The Social Costs and Benefits of Too-Big-To-Fail Banks: A Bounding Exercise[1]

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Abstract

While the Too Big To Fail issue has received wide attention in the academic literature and popular press, there is little agreement regarding economies of scale for financial firms. We take the stand that systemic risk increases when the larger players in the financial sector have a larger share of the output. Our calculations indicate that the cost to the economy as a whole due to increased systemic risk is of an order of magnitude larger than the potential benefits due to any economies of scale when banks are allowed to be large. When distributional and inter generational transfer issues are taken into account, the potential benefits to economies of scale are unlikely to ever exceed the potential costs due to increased risk of financial crisis.

This draft is work in progress. Comments are solicited.

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I. Introduction

Many argue that the market's *ex ante* belief in a public policy of too-big-to-fail (TBTF) caused the excessive risk that produced the recent financial crisis; further, that the government's *ex post* actualization of that TBTF policy produced a series of massive government bailouts (Boyd and Jagannathan (2009), Johnson (2010), Volcker (cited in Casey (2010)). Some of these same individuals have argued that the TBTF banks are inherently costly to society and should be broken into smaller independent pieces. Boyd, Kwak and Jagannathan (2009) provide empirical evidence that the twenty largest banking firms took extra large risks in the 2000s, and suffered extraordinary losses beginning around 2007. Importantly, the rest of the banking industry did not experience losses to nearly the same extent, and only after the crisis had severely damaged the real economy did small and medium sized banks begin to report serious problems. Problems at small and medium-sized banks were an effect of the financial crisis, not a cause. Such empirical evidence cannot "prove" causality running from TBTF to the crisis, but the results are strongly suggestive.

An estimation problem. A counter-argument to the above is that the very large banks exhibit economies of scale, and if they are broken into pieces, efficiency gains will be lost. It is widely believed, however, that scale economies in banking are extremely difficult to estimate empirically. There is a large literature on this topic, and the only general point of agreement is that very small banks (less than a few hundred million in assets) are generally not efficient. One problem for the empirics is that, for this industry, output is difficult to measure. Theory tells us that commercial banks provide three broad classes of economic functions: payments services, inter-temporal risk management in the sense of Diamond and Dybvig (1983), and delegated monitoring in the sense of Diamond (1984) or Boyd and Prescott (1986). The first function is susceptible to measurement using proxy variables such as cash provided and checking account balances/transactions. However, the second two economic functions change the nature of the macroeconomic equilibrium (see studies cited above) and are almost impossible to measure. Various authors have taken different approaches to this problem but none of this empirical literature can claim to be derived from the theory in a serious way.

The policy of TBTF complicates the estimation problem further because this policy provides an obvious advantage to very large banks; they have *de-facto* insurance of all their liabilities. Other banks do not. This advantage looks like a funding cost efficiency and affects Tobin's Q and related measures in the same manner. Unfortunately, the correlation between size and TBTF coverage is believed to be close to one hundred percent. TBTF is not any kind of a scale economy – it is just favorable treatment of a few banks by the government.

Recently, it has been argued that reliable estimates of scale economies for very large banks cannot be obtained in the current environment with a rapidly changing technology and industrial structure. As DeYoung (2010) points out, there are two main problems resulting from using traditional statistical techniques on modern banking data. First, the distribution of bank size is severely skewed[2]. Second, the largest banks differ from smaller banks in kind, not just size. Small and big banks operate differently and make money in different ways.[3]

A Policy Dilemma. If these arguments are correct then the policy-maker can not ascertain if the social cost of these large institutions exceeds the social benefit, or vice-versa. However, the policy-maker must make decisions in real time and to ignore the issue is a decision

[2] Econometric tools provide the most accurate estimates for average companies, but they become less precise for firms that are substantially larger or smaller. The three largest banks, holding more than $2 trillion in assets, are almost ten times as large as the thirteenth largest bank.

[3] The literature on economies of super scale is mixed at best. Some studies using panel data across countries have found evidence of diseconomies of scale in very large banks (De Nicolo, 2000). Moreover, there is evidence that although large banks are better diversified than smaller banks, they offset this advantage by increasing risk in other ways, especially through the use of financial leverage (Boyd and Runkle, 1993).

in itself. This is especially true at the present time, since the recent bailout greatly increased concentration in the US banking industry (Wheelock and Wilson, 2011). We believe we have found a new and different way to approach this problem.

In this study, we take a different approach to the issue by placing bounds on the social costs and benefits of TBTF banks. We estimate the social cost of the recent financial crisis assuming (initially) that the crisis was strictly caused by the TBTF banks.[4] We use assumptions that are consistently biased so as to produce the lowest conceivable crisis cost estimates. Next, we estimate the economies of scale benefits of TBTF banks and make similarly Herculean assumptions about economies of scale so as to obtain the largest imaginable social benefits estimates. Then, we compare costs and benefits using a methodology due to Boyd, Kwak and Smith (2005, hereafter BKS). Their method converts both costs and benefits into a comparable metric: the present value-added to (or lost from) real per-capita GDP at a base date.

As we will see in the next section, the costs are assumed to cover a relatively short time period while the benefits are assumed to go to infinity. Therefore, we must employ a social discount factor to compare the two. There is an old and ongoing debate on how this is to be done, and therefore, we employ several methods recommended by different scholars.[5]

Findings. To briefly summarize our findings, they show that even under these extreme assumptions, the social costs of TBTF banks substantially exceed the benefits. Thus, our results may be interpreted as supporting the case for breaking up these institutions. If the reader believes that TBTF is only one of several factors leading to the crisis, we make probability calculations showing how large the role of TBTF banks would have to have been such that the costs and benefits were equated. Our results show that if the policy of TBTF increases the crisis

[4] . This is an extreme assumption admittedly and it is relaxed later in the paper.
[5] http://onlinelibrary.wiley.com/doi/10.1002/pam.20047/pdf and http://www.adb.org/Documents/ERD/Working_Papers/WP094.pdf .

probability by even a modest amount then the costs of the policy exceed the benefits. Finally, we know there will be some readers who believe that the recent financial crisis was caused by entirely different factors, unrelated to the existence and actions of TBTF banks. Such readers will find this paper of limited interest. If the reader believes that the presence of TBTF banks actually *reduces* the frequency/cost of financial crises, read no further; our entire analysis assumes the opposite. Based on the recent press and current political debate we suspect that such individuals will be in the minority.[6]

II. Estimating the Costs of the Financial Crisis

In order to estimate the costs associated with the TBTF banks, we estimate the real per-capita output losses associated with the recent financial crisis. These real cost estimates include output lost during the crisis as well as output lost during the time it takes the economy to recover to its pre-crisis trend level of output. Using the methodology of BKS we assume that, had the financial crisis not occurred, output would have continued to grow at the long-run trend growth rate of the economy. We use two different methods to estimate the long-run pre-crisis trend in output. Our first estimate is very simple - a 25 year arithmetic average of historical US growth rates in real per-capita GDP over the period 1983-2007. That rate is 2.23%.

Our second long-run trend estimator for the United States is more sophisticated and employs the maximum likelihood estimator proposed by Easterly *et al.* (1993). With this method, the trend estimate depends on the United States' own growth rate and the world growth rate. If we define g_t as the estimated growth rate in real per capita GDP for the United States in

[6] See, for example, the HBO movie "Too Big to Fail" ("Too Big to Fail." Dir. Curtis Hanson. Perf. James Woods and Toper Grace. HBO, 2011); or the Gretchen Morgensen and Joshua Rosner book *Reckless Endangerment: How Outsized Ambition, Greed, and Corruption led to Economic Armageddon* ,Morgenson, Gretchen and Joshua Rosner, Times Books, 2011.

period t, w_t as the world growth rate in period t, $\bar{g}_t$ as the historical average growth rate as of year t, and n as the number of years used to compute the historical average, then the Easterly *et al*. (1993) estimate yields a growth rate estimate of 2.16% from the years 1988-2007. This trend rate of real GDP growth is defined as:

$$g_t = \left[n * \frac{var(w_t)}{var(\bar{g}_t)+n*var(w_t)}\right] * \bar{g}_t + \left[n * \frac{var(\bar{g}_t)}{var(\bar{g}_t)+n*var(w_t)}\right] * w_t \, . \qquad (1.)$$

The estimate obtained using the method of Easterly *et al.* (1993) provide a trend rate of 2.16%, which is lower than the average rate of 2.23%. This consequently leads to smaller estimated output losses resulting from the financial crisis. We then use these two trend estimates to obtain the hypothetical real per capita GDP per capita values for 2007 and after - economic performance that might have obtained had the crisis not occurred.

Next, we need to know the economy's actual output path. To estimate the economy's actual output path, we use reported US real per-capita GDP figures for 2007-2010. After that we must make estimates. Our first set of estimates employs Blue Chip's consensus GDP forecasted growth rates of 2.7%, 3.2%, and 3.2% for the years 2011-2013. [7] Our second set of estimates uses the Organization for Economic Co-operation and Development's economic growth forecasts of 2.6% and 3.1% for 2011 and 2012, and then Blue Chip's 2013 growth rate forecast of 3.2%. [8]

To be conservative in estimating the crisis cost, we assume that the crisis ends in 2013, so for the years 2014 and after we assume real per-capita GDP has risen to the pre-crisis trend. Thus, the trend GDP line and the Actual GDP lines come together in 2014, forcing the loss estimates to be zero from that date onward. An example of the result of this procedure is shown

[7] http://www.erfc.wa.gov/forecast/documents/p0511.pdf)

[8] (http://www.oecd.org/document/48/0,3746,en_2649_33733_45268528_1_1_1_1,00.html

in Figure 1, which employs the simple average output trend estimate. Our estimate of the social loss is the integral of the area between the two lines in Figure 1.

We assume that the financial crisis is over rather quickly in 2014 and there are no further economic losses after that date. This is an extremely conservative assumption that reduces our crisis cost estimates. By contrast, BKS find that only four out of twenty-three countries in their sample of historical banking crises re-attain their pre-crisis trend level of output within seventeen years after a crisis onset. In Figure 2, we show a representative country estimate from BKS, the case of Norway. This clearly shows the tail of output losses that continued long after the Norwegian banking system was repaired and economic growth began to recover.[9] As will be seen in a moment, we obtain cost estimates of roughly 40% of base year (2007) GDP. This may be contrasted with BKS who find a lower bound cost estimate of 52% of base year GDP and an upper bound of 319%.

By integrating the difference between the actual real per capita GDP and the trend values, discounting this amount back to 2007, and expressing it as a percentage of 2007 real per capita GDP, we are able to arrive at our loss estimates. As shown in Table 1, when simple average historical growth is used for the historical growth trend, this estimate ranges between 37.8% and 44.64% of 2007 real per-capital GDP, depending on the social discount rate. When trend growth is estimated with the Easterly *et al.* (1993), cost estimates range between 36.61% and 43.22% of 2007 real per capita GDP. Let us define the present discounted value of these costs as *C*.

Finally, we note yet another major source of conservatism in our crisis cost estimates. We are assuming that all economic costs are represented by lost output in the United States and *assign no weight to economic problems elsewhere in the world.* This seems an heroic

[9] See discussion in Boyd, Kwak and Smith, *op. cit.* pages 981 and 984.

assumption given that this crisis unquestionably originated in the United States and did, in fact, cause economic hardship elsewhere.

III. The Social Discount Rate

In conducting a cost-benefit analysis, it is necessary to reduce both costs and benefits to a single date in order to directly compare them. For risky projects, a higher social discount rate is typically used in order to reflect the riskiness of the project. In order to obtain an estimate of a risky social discount rate, we use the methodology of Boardman (2001). We arrive at an estimate of 6.77% by averaging the real pretax rate of return on Moody's AAA long-term corporate bonds over the period 1947-2007.

Now, we believe that both the social costs and benefits of TBTF banks are inherently risky and thus, a risky social discount factor seems appropriate. However, a high social discount rate tends to increase the cost estimates and reduce the benefit estimates relatively. That is so because the costs are spread over just a few years but the benefits (as will be explained) are assumed to go to on forever. In order to maintain our intentional bias in the estimation procedure we therefore also employ riskless social discount rates. For this we use the methods of the General Accounting Office as explained in Moore *et al.* (2004). These are estimated by using the average nominal yield on Treasury debt maturing between one year and seven years, and then subtracting a forecast of the rate of inflation.[10] We used both five and seven-year Treasury bond rates from the postwar period of 1947-2007 to arrive at estimates of 2.4% and 2.6%.[11]

[10] http://www.clevelandfed.org/Research/data/US-Inflation

Yet another way to estimate the social discount rate is based on theory, uses the optimal growth rate model proposed by Ramsey (1928) and is reviewed in Moore *et. al*. (2004). In order to obtain this estimate, we need to estimate the absolute value of the rate at which the marginal value of consumption decreases as per capita consumption increases, *e*, a utility discount rate *d*, which measures the rate society discounts the utility of its future per capita consumption, and the growth rate of per capita consumption *g*. The social discount rate, denoted *o* is then defined as:

$$o = d + ge. \tag{1.}$$

To obtain an estimate for *g*, we regress the natural logarithm of real per capita aggregate consumption on time and use the slope coefficient. We obtained the data on real per capita aggregate consumption from the Bureau of Economic Analysis and estimated the regression using annual data from the postwar period 1947 - 2007 to obtain an estimated growth rate of 3.6%[12] Brent (1994) suggests that *e* should be between 0 and 1, with 0.5 as a benchmark. Arrow et al. (1995) argue that individuals reveal their own values of *e* by their risk taking and inter-temporal choice behavior, and suggest that individual elasticities of marginal utility of consumption lie between 1 and 2. Thus, the proposed values for *e* vary between zero and two, with $e = 1$ being a reasonable compromise. Arrow suggests a figure of around 1 percent for *d*, which we use in our calculations. Thus, with estimates of $g = 3.6\%$, $e = 1$, and $d = 1$ gives us another estimate of the (gross) social discount factor *o*. Substituting into (1.):

$$o = d + ge = 1.0 + .036*1.0 = 1.036. \tag{2.}$$

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[11] Both the social costs and benefits are clearly risky and should, we believe, be discounted at a social discount rate reflecting that fact. The nature and costs of future banking crises are unknown, as are future changes in the banking technology and industrial organization. However, our intentionally conservative bias requires that we also employ risk-free social discount rates.

[12] Data come from (http://www.bea.gov/)

IV. Estimating The Benefits of Economies of Scale in TBTF Banks

Hughes, Mester and Moon (2001) have obtained some of the largest banking scale economy estimates in the literature and we shall first use their benefits estimates in our calculations. Mester (2010) has recently argued that these scale economies currently remain intact and would be lost if the largest banks were broken up. "The literature on scale economies in banking, including my own studies, suggests that imposing a strict size limit would have unintended consequences and work against market forces." (*op. cit*, page 10).

Hughes, Mester, and Moon (*op cit*). find that when managers are allowed to make value maximizing decisions and rank projects based on both their profitability and risk, scale economies increase with bank size suggesting that even mega-mergers are exploiting scale economies.[13]

For their full sample, the mean measure of scale economies for the banking industry is 1.145, while the largest banks with assets of more than $50 billion have scale economies of 1.25. This implies that TBTF banks are on average (1.25-1.145)/1.145 = 9.2% more efficient than the overall industry.[14] We define the returns-to-scale parameter as *l*. For our first benefits calculations, therefore, we assume that the largest banks obtain economies of scale that, *ceteris paribus*, increase their contribution to national output by l = 9.2%. This value-added is being produced under the current banking arrangement and would be lost if the TBTF banks were

[13] An important innovation of this study is that it identifies and measures scale economies not just in terms of operating costs, but also in terms of risk management via diversification. The authors argue that to ignore scale economies in risk management results in a serious miss-specification.

[14] Recall that this study was published in 2002 and employs data earlier than that. Thus, at this time banks with assets exceeding $50 billion were clearly TBTF. Their sample includes 15 banks in this size category which were the largest banks in the United States at that time.

broken up. Thus, the benefits we are estimating are effectively a counter-factual: an estimate of existing economic benefits that could be lost in the future.

A new, unpublished study (Wheelock and Wilson, 2011) obtains economies of super-scale estimates that appear to be even larger than those obtained by Hughes *et. al., (op. cit.).* We next assume their economy of scale results in our calculations. However, they do not provide a breakdown that allows us to compare TBTF banks (roughly the largest 20) with the rest of the banking industry.[15] What they do provide is an estimate of the economies of scale advantage of the largest four banks *vis-a-vis* the costs that would result if the largest four were broken into eight equal sized banks. This cost advantage estimate is 16% and that is what we shall employ in what follows (Wheelock and Wilson, *op cit.* p. 18).[16]

IVa. Numerical Implementation: National Income Accounts Value-added Sector

We examine the percentage of total real per capita GDP provided by TBTF banks, which we define as s. From the National Income Value-Added Accounts[17] we obtain the data for the sector called "Federal Reserve Banks, Credit Intermediation, and Related Activities" and employ an average of this sector's percentage value-added to national output over the twenty-year period between 1988 and 2007 and obtain s = 3.63%. The annual gain attributable to economies of scale in TBTF banks is sl, and we shall assume that these benefits are annuity-like and continue indefinitely into the future. Therefore we have:

$$V = sl/o, \qquad (3.)$$

[15] We have repeatedly asked the authors to make these calculations for us which should be a easy task. They have not done so, presumably because their paper is still unpublished.
[16] Note that their estimated cost advantage must be considerably larger when the top four banks are compared with the overall industry.
[17] [[http://www.census.gov/eos/www/naics/]]

where *V* is the period zero value of the entire future stream of economies of scale additions to real economic output going out to infinity.

Note that with this procedure, we are attributing the super-scale economy gain not just to TBTF banks, but to *all commercial banks plus the Federal Reserve Banks, plus other miscellaneous financial intermediaries.* This is yet another intentional bias (a very large one) in favor of the social value of TBTF banks.

From Table 2, we can see that when the Moon *et al. (op. cit.)* scale estimates are employed, the discounted value of TBTF benefits ranges between 4.93% and 13.92% of base year per-capita output. When the larger Wheelock and Wilson scale estimates are employed, it ranges between 8.58% and 24.20%. These calculations show just how sensitive the computations are to the choice of discount rate. That is true, of course, because of the infinite life assumed for the stream of TBTF benefits.

V. Comparing Costs and Benefits

Having assembled both the cost and benefits estimates we can now compare them. Table 3. shows the cost and benefits estimates obtained when the 25-year average is used to approximate trend growth in real, per-capita GDP. Column 5. shows the cost to benefit ratio when the Blue-Chip economic indicators are employed for future output over the period 2011-13, and Column 6 shows the cost-benefit ratio when the OECD economic forecasts are used. The cost benefit ratio ranges from a high of 7.76 to a low of 1.82, depending mostly on the social discount rate *o.* Still, in all cases including the most extreme, the estimated cost of TBTF exceeds the estimated benefit by a healthy margin.

Table 4. shows the cost and benefits estimates obtained when the method from Easterly *et al.* (1993) is used to approximate trend growth in real, per-capita GDP. Column 5. shows the cost to benefit ratio when the Blue-Chip economic indicators are employed for future output over the period 2011-13, while Column 6 shows the cost-benefit ratio when the OEDC economic forecasts are used. These cost benefit ratio ranges from a high of 7.52 to a low of 1.76. Again, in all cases including the most extreme, the estimated cost of TBTF exceeds the estimated benefit by a healthy margin.

The Payback Period. Tables 5. and 6. use a different metric for comparing costs and benefits - one that is not so highly dependant on the choice of the social discount rate o . This is the Payback Period, a commonly used analytical tool in accounting. In this application, the Payback Period measures how many good, non-crisis years it would take to make up for the social cost of a single crisis. TBTF benefits are not discounted in these calculations, but the 6 years of crisis costs are discounted to reduce them to a single cost number. When the 25-year average growth rate is used to estimate trend real per-capita growth (Table 5), these payback period estimates vary between 133.66 and 65.09 years. When the Easterly *et al. (op. cit)* method is used to estimate trend real per-capita growth (Table 6), these payback periods vary between 129.39 years and 63.04 years. Therefore, the shortest payback period, under the most extreme assumptions, is 63.04 years.

Crisis Arrival Rates Under TBTF: Actual Experience. Lavaen and Valencia (2008) document 124 systemic banking crises in 161 countries over a 37 year period. What they do not report, however, is the average number of years that each of the 161 countries is actually present in the data set. Based on some hands-on experience working with these data, we shall assume that the average country is present in the sample for 20 years. This means we have 161 * 20 county-year points (total data points), and 124 systemic crises documented around the world. Therefore, the average crisis-arrival rate in recent years has been 124 / (161 * 20) = .0385; or a crisis arriving approximately every 26 years. It is also the case that virtually all modern systemic banking crises have involved some form of TBTF policy.[18]

We can compare the payback period to the average actual crisis arrival rate in modern history. The shortest payback period was 63 years or about 2.4 times the average world time between crises. Again, there is strong support for the conclusion that TBTF costs exceed TBTF benefits.

VI. What if TBTF is One among Several Causes of Financial Crises? Some Probability Calculations

Even without TBTF banks, financial systems can exhibit crises as is demonstrated by decades of monetary history in the United States and elsewhere. In this section we allow for that possibility in a stochastic simulation exercise.

In what follows, there are two regimes: i. TBTF banks are present, and ii. TBTF banks are not present. Banking crises can occur in either regime, as will be discussed below. In all years in the TBTF regime, TBTF banks are assumed to provide social benefits due to scale economies, even during crises. For this section we assume that the *annual* social benefit of TBTF banks is at the mid-point of our previous estimates reported in Tables 5. and 6. which is ls = .4574%.

[18] Jo Stiglitz, speeches. "If you don't think your country has the policy of TBTF, that's because your country hasn't had a banking crisis". Speeches. Find written citation.

The structure of the simulation exercise is explained in Figure 3. In the no-TBTF regime, the social benefits of economies of scale are never obtained and the social benefit provided in non-crisis years is zero. When a crisis occurs, we assume the same social cost of a banking crisis that was estimated earlier. In either regime, we further assume that when a crisis occurs, it lasts exactly six years (as in the previous analysis the crisis was assumed to last from 2008 – 2013). A crisis realization is assumed to produce an *annual* crisis cost at the midpoint of our previous crisis cost estimates from Tables 5 and 6. This represents the *annual* cost of the crisis in terms of lost real GDP per-capita, and the number obtained is 6.65%. A crisis is treated as a single period and annual costs are simply multiplied by six. Then, by assumption, the economy always returns to a non-crisis state; thus, there is no randomness in leaving a crisis state. The single random variable in our simulations is the probability of going from a non-crisis to a crisis state.

In what follows, we run a number of annual simulations in which costs and benefits are allowed to accumulate for 1000 years and then discounted back to the base year. For this purpose, we employ a social discount rate of o = 4.59% which is the mid-point of all the social discount rate estimates in Tables 5. and 6. For purposes of comparison all parameters are fixed and the only variable that changes is the probability of a crisis in the TBTF regime and in the no-TBTF regime With crises occurring infrequently, 1000 years is not a "large" simulated dataset and results can vary from simulation to simulation. We therefore run 1000 simulations for each case and what is reported here is an average of those 1000 trials.

As mentioned in the introduction, it is fundamental to this analysis that TBTF increases the probability of a crisis. That assumption is maintained in the simulations. If this were not assumed, the TBTF regime would always dominate the no-TBTF regime by construction.

The TBTF regime would exhibit lower expected crisis costs and would have positive returns in non-crisis states. The No-TBTF regime would not have any positive returns in non-crisis states and *no trade-off could exist.*

The simulation results are shown in Table 7. We assume that the crisis probability in the TBTF regime is either .03, .04, or .05. This choice is dictated by our earlier calculations suggesting that under TBTF crises arrive about every twenty five years (probability = .04). We experiment with lower (.03) and higher (.05) probabilities. In columns 1 and 2 of Table 7 we assume considerably lower crisis arrival rates for the No-TBTF regime and compare results. Finally, in column 3 of Table 7 we show the indifference probability; that is the probability under No-TBTF that approximately results in equal social costs/benefits under the two regimes.

The first thing to observe is that in all the calculations, the net benefit is always negative. This is consistent with what we have seen earlier; crisis costs simply dominate the benefits of TBTF. Note also that in all three panels when crisis costs are considerably lower under NO-TBTF than under TBTF, the NO-TBTF regime is always the better of the two. Finally, and of most interest, observe column 3 where the indifference probabilities are shown. For example, consider panel B where indifference occurs at a No-TBTF crisis probability of .0033. This is just .007 lower than the crisis probability under TBTF which is .04. (entry at far right, bottom). Therefore, we can deduce that if TBTF increases the probability of a financial crisis by more than 17.5% vis-à-vis the No-TBTF regime, then the No-TBTF regime is the better of the two. Similarly, in Panel A (C) if TBTF increases the probability of a financial crisis by more than 23.3% (4%) vis-à-vis the No-TBTF regime, then the No-TBTF regime is the better of the two.

In sum, if TBTF increases the likelihood of a crisis by much at all then it is not a good policy. We remind the reader that these results are obtained under a host of biasing assumptions.

VI. Conclusion

Having completed the bounding exercise, we finally take the liberty of relaxing (just) one of the strong assumptions that was employed previously. We substitute realistic estimates for the financial crisis cost by employing the results of BKS. They find a lower bound on their crisis cost estimate (in period 0 discounted dollars) of 52% of real per-capita GDP, and an upper bound of 318.7%. (BKS, Table 4.). For internal consistency, we now employ the same social discount rate as BKS (5.25%) in discounting the benefit stream due to TBTF. With this single change, the cost/benefit ratio of TBTF is 8.17 at the BKS lower bound and 29.14 at the midpoint of their upper and lower bounds. Depending on which benefit estimate is employed, the payback period at the BKS cost mid-point is in the hundreds of years.

Our work needs to be further tested and we encourage others to consider the bounding methodology as an alternative to econometric techniques. The policy-maker needs to make decisions and cannot wait while economists experiment with new empirical methodologies or search for new data. Our main point is that the costs of TBTF seem to substantially exceed the benefits – at least in terms of economies of scale. This suggests that the link between TBTF banks and financial crises needs to be broken. One way to achieve that is to break the largest banks into much smaller pieces as argued by Boyd and Jagannathan (2009). But there are other policies that could be effective. One alternative is attractive if economies of super-scale are actually as large as some believe and go on without limit. That is to simply turn the TBTF banks into something like regulated public utilities. This would require regulating their rates of return on capital and managerial compensation just as is done by state public utility commissions. A third alternative is to require them to hold very high capital ratios - as high as 25 or 30 percent. It has recently been forcefully argued by Hellwig *et. al.* (2010) that such capital requirements are only costly because of policy interventions in the form of tax deductibility of interest expense and the policy of TBTF itself.

Appendix

Notation

$\boldsymbol{C}$ = The present discounted value of social output losses due to the financial crisis, in 2007 dollars.

d = The utility discount rate, which measures the rate society discounts the utility of its future per capita consumption.

e = The absolute value of the rate at which the marginal value of that consumption decreases as per capita consumption increases.

g = The growth rate of per capita consumption

g_t = Estimated growth rate in real per capita GDP for the United States in period t

$\bar{g}_t$ = Historical average growth rate as of year t

l = Efficiency advantage of TBTF banks relative to the banking industry.

o = The social discount rate.

p = Probability of a crisis arrival.

s = Share of total real per-capita GDP that is produced by TBTF banks. (Estimate from Flow-of-Funds data, s = 3.63%)

V = Discounted 2007 value of the net social benefit of TBTF banks (in terms of their contribution to real per-capita GDP).

w_t = World growth rate in period t.

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Figure 1.

Estimate of Social Loss Due to Crisis

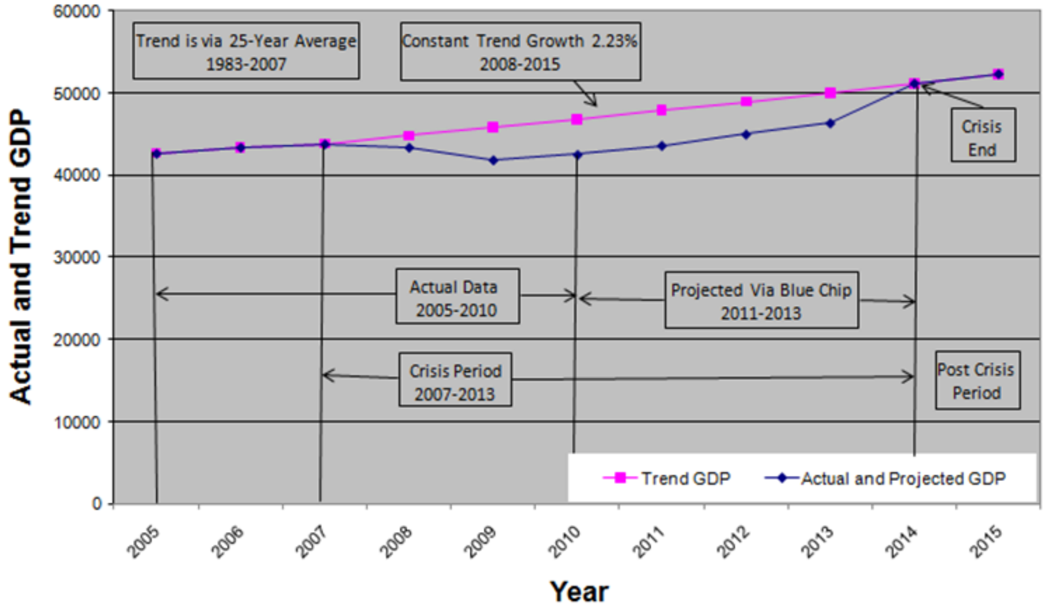

Figure 2.
From Boyd, Kwak and Smith (2005)
Showing Long Period of Real Economic Losses .

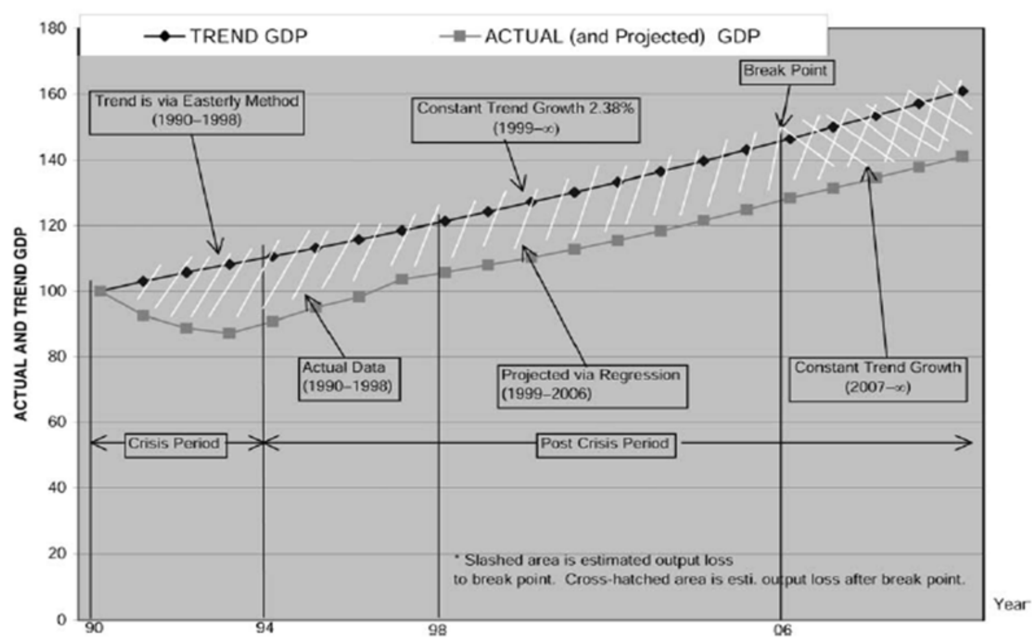

Figure 3. Stochastic Simulations:
Regimes, Transition Paths, and Probabilities

P = Transition probability
P_n = Transition probability of going from the no crisis to crisis state in No-TBTF regime
P_i = Transition probability of going from the no crisis to crisis state in TBTF regime

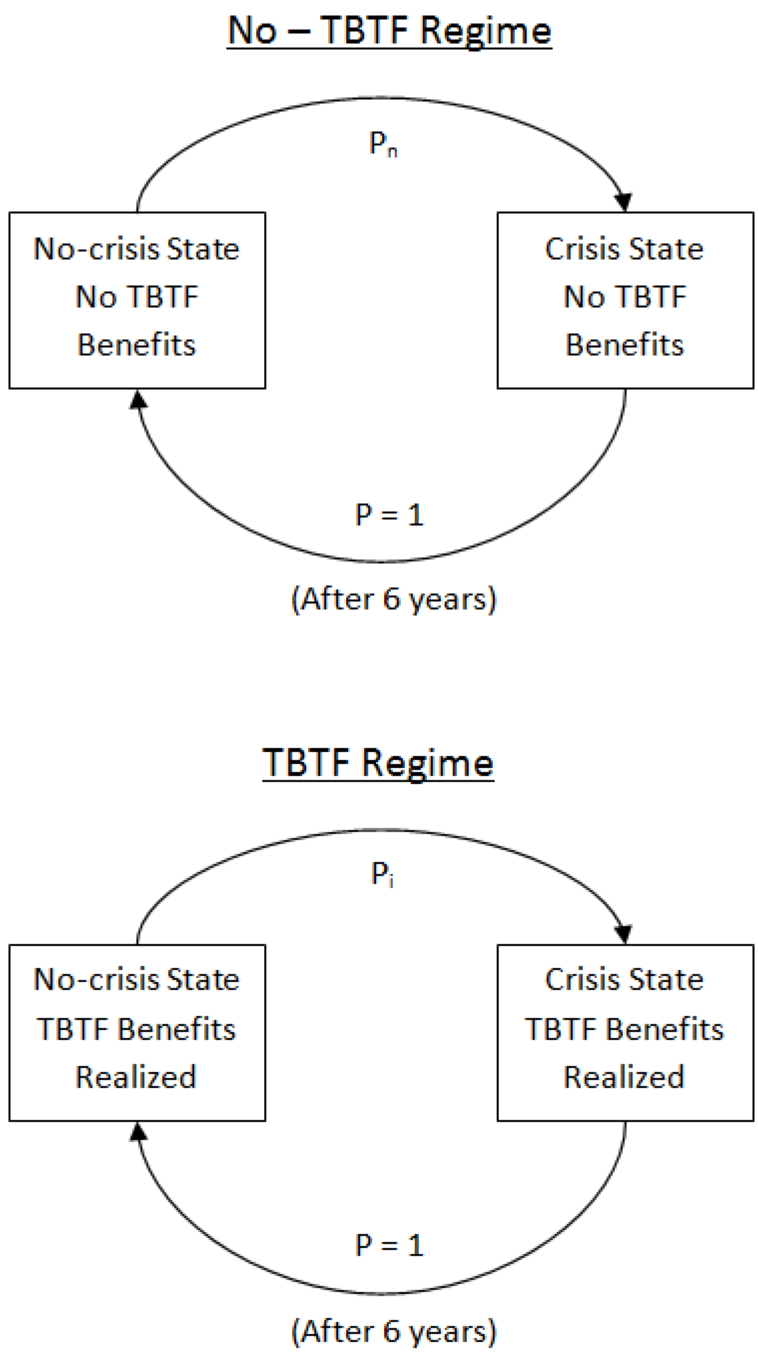

Table 1

Estimated Economic Losses Due to the Banking Crisis

	Blue Chip Estimates for 2011-2013		OECD estimates	
Social Discount Rate	Total Loss in real GDP Per Capita	Loss as a Percentage of 2007 Real GDP per capita	Total Loss in real GDP Per Capita	Loss as a Percentage of 2007 Real GDP per capita
Panel A: Trend predicted using 25-year average				
6.77%	16,558	37.80%	16,775.70	38.30%
3.60%	18,472	42.17%	18,727.98	42.76%
2.60%	19,142	43.70%	19,412.10	44.32%
2.40%	19,281	44.02%	19,553.24	44.64%
Panel B: Trend predicted using Easterly Method				
6.77%	16,035.99	36.61%	16,253.43	37.11%
3.60%	17,878.00	40.82%	18,134.01	41.40%
2.60%	18,522.90	42.29%	18,792.76	42.91%
2.40%	18,655.91	42.59%	18,928.64	43.22%

1. Panel A estimates losses based on trend calculations which are the average growth rate of real per capita GDP of 2.23% over the period from 1983-2007, the year that is considered the onset of the crisis

2. Panel B estimates losses based on trend calculations which 2.16% based on the method by Easterly et. al 1993 over the period from 1983-2007, the year that is considered the onset of the crisis

3. Blue Chip growth estimates were used to predict the actual real per capita GDP values from 2011-2013 in Columns 2 and 3

4. OEDC estimates were used to predict the actual real per capita GDP values from 2011-2012, and Blue Chip's estimate was used for 2013 in Columns 4 and 5

Table 2

Estimated Social Value-added of TBTF Banks Resulting from Economies of Scale

Social Discount Rate	Benefit as a Percentage of 2007 Real Per Capita GDP
Panel A: Moon et. al. Measure of Scale Economies	
6.77%	4.93%
3.60%	9.28%
2.60%	12.84%
2.40%	13.92%
Panel B: Wheelock & Wilson Measure of Scale Economies	
6.77%	8.58%
3.60%	16.13%
2.60%	22.34%
2.40%	24.20%

1. Panel A estimates TBTF benefits based on scale economies obtained by Hughes, Mester, Moon (2001)

2. Panel B estimates TBTF benefits based on scale economies obtained Wheelock and Wilson (2011)

3. Benefits are expressed as a percentage of 2007 Real Per Capita GDP.

Table 3

Summary of Costs and Benefits as a Percentage of 2007 Real Per Capita GDP

Calculating Using 25-Year Averages

Social Discount Rate	Blue Chip Cost Estimates	OECD Cost Estimates	Benefit Estimate	Blue Chip Cost Benefit Ratio	OECD Cost Benefit Ratio
Panel A: Moon et. al. Measure of Scale Economies					
6.77%	37.80%	38.30%	4.93%	7.66	7.76
3.60%	42.17%	42.76%	9.28%	4.55	4.61
2.60%	43.70%	44.32%	12.84%	3.40	3.45
2.40%	44.02%	44.64%	13.92%	3.16	3.21
Panel B: Wheelock & Wilson Measure of Scale Economies					
6.77%	37.80%	38.30%	8.58%	4.41	4.46
3.60%	42.17%	42.76%	16.13%	2.61	2.65
2.60%	43.70%	44.32%	22.34%	1.96	1.98
2.40%	44.02%	44.64%	24.20%	1.82	1.84

[1.] TBTF cost calculations use estimates based on the average growth rate of real per capita GDP of 2.23% over the period from 1983-2007, the year that is considered the onset of the crisis

[2.] Panel A estimates TBTF benefits based on scale economies obtained by Hughes, Mester, Moon (2001)

[3.] Panel B estimates TBTF benefits based on scale economies obtained Wheelock and Wilson (2011)

[4.] Blue Chip growth estimates were used to predict the actual real per capita GDP values from 2011-2013 in column 2

[5.] OEDC estimates were used to predict the actual real per capita GDP values from 2011-2012, and Blue Chip's estimate was used for 2013 in Columns 4 and 5

[6.] Column 4 shows the estimated benefit of TBTF banks as a percentage of 2007 real per capita GDP

[6.] Column 5 was calculated by taking the ratio of Column 2 to Column 4

[6.] Column 6 was calculated by taking the ratio of Column 3 to Column 4

Table 4

Summary of Costs and Benefits as a Percentage of 2007 Real Per Capita GDP

Calculated Using Easterly Method

Social Discount Rate	Blue Chip Cost Estimates	OECD Cost Estimates	Benefit Estimate	Blue Chip Cost Benefit Ratio	OECD Cost Benefit Ratio
Panel A: Moon et. al. Measure of Scale Economies					
6.77%	36.61%	37.11%	4.93%	7.42	7.52
3.60%	40.82%	41.40%	9.28%	4.40	4.46
2.60%	42.29%	42.91%	12.84%	3.29	3.34
2.40%	42.59%	43.22%	13.92%	3.06	3.11
Panel B: Wheelock & Wilson Measure of Scale Economies					
6.77%	36.61%	37.11%	8.58%	4.27	4.33
3.60%	40.82%	41.40%	16.13%	2.53	2.57
2.60%	42.29%	42.91%	22.34%	1.89	1.92
2.40%	42.59%	43.22%	24.20%	1.76	1.79

1. Panel B estimates losses based on trend calculations which 2.16% based on the method by Easterly et. al 1993 over the period from 1983-2007, the year that is considered the onset of the crisis

2. Panel A estimates TBTF benefits based on scale economies obtained by Hughes, Mester, Moon (2001)

3. Panel B estimates TBTF benefits based on scale economies obtained Wheelock and Wilson (2011)

4. Blue Chip growth estimates were used to predict the actual real per capita GDP values from 2011-2013 in column 2

5. OEDC estimates were used to predict the actual real per capita GDP values from 2011-2012, and Blue Chip's estimate was used for 2013 in column 3

6. Column 4 shows the estimated benefit of TBTF banks as a percentage of 2007 real per capita GDP

7. Column 5 was calculated by taking the ratio of Column 2 to Column 4

8. Column 6 was calculated by taking the ratio of Column 3 to Column 4

Table 5

Payback Period

Calculated Using 25-Year Averages for Trend Growth

Social Discount Rate	Blue Chip Cost Estimates	OECD Cost Estimates	Annual Benefit Estimate	Payback Period Blue Chip	Payback Period OECD
Panel A: Moon et. al. Measure of Scale Economies					
6.77%	37.80%	38.30%	0.3340%	113.18	114.67
3.60%	42.17%	42.76%	0.3340%	126.27	128.02
2.60%	43.70%	44.32%	0.3340%	130.85	132.69
2.40%	44.02%	44.64%	0.3340%	131.79	133.66
Panel B: Wheelock & Wilson Measure of Scale Economies					
6.77%	37.80%	38.30%	0.5808%	65.09	65.94
3.60%	42.17%	42.76%	0.5808%	72.61	73.62
2.60%	43.70%	44.32%	0.5808%	75.25	76.31
2.40%	44.02%	44.64%	0.5808%	75.79	76.86

1. TBTF cost calculations use estimates based on the average growth rate of real per capita GDP of 2.23% over the period from 1983-2007, the year that is considered the onset of the crisis

2. Panel A estimates TBTF benefits based on scale economies obtained by Hughes, Mester, Moon (2001)

3. Panel B estimates TBTF benefits based on scale economies obtained Wheelock and Wilson (2011)

4. Blue Chip growth estimates were used to predict the actual real per capita GDP values from 2011-2013 in column 2

5. OEDC estimates were used to predict the actual real per capita GDP values from 2011-2012, and Blue Chip's estimate was used for 2013 in column 3

6. Column 4 shows the estimated annual benefit of TBTF banks as a percentage of 2007 real per capita GDP

7. Column 5 was calculated by taking the ratio of column 4 to column 2

8. Column 6 was calculated by taking the ratio of column 4 to column 3

Table 6

Payback Period

Calculated Using Easterly Method for Trend Growth

Social Discount Rate	Blue Chip Cost Estimates	OECD Cost Estimates	Annual Benefit Estimate	Payback Period Blue Chip	Payback Period OECD
Panel A: Moon et. al. Measure of Scale Economies					
6.77%	36.61%	37.11%	0.3340%	109.61	111.10
3.60%	40.82%	41.40%	0.3340%	122.21	123.96
2.60%	42.29%	42.91%	0.3340%	126.61	128.46
2.40%	42.59%	43.22%	0.3340%	127.52	129.39
Panel B: Wheelock & Wilson Measure of Scale Economies					
6.77%	36.61%	37.11%	0.5808%	63.04	63.89
3.60%	40.82%	41.40%	0.5808%	70.28	71.28
2.60%	42.29%	42.91%	0.5808%	72.81	73.87
2.40%	42.59%	43.22%	0.5808%	73.33	74.41

1. TBTF cost calculations use estimates based on the average growth rate of real per capita GDP of 2.23% over the period from 1983-2007, the year that is considered the onset of the crisis

2. Panel A estimates TBTF benefits based on scale economies obtained by Hughes, Mester, Moon (2001)

3. Panel B estimates TBTF benefits based on scale economies obtained Wheelock and Wilson (2011)

4. Blue Chip growth estimates were used to predict the actual real per capita GDP values from 2011-2013 in column 2

5. OEDC estimates were used to predict the actual real per capita GDP values from 2011-2012, and Blue Chip's estimate was used for 2013 in column 3

6. Column 4 shows the annual estimated benefit of TBTF banks as a percentage of 2007 real per capita GDP

7. Column 5 was calculated by taking the ratio of column 4 to column 2

8. Column 6 was calculated by taking the ratio of column 4 to column 3

Table 7

Simulated Presented Discount Value of Two Regimes, TBTF and no-TBTF

Panel A: Assume TBTF Crisis Probability is 0.03			
Assume Probability Under no-TBTF Regime	p = 0.01	p = .015	**p = 0.023**
TBTF Regime Crisis Cost	-0.170	-0.160	
no-TBTF Regime Crisis Cost	-0.094	-0.129	
Difference in Probabilities	0.020	0.015	**0.007**
Panel B: Assume TBTF Crisis Probability is 0.04			
Assume Probability Under no-TBTF Regime	p = 0.02	p = .025	**p = 0.033**
TBTF Regime Crisis Cost	-0.265	-0.245	
no-TBTF Regime Crisis Cost	-0.185	-0.216	
Difference in Probabilities	0.020	0.015	0.007
Panel C: Assume TBTF Crisis Probability is 0.05			
Assume Probability Under no-TBTF Regime	p = 0.02	p = .025	**p = 0.048**
TBTF Regime Crisis Cost	-0.344	-0.368	
no-TBTF Regime Crisis Cost	-0.182	-0.246	
Difference in Probabilities	0.020	0.025	**0.002**

(1) Panel A (B, C) assumes that the TBTF crisis probability equals 0.03, (.04, .05)
(2) Probability Under no-TBTF Regime is the crisis probability under no-TBTF Regime Crisis Cost
(3) TBTF Regime Crisis Cost represents the present discounted value of TBTF banks as a percentage of base year GDP in TBTF Regime
(4) No-TBTF Regime Crisis Cost represents the present discounted value of TBTF banks as a percentage of base year GDP in no-TBTF Regime
(5) Difference in probabilities is the difference in the panel probability of TBTF crisis and the column probability under no-TBTF regime