakness appears, making insolvency more likely. To limit this problem, safety and soundness regulations impose certain requirements, such as the liquidity coverage ratio (LCR) recently established in the international Basel III accord, which requires a certain balance between the liquidity of the assets of a firm and its fragile debt. Second, higher δ implies higher effective DIP financing needs of the firm to continue business

[8] The financial institution engages in maturity transformation when it borrows short-term (e.g., through deposits and repurchase agreements) and lends long-term (e.g., through mortgages and industrial loans), acting as an intermediary between lenders and borrowers in the economy.

as usual in the event of bankruptcy. This is mainly because once the firm has failed, any QFCs are exempt of the automatic stay, and their liquidation means that counterparties retain collateral, depleting the assets of the firm at a discount rate (determined by the haircut on the collateral).

The purpose of targeting a high LCR is to tame the first negative effect, i.e., decrease the probability of failure. The purpose of using the LWs process to quantify and minimize $\delta(1-\kappa)A$, instead, is to minimize the second negative effect, i.e., limit the DIP financing needs. In summary, the traditional approach of safety and soundness regulation differs from, and is complemented by, the LWs review process.

This concludes our description of the choices of the firm. Summarizing, in our model, the vector X consists of these key firm characteristics:

$$X = \{A, C^p, C^b, \rho, \lambda, \kappa, \delta\},$$

namely, the size of its balance sheet, complexity in production, complexity due to regulatory arbitrage, balance sheet risk, liquidity, equity financing, and the structure of its debt. It is plausible to think that, while characteristics such as equity financing and liquidity choices have been highly scrutinized by supervisory controls since before DFA, they are now being evaluated under a new perspective: what choices are likely to facilitate the orderly liquidation of the firm in case of distress—as opposed to what choices are going to minimize the probability of distress. Other characteristics, such as size of balance sheet, complexity in production, complexity due to regulatory arbitrage, or the structure of debt, although always important to supervisors, are now formally required within the LW review process to comply with the standard of facilitating resolution. This constitutes an expansion of the subset ω of firm characteristics that are constrained by regulation because of the introduction of LW requirements under Title I of DFA. Finally, characteristics that are harder to measure and control, such as the risk-taking of the firm, are at the heart of the choices of the firm x that remain subject to the moral hazard problem with TBTF institutions.

How Living Wills May Help With Time Inconsistency

Reflecting regulatory requirements in DFA, we have modeled LWs as instruments to *disclose* the efficient way to liquidate a firm, as well as to *control* a subset of firm characteristics ω in X. In reality, the way in which regulators control firm characteristics is through an

iterative process with the regulated firms. That is, if a firm's choices in ω described in the LW imply that its unassisted resolution plan is deemed "noncredible" by the regulators, the firm is required to change its choices in ω in order to solve the shortcomings of its resolution plan. For example, if the LW describes a firm that is too large or too complex, it may be asked to divest some of its assets. Or, if the proportion of fragile debt is too large, regulators can ask the company to change their capital structure to compensate for this added fragility. Then, a new LW is crafted given the new structure of the firm, and it is evaluated again by regulators.

As we argued in Section 2, regulators hope that LWs will alleviate the time-inconsistency problem of the planner. They may do this by minimizing both the intensive (the amount b) and extensive (the probability π) margins of intervention. They accomplish this in two related ways:

1. Ex post: by disclosing information on how to maximize the liquidation value of the assets of the firm;

2. Ex ante: by controlling the choices of the firm in ω and disclosing that an efficient resolution plan is in place that does not involve intervention.

As we argued when discussing payoffs in Section 1, the ex-post gains occur because a good LW maximizes the liquidation value of the assets, since (i) it constitutes a detailed description of the assets and business model of the firm (e.g., by describing economies of scope, location, and logistic needs of core functions); (ii) it minimizes the market disruptions triggered by the failure of the firm (e.g., by listing the main counterparties and any relevant cross guarantees); and (iii) it increases the likelihood of market-based reorganization options (e.g., by providing a readily available description of financing needs and better information about the company that implies better pricing of DIP financing, higher likelihood of a private acquisition, or less need of assistance in a purchase and acquisition process). This implies that LWs can improve the payoff to society, u_P, in the nodes that do not involve the planner's intervention, $i = M, K_R, K_L$, by increasing the liquidation value of the firm, $\mathcal{V}_i\left(V\left(X,\theta\right)\right)$, and/or reducing the externalities $\alpha^i\left(X\right)$.

The requirement of LWs will bring ex-ante gains to society whenever the increase in payoffs, u_P, in the no-intervention nodes implies that the strategy of the planner of no intervention dominates that of intervention, as indicated in equation 2. When the firm anticipates fewer instances in which a bailout will be chosen given insolvency, it finds it profitable to make choices in x that decrease the probability of insolvency, $\pi\left(X\right)$. This way, LWs may lessen the TBTF problem.

Related Proposals

There are several regulatory proposals and initiatives that relate to the LW's power to commit not to bail out. For the purpose of our discussion, they can be classified in two groups.

The first group of proposals seeks to enhance clarity and commitment to priority rules that assign losses in bankruptcy. For example, Barry Adler of NYU Law has presented the idea that LWs can effectively establish a priority rule in case of failure; that is, it would indicate how debt of different classes (or "priority tranches") would be converted sequentially into capital if the firm is in financial trouble.[9] This way the firm would automatically recapitalize until it is solvent again. A clear benefit is that a LW would make transparent the incentives of the owners of more junior debt to make the interest rate they demand depend on the ex-ante risk choices of the firm. Moreover, with iterative conversion of debt into equity preventing failure, it could minimize the liquidation of collateral, since the most senior debt may still be repayable.

In a similar spirit are proposals to impose certain requirements on the combination of capital and long-term debt ("total loss capacity") at the parent of a bank holding company (BHC). The idea is that these debt holdings at the parent company would serve as a cushion for losses in subsidiaries, which are in turn financed by the parent company holding their equity. This structure would be particularly useful if the BHC were to be resolved using a strategy of "single point of entry" (where only the parent company files for bankruptcy), as favored by the chairman of the FDIC in recent speeches (see Gruenberg 2015). Herring and Calomiris (2011) had previously argued for a similar cushion for losses in the form of convertible debt. This is debt that converts automatically to capital under certain triggers tied to financial strength measures. These proposals, as well as any other effort that selectively puts creditors who are able to monitor the firm's choices in X on the hook for losses in the event of financial distress, could complement the requirement and regulation of LWs in the objective of alleviating the TBTF problem.

A second group of proposals seeks to enhance the efficiency of unassisted bankruptcy. For example, an important effort has been made to make financing through "swaps" less problematic in the event of failure. A swap is a type of derivative, a financial contract between two parties that agree to exchange cash flows replicating the payments of underlying securities (for example, the coupons of a bond or a future

[9] See Chapter 8 in Acharya et al. (2010).

on an exchange rate). Changes in the value of these swaps are typically backed by posting collateral (i.e., if a change in the market implies that counterparty A is expected to have to transfer to counterparty B a cash flow with net present value of M, then to insure B against the failure of A we will see A transferring collateral with value M to B). In the event of bankruptcy filing, these swap contracts are qualified to be exempt of the automatic stay. This means, in our example, that if A files for bankruptcy, the swap is automatically terminated, and B keeps the collateral amount M—hence depleting B of these funds immediately. In a recent joint initiative of the FDIC and the International Swaps and Derivatives Association, 18 of the largest global bank holding companies, which constitute a majority of the swap market, have voluntarily agreed to end the automatic termination of covered derivative contracts in the event of a bankruptcy or public resolution of a systemic financial institution, effectively changing the priority ordering of creditors. This should help minimize the need of DIP financing of a bankrupt firm, increasing its liquidation value. Similar agreements, if they were to include other types of derivatives, such as repurchase agreements, would erode one of the main advantages of OLA with respect to bankruptcy: the brief two-business-day stay that OLA can impose on all qualified financial instruments.

Researchers at the Hoover Institution Resolution Project have proposed more encompassing reforms of bankruptcy law that would go beyond curtailing exemptions to the automatic stay, giving increased flexibility to judges and even allowing for external interim funding as part of the procedure (Jackson 2014). These proposals are compatible, and would work best, with a regulated LW that provides useful information to bankruptcy judges, as mandated by DFA.

4. IMPLICATIONS

We have so far answered our main question of how can LWs help tame the moral hazard problem behind TBTF. In this last section we focus instead on two related questions. First, we are interested in learning what are the contexts in which requiring LWs is more likely to be helpful. Second, we would like to know what are the key characteristics that make LWs the most useful. As a preview of our conclusions, we find that LWs are most likely to be useful in the absence of other forms of commitment not to bail out, if externalities are important, and whenever institutions are in place such as the OLA (with the ability to more efficiently finance wind downs, which provides higher value to unsecured lenders). We also find that LWs are most useful

when they communicate enough information to creditors about their expected losses in the event of failure.

When is Regulation of LWs Likely to be Most Useful?

A good LW provides information that maximizes the going concern of the failing firm. Because of this feature, one could think about LWs as a regulated version of debt covenants or credit line provisions, which are put in place by market participants in the absence of a safety net or financial firm regulation. Because creditors increase their expected payouts if the going concern of the firm is maximized in the event of failure, structuring the firm in a way that makes it easy to resolve will increase the liquidation value of the firm, and hence the expected payoff to creditors in the event of failure.

In this section we will compare outcomes for society depending on whether LWs are unregulated (in the form of debt covenants) or regulated (supervisors review them). Why and when is the regulation of LWs needed? There are two important frictions why the market may not impose the same constraints on firms under privately arranged debt covenant than under regulated LWs: lack of commitment and the existence of externalities from liquidating a SIFI. We discuss them next.

Lack of commitment implies too many failures and makes the regulation of LWs necessary. Our model illustrates that, in the absence of commitment to not bail out, the price of debt may be insensitive to the quality of the market-provided LW (or, in other words, to the expected liquidation value of the firm in the event of insolvency). In other words, the price of debt may be hump-shaped in firm characteristics such as size, complexity, and risk, since a bailout is expected when these take high values. This results in market-provided LWs that do not impose the right limits on ω and firm choices that imply a high probability of a bailout (firms that are too large, complex, illiquid, and risky). The need to require credible LWs (i.e., limits on ω that are regulated) parallels (and complements) other safety and soundness regulations, such as capital requirements, in the presence of a safety net for financial firms. Summarizing:

Implication 1 *Whenever the planner cannot commit to a resolution strategy, unregulated LWs are not efficient, and the probability of default is inefficiently large.*

Externalities also make the regulation of LWs necessary. Our analysis illustrates that, even if the planner would have the technology to commit to never intervene, the quality of the LWs may be suboptimal

if there are externalities. This is because, even though the price of debt does respond to the limits on X imposed by the unregulated LWs in this hypothetical scenario without bailouts, creditors do not internalize the spillovers to the rest of the economy of the firm failing, resulting in suboptimal limits on X for unregulated LWs. In fact, in this hypothetical scenario without bailouts, externalities are the only reason for regulating LWs. Summarizing:

Implication 2 *Whenever the planner can commit to a resolution strategy, unregulated LWs are efficient if and only if externalities are not important.*

Our analysis also points out that, even in the absence of the two frictions we just discussed, regulating LWs may not be enough to achieve efficiency. In particular, we can think of two instances in which welfare can be improved ex post by having an institution provide interim financing to wind down insolvent SIFIs. OLA is one such institution. First, if aggregate macroeconomic conditions are bad the cost of DIP financing will be high. OLA has an advantage in these instances, since it can use the OLF to fund the firm's operations. This will mean firms that fail in situations of economic crisis may be more efficiently resolved through OLA. Second, if externalities are important, the greater likelihood of an orderly liquidation through OLA than bankruptcy will also mean that the availability of OLF funds may improve ex-post welfare. If neither of these two conditions are present, however, LWs can provide the same welfare relying solely on bankruptcy. Summarizing:

Implication 3 *OLA may improve efficiency by providing financing below DIP market rates in states of bad aggregate conditions or whenever externalities are important.*

A different argument in favor of OLA that is commonly cited relies on the fact that it makes DIP financing available for a firm facing a "pure liquidity shock." For such a firm, liquidation would be inefficient, and the availability of OLF funds could improve welfare. For this argument to be relevant, however, one would need to justify why solvent firms may become illiquid.

We have identified conditions under which OLA may be needed on top of regulation of LWs to improve ex-post welfare. A caveat arises when analyzing the equilibrium of the game, however: OLA needs credible LWs to improve ex-ante welfare. This is because the same cheap DIP financing that improves welfare ex post by increasing the liquidation value of the firm will make failure less costly to creditors of such firms. Hence, commitment not to bail out will be sufficient for the existence of OLA to be welfare enhancing, but in its absence the

positive effect ex post may be cancelled by an increasing probability of failure, π, through the moral hazard in the choices of x. Regulating the quality of LWs improves liquidation outcomes, but also, importantly, it expands the set of characteristics ω on which regulators put constraints, decreasing the incentives of the planner to intervene ex post. In other words,

Implication 4 *Whenever the planner cannot commit to a resolution strategy, for OLA to increase ex-ante welfare we need to complement it with regulated LWs that (i) improve liquidation outcomes outside of OLA* ($i = M, K_L, K_R$)*, and (ii) constrain the choices of the firm.*

These results raise some important issues. First, how are regulators supposed to identify being in an aggregate state that makes funds for market-based resolution scarce? If such a state can be determined following objective criteria, should OLA only be invoked using such an objective trigger? Second, if the main contribution of OLA is to provide funding, should this institution be defined in this narrower way, leaving the actual reorganization of the firm to a bankruptcy court, which is more likely to respect priority rules?[10] Limiting the powers of regulators to intervene in the event of financial distress will decrease moral hazard, but our analysis indicates that setting the limits right is a complicated matter.

We have established that LWs can help to increase ex-ante welfare given the existence of OLA and the possibility of other forms of bailouts. It is important to emphasize as well that the optimal structure of the firm balances efficiency in normal times with low likelihood of failure *and* ease of resolution. More information on externalities and evidence on the ability of different methods of resolution to maximize the liquidation value of firms would be valuable input to improve the regulation of financial firm resolution.

What are Useful Characteristics of LWs?

To finalize our analysis, we want to stress the key characteristics of LWs that the model underlines. First, LWs are the instrument that discloses to creditors the restrictions on X contained in ω. Second, they also provide them with information about their payoffs in each possible resolution method by describing the value of the firm. In the model, these two characteristics of LWs are necessary for debtholders

[10] See bankruptcy reform proposals by Jackson (2014).

to correctly estimate the probability of repayment and to price the debt accordingly. That is, creditors need to observe X to tame moral hazard by making the price of debt sensitive to firm choices. More generally, an important lesson may apply to LWs outside of our model:

Implication 5 *In order for LWs to lessen the time inconsistency problem, we need creditors to have access to the resolution plan and understand the implied priority order of payments under each possible resolution method.*

When thinking about this characteristic of "transparency" of the LWs, it is interesting to consider the scenario in which regulators have commitment not to intervene. In this scenario, the simple disclosure of X would imply that creditors would themselves impose limits on the firm's choices (through unregulated LWs) by having the price of debt depend on X. As Implication 2 stated, if externalities are not important, this may be an efficient equilibrium without regulation and plausibly a desirable situation for society. An important question, however, is whether with unregulated LWs such a level of disclosure of the firm's choices would be feasible, or if it would be incompatible with competition among different financial firms. If the latter were the case, there may be a role for regulation of LWs (imposing limits on X without disclosing the X itself) even in a world with perfect commitment to not bail out.

5. CONCLUSION

It has been argued that living wills are a promising new tool in supervision that may help policymakers alleviate the TBTF problem. In this article we have described the mechanism through which they may achieve that objective and under what conditions they are more likely to succeed. A key insight from our analysis is that the requirement for financial firms to file living wills is not equivalent to regulators tying their hands ex ante so that they are not able to intervene with a bailout in the event of financial distress. Instead, the requirement that firms have living wills in place is meant to make the outcomes from bankruptcy better for society. This has two beneficial effects. First, it directly lessens the moral hazard problem that the possibility of bailouts creates by expanding the set of choices of the firm on which supervisory requirements are imposed: If the size or the complexity the firm has chosen is such that the plan for resolution unveils important costs to using bankruptcy, regulators can require the firm to adjust its structure. This makes the ex-post choice of policymakers not to intervene more attractive and hence more likely. If unassisted failures are

more likely, in turn, a second, indirect effect arises: Debtholders who stand to lose in those failures will increase their monitoring of hard-to-regulate risk choices of the firm, again decreasing the moral hazard problem.

Because regulators are not ruling out ad-hoc funding, in particular cases when intervention seems a better choice (such as when a firm fails in the midst of adverse aggregate conditions), bailouts are still an available tool for policymakers. However, through their increased monitoring of firm characteristics key to the strength of financial institutions, living wills may not only decrease the probability of intervention, but also the size of the public funds involved in interventions when they happen, saving society the costs these transfers may involve.

It is important to keep in mind, however, that there are tradeoffs involved in the requirement of living wills: There are costs to the firms of writing a living will and making the changes to its structure that regulators deem necessary to make their unassisted resolution through bankruptcy viable. Hence, regulators need to exercise care that (i) the company does invest the necessary resources to produce a truthful and useful living will, and (ii) that the costs of the changes and the resources necessary to craft a good living will do not wipe out the expected benefits to society from having more resolvable and resilient financial firms.

It is important that the implications from our analysis are taken with caution and understood within the context of our assumptions. For simplicity of the analysis, we have assumed that the policymaker is able to perfectly evaluate the implications (for stakeholders of the firm, as well as for the economy as a whole) of resolving a financial firm in distress of certain characteristics through bankruptcy or the Orderly Liquidation Authority, and we compare that scenario with that of a bailout or a market-based resolution. Further research that considers more realistic informational constraints on the policymakers regulating the living will review process is likely to qualify our implications.

Moreover, our analysis highlights the important role that externalities play in determining the efficiency of an institution such as the Orderly Liquidation Authority, or even the regulation of living wills. Our framework allows us to compare welfare with regulated living wills in place to welfare without them, in a world where we rely on the debt market to monitor firm choices and to price debt accordingly. The importance of externalities is a key parameter in this comparison. Quantitative explorations of the advantages and disadvantages of different methods for resolution, including quantification of potential externalities, would greatly enhance our understanding of the potential for living wills and any related proposals to end the TBTF problem.

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