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The Political Economy of Too-Big-To-Fail

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The Political Economy of Too-Big-To-Fail

Abstract

I consider a two-period model in which being “too big” is only a necessary condition for an insolvent firm to receive a government bailout because, in addition to meeting a threshold asset size, the firm must engage in a lobbying contest in order to be bailed out. The firm has a political advantage because its probability of winning the contest is increasing in its size. When the firm experiences an unfavorable price shock, I find that the *balance* between the size of the requisite bailout and the firm's political advantage of being "too big to fail" determines the firm's probability of getting a bailout. Surprisingly but consistent with the US government's differential treatment of Lehman Brothers and Bear Stearns during the 2008-2010 financial crisis, I find that a smaller firm may receive a bailout while a bigger firm will not, although both firms meet the threshold size of “too big to fail” and a firm's political advantage is increasing in its size.

JEL-Codes: O100, P160, P480.

Keywords: insolvency, bail-out, biased contest, political advantage, too-big-to-fail.

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"In Washington, the view is that the banks are to be regulated, and my view is that Washington and the regulators are there to serve the banks." Rep. Spencer Bachus¹ – Chairman of the US House Financial Services Committee, 2011-2013.

1. Introduction

In the aftermath of the 2008-2010 financial crisis, the concept of too-big-to-fail (TBTF) has received renewed attention (e.g., Bernanke, 2010; Stern, 2009(a), and 2009(b)) after receiving similar attention in the 1980s following the bailout of Continental Illinois National Bank of the USA in 1984. The term too-big-to-fail was popularized by U.S. congressman Stewart McKinney during the hearings in the US congress into the bailout of Continental Illinois in 1984 (Todd and Thomson, 1990).

In testimony before a Financial Crisis Inquiry Commission in September 2010, the then Chairperson of the US Federal Reserve Bank, Ben Bernanke, said (Bernanke, 2010):

"A too-big-to-fail firm is one whose size, complexity, interconnectedness, and critical functions are such that, should the firm go unexpectedly into liquidation, the rest of the financial system and the economy would face severe adverse consequences. ... Governments provide support to too-big-to-fail firms in a crisis not out of favoritism or particular concern for the management, owners, or creditors of the firm, but because they recognize that the consequences for the broader economy of allowing a disorderly failure greatly outweigh the costs of avoiding the failure in some way."

Bernanke (2010) referred to size, complexity, and interconnectedness as separate characteristics of a firm that is too-big-to-fail.² This suggests that a big firm may not necessarily have significant interconnectedness or complexity. But it also reasonable to think that interconnectedness and/or complexity are positively correlated with size. In fact, under the

¹ Quoted from an interview with *The Birmingham News* in December 2010:
<https://www.nytimes.com/2010/12/17/business/economy/17norris.html>

²A precursor to too-big-to-fail was the "essentiality doctrine", a 1950 amendment to the US *Federal Deposit Insurance Act* (FDIA). Under the "essentiality" doctrine, a failing bank is eligible for government assistance, no matter the cost, if the FDIC Board of Directors concludes that the bank "... is essential to provide adequate banking service in its community." (Sprague, 1986, p. 27). The essentiality doctrine was first used in 1971, twenty-one years after the FDIA was amended, to bail out Unity Bank, a small bank in Boston (Sprague, 1986). By broadly interpreting the term "community", the "essentiality" doctrine was used to bail out other banks in the 1970s and early 1980s (Todd and Thomson, 1990).

doctrine of too-big-to-fail, what matters is what the government perceives as the size of the firm. For example, in their study of banks, Brown and Dinc (2009, p. 1392) used employee expenses as one of their measures of a government's perception of the size of a bank because, as they observed, "... using employee expenses will incorporate the government aversion to large layoffs upon the failure of large banks."

According to Kaufman (2014, p. 215), "TBTF frequently also goes by other names, such as: "too big to unwind", "too big to liquidate", "too important to fail", "too complex to fail", "too interconnected to fail", and, most recently, "too big to prosecute or jail". In the USA, the TBTF policy was introduced by bank regulators in 1984 following the Continental Illinois National Bank crisis. The Comptroller of the Currency at that time, while testifying before the U.S. Congress on the bailout of Continental Illinois National Bank, implied that regulators could not close any of the 11 largest multinational banks without the closure having a significant impact on the U.S. financial system and economy.

I note that Bernanke's (2010) definition of TBTF was not restricted to financial institutions. While financial institutions have been the main beneficiaries of TBTF policy, non-financial firms have also received such support from governments.³ For example, the US government bailed out the auto manufacturer, Chrysler, in 1980 by providing \$1.5 billion in loan guarantees. In 2001, President George W. Bush and Congress passed the *Air Transportation Safety and Stabilization Act*, providing \$15 billion to the airline industry.⁴ In 1971, Lockheed

³In an article titled "Is Shell too big to fail?", Butler (2016) opined that Shell, the oil giant, cannot fail because "... How could anyone be so foolish as to think that a company with earnings of \$19bn in 2014, with reserves of 13bn barrels of oil and gas and with daily production of 3m barrels of oil and gas could possibly fail? Shell is not too big to fail but failure should not be allowed to happen. The company represents a significant part of the London market and part of most major institutional portfolios. ... Its decline would be a cause of great political and economic concern."

⁴ <http://www.cnn.com/2001/US/09/21/rec.congress.airline.deal/>

Aircraft Corporation was bailed out by the US government⁵ and in 1970, Penn Central Railroad -- while on the verge of collapse -- got government aid by claiming it was vital to national defense interests.⁶ During the 2008-2010 crisis, the auto manufacturers, General Motors and Chrysler, received billions of dollars of bailout money from the governments of Canada⁷ and the USA⁸. In the case of the USA, General Motors was a beneficiary of the government's Troubled Assets Relief Program (TARP). Since 1966, the Canadian aircraft manufacturer, Bombardier, has been bailed out several times by the federal government of Canada and the provincial government of Quebec.⁹ In a recent paper, Azgad-Tromer (2017) discussed the bailout of -- what he referred to as -- socially important *non-financial* institutions.

The moral hazard implications of TBTF are well known and acknowledged (e.g., Bernanke, 2010; Dam and Koetter, 2012; Stern, 2009(a); 2009(b) and Stern et al., 2004).¹⁰ Expected beneficiaries of TBTF are likely to take excessive risks, sub-optimal investment decisions, and become oversized. The *Dodd-Frank Wall Street Reform and Consumer Protection Act* that was enacted in the USA in 2010 was intended to address some of the moral hazards of TBTF, including limiting the size¹¹ of firms through legislation (Acharya et al., 2011; Kaufman, 2014).

⁵ <https://www.nytimes.com/1976/02/10/archives/gao-questioning-lockheed-ability-to-repay-in-time-deadline-involves.html>

⁶ <https://www.nytimes.com/1974/11/03/archives/penn-entr-a-hell-of-a-way-to-run-a-government.html>

⁷ <https://www.theglobeandmail.com/report-on-business/canadian-taxpayers-lose-35-billion-on-2009-bailout-of-auto-firms/article23828543/>

⁸ <https://www.thebalance.com/auto-industry-bailout-gm-ford-chrysler-3305670>

⁹ <https://www.theglobeandmail.com/report-on-business/rob-commentary/quebecs-bombardier-bailout-is-not-an-investment-its-corporate-welfare/article27081111/>

¹⁰For an analysis of a more egregious form of such moral hazard, see Akerlof et al. (1993).

¹¹On May 22, 2018, the US Congress weakened some of the rules in the Dodd-Frank Wall Street Reform Act. It relaxed rules on banks from \$100 billion to \$250 billion in assets. Banks with assets in this range can no longer be considered "too big to fail." This means that they no longer have to hold assets to protect against a liquidity crisis and they also may not be subject to the Fed's "stress tests."

Contrary to Ben Bernanke's 2010 testimony that "governments provide support to too-big-to-fail firms in a crisis not out of favoritism or particular concern for the management, owners ...", Mishkin (2006, p. 992) claimed that:

"... it is more accurate to attribute banking crises not to too-big-to-fail, but rather to "too-politically-important-to-fail" which includes almost all banks. This is certainly true for emerging market countries, where bankers are particularly powerful, leading governments to bail out almost all banks. It was also true in the United States. The savings and loan crisis was not caused by too-big-to-fail: none of these thrift institutions were sufficiently large to pose systemic risk from one of their failures."

Echoing the sentiments of Mishkin (2006), Kane (1990), and Strahan (2013) argued that the personal interests of policy makers may override social welfare or may be influenced by lobbying by firms in the financial industry. Based on the response of governments to banking problems across a large sample of countries, Brown and Dinc (2005) found that governments were more likely to close failed banks after elections, when newly-elected leaders can blame losses on previous politicians. In a study of bank bailouts in Germany from 1995 to 2006, Dam and Koetter (2012) concluded that bank bailouts were significantly less likely during election periods. They also found that larger margins of electoral victories by incumbent politicians increased the reduction of bailout expectations, an indication that more powerful politicians were more able to withstand the lobbying efforts of pro-bailout interests. Based on an analysis of bailouts in North America and European countries like Ireland, Denmark, Britain, and France, Grossman and Woll (2014) found that bailouts depended on economic conditions and the different types of business-government relations that banks were able to sustain with bureaucrats and politicians.

Governments may lack the commitment to refuse to bail out insolvent firms or banks (e.g., Farhi and Tirole, 2012; Strahan, 2013). In their evaluation of the *Dodd-Frank Wall Street and Consumer Protection Act*, Acharya et al. (2011) reached a similar conclusion. In the USA,

the *Federal Deposit Insurance Corporation Improvement Act* (FDICIA) in 1991 was intended to limit, if not eliminate, the policy of "too big to fail" (Stern and Feldman, 2004; Kaufman, 2014). Yet, many firms were bailed out during the 2008-2010 financial crisis. Stern and Feldman (2004) argued that FDICIA has not been effective at fixing the problem of "too big to fail".

It is not always obvious which institutions are TBTF and would be rescued in the event of a crisis (Brewer and Jagtiaini, 2013; Kaufman, 2014; Dam and Koetter, 2012). For example, during the 2008-2010 financial crisis, Bear Stearns received government support but Lehman Brothers did not although Bear Stearns had total assets with a book value that was only about 55% of the corresponding asset value of Lehman Brothers (Brewer and Jagtiaini, 2013).¹²

Notwithstanding the uncertainty surrounding the bailout of an insolvent bank, Brewer and Jagtiaini (2013), using data from the merger boom of 1991 to 2004, found that banks were willing to pay an extra premium of at least \$15 billion in order to have asset sizes that are commonly viewed as thresholds for being TBTF.

In light of the preceding discussions, Mishkin's (2006) claim that a firm's size may not matter and that what matters is whether the firm is "too-politically-important-to-fail" may not be out of place. But Bernanke's (2010) claim also has some merit.

In this paper, I consider a firm that is "too big to fail" and "too politically important to fail". In the model, "too big" is only a necessary condition for an insolvent firm to receive government support because, in addition to meeting a threshold size, the firm must engage in a lobbying contest against an anti-bailout group in order to receive support. The firm has a political advantage because its probability of winning the bailout contest is increasing in its size. The contest between the firm and the anti-bailout group is consistent with public backlash against

¹²Bear Stearns was sold to JP Morgan for \$2 a share in a deal in which the US Federal Reserve paid \$30 billion to take on some of Bear Sterns' bad assets (Sorkin, 2009).

government bailouts of private firms. This public backlash has been expressed in well-known derogatory phrases like "socializing losses and privatizing benefits"¹³ and "corporate welfare." Politicians and bureaucrats are sensitive to such public backlash. For example, according to Sorkin (2009, p. 37), Henry Paulson, who was Secretary of the Treasury during the 2008-2010 financial crisis had told Jamie Dimon, then CEO of JP Morgan, that he (Paulson) was facing a revolt akin to an anti-tax revolt by people in government against bailing out Wall Street firms. Paulson also told President George W. Bush, who was against the bailouts because of the political costs, that the bailouts were a necessary evil.¹⁴

I find that when there is an unfavorable price shock, a bigger firm may have a smaller probability of being bailed out than a smaller firm, although there is a policy of too-big-to-fail, each firm's asset size meets the too-big-to-fail threshold, and a firm's political advantage in the bailout contest is increasing in its size. This counterintuitive result is consistent with the US government's bailout of Bear Stearns and non-bailout of Lehman Brothers although, as mentioned above, Lehman Brothers was almost twice as large as Bear Stearns. This surprising and differential bailout response was alluded to by Wallison (2018) when he observed that "Bear (Stearns) was the smallest of the five large Wall Street investment banks ... Lehman, the next smallest, was 50% larger than Bear. It was reasonable to believe that if the government was going to rescue the smallest of these firms, it would certainly rescue those that were larger." *Parenthesis mine.*

¹³ On a CNBC program in March 2009 after the US government bailed out Bear Stearns, the host Matt Lauer asked Henry Paulson, who was then Secretary of the Treasury, "Does the Fed react more strongly to what's happening on Wall Street than they do to what's happening to people in pain across the country, the so-called people who live on Main Street?" (Sorkin, 2009, p. 32).

¹⁴ According to Sorkin (p. 39), Paulson told President Bush that "You may need a bailout as bad as it sounds."

I discuss alternative explanations of the aforementioned result of the differential bailout probabilities of big and small firms and show that my model proves this result under *weaker* assumptions.

The paper is organized as follows: in the next section, I study a model of a too-big-to-fail firm that faces political opposition and discuss my results. I conclude the paper in section 3.

2. A model of too-big and too-politically-important-to-fail

Consider a two-period model with risk-neutral agents. There is a firm with production function, $y = 2\sqrt{k}$, where k is the firm's input. Normalizing the price of the input to 1, the firm's total cost is $k + F$, where $F > 0$ is fixed cost¹⁵ and k is variable cost. The price, p , of the firm's output, y , is a random variable that is continuously distributed on $[\underline{p}, \bar{p}]$ with pdf, $h(p) > 0$, where $\underline{p} \geq 0$ and $\bar{p} > \underline{p}$. Output is produced in period 1 but the realization of the price and income occur in period 2. In period 2, conditional on the realization of the price of its output, the firm's profit is $\pi = py - k - F$.

In period 2, let the liquidation value of the firm's production unit or plant be L (e.g., Bulow and Shoven, 1978). Then in this simple model, the firm's total asset is $L + py = L + 2p\sqrt{k}$ and its total liability is $k + F$. The firm's earnings asset is $py = 2p\sqrt{k}$ and the value of its physical asset is L .¹⁶ I use k to represent the size of the firm because $L + 2p\sqrt{k}$ is increasing in k .

¹⁵The fixed costs may include debt service costs, property taxes, insurance premium, rent, fixed salaries, etc.

¹⁶For a bank, k may be deposits that are transformed into investments (which are the bank's assets) of random value, py . For work on estimating the production function for banks and non-financial institutions, see for example, Clark (1984), Hunter and Timme (1986), and Hancock (1986). Clark (1984, p.67) concluded that, for banks, "... the assumption of a Cobb-Douglas production function does not appear to be inappropriate."

In this two-period model, the firm is insolvent if it cannot pay its liabilities (e.g., Stiglitz, 1969, 1972; Bulow and Shoven, 1978; Hellwig, 1981).¹⁷ Therefore, the firm is insolvent if $\pi = L + py - k - F < 0$. Otherwise, the firm is solvent.

If the firm is insolvent in period 2, it may or may not be bailed out by the government. In this two-period model, a bailout does not mean that the firm continues to operate. It means that the firm is liquidated *without* its creditors and suppliers (counterparties) suffering any losses. If the firm is not bailed out, some or all of its creditors and suppliers will incur some losses. It may also mean that the firm is taken over by the government or another firm with the government paying off the firm's creditors and suppliers. If the firm is solvent in period 2, it is liquidated *without* its creditors and suppliers (counterparties) suffering any losses and its owners may get a positive payoff.

I assume that if the firm is liquidated, its owners get a payoff of zero (see, for example, Bulow and Shoven, 1978; Hellwig, 1981; White, 1989) and that there are no principal-agent issues. For the firm to receive a bailout, a necessary but not sufficient condition is that it must be sufficiently big in size. I capture this as $k \geq k_{min} > 0$.

Define $D \equiv F - L$ and assume that is positive. If the government bails out the firm, it gives the firm an amount equal to $-\pi = D + k - py \equiv R(k)$. However, an anti-bailout or no-bailout group can lobby the government, so that the firm does not receive this bailout.¹⁸ Let e_f and e_{ng} be the efforts of the firm and the anti-bailout group in the lobbying game (a bailout

¹⁷In the case of a bank, it can be insolvent or forced into liquidation if it faces a liquidity problem caused by a bank run (e.g., Diamond and Dybvig, 1983; Keister, 2016). A firm that does not have enough cash flow to pay its liabilities can borrow and so does not need to go bankrupt. But even in a model with more than two periods, a no-Ponzi condition needs to be imposed on the firm to avoid rolling over its financial obligations perpetually. Certainly, many firms go bankrupt for reasons not related to a finite-time horizon.

¹⁸For example, as Mishkin (2006, p. 997) observed "Even if the market expects bank bailouts, there is some probability that the bailout will not occur... "

contest) respectively. Suppose that the firm and the anti-bailout group win the bailout contest with the following probabilities¹⁹ (respectively):

$$r_f = \frac{e_f + g(k)}{e_f + g(k) + e_{ng}} \text{ and } r_{ng} = \frac{e_{ng}}{e_f + g(k) + e_{ng}}, \quad (1)$$

where $g(k)$ is strictly increasing in k , $g(k)$ is non-negative, and $g(k) > 0$ if and only if $k \geq k_{min}$.

The requirement of $k \geq k_{min}$ captures a "too-big" threshold. However, consistent with the fact a government may not bail out an insolvent but big firm, the probability in (1) is such that the firm may lose the bailout contest. But notice that, given $g'(k) > 0$, the firm's probability, r_f , of getting government assistance, in the event of being insolvent, is increasing in k (i. e., $\frac{\partial r_f}{\partial k} > 0$). This is the firm's *political advantage* of being "too-big-to-fail". To elaborate, the term, $g(k)$, in the contest success function in (1) is a head start for the firm in the contest or implies a biased contest in the sense of, for example, Konrad (2002), Kirkegaard (2012), and Segev and Sela (2014). Even if $e_f = 0$, the firm's probability of getting a bailout is $r_f > 0$, so long as $k \geq k_{min}$ which implies $g(k) > 0$. And if the anti-bailout group does not lobby (i.e., $e_{ng} = 0$), then the firm will definitely be bailed out if it becomes insolvent so long as $k \geq k_{min}$.

The firm's political advantage, $g(k)$, is a reduced form of capturing the factors that Bernanke (2010) mentioned as underpinning the doctrine of too-big-to-fail.²⁰ However, the lobbying efforts of the anti-bailout group plays a moderating and countervailing role. The formulation in (1) captures the political economy of too-big-to-fail.

¹⁹ This contest success function was used in Amegashie (2006). Its microfoundation was studied in Rai and Sarin (2009). Hao, Skaperdas, and Vaidya (2013) present a survey of the literature on contest success functions.

²⁰For example, following Corchon and Dahm (2010), suppose the government official in charge of the bailout contest gets a payoff of $\alpha U(e_f + g(k))$ if he bails out the firm and $(1 - \alpha)U(e_{ng})$ if he does not bailout the firm, where $U'(\cdot) > 0$. Suppose $U(x) = x$. The term, α , is uniformly distributed on $[0,1]$ and may represent factors other than lobbying efforts and $g(k)$ that affect the bailout decision. Then the probability that the firm wins the contest (is bailed out) is $prob[\alpha U(e_f + g(k)) \geq (1 - \alpha)U(e_{ng})] = r_f$ as given in (1).

If the anti-bailout group is successful in the contest, the status-quo is maintained (i.e., no bailout to the firm), so I assume that the anti-bailout group gets zero. If the firm is solvent, there is no need for a bailout.

The timing of actions is as follows:

- (a) In period 1, the firm chooses its input, k .
- (b) In period 2, the price of output, p , is realized which determines whether the firm is solvent or not. If the firm is insolvent, the amount, $R(k)$, required for a bailout is common knowledge. And if $k \geq k_{min}$, there is a bailout contest as described above. If the firm is solvent, there is no contest and there is no bailout.

I look for a subgame perfect Nash equilibrium of this game by backward induction. So I start from period 2 where k, D , and p are known parameters. Suppose the firm is insolvent. Conditional on $k \geq k_{min}$ and $R(k) \equiv D + k - py > 0$, the payoffs in period 2 may be written as:

$$\Omega_f = \frac{e_f + g(k)}{e_f + g(k) + e_{ng}} R(k) + \frac{e_{ng}}{e_f + g(k) + e_{ng}} (0) - e_f, \quad (2)$$

and

$$\Omega_{ng} = \frac{e_{ng}}{e_f + g(k) + e_{ng}} (0) - \frac{e_f + g(k)}{e_f + g(k) + e_{ng}} R(k) - e_{ng}, \quad (3)$$

It is easy to show that, *for a given set of parameters*, the unique Nash equilibrium in period 2 is given by:

$$\begin{cases} e_f^* = \frac{R(k)}{4} - g(k) \\ e_{ng}^* = \frac{R(k)}{4} \end{cases}, \text{ if } 0 \leq g(k) < \frac{R(k)}{4}, \quad (4a)$$

or

$$\begin{cases} e_f^* = 0 \\ e_{ng}^* = 0 \end{cases}, \text{ if } g(k) \geq R(k). \quad (4b)$$

or

$$\begin{cases} e_f^* = 0 \\ e_{ng}^* = \sqrt{R(k)g(k)} - g(k) \end{cases}, \text{ if } \frac{R(k)}{4} \leq g(k) < R(k). \quad (4c)$$

Relative to the requisite bailout amount, the equilibria in (4a), (4b), and (4c) represent low, high, and intermediate values respectively of the firm's political advantage, $g(k)$, of being too-big-to-fail. Note that if $g(k) = 0$ for all k , then the only equilibrium is the equilibrium given in (4a) and if $g(k) = \infty$ for all $k \geq k_{min}$, then (4b) is the only equilibrium. Of course, I have ruled out these extreme cases.

The firm's probability of getting a bailout is $r_f^* = \frac{R(k)/4}{R(k)/2} = 0.5$ in the equilibrium in (4a), $r_f^* = \frac{g(k)}{g(k)} = 1$ in the equilibrium in (4b), and $0.5 \leq r_f^* = \sqrt{\frac{g(k)}{R(k)}} < 1$ in the equilibrium in (4c),

where in (4c), $r_f^* = 0.5$ if and only if $g(k) = \frac{R(k)}{4}$.

The firm's equilibrium payoff in period 2 is:

$$\Omega_f^* = \frac{R(k)}{4} + g(k), \text{ if } 0 \leq g(k) < \frac{R(k)}{4}, \quad (5a)$$

or

$$\Omega_f^* = R(k), \text{ if } g(k) \geq R(k). \quad (5b)$$

or

$$\Omega_f^* = \sqrt{R(k)g(k)}, \text{ if } \frac{R(k)}{4} \leq g(k) < R(k). \quad (5c)$$

Now consider period 1. For a given p , the firm is solvent if $\pi = L + 2p\sqrt{k} - k - F \geq 0$. This gives $p \geq \frac{k+D}{2\sqrt{k}} \equiv \hat{p}(k)$, where $D \equiv F - L > 0$. Otherwise, if $p < \hat{p}(k)$, the firm is insolvent and, as explained above, it is liquidated with some or all of its creditors and suppliers incurring losses or, it is bailed out by the government in the sense that none of its creditors and suppliers incur losses.

There are two cases of the firm's payoff. In the first case (hereafter case A), the firm's expected payoff in period 1 is:

$$\Pi_f^A(k) = \int_{\hat{p}(k)}^{\bar{p}} (2p\sqrt{k} - k - D) h(p) dp + \int_{\underline{p}}^{\hat{p}(k)} (0) h(p) dp, \quad (6a)$$

if $0 \leq k < k_{min}$.

In case A, the firm does not qualify for a bailout because $k < k_{min}$. If $k \geq k_{min}$ and the firm is in a bailout contest against the anti-bailout group, the equilibrium is either (4a), (4b), or (4c). The equilibrium in (4a) requires that $g(k) < \frac{R(k)}{4}$. This can be rewritten as

$p < \frac{k+D}{2\sqrt{k}} - \frac{2g(k)}{\sqrt{k}} \equiv \hat{p}_b(k) < \hat{p}(k)$. Using (5a), the firm's expected payoff in period 1, conditional on being insolvent, is:

$$\Pi_f^{4a}(k) = \int_{\underline{p}}^{\hat{p}_b(k)} \left(\frac{D+k-2p\sqrt{k}}{4} + g(k) \right) h(p) dp, \quad (6b)$$

if $k \geq k_{min}$.

Now consider the equilibrium in (4b). It requires that $g(k) \geq R(k)$. This can be rewritten as $p \geq \frac{k+D}{2\sqrt{k}} - \frac{g(k)}{2\sqrt{k}} \equiv \hat{p}_c(k)$. Combining this with $p < \frac{k+D}{2\sqrt{k}}$ gives $\frac{k+D}{2\sqrt{k}} - \frac{g(k)}{2\sqrt{k}} \leq p < \frac{k+D}{2\sqrt{k}}$ or $\hat{p}_c(k) \leq p < \hat{p}(k)$. Using (5b), the firm's expected payoff in period 1, conditional on being insolvent, is:

$$\Pi_f^{4b}(k) = \int_{\hat{p}_c(k)}^{\hat{p}(k)} (D + k - 2p\sqrt{k}) h(p) dp, \quad (6c)$$

if $k \geq k_{min}$.

And finally, using $\frac{R(k)}{4} \leq g(k) < R(k)$ in (4c) and the payoff in (5c), we have

$$\Pi_f^{4c}(k) = \int_{\hat{p}_b(k)}^{\hat{p}_c(k)} \sqrt{R(k)g(k)} h(p) dp, \quad (6d)$$

if $k \geq k_{min}$.

This gives the firm's expected payoff in period 1 as (case B):

$$\Pi_f^B(k) = \int_{\hat{p}(k)}^{\bar{p}} (2p\sqrt{k} - k - D) h(p) dp + \Pi_f^{4a}(k) + \Pi_f^{4b}(k) + \Pi_f^{4c}(k), \quad (7)$$

given $k \geq k_{min}$.

The firm's problem is to choose k to maximize the expected payoffs in each of the two cases above and choose the input level that corresponds to the case with the higher expected payoff. Let the optimal input levels in cases A and B be k_a^* and k_b^* respectively.

In both cases A and B, we require $\hat{p}(k) \equiv \frac{D+k_j}{2\sqrt{k_j}} < \bar{p}$, $j \in \{a, b\}$. This gives:

$$k_j^2 + (2D - 4\bar{p}^2)k_j + D^2 < 0, \quad (8)$$

$j \in \{a, b\}$.

In case B, we require $\frac{k_b+D}{2\sqrt{k_b}} - \frac{2g(k_b)}{\sqrt{k_b}} \equiv \hat{p}_b(k) > \underline{p}$. This gives:

$$D + k_b - 4g(k_b) - 2\underline{p}\sqrt{k_b} > 0. \quad (9)$$

2.1 Numerical examples

Using Liebniz rule gives $\frac{\partial^2 \Pi_f^A(k)}{\partial k^2} = -\frac{1}{2k^{3/2}} \int_{\hat{p}(k)}^{\bar{p}} p h(p) dp + \frac{1}{8} \left(1 - \frac{D}{k}\right)^2$. This derivative

has an ambiguous sign. In fact, the payoff functions in cases A and B are non-concave. This makes it difficult to obtain analytical results. Therefore, I choose parameters and specific functions to illustrate some solutions using the math software, Maple.

To ensure that the firm's choice of input, whenever possible, is over a compact set, I assume that the firm faces a maximum input constraint, $k \leq 100$. This may be due to credit market frictions or imperfect capital markets or constraints on mobilizing resources. This

assumption is reasonable and does not drive the results in this paper. However, in some cases, it helps to rule out corner solutions.²¹ As argued in section 2.2.1, it is $g(k)$ that drives the results.

In what follows, recall that I use k to represent the size of the firm because the firm's assets, $L + 2p\sqrt{k}$, is increasing in k .

Suppose $k_{min} = 39$, $D = 10$, $\bar{p} = 8$, $\underline{p} = 2$, $g(k) = \ln(k)$, and the price is uniformly distributed on $[\underline{p}, \bar{p}]$. Then (8) holds if $0.42 < k_j < 235.57$, where $j \in \{a, b\}$. And (9) holds if $k_b < 4.50$ or $k_b > 32.00$. Then, noting that $k_{min} = 39$ and $k \leq 100$, the firm chooses k_a to maximize $\Pi_f^A(k)$ over the non-compact set $k_a \in (0.42, 39)$ and chooses k_b to maximize $\Pi_f^B(k)$ over the compact set $[39, 100]$. The results are summarized in Table 1.

Table 1: Optimal input levels and profits given $k_{min} = 39$, $D = 10$, $\bar{p} = 8$, $\underline{p} = 2$, $g(k) = \ln(k)$, and $p \sim U[\underline{p}, \bar{p}]$.

	k_j^*	$\Pi_f^j(k_j^*)$
Case A	34.79	17.37
Case B	47.92	19.44

The expected payoffs, $\Pi_f^A(k_a)$ and $\Pi_f^B(k_b)$, are strictly concave on $k_a \in (0.42, 39)$ and $k_b \in [39, 100]$ respectively with stationary points at $k_a^* = 34.79$ and $k_b^* = 47.92$. Table 1 shows that the firm's optimal input is $k_b^* = 47.92$. This gives the higher payoff.

²¹In particular, when the same corner solution exists for both firms, the distinction between a big firm and a small firm is less clear-cut. More importantly, I want to use differences in sizes that are endogenous in the model.

Now suppose we maintain the parameters and functions above but set $D = 5$. I think of this as holding L fixed and varying F .²² Then $k_a^* = 31.69$, and $k_b^* = 40$. The corresponding profits are $\Pi_f^A(k_a^*) = 21.09$, and $\Pi_f^B(k_b^*) = 22.25$. Thus, the firm's optimal input is $k_b^* = 40.00$.

I now compute cut-off values of the price for $k_b^* = 47.92$ and $k_b^* = 40.00$.

Table 2: Cut-off values of price given $k_{min} = 39$, $\bar{p} = 8$, $\underline{p} = 2$, $g(k) = \ln(k)$, and $p \sim U[\underline{p}, \bar{p}]$.

	$D = 5, k_b^* = 40.00$	$D = 10, k_b^* = 47.92$
\hat{p}_b	2.39	3.07
\hat{p}_c	3.27	3.90
\hat{p}	3.55	4.18

Now consider two firms, 1 and 2, that -- in the event of bankruptcy -- separately engage in a lobbying bailout contest against the anti-bailout group.²³ Suppose the parameters in Table 1 hold but firm 1 has $D = 5$ and firm 2 has $D = 10$. Then we can compute their bailout probabilities as summarized in Table 3.

Table 3: Probabilities of a bailout, r_f^* , for different realizations of the price of output if both firms are insolvent, given $k_{min} = 39$, $\bar{p} = 8$, $\underline{p} = 2$, $g(k) = \ln(k)$, and $p \sim U[\underline{p}, \bar{p}]$.

Price	r_f^* for firm 1, $k_b^* = 40.00$	r_f^* for firm 2, $k_b^* = 47.92$
$p \in [2.00, 2.39]$	50.00%	50.00%
$p \in [2.39, 3.07]$	$50.00\% \leq r_f^* \leq 77.33\%$	50.00%
$p \in [3.07, 3.27]$	$77.33\% \leq r_f^* < 100\%$	$50.00\% \leq r_f^* \leq 55.31\%$
$p \in [3.27, 3.55]$	100%	$55.31\% \leq r_f^* \leq 66.42\%$
$p \in [3.55, 8.00]$	Solvent	Solvent or insolvent

²²This is not crucial because the results hold even if $L = 0$ and also hold for firms with different values of L .

²³Separate contests may emerge because the public authority may receive bailout requests or take bailout decisions sequentially as happened in the case of Bear Stearns and Lehman Brothers. In March 2008, the Federal Reserve Bank of New York provided an emergency loan to Bear Stearns to avert its collapse. Six months later on September 15, 2008 when Lehman Brothers filed for bankruptcy, it did not receive a bailout assistance from any public agency.

Note that for $p \in [\hat{p}_c, \hat{p}_b]$, the probability of a bailout, $r_f^* = \sqrt{\frac{g(k)}{D+k-2p\sqrt{k}}}$ is strictly

increasing in p . Hence, in the interval $p \in [3.07, 3.27]$, a firm's *maximum* probability of a bailout occurs at $p = 3.27$ and its *minimum* probability occurs at $p = 3.07$. Evaluating r_f^* for firm 2 at $k_b^* = 47.92$, $D = 10$, and $p = 3.27$ gives $r_f^* = 55.31\%$. Evaluating r_f^* for firm 1 at $k_b^* = 40.00$, $D = 5$, and $p = 3.07$ gives $r_f^* = 77.33\%$. Therefore, for $p \in [3.07, 3.27]$, firm 1 has a higher probability of a bailout than firm 2. In Table 3, this was how the other maximum and minimum bailout probabilities were computed.

If I repeat the exercise above but assume that the price has a triangular distribution with probability density function, $h(p) = \frac{1}{30}p$ on $[2, 8]$ and zero elsewhere, I get:

Table 4: Probabilities of a bailout, r_f^* , for different realizations of the price of output *if both firms are insolvent*, given $k_{min} = 39$, $\bar{p} = 8$, $\underline{p} = 2$, $g(k) = \ln(k)$, and $h(p) = \frac{1}{30}p$ on $[\underline{p}, \bar{p}]$.

Price	r_f^* for firm 1, $k_b^* = 40.26$	r_f^* for firm 2, $k_b^* = 44.05$
$p \in [2.00, 2.40]$	50.00%	50.00%
$p \in [2.40, 2.93]$	$50.00\% \leq r_f^* \leq 67.63\%$	50.00%
$p \in [2.93, 3.27]$	$67.63\% \leq r_f^* < 100\%$	$50.00\% \leq r_f^* \leq 59.63\%$
$p \in [3.27, 3.57]$	100%	$59.63\% \leq r_f^* \leq 75.38\%$
$p \in [3.57, 8.00]$	Solvent	Solvent or insolvent

Finally, if I repeat the exercise in Table 4 but assume that $g(k) = 0.001k^2$ (a strictly convex function), I get:

Table 5: Probabilities of a bailout, r_f^* , for different realizations of the price of output *if both firms are insolvent*, given $k_{min} = 39$, $\bar{p} = 8$, $\underline{p} = 2$, $g(k) = 0.001k^2$, and $h(p) = \frac{1}{30}p$ on $[\underline{p}, \bar{p}]$.

Price	r_f^* for firm 1, $k_b^* = 40.09$	r_f^* for firm 2, $k_b^* = 44.97$
$p \in [2.00, 3.05]$	50.00%	50.00%
$p \in [3.05, 3.43]$	$50.00\% \leq r_f^* 100\%$	50.00%
$p \in [3.43, 3.50]$	100%	50.00%
$p \in [3.50, 3.56]$	100%	$50.00\% \leq r_f^* \leq 52.91\%$
$p \in [3.50, 8.00]$	Solvent	Solvent or insolvent

The examples in tables 3, 4, and 5 show that there are cases in which the smaller firm (i.e., firm 1) has a higher bailout probability than the bigger firm (i.e., firm 2) but there are *no* cases in which the reverse holds. Based on these examples and others (not reported here), the following proposition is stated:

Proposition 1: *There exist subgame perfect Nash equilibria which are consistent with a smaller firm having a higher probability of getting bailout assistance than a bigger firm, although there is a bias in favor of too-big-to-fail (i.e., a firm's political advantage is increasing its size,*

$\frac{\partial r_f}{\partial k} > 0$) *and both firms meet the threshold size of too-big-to-fail (i.e., $k \geq k_{min}$).*

Although a firm with a bigger size has a smaller probability of a bailout, it rationally chooses the bigger size because its objective is to maximize its *expected payoff*, *not* to maximize its probability of a bailout.

2.2 Discussion

As mentioned in section 1, during the 2008 financial crisis, Lehman Brothers was not bailed out but Bear Stearns was bailed out although Lehman Brothers was almost twice as big as

Bear Stearns. Proposition 1 is consistent with the favorable treatment of Bear Stearns and the unfavorable treatment of Lehman Brothers, although a policy of too-big-to-fail was in place.

To see the intuition behind proposition 1, let us, for the sake of exposition compare the equilibria in (4a) and 4b). In (4b), $g(k) \geq R(k)$. If the bailout money, $R(k)$, is sufficiently small relative to the firm's political advantage of "too-big-to-fail", $g(k)$, it is not worthwhile for the anti-bailout group to lobby against bailing out the firm. So the firm gets a bailout with certainty. In contrast, if --- as in (4a) --- the bailout money, $R(k)$, is sufficiently big relative to the firm's political advantage of "too-big-to-fail", $g(k)$, then the anti-bailout group lobbies against a bailout and the firm gets a bailout with smaller probability even though it is bigger. Note also that in (4c), the firm's equilibrium bailout probability, $r_f^* = \sqrt{\frac{g(k)}{R(k)}}$, is decreasing in the size of the bailout but increasing in the firm's political advantage. Therefore, it is the *balance* between the size of the bailout²⁴, $R(k)$, and the firm's political advantage, $g(k)$, of being "too-big-to-fail" that determines the firm's probability of getting a bailout. As noted earlier, the equilibria in (4a), (4b), and (4c) represent low, high, and intermediate values respectively of the firm's political advantage, $g(k)$, of being too-big-to-fail.

The prospect of getting assistance in the case of insolvency may imply that the firm's size would be bigger than its size in the absence of the possibility of being bailed out. However, this need not be the case. The benefit of too-big-too-fail is the bailout support from the government in the event of insolvency. Its cost is the threshold size, k_{min} , required to qualify for the bailout. If k_{min} is too high, the firm will choose the size that maximizes the expected payoff in case A and will not be bailed out if it is insolvent.

²⁴The size of the requisite bailout is definitely a consideration. Sorkin (2009, p. 300) reported that Hank Paulson was not interested in a bailout proposal by Bank of America for the US government to take \$40 billion of Lehman's losses because it was too much.

2.2.1 Alternative explanations

Public backlash against bailing out a firm may be stronger if some firms had earlier been bailed out. This is likely to reduce the chances of a bailout for subsequent firms. This argument is very plausible and was partly at play in the Bear Stearns-Lehman case. But it is an argument that is independent of the size of the firm.

In my model, the preceding argument can be captured by assuming that subsequent firms for a bailout have a political disadvantage or smaller or zero political advantage in the bailout contest. A political disadvantage may be captured by $-g(k)$ whose absolute value is so big that the firm cannot win the contest. In the case of zero political advantage, $g(k) = 0$ for all k . Then, as pointed out above, the only equilibrium will be the equilibrium given in (4a). Therefore, if $g(k) = 0$ for all k , the probability of an insolvent firm getting a bailout is 50% *regardless of its size*²⁵ while a previously insolvent firm, with $g(k) > 0$, had at least a 50% probability and, in some cases, a 100% probability of getting a bailout depending on the requisite bailout amount and its size. The argument in this paper does not depend on the sequence of bailout requests to obtain the result in proposition 1.

Another explanation is that limited funds for bailouts reduce the chances of subsequent firms getting a bailout because the funds may have run out. This explanation is related to the preceding explanation because the scarcity of resources for bailing out subsequent insolvent firms may be one of the reasons for a stronger public backlash against bailing them out.

The model in this paper gives the result in proposition 1 without assuming that subsequent firms have a smaller political advantage or a political disadvantage in the bailout contest. Thus, under *weaker* assumptions, it shows that a bigger firm may have a smaller

²⁵Therefore, proposition 1 will not hold if $g(k) = 0$ for all k .

probability of bailout than a smaller firm, although there is a policy-bias in favor of too-big-to-fail. In addition, it relates the bailout probabilities of insolvent firm to their sizes.

2.3 Uncertain threshold size of too-big-to-fail

I have assumed that the threshold size, k_{min} , is known. Suppose instead that k_{min} is not known to the firms but it is distributed continuously on $[\underline{k}, \bar{k}]$ with density $\theta(k_{min})$, where $\underline{k} > 0$. Then a firm's expected payoffs are now:

Case A:

$$\Pi_f^A(k) = \int_{\underline{p}}^{\bar{p}} (2p\sqrt{k} - k - D) h(p) dp, \quad (10)$$

if $0 \leq k < \underline{k}$.

Case B:

$$\widetilde{\Pi}_f^B = \int_{\underline{p}(k)}^{\bar{p}} (2p\sqrt{k} - k - D) h(p) dp + \int_{\underline{k}}^k (\Pi_f^{4a}(k) + \Pi_f^{4b}(k) + \Pi_f^{4c}(k)) \theta(k_{min}) dk_{min}, \quad (11)$$

if $k \geq \underline{k}$.

As an example, suppose that k_{min} is uniformly distributed on $[26, 52]$, so that the expected threshold size is $(26 + 52)/2 = 39$, the *same* as the threshold size in the case of certainty in the previous examples. Then the probability that, in the event of insolvency, the firm will *participate* in a bailout contest is:

$$prob(k \geq k_{min}) = \int_{\underline{k}}^k \theta(k_{min}) dk_{min} = \begin{cases} 0, & \text{if } k \in [0, 26) \\ \frac{k-26}{26}, & \text{if } k \in [26, 52] \\ 1, & \text{if } k \in (52, 100] \end{cases} \quad (12)$$

Given (12), it follows that there are discontinuities in the payoff in (11). Taking these discontinuities into account and using the parameters and functions in Table 5, I find that the optimal size for firm 2 with $D = 10$ is a corner solution at $\tilde{k}_b = 52$ while for firm 1 with $D = 5$,

it is an interior solution at $\tilde{k}_b = 40.99$. Firm 1 increases its optimal input level (size) from 40.09 (when k_{min} was known) to 40.99 while firm 2 increases its size from 44.97 to 52. Surprisingly, uncertainty about the too-big-to-fail threshold could lead to an increase in the sizes of the firms. Firm 2, the firm with the bigger fixed costs, chooses a size that *guarantees* that, in the event of insolvency, it will participate in a bailout contest. Firm 1 chooses a size that gives a $\frac{40.99-26}{26} = 57.65\%$ probability that, in the event of insolvency, it will *participate* in a bailout contest. Then noting that, in the event of insolvency, the probability that firm 1 will be bailed out is the joint probability $\tilde{r}_f = 0.5765r_f^*$ gives:

Table 6: Probabilities of a bailout for different realizations of the price of output *if both firms are insolvent*, given $k_{min} = 39$, $\bar{p} = 8$, $\underline{p} = 2$, $g(k) = 0.001k^2$, and $h(p) = \frac{1}{30}p$ on $[\underline{p}, \bar{p}]$.

Price	\tilde{r}_f for firm 1, $k_b^* = 40.99$	r_f^* for firm 2, $k_b^* = 52$
$p \in [2.00, 3.07]$	28.82%	50.00%
$p \in [3.07, 3.46]$	$28.82\% \leq \tilde{r}_f < 57.65\%$	50.00%
$p \in [3.46, 3.55]$	57.65%	50.00%
$p \in [3.55, 3.59]$	57.65%	$50.00\% \leq r_f^* \leq 51.43\%$
$p \in [3.59, 8.00]$	Solvent	Solvent or insolvent

In this case, there are price realizations for which the bigger firm has a higher bailout probability and other price realizations for which the smaller firm has a higher bailout probability. However, this does not overturn proposition 1.

3. Conclusion

The proof of proposition 1 on the basis of numerical examples may be a limitation of this paper. But this need not be the case. Having explained the intuition of this result in terms of how the balance of a firm's size and its political advantage (due to being too-big) account for its probability of a bailout, it should be clear that the result is not driven by numerical examples.

Given scarce bailout money, an extension might to consider two firms and an anti-bailout group in the bailout contest in which the firms are also competitors because each firm lobbies for its bailout. However, there is some evidence that in such situations, firms (e.g., banks, or the financial industry, or auto manufacturers) form a coalition and lobby as a single cohesive group (e.g., Grossman and Woll, 2014). To the extent that mergers or acquisitions can increase the asset size and interconnectedness of a firm, one can consider an extension in which in period 1, two firms engage in a contest for the right to acquire or merge with a third firm. In this case, k will be a binary choice variable with its higher value being the post-merger size of the firm.

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