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ABSTRACT

Due to the perception of an implicit public guarantee, banks too-big-to-fail may charge lower loan rates for the same risk in comparison to other groups of banks. However, empirically identifying such effect is challenging because size has many other advantages to banks besides the implicit guarantee. This paper makes use of the natural experiment represented by the discovery of new and large Brazilian oil reserves to conjecture an increase in the bailout perception of some Brazilian banks (the proposed too-rich-to-let-me-fail argument). It then investigates how the difference in loan pricing behavior across banks of different sizes has changed after the discovery. Results show that the difference of loan rates between medium and large banks decreases after the discovery. One possible explanation is that the conjectured increase in the bail-out perception affects mostly medium banks, which are at the margin to become too-big-to-fail, although other explanations are also feasible.

Keywords: too-big-to-fail; loan pricing; oil discovery

JEL Classification: C21; G21; G3

1. INTRODUCTION

Failures in large financial institutions expose the financial system and the real economy to the materialization of systemic risks. Market participants may therefore conclude that such institutions cannot fail or, to use the common jargon, that they are too-big-to-fail (TBTF). More specifically, market participants, including the banks themselves, are likely to conclude on the existence of an implicit public guarantee, at least to the creditors and (non-insured) deposits of these institutions. Consequently, the hypothetical public guarantee functions as a market friction. While *ex post* it is useful to prevent systemic risk, *ex ante*, it is socially costly because it reduces need of creditors to monitor and price the risks undertaken by the bank (Flannery, 1998; Sironi, 2003). Therefore, *ex ante* it leaves more freedom for shareholders to take excessive risks so that they can benefit further from the limited liability and unlimited potential payoff of risky strategies (moral hazard). However, whether there is indeed perception of such public guarantee by banks in the first place is an empirical issue of difficult identification.

The empirical literature on the bank behavior distortions produced by the moral hazard related to the too-big-to-fail phenomenon focuses mainly on the relation between aggregate bank performance and bank size. The conclusions are usually mixed. Boyd and Runkle (1993), using different measures of performance, find limited support for the moral hazard effects for a US sample starting in 1971. Boyd and Gertler (1994) find a negative relation between size and performance for US banks over the period 1983-1991 and suggest this could be driven by the TBTF argument. On the other hand, Ennis and Malek (2005) observe a positive relationship, using a more recent US sample, and contest the previous conclusion. Besides the different sample periods, the lack of a clear relationship may be partly related to the difficulty of analyzing aggregate measures of bank performance (e.g., Z-score) that usually embed together the concepts of volatility of assets, return on assets and leverage, all of which potentially affected by moral hazard arguments. Therefore, many different aspects of bank behavior may be entangled in such measures, such as pricing and selection of borrowers, exposure limits and decisions on the capital structure. In some other cases, the performance measure used accounts for a much narrower concept, such as loan charge-offs, and miss an important counterpart of the picture, such as loan interest rates. Furthermore, the data commonly used comprise accounting measures of ex post performance, that are neither necessarily consistent with market valuation of banks nor with ex ante risk taking behavior. More recent papers about distortions on bank behavior derived from implicit guarantees also suffer from similar limitations when measuring aggregate performance or aggregate risk (e.g., Gropp et al., 2010b).

The discussion above points to the need of using disaggregated data to better trace out the effect of the potential public guarantee perception on banks' behavior. This paper uses data on the borrower-loan level to focus on bank risk pricing behaviors related to the moral hazard posed by the guarantee perception. More concretely, it starts from the relation between loan interest rates and bank size, controlling for borrower risk, bank and loan characteristics. Banks that enjoy a perceived public guarantee (e.g., large banks) would charge lower rates for the same risk than other groups of banks, because they are under lower pressure from creditors and non-insured deposits to improve performance or to raise capital. More formally, such banks can give priority to the accumulation of reputational capital instead of financial capital (Boot et al., 1993). And reputational capital is likely to increase when banks charge lower rates than their competitors. The implication of lower rates is also similar to the moral hazard effect derived from the reduction of market discipline discussed in the deposit insurance literature (e.g., Merton, 1977). Other dimensions of the risk-taking behavior of banks are not analyzed in this paper. Those would include variations in the risk composition of the portfolios (better known as risk shifting) as well as variations in the sizes and maturities of the loans granted.

This paper is related to the literature on differences of loan pricing across different groups of banks. This is a scarce literature, possibly due to the unavailability of data on loan rates or loan spreads. It also focuses on varying objectives. Sapienza (2004) examines the behavior of State-owned banks in Italy and finds that they charge lower interest rates than do privately owned banks to similar or identical firms. Santos (2010) investigates the effect of the subprime crisis and finds that US banks charged higher loan spreads during the crisis and that this increase was higher for banks that incurred larger losses. Gropp et al. (2010a) is the paper closest in objective to ours as it investigates the effect of an explicit public guarantee in Germany. After its removal following a lawsuit, banks that enjoyed the explicit guarantee cut-off their riskiest borrowers and increased interest rates on the remaining ones.

Even using disaggregated data and focusing only on the loan pricing behavior of banks, the identification of the potential effect of the implicit public guarantee is conceptually challenging. The greatest difficulty lies on the fact that size is generally associated to many other advantages to banks, besides the implicit guarantee, such as higher efficiency, better technology and higher diversification (cf. Boyd and Runkel, 1993; Maechler and McDill, 2006; Imai, 2006) and these are usually difficult to empirically control for. One possibility is to try to extract the probability of bail-out of each bank from other sources, apart from the size figures. Gropp et al. (2010b) use the rating agencies' expectation of external support to each bank reflected in their "support ratings" or "issue ratings" to track down those probabilities. The main drawback of this approach is the assumption that banks will act with the same perception of rating agencies. Another possibility is to try to disentangle the guarantee effect from the other benefits of size by means of a natural experiment that affects only the guarantee perception or efficacy. As mentioned earlier, Gropp et. al. (2010a) indeed carries out this approach by exploiting an exogenous legal change that removed an explicit public guarantee in Germany.

Another natural experiment could result from an exogenous large increase in the perceived propensity of the State to bail-out banks. We conjecture that a State that is considered to become suddenly and unexpectedly much richer could prompt such perception. That Sate would be considered, after the natural experiment, a State too rich to let some banks fail. We call this argument the Too-rich-to-let-fail argument, a variant of the TBTF phenomenon. Brazil indeed experienced a sudden exogenous large increase in the perception of the State wealth when a huge amount of oil beneath the salt layer was discovered in the Tupi region in 2007 and made the headlines both nationally as worldwide.[1] Brazil was suddenly considered among the largest potential producers of oil worldwide. But the Tupi discovery was viewed by most specialists at that time as just a piece of a huge reserve of oil in an extensive area, ranging at least from Espírito Santo to Santa Catarina State, measuring 500 miles long and 125 miles wide. The president of the Brazilian Association of Petroleum Geologists, the national branch of AAPG (US), estimates reserves of up to 100 billion barrels in a huge region.[2] This paper uses this big oil discovery as a natural experiment to disentangle the public guarantee effect present in the bank size measure.[3]

Section 2 discusses in more detail the macro and micro impacts of the oil discovery as well as hypothesizes the link to the loan pricing of banks. Section 3 discusses many aspects of the methodology adopted. Section 4 comments on the data used and the characterization of the resulting samples. Section 5 shows and interprets the main results and performs many robustness analyses. Section 6 concludes.

1. EFFECTS OF THE BRAZILIAN BIG OIL DISCOVERY

Table 1 below shows the wealth represented by the new oil discovered through various lens, which include the proportion to GDP, to total assets of the banking system, to total equity of the banking system, to total deposits and to the current Brazilian oil reserves.

Two scenarios are presented in Table 1. The first one (column 2) considers only the Tupi field discovery, which, according to the official announcement in November 2007, will produce between five and eight billion barrels (we consider eight billion barrels in Table 1). The second one (column 3) are based on optimistic forecasts made by some specialists regarding the potential for a much larger region

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[1] <http://www.economist.com/node/10677726>;
http://www.businessweek.com/bwdaily/dnflash/content/nov2007/db20071115_045316.htm;
http://www.bloomberg.com/apps/news?pid=newsarchive&sid=a5Vhp3Ss07rw.

[2] http://www.ogfj.com/index/article-display/6444410005/articles/oil-gas-financial-journal/ep/offshore/brazilian-pre-salt.html.

[3] Notice that the nature of the Brazilian natural experiment is completely different from the nature of the German experiment exploited in Gropp *et al.* (2010a). Also, the two countries have very different banking, institutional and even cultural environments. Therefore, effects associated to implicit public guarantees need not to be similar between the two countries.

Table 1
Oil Revenues
(Oil prices at usd 100 per barrel)

	Tupi field (8 billon)	*Huge reserve (100 billion)*
Gross revenues[1]	USD 800 bill	USD 10 tri
% of the current oil reserves[2]	66.67%	833.33%
Goverment tax revenues[3]	USD 280 bill	USD 3,500 bil
(% of GDP)[4]	20.29%	253.62%
% of Brazilian financial system[5]		
(% of total assets)	19%	241%
(% of total equity)	165%	2,058%
(% of total deposits)	43%	539%

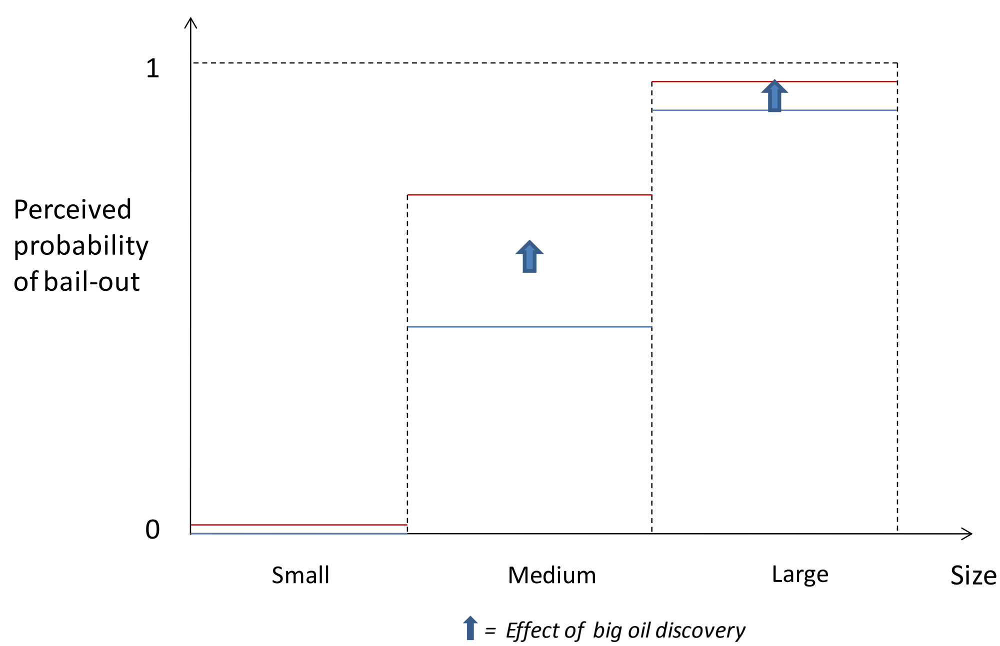
1. Gross revenues are the volume of the new oil discovered multiplied by oil prices at USD 100.00 per barrel.
2. Current oil reserves used in the calculation = USD 1,200 billions.
3. Government tax revenues = 35% of gross revenues.
4. 2007 Brazilian GDP used in the calculation = USD 1.38 trillions.
5 Size of the Brazlian financial system as of 2007.
Sources: Central Bank of Brazil and Brazlian media.

that could achieve up to 100 billion recoverable barrels. Both scenarios consider oil prices at USD 100 per barrel. The first line of table 1 reports the gross revenues corresponding to the two cases (oil prices multiplied by the volume of the new oil reserves discovered). The other lines show the magnitude of the new oil reserves relative to the Brazilian economy (using the 2007 GDP of USD 1.38 trillion) and the Brazilian financial sector (total assets, total equity and total deposits in 2007). In those calculations, we consider only 35% (the average tax income to GDP ratio in Brazil) of the gross revenues to approximate the government tax revenues from the new oil reserves. In the case of the Tupi field, the government tax revenue relative to GDP (20%) and to the Brazilian banking system (19%, 165% or 43%, depending on the dimension considered) are very high, giving support to the view of the oil discovery as a strong positive exogenous shock.

Historically, large reserves of oil do not necessarily represent a blessing to a country. Its effect depends on the institutional strengths of the country, the ensuing macroeconomic policies and basically on how this wealth is translated into the country's external accounts. Venezuela, for example, has followed the path of high government spending and confrontations with the private sector. On the other hand, we conjecture that the perceived general first impression of the Brazilian oil discovery was very much positive, given the consistent macro policies followed by the recent Brazilian governments and the consolidation of the Brazilian democratic institutions. At that time, there was indeed a sentiment of euphoria in many circles (Note 1), despite doubts concerning the system of exploration of the new oil reserves and the investment capacity of Petrobras, the Brazilian oil company.

However, the government decision to bail-out large or systemically important banks may not be very sensitive to an increase, even large, of the State wealth. The history of Latin America, a region not necessarily known for the richness of their states, is full of examples of many bank rescues. The recent past of Iceland is another illustrative case where the State took over a lot of bad bank debts, prevented the dissemination of a banking crisis but suffered a sovereign risk crisis afterwards (c.f. Gray, 2009). On the other hand, this papers conjectures that a large jump in the State wealth would more effectively increase the perceived probability to bail-out medium banks. These are banks that are at the margin to become TBTF: They are not systemically important but their failure could still cause disruptions to the financial system. And a richer State might be tempted to avoid disruptions in the first place. Figure 1 below shows the perceived probability of bail-out perception as a function of size (a proxy for systemic importance) and displays our conjecture for the effect

Figure 1
Conjecture about the Effects of Oil Discovery



of the big oil discovery. Large banks have already a very high probability (in the extreme TBTF case, 100%) of bail-out before the discovery and experience a slight or null increase in the bail-out perception afterwards. The small banks, whose failure do not cause any harm to the financial system, have already null probability of bail out before the discovery and remain so afterwards. Only the medium banks experience a notable increased perception of bail-out due to the oil discovery. As far as the impact of the oil discovery on the loan pricing of banks is concerned, the previous conjecture translates into the testable hypothesis that, after the discovery, medium banks diminish their loan interest rates in relation to large banks (the TRTLF argument applied to medium banks). In other words, the difference of loan rates between medium and large banks decreases after the oil discovery. We aim at testing this hypothesis in the remainder of the paper.

Possible transmission mechanisms of increased bail-out perception include, for example, higher probability of Central Bank loans being granted to banks in difficulties, higher probability of political approval to additional resources needed by the deposit insurance fund to cover an asset shortfall of a failing bank (in case the limit of deposits insured is not sufficient for the rescue of the bank) as well as perception that public banks will have larger resources and implicit permission to acquire banks in difficulties. Although some of these mechanisms may require changes in the current Brazilian law and regulations and/or political approval, this paper works with the assumption that a richer State, including its politicians, would not find amendments to current legislation a major obstacle to a more active rescue attitude, and that this view is shared by the banks themselves. In fact, authorization for public banks to acquire other financial institutions was formally given in October 2008, shortly after the manifestation of liquidity problems in many small and medium Brazilian banks as a result of the impact of the international financial crisis in Brazil (Provisional Act 443[4]).

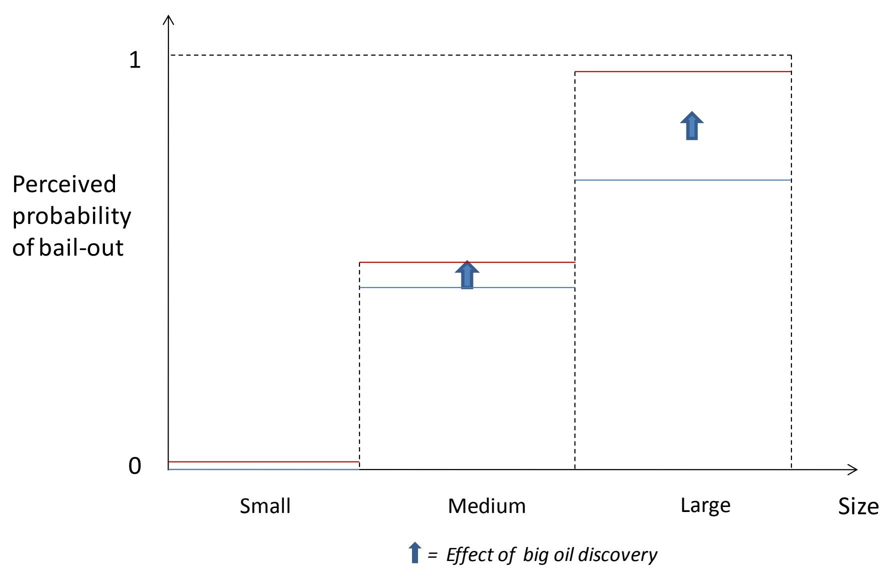
Would the TRTLF argument be realistically discussed in bank pricing decisions? We argue that this is more likely for non-large banks, which tend to be less hierarquical, similarly to the argument that non-large banks process better soft information (Stein, 2002). Indeed, in medium banks, the board may have a direct bearing on the credit committees responsible for pricing policies, for example because its members may have been former participants of the latter. This point further strengthens our conjecture that an empowerment in the implicit public guarantee is best reflected in the behavior of medium rather than large banks.

One may wonder whether there is an alternative explanation to the TRTLF argument related to medium banks that could equally rationalize the difference of loan rates between medium and large banks decreasing after the oil discovery. The answer is yes but the alternative story is not so alternative because it elaborates on another version of the TRTLF argument. Figure 2 displays an alternative conjecture for the effect of the big oil discovery on the perceived probability of bail-out as a function of size. Here, large banks are the ones who experience the highest increase in the bail-out perception (TRTLF argument applied to large banks). This could prompt them to decrease their loan rates in relation to medium banks, leading to a larger rate difference between medium and large banks after the discovery, in contrast to the original conjecture. However, the contrary is also possible based on considerations about variations of the charter value of banks (c.f. Keeley, 1990). A stronger public guarantee increases the charter value of large

[4] <http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2008/Mpv/443.htm>

banks giving their shareholders a higher incentive to protect this new value. As a result, they may be willing to take less risk or, at least, to price loans more conservatively. In that case, large banks would increase their loan rates in comparison to medium banks for the same risk after the discovery, leading to a decrease in the difference of rates between medium and large banks in the post-discovery period, similarly to the implication of the TRTLF argument applied to medium banks. How is then possible to try disentangle these two alternative versions of the TRTLF argument? One possibility is to examine loan rate differences between other groups of banks (large and small or medium and small). However, these other groups may comprise much fewer loan observations, reducing the statistical power for explaining the respective rate differences. We explore this path anyway in the section on results.

Figure 2
Alternative Conjecture about the Effects of Oil Discovery



2. METHODOLOGY

To effectively take into account the non-monotonous effect of bank size, assumed in the conjecture of Figure 1, a categorical representation of size must be considered in our models.[5] Discrete measures of size in the investigation of TBTF effects are used, for example, in Boyd and Gertler (1994) and Oliveira

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[5] In a continuous size model, the sign of the bank size coefficient is ambiguous. Indeed, the effect of the oil discovery treatment for a bank of smaller size in comparison to a bank of larger size would be γ·(smaller size-larger size), where γ is the coefficient of continuous size. So, the conjecture of Figure 1 implies that this treatment effect is negative for the range of medium sizes and above, so that $\gamma>0$ is expected in this case. On the other hand, the conjectured negative effect for the oil discovery treatment of a medium bank in comparison to a small bank is γ·(medium size-small size), implying $\gamma<0$ in this other case.

et al. (2011).[6] We consider three size classes (large, medium and small) and exclude government-owned banks from the analysis, not to mix the effects of explicit and implicit public guarantees. The large group mimics systemically important or TBTF banks. We take the cluster analysis results of Oliveira et al. (2010) to define this group. The medium group comprises the N=30 largest banks in asset size, excluding banks from the large group. Although we perform some robustness analysis on the value of N, we do not try to investigate further the systemic importance of medium banks beyond the size measure. The academic literature is still far from consent on appropriate measures of systemic importance (e.g., Tarashev et al., 2010) and size is easily observed. The remaining group of banks is included in the small group. In all regressions of this paper, the small group is the omitted basal class.

Let $LOAN\_RATE_{l,b,f,t}$ be the interest rate charged by bank *b* on new loan *l* granted to firm *f* at time *t*. The starting point is the difference-in-difference model below (with potential multiple treatments), where the dependent variable $LOAN\_RATE_{l,b,f,t}$ is regressed against a dummy variable of the period after the oil discovery, the categorical bank size measure and the interaction of the two, among several other controls.

(1) $LOAN\_RATE_{l,b,f,t} = c + \alpha \cdot \text{oil discovered}_t + \beta_1 \cdot \text{Large}_b + \beta_2 \cdot \text{Medium}_b + \gamma_1 \cdot \text{oil discovered}_t \cdot \text{Large}_b + \gamma_2 \cdot \text{oil discovered}_t \cdot \text{Medium}_b + \text{bank controls}_{b,t} + \text{firm controls}_{f,t} + \text{loan controls}_{l,t} + \text{macro controls}_t + \text{error term}_{l,b,f,t}$

The oil discovered dummy captures aggregate unobserved factors that affect loan interest rates over time in the same way for all banks and that may or may not be related to the oil discovery. The size variable captures cross-section differences between banks of different sizes before the oil discovery, which are not necessarily related to the standard TBTF argument. Examples of such factors include technology, efficiency and diversification, as mentioned previously in the paper. As larger banks tend to be more developed with respect to those elements, the resulting risk they carry on is lower, leading to an expectation that $\beta_1<0$ and $\beta_1<\beta_2$. (To the extent that economies of scale are also present in the transition from the small to the medium group, $\beta_2< 0$ could also be defended.) At the same time, the standard TBTF argument that rationalizes stronger public guarantees for large banks also produces the same expectations ($\beta_1<0$ and $\beta_1<\beta_2$). Therefore, analyzing the signs and the relative magnitudes of β_1 and β_2 does not allow the identification of the perception of implicit guarantees. This is best accomplished by the analysis of the coefficients of the interaction variables, as they measure how loan rates of banks of different sizes reacted differently to the effect of the oil discovery and the supposed consequent stronger public guarantee. A negative sign for γ_1 would capture the extent to which large banks, that may already be TBTF, benefit further from a perception of a richer State with stronger implicit guarantees. As medium banks are likely

[6] Boyd and Gertler (1994) find evidence that the relationship between size and performance is highly non-linear. This argument can be interpreted as supporting the categorization of size also when it is not interacted, as we do in (2).

to be the most benefitted from the oil discovery according to our conjecture of Figure 1, not only the expectation towards $\gamma_2 < 0$ is clearer, but we also rather expect $\gamma_2 < \gamma_1$.

Firm controls in (1) try to capture the multifaceted aspects of a firm creditworthiness. Santos (2010), for example, uses a huge set of firm balance-sheet variables, as well as information on firm stock prices but, even so, include fixed effects to account for unobserved firm effects. Further, as the above data is, generally, mostly or only available for publicly-listed firms, privately-owned firms are usually excluded from many empirical analyses, as in Santos (2010). The main data source of this paper is the Brazilian Public Credit Register (BPCR), a huge repository of Brazilian banks' loans, which presents, however, even stronger limitations on firm-level variables.[7] Even balance-sheet data on Brazilian publicly-listed firms is scarce in the register. Therefore, we adopt a similar strategy to Santos (2010) and see the firm controls as unobserved firm-time fixed effects in the previous regressions.[8] Indeed, firm-time fixed effects have been an important research tool in the applied banking literature lately (e.g., Jimenez et al., 2010) find a stronger bank-lending channel when those effects are accounted for).[9]

In practice for the estimation, we take the difference of rates across banks of different sizes (with Δsize > 0 by construction) for the same firm and same month in the previous equation 1. As discussed in more detail later, our sample comprises only firms that have taken out at least two loans in the same month from different banks. Equation 1 becomes, after the differencing operation, equation 2. Notice that not only firm controls disappear in equation 2, but also macro controls and the isolated oil discovered dummy, as firm-level and time-level variables cannot be identified in the presence of firm-time fixed effects.

$$(2)\quad \Delta LOAN\_RATE_{\Delta l,\Delta b,f,t} = \beta_1 \cdot I(Large,Small)_{\Delta b} + \beta_2 \cdot I(Medium,Small)_{\Delta b} + \beta_3 \cdot I(Large,Medium)_{\Delta b} + \gamma_1 \cdot oildiscovered_t \cdot I(Large,Small)_{\Delta b} + \gamma_2 \cdot oildiscovered_t \cdot I(Medium,Small)_{\Delta b} + \gamma_3 \cdot oildiscovered_t \cdot I(Large,Medium)_{\Delta b} + \Delta bank\ controls_{\Delta b,t} + \Delta loan\ controls_{\Delta l,t} + new\ error\ term_{\Delta l,\Delta b,f,t}$$

where I stands for the indicator operator of the pair of banks in parentheses and with $\beta_3 = \beta_1 - \beta_2$ and $\gamma_3 = \gamma_1 - \gamma_2$ by construction.

[7] The only firm-level variables contained therein are the regulatory credit ratings, which mimic basically categories of past-due ranges, and the firm past payment behavior. They provide limited usefulness to accurate credit risk measurement.

[8] Santos (2010) uses firm-bank fixed effects instead, in the analysis of loan pricing behavior following the subprime crisis.

[9] Slight variations of the tool have also been adopted. Facing the same limitations of the BPCR, Rodrigues *et al.* (2006) use firm-level fixed effects and a one-month sample to study the effect of the new Brazilian payroll-deducted type of credit on interest rates. Sapienza (2004), with access to a much richer set of firm characteristics, uses a matching sample strategy to investigate different pricing behaviors of different groups of banks.

Notice that previous observations imply that we expect $\beta_3 < 0$ and $\gamma_3 > 0$. More generally, recalling our previous comments, the ideal identification of the effects of the supposed stronger public guarantees on bank loan rates according to the conjecture of Figure 1 would require $\gamma_3 > 0$, $\gamma_2 < 0$ and $\gamma_1 \leq 0$.

We use several bank controls. The most important is the funding cost (FUNDING COST), derived from funding expenses divided by selected liabilities as present in bank balance sheets. Although more sensitive to bank risk than the risk-free rates commonly used in the empirical banking literature, this funding cost measure is still a backward-looking accounting concept. Therefore, we also control for indicators of bank risk and bank financial position, to help control for the true funding cost that a bank faces. Non-performing loans (NPL), net loan charge-offs as a fraction of total loans (CHARGEOFFS) or the volatility of return of assets (ROAVOL) may mean that the bank faces higher costs of funds, suggesting a positive impact on loan interest rates. Similarly, capital to assets ratio (CAPITAL) and holdings of cash and marketable securities as a fraction of total assets (LIQUIDITY) translate an improved financial position of the bank, leading to lower costs of funding and, therefore, lower loan interest rates. It is also possible that banks with worse capital and liquidity positions are willing to set higher interest rates to improve their financial stance (e.g., Boot at. al., 1993), suggesting again negative coefficients. On the other hand, a positive effect LIQUIDITY could also be found. A bank with high liquidity may choose higher interest rates to compensate for the low return of its liquid assets. Finally, we also control for return on assets (ROA) since a bank with high ROA may be more efficient in the use of its assets and therefore of less need for higher loan rates.

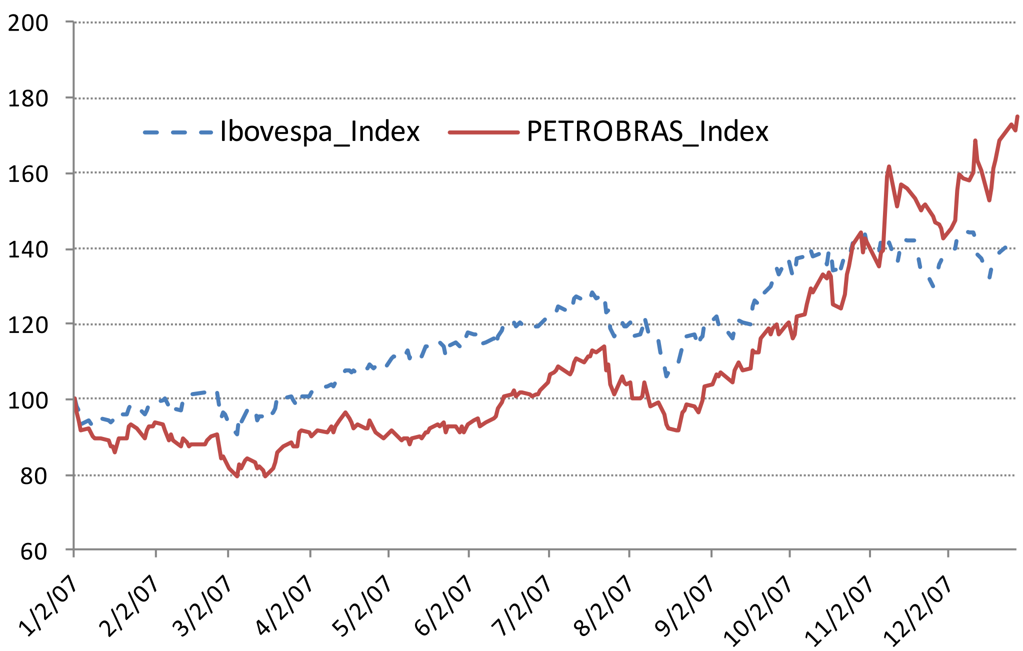
The set of loan controls include the log of the loan amount (LAMOUNT) and the log of the loan maturity in days (LMATURITY). Larger or longer loans represent higher credit risk, so the expected effect of these variables on loan interest rates is positive.[10] On the other hand, these loan controls can be jointly determined with loan interest rates and also reflect credit demand characteristics. For example, more expensive loans may be associated to less demand for larger amounts and a preference for shorter maturities, so that negative signs for these loan controls may also be found. We estimate our models both with and without these two variables.[11] A final control refers to the log of the time of relationship in days of each pair firm-bank (LRELATIONSHIP). A longer relationship may indicate lower credit risk of the firm, but could also represent greater information monopoly to the bank, so the effect on loan rates is ambiguous.

[10] Larger loans may also entail economies of scale in the processing and monitoring the loan.
[11] Notice that as only new loans are considered there is no option to use lags of the variables as instruments.

3. DATA AND SAMPLE CHARACTERIZATION

The data sources for this project come from BPCR and COSIF –the accounting database of Brazilian financial institutions, owned and managed by Central Bank of Brazil. The former provides information on loan interest rates and loan controls, whereas the latter provides information on bank sizes and most of other bank controls.[12] The sample used in the estimation comprises new working capital loans granted in the period from May 2007 to May 2008. The oil discovery was officially announced to the market by the Brazilian Securities and Exchange Commission on November 8, 2007.[13] On this same day, Petrobras stock price jumped upwards in comparison to Brazilian stock exchange index (Figure 3).[14] As we work with monthly data, November 2007 considered works both as the end of the pre-discovery period and the start of the post-discovery period. We, therefore, excluded it from the analysis.

Figure 3
Stock Prices: Ibovespa and Petrobras Indices



Source: BOVESPA

[12] The exceptions are CONCENTRATION control which comes also from BPCR.
[13] The sample comprises only fixed rate loans with non-earmarked resources and regulatory classification equal or better than C (a proxy for loans that do not result from renegotiations).
[14] We also take into account the possibility that some information on the discovery was previously known to the market, so that we investigate the effect of an earlier start of the treatment period in the robustness analysis.

The length of the used time period deserves some comments. Using longer periods after the oil discovery would contaminate the sample by the impacts of the international financial crisis on Brazilian banks. In fact, Brazilian financial markets stayed quite immune to the international financial crisis until May 2008, when Brazilian stock prices started to plunge. It is also possible that the perception of a stronger public guarantee reduces sometime after the discovery due to uncertainties concerning the exploration of the new oil reserves, so that using longer periods may in fact diminish statistical significance of the relevant coefficients.[15] On the other hand, using short periods may limit too much the statistical power of the sample (further to the constraint on the group of firms considered). Yet, very short post-discovery periods may not capture the oil discovery effect on loan interest rates, given that decisions on loan (re)pricing are taken by infrequent meetings of banks' credit committees. A six-month period, both before and after the oil discovery, is chosen as a middle-ground option.

Working capital is a convenient loan type for this study for several reasons. First, it is a representative form of bank credit to firms (both in number of contracts and loan amounts), so that its interest rate movements should also be representative of the overall credit (re)pricing behavior of banks. It is also a rather standard type of loan. Nevertheless, to further standardize the contracts, we restrict the sample to loans without collateral or private guarantee, given that information on collateral value or percentage of amount guaranteed is absent in BPCR. Third, representing a more immediate funding of firms, demand for working capital tends to have lower price elasticity than other forms of credit (e.g., credit for investment). Consequently, it helps, together with the fixed firm-time effects, to identify time variations in loan interest rates that are bank driven.[16] Finally, the typical short-term maturity of working capital loans limits the scope for other potential explanations of different re-pricing behaviors among banks. In theory, one could argue that different pricing responses following the oil discovery could be driven by different speeds or abilities of banks in the processing of the new post-discovery macro scenario and its spillover to firms' creditworthiness. In the short-term horizon, however, the new macro scenario is still far away and reprocessing is less needed for risk analysis, so that different bank skills are generally not likely to be a relevant issue.[17] Anyway, to make our defense stronger, we also exclude from the sample firms of the oil and gas sector, to which risk re-pricing may occur sooner.

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[15] Also, using a long pre-discovery period creates difficulties related to bank mergers and acquisitions, as well as incorporates different structure and competition regimes for the Brazilian banks.

[16] A similar argument is employed in Ivashina and Scharfstein (2008) in connection to working capital.

[17] Notice that the short-term character of working capital does not harm the argument about the strength of the implicit guarantee in the first place, because it is reasonable to expect that the State has greater ability to anticipate in the short-term the benefits of the post-discovery macro scenario than the firms themselves. In other words, the State, being the lender of last resort, does not need to wait until when oil revenues are available to behave as richer.

Due to the estimation strategy represented by equation (2), only new loans that have been taken by the same firm with at least two private banks in the same month are considered. The final sample has 1,964 loans (or equivalently firm-month-bank observations) that were taken out by 886 firms, a small percentage of overall sample that includes also loans taken out by a firm that did not take any other loan in another bank in that month. The much larger overall sample includes 163,690 loans from 110,010 firms. Of the final sample loans, 834 were taken out before the oil discovery and 1,130 afterwards. There are 150,782 firm-month pairs in the overall sample, of which 982 comprise the final sample.[18]

Table 2 shows the differences between the two samples. The number of banks in the final sample is approximately half of the number of banks in the overall sample but this difference is mainly driven by the group of small banks. Bank asset sizes are similar between the two samples, with larger relative differences again for the group of small banks. Loan rates are also similar among the two samples, although they are clearly smaller in the final sample for the small banks and for the medium banks before the oil discovery. Competition with larger banks in the final sample may explain part of these rate differences. Loan amounts are clearly larger for the final sample (more than twice the size than in the overall sample). Firms that work with more than one bank may have a larger credit demand, leading to larger loan amounts. These firms are also generally more well known by the banks since they have longer relationships (approximately eight months longer) than the universe of firms of the overall sample. Their loans have also slightly shorter maturities (around two months shorter). The magnitude of these loan characteristics differences between the samples can vary across the group of banks considered and the time period analyzed (before or after the oil discovery). Recognizably, these differences may introduce some bias in our estimations.

Table 3 characterizes the final sample. It compares loans taken out before the oil discovery with those taken out after the discovery. It also compares characteristics of banks that granted these loans in the two periods. There has been an increase in loan rates after the discovery that could be related to some bank variables (e.g., leverage, liquidity, ROA) according to explanations previously given in Section 3, or to a shift towards riskier firms after the discovery (not captured in the sample due to the absence of firm variables). A defensive movement anticipating the effects of the international financial crisis in Brazil could also have had an influence. On the other hand, this loan rate increase does not appear to be driven by funding costs or bank risk (ROAVOL), which decreased after the discovery, or by the size of bank assets, which increased after the discovery. Further, as the next table reveals, the loan increase is not widespread

[18] The small number of observations represents a more serious statistical constraint for the medium and small banks that already have fewer loans in the overall sample.

across all banks: Medium banks have not increased their rates in a significant way. For the purposes of this paper, we are more interested on differences of loan rates across banks, rather than on loan rate levels.

Table 2
Comparison of Final and Overall Samples

	Before oil discovery		*After oil discovery*	
	Final sample	*Overall sample*	*Final sample*	*Overall sample*
All Banks				
# Loans	834	71,700	1,130	91,990
# Banks	23	40	27	51
# Firm	394	55,825	524	70,331
# Firm-month	427	66,211	584	84,571
Bank asset size (R$ billion)	158	155	198	218
Loan rate (% aa)	42.09	44.30	45.88	46.42
Loan amount (R$)	131,608	51,435	179,914	63,917
Loan maturity (days)	309	354	278	362
Relationship (days)	2,258	2,004	2,313	2,039
Large banks				
# Loans	645	58,010	878	77,599
# Banks	5	6	6	8
Bank asset size	196	186	246	254
Loan rate	42.17	42.94	46.24	46.17
Loan amount	73,421	44,260	185,977	57,844
Loan maturity	339	378	299	381
Relationship	2,315	2,002	2,257	2,062
Medium banks				
# Loans	82	5,358	113	4,596
# Banks	6	8	9	11
Bank asset size	59	63	66	73
Loan rate	45.87	52.20	48.01	49.69
Loan amount	335,085	105,503	185,338	111,952
Loan maturity	163	185	149	178
Relationship	3,558	3,750	4,400	3,882
Small banks				
# Loans	107	8,332	139	9,795
# Banks	12	26	12	32
Bank asset size	1.6	1.1	1.7	1.4
Loan rate	38.70	48.70	41.87	46.85
Loan amount	326,429	66,625	137,209	89,493
Loan maturity	241	297	252	298
Relationship	917	898	974	990

Sources: Brazilian Public Credit Register and the Accounting Database of Brazilian Financial Institutions (COSIF).
Note: Variables defined in Section 3.

Table 4 offers a first look at the question whether large and medium banks set differently loan rates after the large oil discovery. The comparison between large and medium banks is the most relevant one for the conjecture of Figure 1. Average figures are computed based only on firms that took out loans from both these groups of banks in the same month. Large banks increased their rates after the oil discovery by almost 5 p.p., a difference that is statistically significant and that may be related to the arguments raised in discussion of the previous table. In contrast, loan rates of medium banks basically remained on the same level as before the oil discovery. Further, the distance between rates of large and medium banks increased after the oil discovery in a statistically significant way. Table 5 shows differences in bank variables between large and medium banks both before and after the discovery. It reveals that the increase in the rate gap between large and mediums banks occurs despite the shortening of the funding cost gap and the widening of the asset size gap between these two groups of banks. The results of Tables 4 and 5 lend support to the conjecture of Figure 1 that medium banks acted after the discovery according to an increased perceived perception of bailout. In the next section, we investigate whether this evidence continues to hold in a multivariate setting.

Table 3

Characterization of the Final Sample

	Before oil discovery	*After oil discovery*	*Difference*	*t–statistic*
Loan rate	42.09	45.88	3.79[c]	4.70
Loan amount	131,6	179,9	48,3	0.85
Loan maturity	309.49	278.20	–31.28[c]	–2.83
Relationship	2258.32	2313.36	55.04	0.36
Asset size	1.58e+11	1.98e+11	3.99e+10[c]	8.36
Leverage	10.73	12.02	1.28[c]	5.64
Liquidity	0.161	0.165	0.004[c]	1.58
Funding cost	0.009	0.008	–0.0005[c]	–12.12
ROA	0.002	0.0013	–0.0007[c]	–10.41
ROAVOL	0.0015	0.0013	–0.0002[c]	–3.33

Sources: Brazilian Public Credit Register and Accounting Database of Brazilian Financial Institutions (COSIF).
Notes: Variables defined in section 3. The symbols [a], [b] and [c] indicate coefficients statistically significant at 10%, 5% and 1%, respectively.

Table 4

Oil Discovery and Loan Interest Rates: Univariate Analysis

Firms took out loans in both groups of banks	*Before oil discovery*	*After oil discovery*	*Difference*	*t-statistic*
Large	42.50	47.21	4.71[c]	1.59
Medium	47.99	47.82	–0.18	–0.06
Difference	–5.49[b]	–0.608	4.89[c]	
t-statistic	1.79	0.22	–1.58	

Source: Brazilian Public Credit Register.
Note: The symbols [a], [b] and [c] indicate coefficients statistically significant at 10%, 5% and 1%, respectively.

Tables 6 offers similar first looks at other possible responses of banks not analyzed in this paper, such as variations in the amount and maturity of loans granted. We see that loan amount variations between the periods and across the banks are not significant. Loan maturity variations are only significant across banks, with large banks extending longer loans than medium banks, but with no significant change along time. These results indicate that loan pricing is likely to be the main channel of adjustment in response to the oil discovery. Also, Table 6 may indicate that the potential endogeneity, when using these variables as further controls in our estimations, is limited.

Table 5

Oil Discovery and Bank Variables: Univariate Analysis

Firms took out loans in both groups of banks	*Before oil discovery*	*After oil discovery*	*Difference*	*t–statistic*
Difference between LARGE and MEDIUM banks				
Asset size	1.30e+11	2.00e+11	7.00e+10[a]	6.38
Leverage	–3.16	–1.22	1.94[b]	2.05
Liquidity	0.069	0.063	–0.006	–0.58
Funding Cost	0.0009	0.0005	–0.0004[a]	–2.74
ROA	0.0006	0.0006	–0.00007	–0.30
ROAVOL	–0.0002	0.0001	0.0003[a]	5.26

Sources: Accounting Database of Brazilian Financial Institutions (COSIF).

Note: The symbols [a], [b] and [c] indicate coefficients statistically significant at 10%, 5% and 1%, respectively.

Table 6

Oil Discovery and Other Responses: Univariate Analysis

Firms took out loans in both groups of banks	Before oil discovery	After oil discovery	Difference	t-statistic
Response: Loan Amount				
Large	104,549	156,981	52,431	0.89
Medium	131,957	179,313	47,355	0.42
Difference	27,408	22,332	–5,076	
t-statistic	0.3477	0.2464	–0.2330	
Response: Loan Maturity				
Large	244.80	230.46	–14.34	–0.39
Medium	161.32	143.54	–17.78	–0.72
Difference	–83.48[a]	–86.92[a]	–3.44	
t-statistic	–2.68	–2.88	–0.21	

Sources: Brazilian Public Credit Register.

Note: The symbols [a], [b] and [c] indicate coefficients statistically significant at 10%, 5% and 1%, respectively.

4. RESULTS

We begin by investigating how differences in loan pricing across banks of different sizes has changed after the oil discovery. Table 7 presents the estimation results, according to equation (2), of models using only loan controls, only bank controls or the full set of controls.

The coefficients of the dummies I(Large,Small) and I(Large,Medium) (β_1 and β_3, respectively) are negative and statistically significant in two models, as expected according to Section 3. The coefficient of the dummy I(Medium,Small) (β_2) is never significant, suggesting economies of scale are not present in the transition from the small to the medium group or simply that the few firms that take out loans in both medium and small groups is not sufficient to provide the respective significancy. Of greater interest to the purpose of our paper is, however, the coefficient of the interaction Oil Discovered × I(Large,Medium) (γ_3). It is positive and significant in all models, indicating that the medium banks are the ones which diminished their rates *in relation* to large banks in the oil discovered period, leading to a more similar loan pricing between the two groups after the discovery. The pervasive significance of this variable across models of Table 7 lends support to the hypothesis of greater reduction of market discipline exerted upon medium banks according to Figure 1, as a consequence of a stronger perceived public guarantee to these banks. The magnitudes of γ_3 are at least twice greater than the average monthly variation in the sample period before November, 2007, of the difference of rates charged by a large and medium bank for the same borrower and month (not shown). This represents evidence of the economic significance of the captured effect.[19]

The coefficient of the interaction Oil Discovered × I(Medium,Small) (γ_2), never being significant (although always negative), does not corroborate the previous hypothesis but this could be due, as previously mentioned, to the very small number of firms that take out loans in both medium and small groups of banks in the same month. Consequently, it does not necessarily represent evidence against conjecture of Figure 1. On the other hand, the positive and significant coefficient of the interaction Oil Discovered × I(Large,Small) (γ_1) (though significant only at 10% in the specification without loan controls) goes against the market discipline hypothesis that would imply $\gamma_1<0$ otherwise, as discussed in Section 2. Therefore, the increase of loan rates by large banks *in relation* to small banks reveals that the market discipline story associated to conjecture of Figure 1 is not sufficient to describe the pricing behavior of *all* banks as a consequence of the oil discovery. It may need to be complemented, particularly for large banks, by a charter value argument as described in Section 2. The conjecture of Figure 2 associated with the charter value effect on loan pricing cannot be discarded. Notice, nevertheless, that the

[19] And the magnitude of γ_3 found in several other models of this section is even greater. Also, in many models of this Section, such as the model with the full set of controls at Table 7, the absolute magnitude of γ_3 is very similar to the magnitude of β_3.

Table 7

Discrete Size Models

Dependent variable is ΔLOAN RATE, the difference of rates across banks charged on the same borrower at the same month . I(A,B) is a dummy variable that takes the value one if loans were taken out from banks of sizes A and B. Oil Discovered is a dummy variable that takes the value one for loans taken out after the oil discovery. ΔLMATURITY, ΔLAMOUNT, ΔLRELATIONSHIP, ΔFUNDING COST, ΔLIQUIDITY, ΔLEVERAGE, ΔROA and ΔROALVOL are the difference across banks of the respective variables, which are defined in Section 3. Models were estimated with errors clustered by borrower to correct for correlation across observations of a given firm and with the constraints b3 = b1–b2 and g3 = g1–g2; [a], [b] and [c] indicate coefficients statistically significant at 10%, 5% and 1%, respectively. *p*-values are in brackets.

y = Δ *Loan Rate*	***Only loan controls***	***Only bank controls***	***Both controls***
I(Large,Medium) (β3)	–2.257	–8.532[c]	–6.587[c]
	[0.230]	[0.000]	[0.002]
I(Large,Small) (β1)	–0.215	–9.909[c]	–7.782[c]
	[0.877]	[0.000]	[0.000]
I(Medium,Small) (β2)	2.042	–1.378	–1.195
	[0.350]	[0.590]	[0.628]
Oil Discovered x I(Large,Medium) (γ3)	5.374[b]	5.679[b]	7.216[c]
	[0.039]	[0.045]	[0.006]
Oil Discovered x I(Large,Small) (γ1)	4.747[b]	3.872[a]	5.332[c]
	[0.013]	[0.058]	[0.007]
Oil Discovered x I(Medium,Small) (γ2)	–0.626	–1.806	–1.883
	[0.831]	[0.568]	[0.530]
Loan controls	Yes	No	Yes
Δ LMATURITY	–2.232[c]		–1.348[c]
	[0.000]		[0.003]
Δ LAMOUNT	–6.932[c]		–6.224[c]
	[0.000]		[0.000]
Bank controls	No	Yes	Yes
Δ LRELANTIONSHIP		0.0005[c]	0.0005[c]
		[0.010]	[0.006]
Δ FUNDING COST		905.255[b]	982.500[c]
		[0.028]	[0.007]
Δ LIQUIDITY		53.954[c]	50.379[c]
		[0.000]	[0.000]
Δ LEVERAGE		0.620[c]	0.247[a]
		[0.000]	[0.063]
Δ ROA		–728.801[c]	–547.590[b]
		[0.001]	[0.017]
Δ ROAVOL		553.838[b]	452.707[a]
		[0.020]	[0.058]
Number of borrowers	886	886	886
Number of observations	982	982	982

estimated coefficient γ_1 is smaller than γ_3. Also, the signs of several controls used at Table 7 are again consistent with the explanations raised in Section 3.

Further estimations are conducted to investigate the robustness of our previous findings. The previous models with only bank controls and with both bank and loan controls are referred hereafter as the baseline models. To check whether our results are capturing relative movements of loan rates between the different groups of banks that have started before the oil discovery and have, therefore, no relation with the former, we include linear time trends or time dummies, both interacted with each pair of different bank groups.[20] In models (2) and (5) of Table 8 and models (2) and (4) of Table 9, we include those interactions restricted to the period before the oil discovery. Including those interactions after the oil discovery would also capture the different effects of the oil discovery by bank size (the main subject of the paper) if those effects do not materialize immediately. So in the previous models we prefer to continue to identify the oil discovery effects through the coefficients γs on the standard interactions with the oil discovery dummy used in the baseline models. On the other hand, in models (3) and (6) of Table 8 we replace these standard interactions with linear trends after the discovery (besides the trends before the discovery) interacted with the bank group pairs. In these models the effects of the oil discovery are assumed to be captured by a change in magnitude of the linear trends at the point of the oil discovery. The expected directions of those changes correspond to the expected signs of the coefficients γs for the respective bank group pairs. For example, we expect a positive increase in the trend of the pair (large, medium), similarly to the expectation that $\gamma_3>0$.

At Table 8, models 2, 3, 5 and 6, we indeed find that a positive and a negative linear trend before the oil discovery are significant, respectively for the pair (large, medium) and for the pair (medium, small). However, in models 2 and 5, their magnitudes are much smaller in absolute terms than the corresponding interactions with the oil discovery dummy (γ_3 and γ_2, respectively) indicating that the oil discovery had a material effect in changing the relative movement of rates across bank groups. In those models, also notice that coefficient γ_2 increases its significancy level to 13.5% or 3.7% respectively, and, more interestingly, coefficient γ_1 loses significancy, indicating no effect of the oil discovery on the difference between large and small banks, which is consistent with the conjecture of Figure 1. On their turn, in models 3 and 6 we observe that the trend of the pair (large, medium) is greater after the discovery than before the discovery as expected (and such difference is confirmed statistically significant). On the other hand, against the expectations derived from the conjecture of Figure 1 and

[20] The inclusion of time dummies interactions could be motivated by the presence in equation (2) of unobserved macro controls whose effects on loan rates depend on the size category.

consistently with the findings of the baseline models 1 and 2, we find that the trend of the pair (large, small) increases after the discovery and that the trend of the pair (medium, small) does not change its magnitude in a significant way after the discovery.

Table 8

Inclusion of Linear Trends Before and After the Oil Discovery

Dependent variable is ΔLOAN RATE, the difference of rates across banks charged on the same borrower at the same month. I(A,B) is a dummy variable that takes the value one if loans were taken out from banks of sizes A and B. Oil Discovered is a dummy variable that takes the value one for loans taken out after the oil discovered. See Section 3 for the list of controls included in the sets Loan Controls and Bank Controls. Models were estimated with errors clustered by borrower to correct for correlation across observations of a given firm and with the constraints beta3 = beta1–beta2 and gamma3 = gamma1–gamma2 and similar restrictions for the coefficients of [t x (oil discovered) x I(Large,Medium), t x (oil discovered) x I(Large,Small), t x (oil discovered) x I(Medium,Small)] and of [t x (1-oil discovered) x I(Large,Medium), t x (1 - oil discovered) x I(Large,Small), t x (1 - oil discovered) x I(Medium,Small)]. [a], [b] and [c] indicate coefficients statistically significant at 10%, 5% and 1%, respectively. *p*-values are in brackets. Linear time trend not included in the baseline models (1 and 4). Linear time trend before oil discovery is included in models 2 and 5 and linear time trends before and after the oil discovery are included in models 3 and 6.

	With Loan Controls			***No Loan Controls***		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	(6)
y = Δ Loan Rate	Baseline	Up to Discovery	Different Trends	Baseline	Up to Discovery	Different Trends
I(Large,Medium) (β3)	−6.587[c]	−13.252[c]	−14.180[c]	−8.531[c]	−16.303[c]	-17.760[c]
	[0.002]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
I(Large,Small) (β1)	−7.782[c]	−7.791[a]	−8.618[c]	−9.909[c]	−7.026	-11.970[c]
	[0.000]	[0.079]	[0.001]	[0.000]	[0.120]	[0.000]
I(Medium,Small) (β2)	−1.195	5.461	5.562	−1.378	9.276	5.790
	[0.628]	[0.320]	[0.115]	[0.590]	[0.102]	[0.103]
t x (1- Oil Discovered) x I(Large,Medium)		1.795[b]	2.013[c]		2.058[c]	2.426[c]
		[0.012]	[0.001]		[0.007]	[0.000]
t x (1- Oil Discovered) x I(Large,Small)		0.044	0.3306		-0.585	0.526
		[0.961]	[0.570]		[0.532]	[0.365]
t x (1- Oil Discovered) x I(Medium,Small)		−1.751	−1.683[b]		−2.644[b]	-1.900[b]
		[0.100]	[0.024]		[0.016]	[0.011]
Oil Discovered x I(Large,Medium) (γ3)	7.215[c]	14.107[c]		5.679[b]	13.662[c]	
	[0.006]	[0.000]		[0.045]	[0.001]	
Oil Discovered x I(Large,Small) (γ1)	5.332[c]	5.359		3.872[a]	0.950	

	[0.007]	[0.252]		[0.058]	[0.844]	
Oil Discovered x I(Medium,Small) (γ2)	−1.883	−8.748		−1.806	−12.711[b]	
	[0.530]	[0.135]		[0.568]	[0.037]	
t x Oil Discovered x I(Large,Medium)			3.526[c]			3.607[c]
			[0.000]			[0.000]
t x Oil Discovered x I(Large,Small)			1.679[c]			1.702[c]
			[0.004]			[0.005]
t x Oil Discovered x I(Medium,Small)			−1.847[b]			-1.905[b]
			[0.038]			[0.040]
Loan Controls	Yes	Yes	Yes	No	No	No
-						
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Number of borrowers	886	886	886	886	886	805
Number of observations	982	982	982	982	982	890

Table 9 contains estimations with the inclusion of interactions of bank group pairs with time dummies up to the oil discovery. From a close inspection of models 2 and 4, one can observe that that the previous significances of the linear tendencies before the oil discovery are consistent with the signs and significances of the June 2007 dummy interacted with the pair (large, medium) and of the October 2007 dummy interacted with the pairs (large, medium) and (medium, small). In those models, coefficient γ_2 increases its significancy level to 10.7% or 16.9% respectively (and their absolute magnitudes become even greater than γ_3) and coefficient γ_1 is again insignificant.

The fact that only two months show significances in the time dummies of Table 9 indicates that the relative rate movements before the oil discovery are a more discrete phenomenon. To confirm that fact, we perform new estimations on a period translated entirely to before the oil discovery, notably the period from January 2007 to October 2007. Similar to the previous analysis, we include interactions of each pair of different bank groups with linear trends. Here, those trends are non-restricted along the whole period January 2007 to October 2007. The resulting models shown at columns 2 and 5 of Table 10 display no significances for those interactions nor for pairs of bank groups alone (coefficients β_1, β_2 and β_3). We also postulate an artificial treatment period on the interval from June 2007 to October 2007 and consider its different effects across different bank group pairs (similarly to oil discovery treatment). Again, the resulting models shown at columns 3 and 6 of Table 10 do not display significances for the interactions nor for pairs of bank groups alone. Those results, together with the results of Tables 9 and 10, suggest that relative loan rate movements that are present before the oil discovery are limited and do not constitute a driving force behind the results of our baseline specifications.

Table 9
Inclusion of Time Dummies up to the Oil Discovery

Dependent variable is Δloan rate, the difference of rates across banks charged on the same borrower at the same month. I(A,B) is a dummy variable that takes the value one if loans were taken out from banks of sizes A and B. Oil Discovered is a dummy variable that takes the value one for loans taken out after the oil discovery. See Section 3 for the list of controls included in the sets Loan Controls and Bank Controls. Models were estimated with errors clustered by borrower to correct for correlation across observations of a given firm and with the constraints beta3 = beta1−beta2, gamma3 = gamma1−gamma2 and similar constraints for the coefficents of [Time Dummy x I(Large,Medium), Time Dummy x I(Large,Small), Time Dummy x I(Medium,Small)] for eaxh time dummy. [a], [b] and [c] indicate coefficients statistically significant at 10%, 5% and 1%, respectively. p-values are in brackets. Time dummies up to oil discovery are only included in models 2 and 4.

	With Loan Controls		*No Loan Controls*	
	(1)	*(2)*	*(3)*	*(4)*
y = Δ Loan Rate	Baseline	Up to Discovery	Baseline	Up to Discovery
I(Large,Medium) (β3)	−6.587[c]	−9.890[c]	−8.531[c]	−12.020[c]
	[0.002]	[0.002]	[0.000]	[0.000]
I(Large,Small) (β1)	−7.782[c]	−0.892	−9.909[c]	−2.080
	[0.000]	[0.890]	[0.000]	[0.811]
I(Medium,Small) (β2)	−1.195	8.997	−1.378	9.939
	[0.628]	[0.217]	[0.590]	[0.290]
Jun-07 x I(Large,Medium)		−14.088[b]		−13.109[b]
		[0.018]		[0.041]
Jun-07 x I(Large,Small)		−5.822		−6.612
		[0.428]		[0.481]
Jun-07 x I(Medium,Small)		8.266		6.496
		[0.334]		[0.542]
Jul-07 x I(Large,Medium)		5.595		2.714
		[0.470]		[0.739]
Jul-07 x I(Large,Small)		−8.621		−8.804
		[0.253]		[0.352]
Jul-07 x I(Medium,Small)		−14.216		−11.518
		[0.141]		[0.307]
Aug-07 x I(Large,Medium)		1.772		−2.103
		[0.788]		[0.702]
Aug-07 x I(Large,Small)		−8.261		−7.625
		[0.241]		[0.401]
Aug-07 x I(Medium,Small)		−10.034		−5.521

		[0.306]		[0.602]
Sep-07 x I(Large,Medium)		0.723		0.989
		[0.905]		[0.849]
Sep-07 x I(Large,Small)		−9.272		−10.947
		[0.210]		[0.249]
Sep-07 x I(Medium,Small)		−9.995		−11.937
		[0.268]		[0.236]
Oct-07 x I(Large,Medium)		7.858[b]		9.162[b]
		[0.032]		[0.018]
Oct-07 x I(Large,Small)		−5.425		−7.444
		[0.434]		[0.414]
Oct-07 x I(Medium,Small)		−13.283[a]		−16.607[a]
		[0.076]		[0.081]
Oil Discovered x I(Large,Medium) (γ3)	7.215[c]	10.558[c]	5.679[b]	9.223[b]
	[0.006]	[0.004]	[0.045]	[0.014]
Oil Discovered x I(Large,Small) (γ1)	5.332[c]	−1.643	3.872[a]	−4.009
	[0.007]	[0.807]	[0.058]	[0.653]
Oil Discovered x I(Medium,Small) (γ2)	−1.883	−12.201	−1.806	−13.233
	[0.530]	[0.107]	[0.568]	[0.169]
Loan Controls	Yes	Yes	No	No
-				
Bank Controls	Yes	Yes	Yes	Yes
Number of borrowers	886	886	886	886
Number of observations	982	982	982	982

Next, we perform a robustness analysis on the definition of the banks of medium size. We vary the definition of that group by considering N=20 or 50, so that medium banks comprise now the 20 or 50 largest in asset size, excluding the banks from the large group and the government-owned banks. Estimations with this new medium group definition are displayed at columns 2, 3, 6 and 7 of Table 11. The signs and significances are very similar to the baseline models 1 and 2 with N=30. The magnitudes of the coefficients are also generally close to those of the baseline models, with a particular remark that coefficient γ_3 is a little larger (smaller) in model 2 (model 6) than in the corresponding baseline model.

We also consider an anticipation of the end of the period before the oil discovery to August 2007, to take into account the possibility of privileged information before official news release of the discovery. If, for some reason, a particular subset of banks had previous knowledge of the oil discovery, this could affect our interpretation of the results. Therefore, new estimations are conducted without considering information of two months before the oil discovery, notably September and October 2007, and adding two months to the beginning of the period before the oil discovery, notably March and April 2007. Results shown at columns 4 and 8 of Table 11 are qualitatively similar to those of the baseline specifications.

Finally a comment is due on the equal treatment that is given to both national and international banks in our analysis. One could argue that the strength of the domestic implicit guarantee is likely to be smaller for subsidiaries of international banks because greater reliance of support is expected to come from the home bank or from the government authority of the home country. When we exclude all international banks from the data, the resulting sample becomes too small to provide the same degree of significances of the baseline specifications (results not shown). Since international banks are found in all three size categories of our study, they are not likely to push results in one particular direction and, therefore, we believe that they are not the driving force behind our results.

Table 10

Estimations on Period January 2007 to October 2007

Dependent variable is ΔLOAN RATE, the difference of rates across banks on the same borrower at the same month. I(A,B) is a dummy variable that takes the value one if loans were taken out from banks of sizes A and B. Oil Discovered is a dummy variable that takes the value one for loans taken out after the oil discovery. See section 3 for the list of controls included in the sets Loan Controls and Bank Controls. Models were estimated with errors clustered by borrower to correct for correlation across observations of a given firm and with the constraints beta3= beta1– beta2, gamma3 = gamma1–gamma2 and similar constraints for the coefficients of [t x I(Large, Medium), t x I(Large, Small), t x I(Medium, Small)]. [a], [b] and [c] indicate coefficients statistically significant at 10%, 5% and 1%, respectively. *p*-values are in brackets. Linear trends are included in models 2 and 5 and an artificial treatment (oil discovered in June 2007) considered in models 3 and 6.

	With Loan Controls			***No Loan Controls***		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
y = Δ Loan Rate	Baseline	Trend	Artificial Treatment	Baseline	Trend	Artificial Treatment
I(Large, Medium) (β3)	−6.587[c]	1.398	−0.3159	−8.531[c]	1.109	−0.1008
	[0.002]	[0.715]	[0.906]	[0.000]	[0.777]	[0.971]
I(Large, Small) (β1)	−7.782[c]	−4.148	−5.243	−9.909[c]	−0.014	−2.330
	[0.000]	[0.554]	[0.397]	[0.000]	[0.999]	[0.754]
I(Medium,Small) (β2)	−1.195	−5.546	−4.927	−1.378	−1.124	−2.229
	[0.628]	[0.402]	[0.381]	[0.590]	[0.880]	[0.737]
Oil Discovered x I(Large,Medium) (γ3)	7.215[c]		−3.820	5.679[b]		−3.277
	[0.006]		[0.223]	[0.045]		[0.288]
Oil Discovered x I(Large,Small) (γ1)	5.332[c]		−1.984	3.872[a]		−2.692
	[0.007]		[0.491]	[0.058]		[0.388]
Oil Discovered x I(Medium,Small) (γ2)	−1.883		1.835	−1.806		0.5846
	[0.530]		[0.633]	[0.568]		[0.883]
Trend x I(Large,Medium)		−0.545			−0.431	
		[0.269]			[0.390]	
Trend x I(Large,Small)		−0.295			−0.540	
		[0.511]			[0.253]	
Trend x I(Medium,Small)		0.249			−0.109	
		[0.659]			[0.850]	
Loan Controls	Yes	Yes	Yes	No	No	No
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Number of borrowers	886	886	564	886	564	564
Number of observations	982	982	613	982	613	613

Table 11

Robustness on the Definition of Medium Size and on the Possibility of Inside Information

Dependent variable is ΔLOAN RATE, the difference of rates across banks charged on the same borrower at the same month. I(A,B) is a dummy variable that takes the value one if loans were taken out from banks of sizes A and B. Oil Discovered is a dummy variable that takes the value one for loans taken out after the oil discovered. See section 3 for the list of controls included in the sets Loan Controls and Bank Controls. All models were estimated with errors clustered by borrower to correct for correlation across observations of a given firm and with the constraints beta3 = beta1–beta2 and gama3 = gama1–gama2. [a], [b] and [c] indicate coefficients statistically significant at 10%, 5% and 1%, respectively. p-values are in brackets.
The group of medium size banks is comprised by the by the N largest banks, excluding banks from the large group and the government-owned banks. Models 4 and 8 were estimated without considering information of the two months before the oil discovery, September and October 2007, and adding two months to the beginning of the period before the oil discovery, March and April 2007.

	With Loan Controls				*No Loan Controls*			
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
y = Δ Loan Rate	Baseline	N = 20	N = 50	Exc. Sep-Oct	Baseline	N = 20	N = 50	Exc. Sep-Oct
I(Large,Medium) (β3)	−6.587[c]	−6.433[c]	−6.679[c]	−3.099	−8.531[c]	−8.4596[c]	−8.276[c]	−5.549[b]
	[0.002]	[0.003]	[0.001]	[0.223]	[0.000]	[0.000]	[0.000]	[0.030]
I(Large,Small) (β1)	−7.782[c]	−8.180[c]	−8.036[c]	−5.849	−9.909[c]	−10.091[c]	−10.916[c]	−6.131
	[0.000]	[0.000]	[0.000]	[0.242]	[0.000]	[0.000]	[0.000]	[0.297]
I(Medium,Small) (β2)	−1.195	−1.747	−1.356	−2.749	−1.378	−1.631	−2.639	−0.582
	[0.628]	[0.495]	[0.577]	[0.553]	[0.590]	[0.533]	[0.286]	[0.913]
Oil Discovered x I(Large,Medium) (γ3)	7.215[c]	8.531[c]	7.164[c]	5.791[a]	5.679[b]	3.725[a]	5.691[b]	5.768[a]
	[0.006]	[0.003]	[0.004]	[0.063]	[0.045]	[0.057]	[0.033]	[0.078]
Oil Discovered x I(Large,Small) (γ1)	5.332[c]	5.166[c]	5.098[b]	5.456[b]	3.872[a]	3.719[a]	3.719[a]	2.742
	[0.007]	[0.008]	[0.015]	[0.021]	[0.058]	[0.082]	[0.082]	[0.246]
Oil Discovered x I(Medium,Small) (γ2)	−1.883	−3.365	−2.066	− 0.3346	−1.806	−3.084	−1.972	−3.025
	[0.530]	[0.297]	[0.490]	[0.927]	[0.568]	[0.366]	[0.528]	[0.420]
Loan Controls	Yes	Yes	Yes	Yes	No	No	No	No
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of borrowers	886	886	886	805	886	886	886	805
Number of observations	982	982	982	890	982	982	982	890

5. CONCLUSION

This paper makes use of the natural experiment represented by the discovery of new and large Brazilian oil reserves to conjecture an increase in the bail-out perception of medium Brazilian banks (the too-rich-to-let-me-fail argument –TRTLF). Methodologically, the use of such natural experiment allows us to disentangle the effect of strength of implicit guarantee, which is correlated with bank size, from the other bank characteristics related to size. The paper then investigates how the difference in loan pricing behavior across banks of different sizes has changed after the discovery. The idea is that banks that enjoyed an increase in the perceived public guarantee would lower rates for the same risk in relation to other groups of banks after the discovery, because they become under lower pressure from creditors and non-insured deposits to improve performance or to raise capital.

Results show that the difference of loan rates between medium and large banks decreases after the discovery. This is consistent with the TRTLF argument or, in other words, with the conjectured increase in the bailout perception affecting mostly medium banks, which are at the margin to become too-big-to-fail. The ideal identification is hindered, however, by a small sample problem represented by the few firms that take out loans simultaneously from medium and small banks. Therefore, additional explanations, such as those based on the effect of higher charter values on loan pricing, could also have a bearing on our results.

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