# The Real Effects of Bank Capital Requirements

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Abstract: We measure the impact of bank capital requirements on corporate borrowing and expansion. We use French loan-level data and take advantage of the transition from Basel I to Basel II. While under Basel I the capital charge was the same for all firms, under Basel II, it depends in a predictable way on both the bank's model and the firm's risk. We exploit this two-way variation to empirically estimate the sensitivity of bank lending to capital requirement. This rich identification allows us to control for firm-level credit demand shocks and bank-level credit supply shocks. We find very large effects of capital requirements on bank lending: A 1 percentage point decrease in capital requirement leads to an increase in loan size by about 5%. At the firm level, borrowing also responds strongly although a bit less, consistent with some limited between-bank substitutability. Investment and employment also increase strongly. Overall, because the transition to Basel II led to an average reduction by 2 percentage points of capital requirements, we estimate that the new regulation led, in France, to an increase in average loan size by 10%, an increase in aggregate corporate lending by 1.5%, an increase in aggregate investment by 0.5%, and the creation or preservation of 235,000 jobs.



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# 1. Introduction

The financial crisis has led banks to dramatically reduce their leverage. In this context, capital requirements - the need for banks to hold a predetermined fraction of loan amounts as equity - are the main regulatory tool to reduce bank leverage. The question we address in this paper is whether changes in capital requirements affects bank lending, and corporate policies. There is, on the subject, considerable debate in the academic literature. On the one hand, the "Modigliani-Miller" view (Hanson, Kashyap and Stein, 2009; Admati, DeMarzo, Hellwig, Pfleiderer, 2010) assumes that banks can easily substitute equity for debt - through issues or retained earnings. Under the MM view, tightening capital requirements, even though they force banks to use more equity, do not affect the overall cost of funding and therefore have a negligible impact on bank lending. The alternative, non-MM view, starts from the assumption that raising equity is difficult. When bank equity is scarce, NPV maximizing banks may have to give up positive NPV projects because they consume too much regulatory capital. Under the non-MM view, an increase in capital requirements would decrease lending (Kashyap and Stein, 2004).

In this paper, we use loan-level data to estimate, during the transition from Basel I to Basel II, the effect of changes in capital requirements on bank lending and corporate outcomes. Our identification strategy relies on the specificities of the Basel II regulation. Under Basel I, all loans had a capital requirement of 8% (i.e. all banks had to hold 8% of the face value of the loan as equity). Under Basel II, the capital requirement of a corporate loan depends, in a predictable way, on (1) the borrowing firm's risk and (2) the lending bank's model. In our loan-level data, we observe firm risk. To measure the bank's model, we use an auxiliary dataset on internal risk models of banks. We end up with a measure of the Basel II capital requirement at the firm-bank pair level, and investigate its relationship with lending change between before and after the transition to Basel II.

To implement our test, we combine two sources of data: loan-level data on the one hand, and a survey on internal risk models on the other hand. The datasets come from the French Supervisory Authority, which oversees banks in France. The period we study goes from 2006

to 2011, with French banks transitioning to Basel II in 2008. Our methodology controls for both firm-level, and bank-level, unobservable shocks. First, our sample has a large fraction of firms that borrow from several banks at the same time. For these firms, the relationship between borrowing and capital requirements is identified *within* firms, which allows us to control for unobservable firm-level shifts in credit demand, as the banking literature has done in other contexts (for example, Kwhaja-Mian, 2005; Iyer,Peydro, Schoar, 2012; Jimenez, Ongena, Peydro, Saurina, 2012). Secondly, our methodology also identifies the effect of capital requirements *within* bank. This is because, when borrowing from a given bank, different firms face capital requirements that differ in a predictable way. We use this feature of the data to control for bank unobserved heterogeneity.

We find that the effect of capital requirements is economically large. In our sample, the transition to Basel II reduced the average capital requirement by about 2 percentage points (from 8% to 6%). Given our baseline micro-econometric estimates, this led to an increase in average loan size by approximately 10%. We find that the magnitude of this effect increases over time, after the new regulation is in place. These estimates are robust to the inclusion of firm-level and bank-level shocks, which may be correlated with credit supply and demand shocks.

We then look at firm-level outcomes. Analyzing firm-level outcomes precludes us from controlling for firm and bank level shocks, but we take confidence in the fact that these controls do not affect our loan-level estimates very much. In line with the literature on credit supply shocks, we find some limited evidence of between-bank substitution, so that the effect on borrowing at the firm level remains big, albeit smaller than the effect measured on loan-level data. Looking at real variables, we find that the average reduction by 2 percentage points of the average capital requirements led to an increase of borrowing and investment by some 12bn Euro, which corresponds to 1.5% of aggregate corporate lending, and 0.5% of aggregate corporate investment in France. The effect on job creation is some 235,000 jobs preserved, or about 1% of total employment in the country. All in all, the loosening effect of Basel II seems to have substantially supported the French economy during the financial crisis.

Our analysis has caveats that we do our best to address. First, the transition to Basel II that we study occurred in the beginning of 2008, exactly when the financial crisis started to hit the global financial system. Our methodology allows to control for bank- and firm-level specific shocks, that may have occurred after the transition into Basel II. Our focus on France also helps a little, as French banks were not extremely hurt by the crisis. A second shortcoming is that we measure essentially short-term effects. In the longer run, banks can accumulate enough profits to avoid being constraint by capital scarcity - in other words, MM holds. To look into this issue, we run year-by-year regressions in 2009, 2010, and 2011 (the last year in our data). We find that the impact of capital requirements on lending does not fade out - if anything, it becomes stronger over time. Because more recent data are not yet available, we cannot look into longer run effects. Third, the goal of capital requirements is to reduce systemic risk. Systemic risk is beyond the scope of this paper, which focuses only on lending effects. But the welfare benefits of having a safer banking system may outweigh the costs of depressed lending that we measure.

Our paper is related to the literature that seeks to identify the effect of credit supply shocks (Kwhaja and Mian, 2005; Iyer, Peydro, Schoar, 2012; Jimenez, Ongena, Peydro and Saurina, 2012b; Puri, Rocholl, Steffen, 2011; Schnabl, 2012). With this literature, we share the fact that we are working with loan-level data, so that we can control for firm-specific credit demand shocks. Like these papers, we find reliable evidence that "shocks to bank capital" affect firm-level ability to borrow, and firm-level outcomes. We differ, however, in the type of shock that we study. The credit supply shock literature focuses on bank-level funding shocks, while the type of shock we study is (1) due to the regulator and (2) varying across firms within the same bank.

Given its focus on capital requirements, this paper is more closely related to Aiyar, Calomiris and Wieladek (2012) and Jimenez, Ongena, Peydro and Saurina (2012b). First, our paper focuses on a different shock: the adoption of Basel II (as opposed to discretionary regulatory interventions in the first paper, and countercyclical capital ratios for the second one). Learning from Basel II is important in itself given that firm-specific capital requirements form the basis of modern regulation. Second, these two papers look at the impact of bank-level capital requirement, while we take advantage of the fact that Basel II requirements vary at

the bank-firm level. This allows to control for bank-specific shocks, a particularly important control during the financial crisis.

Section 2 focuses on the empirical strategy, which relies in great part on the specificities of the Basel II regulation. Section 3 describes the data. We use two key sources of data: loan-level data (which is standard in this type of study), and a survey on internal risk model (which is a key dimension of our paper). Section 4 presents the results, while Section 5 concludes.

# 2. The Empirical Strategy

The principle of our empirical strategy is simple: We regress firm borrowing and behavior on the capital requirement that the bank faces. More specifically, when bank *b* lends to firm *f*, we will seek to estimate an equation that resembles to:

$$\Delta Y_{bf} = \beta.\Delta r_{bf}$$

where $Y_{bf}$ is the firm borrowing from the bank (or more generally any kind of corporate policies), while $r_{bf}$ is the capital requirement that the bank is facing. This equation is estimated differencing between before/after the transition from Basel I to Basel II.

In this Section, we describe (1) how we compute the capital requirement $r_{bf}$ and (2) the exact empirical specification and the sources of identification that we use.

## a. Calculating Capital Requirements

Since the Basel I accords in 1988, bank regulators around the world have asked banks to use risk weights to assess the equity needs. The logic is the following. When a bank makes an investment of €100 in a project (for instance a mortgage, or a corporate bond), the regulator requires that the bank holds *r*x100 euros of equity capital, where *r* is the equity requirement. Under Basel I, the equity requirement for corporate lending was 8%. This

meant that if a bank had, say, 10bn€ of equity, it could not make more than 10/0.08=125bn€ of corporate loans. Hence, pre-Basel II, $r_{bf}$ =8% for all banks, and all firms.

The Basel II accords made capital requirements much more heterogeneous across banks and firms. These new agreements were published in 2004. The idea was to reoptimize regulation so as to take into account the rising complexity of banking activities (for instance, securitization), and also to avoid regulatory arbitrage by adapting capital requirements to the riskiness of investment. Indeed, a flaw the Basel I was that, since capital requirements were the same for risky or safe corporations, banks would have strong incentives to only lend to risky firms, so as to maximize expected profits under regulatory constraints. Basel II sought to correct this problem by making capital requirements an explicit, known, function of the risk of the investment.

For corporate loans, capital requirements were mostly a function of the probability of default (PD) of the firm. To estimate the PD of a firm, some banks were allowed to use their own model to estimate the PD of a firm: This is the "internal risk based" (IRB) approach. Banks were encouraged to adopt the IRB approach, but their models first had to satisfy the supervision authorities. Banks who failed to provide satisfactory models were forced to take the "standardized approach". Under this approach, the capital requirement of a corporate loan was a known function of the firm's official rating. Overall then, the capital requirement under Basel II depends on the interaction between the firm's risk, and the bank's model. It is both bank- and firm-specific, which allows for rich identification. We will get back to this in detail in the next Section.

Under the "standardized approach" of Basel II, banking supervisors impose a simple mapping between the public credit rating of the firm on the one hand, and capital requirements on the other hand. This mapping is a known function, and in France, the rating used is the one produced by the Bank of France.

Formally, the "standardized approach" can be modeled as follows. When bank *b* lends to firm *f*, its capital requirement $r_{bf}$ is equal to:

$$r_{bf} = F_{standardized}(rating_f) \qquad (3)$$

where $F_{standardized}$ (.) is the mapping imposed by the supervisor, and $rating_f$ is the official Bank of France credit rating, observable from the data. For all banks under the standard approach, all firms that have the same official rating have the same capital requirement: $r_{bf}$ only depends on the firm rating.

The second category of banks, which are allowed to use their own risk models, improves identification dramatically because they make the capital requirement $r_{bf}$ a function of both *f* and *b*. The intuition is the following.

Under the IRB framework, for a loan to firm *f* by bank *b*, the capital requirement is then given by the compacted Basel formula:

$$r_{bf} = F_{IRB}(Retail_{bf}; PD_{bf}; LGD_{bf}, M_{bf}, Sales_f) \quad (1)$$

where $F_{IRB}$ (.) is a known function. The first two parameters, $Retail_{bf}$ and $PD_{bf}$, are not directly observed, but need to be imputed. $Retail_{bf}$ is a dummy equal to 1 if the firm is classified by the bank in its retail, or its corporate, portfolio. We do not observe this decision directly so we will need to rely on documented regulatory guidances. $PD_{bf}$ is firm *f*'s "regulatory" probability of default, as estimated by bank *b* using the internal model validated by the regulator. We do not observe $PD_{bf}$ directly, so we will rely on its imputation using a survey (more on this below). The remaining parameters are less problematic. $Sales_f$ are the sales of the firm, which are observable in our data. $LGD_{bf}$ is the loss given default, and $M_{bf}$ is the maturity of the loan. Under the regulatory regime adopted by French banks in 2008 ("Foundation IRB"), they are fixed and known: $LGD_{bf}$ =.45 and $M_{bf}$ =2.5.

While we do not know whether firm *f* is effectively allocated the retail or corporate portfolio of bank *b*, we can use regulation to reconstruct the dummy $Retail_{bf}$. In theory, firms whose total sales are below 50 million euros per year, and for which the bank exposure is below 1 million euros, can be classified in the retail portfolio. Such categorization is attractive to banks because capital requirements are lower in the "retail", than in the "corporate" portfolio. In practice, however, there can be deviation from this rule. Larger firms can sometimes be classified as retail if the bank can convincingly argue that firm risk is easy to diversify. On the contrary, banks may fail to take advantage from lower requirements for small firms, for instance when firms move around the size threshold, but does not do so

anymore. Since we do not observe the effective allocation to retail/corporate in our data, we use the theoretical rule: $Retail_{bf}$ =1 if the firm borrows more than 1m from the bank, or makes more than 50m in sales in 2006. We assume that, for each bank-firm pair, this classification does not change over the period.

The regulatory probability of default $PD_{bf}$ is calculated using the internal model of the bank. We do not observe the outcome of the model in our data, but we are able to impute it using another data source (*Common Contreparties*, see below in Section 3.2.). This dataset is a survey on a large sample of firm-bank relationship, which provides us with the internal PD that the bank attributes to the firm. This survey also contains the "official" firm credit rating (from the credit registry maintained at the Bank of France), which we also observe in our main dataset. We thus use the *Common Counterparties* survey to construct, for each of the 7 banking groups operating in France, a mapping between the official rating and the bank's average regulatory PD. As we will see in Section 3.2, this mapping is very precise, essentially because internal models rely on a finite partitioning of the universe of firms (the *internal* ratings), which is quite similar to the partitioning through official credit ratings. So our imputation technique is reliable, and is conceptually similar to the Two-Sample IV technique discussed by Angrist and Krueger (1992).

Given that our imputation technique uses the official credit scores, we control, in our regressions, by the direct effect of the score. We thus ensure that the identification comes from the fact that different banks attribute different PDs to firms with the same official rating. We will show below that there is enough variation on this front in the data.

To summarize, using a mix of regulatory constraints, approximation and alternative data sources, we are able to construct $r_{bf}$, a measure of the capital ratio required for bank *b*, when it lends to firm *f*. This measure varies within firm, across banks, depending on two factors. First, some banks may be in the standard regime, others adopt the IRB approach. Second, within the set IRB lending banks, banks attribute different PDs to the same firm, depending on their internal model.

## b. Model

Using bank-firm loan-level data, we estimate the following equation:

$$\Delta L_{bf} = \alpha_f + \delta_b + \gamma.\Delta r_{bf} + \beta X_f + \varepsilon_{bf} \quad (2)$$

where $\Delta L_{bf}$ is the change in average exposure (outstanding loans) of bank *b* to firm *f*, between the pre and the post period, normalized by average pre-period firm assets.[4] $\Delta r_{bf}$ is the change in regulatory capital requirement between before and after the reform. After the reform, the requirement is estimated using the technique described in the previous Section. Before the reform - under Basel I - it is equal to 8%. $X_f$ are sets of firm specific controls designed to capture observable differences in lending policy that are unrelated to regulation (firm profitability, size, credit rating). $\alpha_f$ is a firm fixed effect, while $\delta_b$ is a bank-specific fixed effects. $\varepsilon_{bf}$ are error terms, which we cluster at the bank *b* level.

The null hypothesis is that $\gamma$=0. In this case, bank lending is not constrained by regulation, for two possible reasons. First, the bank is well capitalized. In this case, the requirement does not matter, as the bank has enough equity to make the loan, as long as it is NPV>0. Since the NPV of the loan is firm specific (it does not depend on the bank), it should be absorbed by the firm fixed effect. Second, the bank has little equity, but can issue more without friction. Under these conditions, the MM theorem is valid: controlling for loan NPV (the firm fixed effect), the capital requirement does not matter, since the cost of capital is unaffected by the fraction of equity used to finance the bank.

The $\gamma$ coefficient is identified under equation (2), which uses a host of controls and fixed effects (both firm- and bank- level). How identification is achieved is discussed in the next Section.

[4] We experimented with alternative specifications, such as the difference in log average exposure of bank *b* to firm *f*, or the difference in log average *change* in exposure, between the period before and the period after the transition. These specifications also delivered economically and statistically significant estimates. But the specification we choose has the advantage to (1) be easily aggregated and (2) account for both loan changes at the intensive and extensive margins.

## c. Identification

In this Section, we examine the identifying power of our approach. An important dimension of equation (2) is that it relies on a measure of capital requirement that is imputed using firm-level official credit ratings. To simplify the description in Section 2.a., our measure of capital requirement is given by the approximate relation:

$$\Delta r_{bf} \approx M_b \text{ x } rating_f - 0.08 \qquad (3)$$

where $rating_f$ is the official rating of the firm, while $M_b$ is the average capital charge for firms that belong in the same official rating category. For banks that adopt the standardized approach, $M_b$ does not depend on b, and is exactly known to the econometrician - who is also the regulator. For banks that adopted the IRB approach, $M_b$ is estimated using the *Common Counterparties* dataset, which provides us with the effective internal-model based regulatory PDs (hence capital requirements) for a large sample of firms, as well as these firm's official ratings. For IRB banks, as seen in Section 2.a., equation (3) is an approximation as capital requirements depend on other factors.

First, our identification technique allows to control for firm-level characteristics. Controlling for risk is particularly crucial to our design as the transition from Basel I to Basel II occurs in early 2008, at the onset of the financial crisis. It may be argued that during the most severe financial crisis in recent history, riskier firms may have been more constrained in their borrowing. At the same time, the capital requirement imposed to these firms under Basel II was substantially higher.

Given that capital requirements are measured with official credit ratings, it is therefore crucial to control for credit ratings in our regression. Our model remains, however, identified. Injecting (3) into (2) clarifies intuitions about identification:

$$\Delta L_{bf} = \alpha_f + \delta_b + \gamma . M_b \text{ x } rating_f + \beta X_f + \varepsilon_{bf} \qquad (4)$$

As this equation makes clear, $\gamma$ is identified, even when one controls for credit rating of the firm, and even for firms which borrow from only one bank. This is because, for a firm with a

given credit rating $rating_f$, different banks face different capital requirements, depending on the model they use. In terms of the model, we take advantage of the fact that, when b≠b', $M_b \neq M_{b'}$. There are two useful sources of variation here. First, the difference between the standard and the IRB approaches: As long as $M_b$ differs between the two approaches, a bank under IRB faces a different capital requirement than a bank under the standard approach, even if the firm's credit rating is the same. Second, within the IRB approach, bank *b* and *b'* also face different capital charges for given rating as long as the models they are using are different enough.

Second, as is standard in the literature, we can use firms with multiple banking relationships to control for firm-level unobservable heterogeneity (in particular, their risk). This is represented in equation (4) by the fixed effect $\alpha_f$. For each firm who borrows from different banks, identification relies on the comparison between bank lending depending on the bank's capital charge. We can do this because the capital charge depends on both the firm and the bank. This approach is well known in the banking literature (see for instance: Khwaja and Mian, 2008, Iyer et al, 2011, Jimenez et al, 2012).

Last, a key advantage of our research design is that we are able to include $\delta_b$, a bank-specific fixed effect, which controls for bank-level credit-supply shocks that are not directly related to the regulatory change. It is identified because the capital requirement $r_{bf}$ varies both across banks *and* firms, in contrast to many papers in the banking literature, which focus on bank-specific shocks and therefore cannot control for bank-wide unobserved shocks.

# 3. Data

To implement the strategy described above, we combine four sources of data. First, we use loan-level data to measure bank lending at the firm level. Second, we use firm-level data to measure firm size, profits, investment and employment. Third, we obtain data on whether banks entered Basel II with the IRB or the standard approach. Last, we use a loan-level survey to measure regulatory capital requirements that banks face for different levels of risk.

## a. Loan-Level Data

We start from a large dataset of bank-firm linkages available at the Bank of France (*Centrale des Risques*). A linkage between bank *b* and firm *f* exists and is reported in the data as soon as bank *b* has an exposure of more than 25,000 euro to firm *f*. The data is thus exhaustive above a certain exposure threshold. The original dataset is quarterly, and provides us with the total exposure, as well as the identifiers of the bank and of the firm. Exposure increases abruptly when the bank extends a new loan to the firm, and then goes down progressively as the firm repays the loan.

Using these data, we construct a balanced, quarterly, panel firm-bank pairs. We include all firm-bank pairs that appear at least once in the large linkage dataset between 2006Q1 and 2012Q4. For each bank-firm pair, we then fill in quarters for which the pair is not in the data. For such filled in observations, we posit that exposure is equal to zero. Hence, if firm *f* borrows from bank *b* and pays back within a year, the *bf* pair will be in our data every quarter from 2006Q1 to 2012Q4, even though exposure will be zero most of the time.

We then collapse this panel, for each bank-firm pair, into two sub-periods: 2006Q1-2007Q4 (before the reform), and 2008Q1-2012Q4 (after the reform). For each bank-firm pair, we take calculate average exposure in each sub-period. This approach allows us to study both the intensive and extensive margin of lending. We end up with a panel of bank-firm pairs, each of them present for two periods (pre- and post reform). For each of these periods, we know the average exposure of the bank to the firm.

## b. Firm-Level Accounting Data

We then merge this collapsed panel with firm-level accounting and rating information, also available from the Bank of France (*Centrale des Bilans*). Such information is provided on an annual basis. Accounting information follows the tax forms that firms have to fill in and is thus both accurate and detailed. Credit ratings are awarded by a special unit at the Bank of

France, which is in charge of maintaining the public credit registry. The credit registry covers a vast number of firms.

We restrict ourselves to firms that provide accounting data over the entire period 2006-2012. We then collapse these annual data into two periods (2006-2007 and 2008-2012), and calculate, within each period, average firm variables (employment, sales, investment, total assets, etc.). We then merge the resulting firm-level panel with the bank-firm-level panel of average exposures. We restrict ourselves to observations, which are in both datasets.

We end up with 421,560 bank-firm pairs, with two observations each. We then compute "Loan change over assets" as the difference between pre- and post-reform average exposure, normalized by pre-period average firm assets. We also calculate average pre-reform return on assets (average EBIT divided by assets), log sales, rating. We report summary statistics in Table 1. Average exposure of *b* to *f* increased by 2 percent of total firm assets. Average ROA in the pre-reform period is approximately 15%.

## c. Measuring Banks' Regulatory Capital Requirements

To calculate the Basel II capital requirement of bank *b* for lending to firm *f*, we need two additional pieces of information: (1) whether bank *b* adopts the IRB or the standardized approach for firm *f* (this may depend on whether firm *f* is in the retail or the corporate portfolio of bank *b*) and (2) what model bank *b* uses for firms with the same Bank of France credit rating as *f*. This requires the use of two additional datasets.

### i. Regulatory Regime Data

First, we collect data on the approach (IRB vs standardized) approved by the French supervisor. We focus on banks that are continuously present throughout the sample. In our data, 256 banks are present; These 256 banks belong to 7 different banking groups, which altogether represent about 80% of the French commercial lending market. Each of these 256 banks submitted its internal risk model to the supervisor, separately for its retail, and its corporate, portfolio. Out of 239 banks with non-empty retail portfolios in our sample, 142 were allowed to transit to the IRB approach. Out of 237 banks with non-empty corporate

portfolios in our sample, 165 had to stay with the standardized approach. We then merge such information with the panel described at the end of the previous Section. In a bank-firm pair, we posit that the firm *f* belongs to the retail portfolio of bank *b* if the exposure of *b* to *f* is below 1 million euro and the annual sales of *f* are below 5 millions euro.

Using this information, we can infer if, post reform, the pair (b,f) is in under the IRB, or under standardized approach. We report descriptive statistics in Table 2. In terms of bank-firm relationship, out of the 421,560 pairs that we follow between before and after the Basel II implementation, 314,942 transit to IRB, while the remaining 106,618 follow to the standardized approach.

### ii. Common Counterparties Data

To calculate the capital requirement of bank *b* with firm *f*, we also need to know the internal model used by the bank. When the bank adopts the standardized approach, we know the capital requirement *exactly*. This requirement is a number fixed by the Supervisory Authority, that depends in a known way of the firm's official (i.e. Bank of France) credit rating. We obtain this information from the French regulator.

For banks under the IRB approach, in order to compute the capital requirement of a firm, we impute the regulatory PD of the firm using an auxiliary dataset, *Common Counterparties*. This survey was conducted in the first quarter of 2008, among a large sample of firms borrowing from the 8 large banking groups in France[5]. For these bank group-firm pairs, the survey reports, among other things, the name of the banking group, the regulatory PD, the internal rating of the firm, and the Bank of France (official) rating of the firm. We use this dataset to estimate, for each firm *f* borrowing from bank group *B*, a model of the internal PD:

$$PD_{Bf} = M_B \times rating_f + \varepsilon_{Bf} \qquad (5)$$

where we use the official rating of firm *f*, split into 12 dummies.

[5] Three of these groups merge in 2009.

To impute the internal PD in our loan-level data, we thus need to first estimate the parameter $M_B$ by running regression (5) on *Common Counterparties*. To assess the explanatory power of this imputation process, we regress, for each one of the 7 banking groups, the internal PD of the firm on the full set of 12 Bank of France rating dummies (from 3++, the safest, to P, the riskiest). We report the outcome of these regressions in Table 3. We find that, for all banks but one, the R squared of the regression is about 20%, with coefficients increasing monotonically. The only exception is banking group "D", whose internal model was not validated by the regulator during the transition: As a result, this bank operates under the standard approach so we do not use its $M_B$ parameter. Note also that coefficients tend to be highly statistically significant. Hence, equation (5) has a lot of predictive power, in spite of its simplicity. The reason is that internal PDs are calculated using discrete internal risk categories (internal ratings), which partially correlate with those of the Bank of France, even though the overlap is imperfect.

Another important condition for our imputation technique to work is that banks have internal models $M_B$ that differ enough. Otherwise, our effect would not be separately identified from the effect of firm ratings. To check this, we run the "transposed" regression from Table 3. For each of the 12 Bank of France ratings, we regress the internal PD of the firm on a full set of bank dummies. We find that the joint significance of these dummies is very high, with an F stat above 80 for 98% of the observations (see the results in Appendix Table A.1). Depending on the rating, the R squared of the regression hovers between .1 and .3, which is high given that we are fitting the PD on a limited set of dummies and thousands of observations. All the numbers are reported in Table A.1, but the bottom line is that the imputation generates enough identifying power, in a fashion similar to a strong instrument.

Then, armed with the estimated $M_B$, we use the fact that, for each firm-bank pair *(b,f)* in our loan-level data, we observe the Bank of France rating of firm *f.* We also use the fact that all banks *b* that have been allowed into the IRB approach, and belong to the same group B, use the same internal risk model: Hence, $M_B$ is the same in all IRB banks of the same group B.

Finally, for each bank-firm pair, we calculate the capital requirement of the potential loan. We follow the approach described in Section 2.a. We assume that the firm is in the retail portfolio of the bank if the bank exposure to it is less than 1 million euro and annual

turnover is less than 50 million; Else, the firm is in the corporate portfolio. Then, we combine the information on the approach (IRB or standardized), along with the imputed portfolio (retail or corporate) and the imputed PD (using the $M_B$ of the group to which *b* belong) for firm-banks in the IRB approach. We then subtract 8% (the pre-Basel II requirement) from this number, and obtain the *change* in capital requirement, for each firm-bank pair in our sample.

Note that our allocation of firms to the retail or corporate portfolio relies on a strict interpretation of the regulation. In practice, the implementation of the regulation is fuzzier, although we cannot check it systematically due to data limitations. Banks are not allowed, in general, to reallocate a firm from the corporate into the retail portfolio. Conversely, some large firms can be put in the retail portfolio if diversification is deemed sufficient by supervisors. To ensure that our results are not too sensitive to our assumption on portfolio allocation, we thus re-rerun regressions on our main specification, but focus on firms whose average sales in 2006-2007 are below 3 million euro (the bottom half of the size distribution). These firms are largely below the official retail limit and are therefore much more likely to be classified as such: since capital requirements are, by design, lower for the retail portfolio, banks have a strong incentive to avoid corporate allocation if they can. We find (results reported in Table A.3) that our results are quantitatively and qualitatively unchanged when we focus on these smaller, likely to be all retail, firms. Hence, the core of our identification does not rest on our retail/corporate measurement, but rather on our imputation of the internal PD, whose precision and identifying power we discussed above.

We report summary statistics for this variable in Table 1. For the average bank-firm pair, capital requirements *decreased* during the transition from Basel I to Basel II, by approximately 2 percentage points, which is very large but initially intended by the regulators. There is, however, a lot of variation in the sample as the standard deviation was approximately 1.7%. A significant number of firms, among the riskiest, experienced an increase in capital requirement, but for the majority, the reform was in effect a positive credit supply shock.

# 4. Results

## a. The Effect of Basel II on Bank Lending

Table 4 reports the regression results of various specifications of equation (2). We start with Panel A. We first describe the alternative specifications before we discuss the economic magnitude of the estimate. In column 1, there are no firm-level controls, and no fixed effects. In this very raw specification, we find a negative and strongly statistically significant impact on lending of higher capital requirement. Column 2 includes firm-level controls: the pre and post-period average bank of France rating discretized into 12 categories, as well as the pre-Basel II level of log sales and ROA. These variables are designed to control for firm size and financial health before the reform. Credit ratings are also included because they serve to calculate the equity requirements (via the imputation of the regulatory PDs), and we want to make sure that the effect of requirements is not identified on firm credit risk, but on its interaction with the model of the bank. Including these controls reduces the estimate from -.22 to -.25.

In column 3, we further include a bank fixed effects, to alleviate the concern that conservative banks (whose equity requirement is high under their own internal model) may be linked to firms that do not borrow very much for other reasons. For instance, mutual banks may be lending to SMEs that do not seek to grow very much, especially in times of crises, and may also end up with higher capital requirements, either because of conservative risk-management practices, or because they were only allowed to adopt the standard approach (which has higher capital requirements). The coefficient becomes slightly more negative to -.31, but keeps the same order of magnitude.

Columns 4-5 seek to control for credit demand shocks by including a firm-level fixed effect in equation (4). The firm fixed effect also allows to control for unobserved heterogeneity in firm-level credit risk that may affect a bank's decision to lend. Note that, for this heterogeneity to matter, it would have to explain lending beyond what the bank of France rating can do, for instance because otherwise risky firms tend to borrow from banks that have very conservative internal risk models. Firm-level risk unobserved heterogeneity is

identified of off firms that borrow from several different banks (they constitute almost 73% of our firm data): The statistical procedure checks that for the average firm, lending growth tends to be larger with banks whose capital charge has decreased the most. We first check that the multi-bank firm sample has similar properties to the overall sample. In column 4, we re-run the same specification as in column 3, but restrict the sample to multibank firms. We find a similar coefficient (-.27 instead of -.31), which suggests that multibank firms are not extremely different from monobank ones. In column 5, we finally include the firm fixed effect, and find a coefficient that is slightly larger (-.36 instead of -.27). Thus, if anything, firm fixed effects tend to make estimates bigger, not smaller. Looking at all five estimates, it is striking to see that they do not change very much across specification, suggesting that unobserved heterogeneity is not so much of a concern in the present setting. Note that this similarity is also present in analogous studies of credit supply shocks (see e.g. Khwaja and Mian, 2008, or Iyer, Peydro and Schoar, 2012).

The economic magnitudes are large. Let us first investigate the cross-sectional explanatory power. First, consider a 1.7 percentage point (one cross-sectional standard deviation) decrease in capital requirement for a given firm. This leads to an increase by .36*0.017=0.61% increase in bank lending as a fraction of firm assets. This corresponds to about 7% of the sample s.d. of bank lending growth. Thus our model does not explain a huge share of the cross-sectional variation, but its explanatory power is in line with other papers in this literature. Secondly, in aggregate, the model has more important implications. As we have seen from Table 1, Basel II has reduced the capital requirement by about 2.1 percentage points for the average bank-firm pair in the sample. Thus, the transition to Basel II has boosted corporate lending by 0.021*0.36=0.75 % of total firm assets percentage points. Since, in the pre Basel II period, average loan size if 7% of firm assets in our sample, our estimate suggests that Basel II had the effect of increasing loan size by about 7%.

Panels B and C further investigate the underlying variation that permits to identify the coefficient on capital charge. One source of identification comes from the fact that some firms borrow from banks that adopt the "standardized" approach (where the capital requirements are given by the regulator as a function of Bank of France ratings), and banks that adopt the IRB approach (where requirements come from the bank's model). The difference between the borrowing from these two types of banks leads to part of the

identification. To investigate its strength, in Panel B, we replace the change in capital requirement by a dummy variable equal to one if the bank moves to the "standardized approach", and zero if it is allowed to adopt the IRB approach. In this panel, we seek to investigate the identifying power of the IRB/standardized difference in capital charge. First, notice that the IRB approach is slightly more advantageous in terms of capital requirements: This was to encourage banks to build good internal risk models. The average capital requirement decreases by 1.6 percentage points for standardized banks, versus 2.1 for IRB ones (see Table A.2). Looking now at Table 4, panel B, we see that lending decreases by approximately 1% of assets more when the lending bank transitions to the standardized approach. This coefficient is significant only in the last three specifications, i.e. in specifications where we control for bank fixed effects. This shows that this effect is identified because some banks were allowed to use the IRB approach for some firms, and had to use the standardized approach for others. This happened because, for some banks, only the retail portfolio was eligible for IRB. Bearing this in mind, the results in Panel B have orders of magnitude consistent with those of Panel A. Given that IRB banks had capital requirements decreases on average .4 ppt larger, and that the estimates from Panel B suggest a corresponding increase in lending that is 1% of asset bigger, the implicit increase in lending for a 1 ppt point decrease in requirement is 1/.4=2.5% of total assets.

Results from Panel C show that the effect is also largely identified *within* the set of banks that adopt the IRB approach. The differences in risk models across banks described in Table 3 are large enough to also strongly contribute to identification. In Panel C, we restrict ourselves to loans where the bank adopts the IRB approach. We see that, for all 5 specifications, the coefficient is strongly significant and has the same order of magnitude as in Panel A.

## b. Transition Dynamics

We now investigate the transition dynamics, and show that the effect of the reform increases over the years until 2011 (we do not have firm controls for the year 2012). For each year $t$ in 2009, 2010 and 2011, for each bank-firm pair, we now compute $\Delta \text{loan}_{bft}$ /

$Asset_f$ as the difference between exposure of *b* to *f* in year *t* and average exposure of *b* to *f* between 2006:Q1 and 2007:Q4, normalized by average firm assets in 2006-2007.

We then re-run regression (2) separately for each year t=2009,2010, 2011, report the results in Table 5 in three separate panels. For each year, we report results for all the 5 specifications used in Table 4. Looking at all specifications, it unambiguously appears that the effect became more and more pronounced over the years, long after the worst of the financial crisis was over. We do not find any evidence that the effect disappears after the reform is put in place, but this may be due to the relatively short period that we study.

## c. The Effect of Basel II on Corporate Outcomes

We now test for the impact of the regulation change on firm-level outcomes. To do this, we run the following regression at the firm level:

$$\Delta Y_f = \gamma.\Delta r_f + \beta X_f + \varepsilon_f \qquad (7)$$

where $\Delta Y_f$ is the change in firm policy (debt, investment etc.), and $X_f$ is a set of firm level controls (the same as in Tables 4-6). $\Delta r_f$ is the average of all changes in capital requirements, across all banks to which firm *f* is linked. This average is weighted by the exposure of banks to firm *f.* The $\varepsilon_f$ are assumed to be heteroskedastic. Since our firm-level dataset is a collapsed version of the loan level data, its summary statistics are not very different. We report them in Table A.4. We report regression results in Table 6.

Note that, since we focus on firm-level outcome (not loan level ones), this methodology does not permit to control for bank nor firm fixed effects. This is a limitation of our study. What gives us confidence in our estimates, however, is that the estimates, with or without bank and firm FE, tend to be extremely stable (see Table 4, Panel A). As we noticed earlier, this suggests that the potential biases that may arise from bank or firm-level heterogeneity (bank-level credit supply shocks, firm-level credit demand shocks etc) are not too large.

We first show that the reform affected overall firm borrowing. We have shown in Tables 4-5 that the change in capital requirement affects bank lending, but it may be the case that

firms can substitute shrinking lending by one bank with borrowing from another bank. Or alternatively, if it becomes easier to borrow from one particular bank (because of decreasing capital charge), the firm may choose to borrow less from other banks. In both cases, even though the reform is shown to have an impact at the loan level, it may have no impact at the firm level.

We check this in Table 6, column 1, where we look at total bank lending for each firm. To compute this variable, we add all the changes in loans to assets, $\Delta loan_{b'f}$ /$Asset_f$, across all banks b' paired with firm f. As shown in column 1, we obtain an estimate of the impact of the reform that is about three times as large as the impact measured in Table 4. This comes from the fact that the average firm borrows from an average of 5 banks: As a result, the effect estimated in Table 4 accumulates. The fact that our firm-level estimate is smaller than 5 times the loan-level estimates is evidence of some limited between-bank substitution. Overall, the estimate in column 1 shows that a 2 percentage point decrease in capital requirement (the Basel I - Basel II transition) causes firm borrowing to increase by about 1.8 percent of total assets, or about 21 billions euros: about 1% of French corporate investment, and 2.5% of aggregate corporate bank lending. Hence, our evidence is consistent with the idea that the transition to Basel II helped foster corporate lending during the crisis.

In column 2, we use as dependent variable the change in bank debt, as reported in company accounts. This variable is the difference between post-reform average bank debt, and pre-reform average bank debt, normalized by pre-period average asset. The estimated effect of capital requirement is half what we find for total bank exposure (.46 instead of .90), which suggests discrepancies between loan-level data and firm-level accounts. One possible explanation for this is that loan-level data - which we use to calculate total bank exposure - are missing exposures lower than 25,000 euros. One possibility is that the effect of Basel II was larger on large exposures, to which banks have paid more attention. An alternative interpretation is that accounting data are somewhat less reliable than loan-level data when it comes to evaluating outstanding bank debt. All in all, we take comfort in the fact that both estimates have similar orders of magnitude, but the confidence band of our estimate of Basel II is large: between 21bn euro (taking bank exposure, cf above paragraph) and 11bn (taking debt from firm accounts).

We turn to real effects in columns 3 and 4. There too, the effect is statistically significant and economically meaningful. A 2 percentage points reduction in capital requirements leads to an increase in fixed assets by some 1% of total assets, or, in aggregate, about 12bn euro (about 0.5 of French aggregate investment). According to the estimate in column 4, the resulting increase in employment would be 1,175bn*0.01*0.02=235,000 jobs. Hence, estimates in Table 7 suggest that the transition to Basel II, by significantly reducing capital requirements for the average firm, did significantly support the French economy during the financial crisis.

# 5. Conclusion

Although present at the heart of the policy debate on the banking regulation, the impact of higher capital requirement on lending and real outcome has been rarely examined in the academic literature at the micro level.

This paper evaluates such impact. The implementation of the Basel II regulatory framework in 2008 in France led banks to substantially modify the regulatory capital associated to each credit line of their corporate portfolio. Exploiting the French national credit register and the internal bank rating models, we are able to match each loan at the firm-bank level with a risk weighted asset charge applied by the bank. We identify the impact of the capital requirement by contrasting the lending of several banks charging different regulatory capital to the same firm. These charges differ across banks because banks are either under different regulatory regimes (e.g. advanced, foundation or standard approach of Basel II) or simply because they differ in their internal models. Therefore our approach controls for demand effect.

We find an increasing impact of an increase of capital requirement by one percent. This impact translates to real corporate outcomes such as employment and investment.

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# Tables

**Table 1: Summary Statistics of the Loan-Level Dataset**

| Variable | Mean | Median | Std Dev | Observations |
|---|---|---|---|---|
| $\Delta Loan_{bf}$ / $asset_f$ | 0.021 | 0.002 | 0.083 | 421,560 |
| $\Delta r_{bf}$ | -0.020 | -0.020 | 0.017 | 421,560 |
| $log(sales_{f,pre})$ | 8.346 | 8.122 | 1.328 | 421,560 |
| $ROA_{f,pre}$ | 0.152 | 0.131 | 0.326 | 421,560 |
| $log(asset_{f,pre})$ | 3.340 | 4.000 | 1.164 | 421,560 |

Source: Loan-level data, Accounting data and Common Counterparties. Note: The unit of observation is a bank-firm linkage *(b,f)*. "$\Delta Loan_{bf}$ / $asset_f$" is the change in loans divided by total assets: The difference between the average quarterly exposure of *b* to *f* in the post reform period (2008:1 - 2012:4), and the average quarterly exposure in the pre reform period (2006:1 - 2007:4), normalized by the firm *f* 's average annual assets in the pre reform period (2006-2007). "$\Delta r_{bf}$" is the change in capital requirement, i.e. the capital requirement calculated in the post reform period minus 8%. The capital requirement is calculated through essentially combining (1) information on whether bank *b* is allowed, or not, to use its internal model to compute the risk of firm *f*, and (2) the imputed internal PD of firm *b* in bank *b*'s system. "$log(sales_{f,pre})$" is the log of pre reform average firm sales (over 2006-2007). "$ROA_{f,pre}$" is the average pre reform return on asset of the firm (EBIT divided by assets). "$log(asset_{f,pre})$" is the log of average pre reform assets of the firm. In our final dataset, we have 421,560 bank-firm linkages.

**Table 2: The Different Basel II Regimes**

| Basel II Approach | # banks | # of bank-firm pairs | Mean Exposure ('000 euros) | Total Exposure (bn Euros) | Percent of Total Exposure |
|---|---|---|---|---|---|
| Standard for the retail porfolio | 95 | 71 225 | 159 | 11,3 | 0,07 |
| Standard for the corporate porfolio | 164 | 35 393 | 1 617 | 57,2 | 0,34 |
| IRB for the retail porfolio | 142 | 288 359 | 154 | 44,4 | 0,26 |
| IRB for the corporate porfolio | 73 | 26 583 | 2 090 | 55,6 | 0,33 |

Source: French Supervision Authority. Note: The unit of observation is a bank-firm linkage. Basel II considers four different regimes of capital requirement: the retail exposure (less than one million of exposure and 50 millions of turnover), the corporate exposure (more than one million of exposure or more than 50 millions of turnover). The "retail" portfolio and the "corporate" portfolios of a given entity can be treated either under the standard approach or the advanced approach. This table displays the number of banks, the number of bank-firm pairs in our sample, the total amount of exposures in each of the four regulatory regimes. Our sample has we have 421,560 bank-firm linkages. The average exposure is computed during the post reform period (2008Q1-2012Q4).

**Table 3: Predicting Internal Probabilities of Default with Firm Ratings and Bank Fixed Effects**

| | Internal Probability of Default, within each Banking Group | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Banking Group (in 2008) | A | B | C | D | E | F | G | H |
| Firm rating = 3++ | -0.01*** | -0.01*** | -0.03*** | -0.01 | -0.01*** | -0.02*** | -0.02*** | -0.03*** |
| | (0.001) | (0.001) | (0.004) | (0.011) | (0.002) | (0.003) | (0.003) | (0.003) |
| Firm rating = 3+ | -0.01*** | -0.01*** | -0.03*** | -0.01 | -0.01*** | -0.02*** | -0.02*** | -0.02*** |
| | (0.001) | (0.001) | (0.002) | (0.006) | (0.002) | (0.002) | (0.002) | (0.002) |
| Firm rating = 3 | -0.01*** | -0.00*** | -0.02*** | 0.00 | -0.01*** | -0.01*** | -0.01*** | -0.02*** |
| | (0.001) | (0.001) | (0.002) | (0.005) | (0.001) | (0.002) | (0.002) | (0.001) |
| Firm rating = 4+ (Reference) | | | | | | | | |
| Firm rating = 4 | 0.01*** | 0.01*** | 0.01*** | 0.00 | 0.00*** | 0.01*** | 0.01*** | 0.01*** |
| | (0.001) | (0.001) | (0.002) | (0.004) | (0.001) | (0.001) | (0.002) | (0.001) |
| Firm rating = 5+ | 0.02*** | 0.02*** | 0.03*** | 0.03*** | 0.02*** | 0.03*** | 0.02*** | 0.03*** |
| | (0.001) | (0.001) | (0.002) | (0.005) | (0.001) | (0.002) | (0.002) | (0.001) |
| Firm rating = 5 | 0.03*** | 0.04*** | 0.05*** | 0.02*** | 0.03*** | 0.05*** | 0.05*** | 0.05*** |
| | (0.001) | (0.001) | (0.002) | (0.006) | (0.002) | (0.002) | (0.002) | (0.002) |
| Firm rating = 6 | 0.04*** | 0.05*** | 0.07*** | 0.01 | 0.02*** | 0.07*** | 0.06*** | 0.06*** |
| | (0.002) | (0.002) | (0.003) | (0.010) | (0.002) | (0.004) | (0.004) | (0.002) |
| Firm rating = 7 | 0.04*** | 0.04*** | 0.16*** | -0.02 | 0.08*** | 0.07*** | 0.01 | 0.13*** |
| | (0.003) | (0.005) | (0.005) | (0.017) | (0.013) | (0.007) | (0.019) | (0.004) |
| Firm rating = 8 | 0.07*** | 0.07*** | 0.19*** | 0.01 | 0.04** | 0.11*** | 0.28*** | 0.19*** |
| | (0.006) | (0.006) | (0.007) | (0.027) | (0.015) | (0.015) | (0.013) | (0.006) |
| Observations | 13334 | 20844 | 20866 | 6129 | 4167 | 7370 | 15187 | 22835 |
| R-squared | 0.191 | 0.170 | 0.167 | 0.009 | 0.185 | 0.221 | 0.105 | 0.195 |

Source: Common Counterparties 2008. Note: This Table describes the predictive power of regression (5) in the main text. For each large banking group separately, we regress the internal default probability on 10 Bank of France ratings (excluding the rating 11 and 12 corresponding to default). Standard deviations are between parentheses. ***, **, * mean statistically significant at 1, 5 and 10%.

**Table 4: Transition to Basel II and Bank Lending**

| Dependent Variable | $\Delta Loan_{bf}$ / $asset_f$ | | | | |
|---|---|---|---|---|---|
| | All Observations | | | Multi-bank firms only | |
| | (1) | (2) | (3) | (4) | (5) |
| *Panel A: Baseline Specification* | | | | | |
| $\Delta r_{bf}$ | -0.22*** | -0.25*** | -0.31*** | -0.27*** | -0.36*** |
| | (0.034) | (0.032) | (0.031) | (0.029) | (0.034) |
| Firm-Level Controls | No | Yes | Yes | Yes | - |
| Bank FE | No | No | Yes | Yes | Yes |
| Firm FE | No | No | No | No | Yes |
| Observations | 421560 | 421560 | 421560 | 387620 | 421560 |
| R-squared | 0.002 | 0.013 | 0.036 | 0.039 | 0.449 |
| *Panel B: "Standardized" Dummy* | | | | | |
| Bank *b* takes standardized approach | -0.00 | -0.00 | -0.01*** | -0.01*** | -0.01*** |
| | (0.004) | (0.004) | (0.002) | (0.002) | (0.002) |
| Firm-Level Controls | No | Yes | Yes | Yes | - |
| Bank FE | No | No | Yes | Yes | Yes |
| Firm FE | No | No | No | No | Yes |
| Observations | 421560 | 421560 | 421560 | 387620 | 387620 |
| R-squared | 0.001 | 0.011 | 0.035 | 0.038 | 0.367 |
| *Panel C: IRB banks only* | | | | | |
| $\Delta r_{bf}$ | -0.16*** | -0.18*** | -0.25*** | -0.22*** | -0.45*** |
| | (1.495) | (1.793) | (1.253) | (1.323) | (1.942) |
| Firm-Level Controls | No | Yes | Yes | Yes | - |
| Bank FE | No | No | Yes | Yes | Yes |
| Firm FE | No | No | No | No | Yes |
| Observations | 314942 | 314942 | 314942 | 285661 | 285661 |
| R-squared | 0.001 | 0.011 | 0.027 | 0.030 | 0.436 |

Note: We use loan-level data described in Table 1. We regress change in log lending on the change in capital requirement between before and after the transition to Basel II, including various sets of controls and fixed effects. Column 1 includes no control and no fixed effect. Column 2 adds in the firm-level controls: changes and pre-period values of log sales, ROA, and firm bank of France rating. Column 3 further adds a bank fixed effect. Columns 4-5 restricts the sample to firms with multiple lenders. Column 4 repeats the specification of Column 3 on this subsample. Column 5 includes the firm fixed effect. The Table is subdivided into three panels. Panel A is the basic specification. Panel B uses a measure of the capital charge that does not include the heterogeneity of Basel II capital charges across IRB banks. It assumes that all IRB banks in CC use the same regulatory PD per risk category. Identification therefore solely comes from the difference between IRB and standardized banks. Panel C shifts the focus to identification within IRB banks, which relies on the difference in internal models: Estimation is restricted to these banks. Error terms are clustered at the bank-level. Standard deviations are between parentheses. ***, **, * mean statistically significant at 1, 5 and 10%.

**Table 5: The Effect of Basel II on Lending: Year-by-year Results**

| Dependent Variable | $\Delta Loan_{bf}$ / $asset_f$ | | | | |
|---|---|---|---|---|---|
| | All observations | | | Multi-bank firms only | |
| | (1) | (2) | (3) | (4) | (5) |
| *Panel A: 2009 - Pre Basel 2 period* | | | | | |
| Change in Capital Charge | -0.09*** | -0.11*** | -0.11*** | -0.09*** | -0.11*** |
| | (0.017) | (0.021) | (0.025) | (0.024) | (0.027) |
| Firm-Level Controls | No | Yes | Yes | Yes | - |
| Bank FE | No | No | Yes | Yes | Yes |
| Firm FE | No | No | No | No | Yes |
| Observations | 421560 | 421560 | 421560 | 387620 | 387620 |
| R-squared | 0.000 | 0.004 | 0.016 | 0.016 | 0.319 |
| *Panel B: 2010 vs pre Basel 2 period* | | | | | |
| Change in Capital Charge | -0.15*** | -0.25*** | -0.27*** | -0.24*** | -0.30*** |
| | (0.020) | (0.025) | (0.031) | (0.028) | (0.034) |
| Firm-Level Controls | No | Yes | Yes | Yes | - |
| Bank FE | No | No | Yes | Yes | Yes |
| Firm FE | No | No | No | No | Yes |
| Observations | 421560 | 421560 | 421560 | 387620 | 387620 |
| R-squared | 0.001 | 0.005 | 0.018 | 0.018 | 0.324 |
| *Panel C: 2011 vs pre Basel 2 period* | | | | | |
| Change in Capital Charge | -0.22*** | -0.35*** | -0.40*** | -0.36*** | -0.44*** |
| | (0.022) | (0.029) | (0.033) | (0.031) | (0.038) |
| Firm-Level Controls | No | Yes | Yes | Yes | - |
| Bank FE | No | No | Yes | Yes | Yes |
| Firm FE | No | No | No | No | Yes |
| Observations | 421560 | 421560 | 421560 | 387620 | 387620 |
| R-squared | 0.002 | 0.006 | 0.022 | 0.022 | 0.329 |

Note: We use loan-level data described in Table 1. This Table uses the same specification as in Table 4, Panel A except for the dependent variable. In Panel A, the dependent variable is the change in log average exposure between the post reform period (2008-2011) and pre reform period (2006-2007).In Panel B, t=2009: The dependent variable is change in log average exposure lending between 2009 and pre Basel II. In Panel C, t=2010. In Panel D, t=2011. Error terms are clustered at the bank level. Standard deviations are between parentheses. ***, **, * mean statistically significant at 1, 5 and 10%.

**Table 6: Capital Requirement and Corporate Policies**

| Dependant Variable : Change in variable over Firm's assets | (1) $\Delta Loan_f$ / $asset_f$ | (2) $\Delta$Bank $Debt_f$ / $asset_f$ | (4) $\Delta$Fixed $Asset_f$ / $asset_f$ | (5) $\Delta Employment_f$ / $asset_f$ |
|---|---|---|---|---|
| $\Delta r_f$ | -0.90*** | -0.46*** | -0.48*** | -0.01*** |
| | (0.041) | (0.036) | (0.064) | (0.001) |
| Controls | Y | Y | Y | Y |
| R-squared | 0.029 | 0.044 | 0.068 | 0.057 |
| Observations | 111877 | 111877 | 111877 | 111877 |

Note: We use firm-level data described in Table A.2. Each column corresponds to a different dependent variable. Column 1 uses the change in aggregate bank exposure to a firm, normalized by pre-reform assets. Column 2 uses change in firm-level bank debt, normalized by pre-period assets. Column 3 uses change in fixed assets, while column 4 contains change in firm-level employment normalized by pre-reform assets. All regressions include, as further controls, pre and post-reform firm rating, as well as pre-reform return on asset, total asset (in log) and turnover (in log). Standard deviations are between parentheses. ***, **, * mean statistically significant at 1, 5 and 10%.

# Appendix Tables

**Table A.1: Do Bank Models Differ Enough From One Another?**

| | Bank Fixed Effect: Distribution | | | Regression Statistics | | | | |
|---|---|---|---|---|---|---|---|---|
| Bank of France Rating | p25 | p50 | p75 | F stat | p value | R squared | # of banks | Obs. |
| 3++ | -0.011 | -0.004 | 0.011 | 120.9 | 0.00 | 0.34 | 136 | 3087 |
| 3+ | -0.010 | -0.003 | 0.010 | 270.9 | 0.00 | 0.30 | 156 | 9686 |
| 3 | -0.009 | -0.004 | 0.008 | 370.3 | 0.00 | 0.25 | 155 | 17042 |
| 4+ | -0.008 | -0.002 | 0.008 | 490.4 | 0.00 | 0.23 | 158 | 26031 |
| 4 | -0.006 | -0.002 | 0.010 | 330.2 | 0.00 | 0.20 | 155 | 20258 |
| 5+ | -0.006 | -0.001 | 0.009 | 220.4 | 0.00 | 0.16 | 146 | 15868 |
| 5 | -0.008 | -0.002 | 0.008 | 80.7 | 0.00 | 0.15 | 143 | 6219 |
| 6 | -0.008 | -0.001 | 0.012 | 20.3 | 0.00 | 0.12 | 116 | 1088 |
| 7 | -0.011 | 0.002 | 0.010 | 10.8 | 0.08 | 0.34 | 31 | 50 |
| 8 | -0.011 | 0.002 | 0.009 | 10.4 | 0.10 | 0.14 | 54 | 126 |
| 9 | -0.008 | -0.007 | 0.016 | 20.0 | 0.06 | 0.38 | 29 | 47 |
| P | -0.013 | -0.003 | 0.012 | 10.9 | 0.02 | 0.32 | 52 | 97 |

Source: Common Counterparties 2008. Note: This Table describes the predictive power of regression (5) in the main text. For each Bank of France rating separately, we regress the internal default probability on 7 banking group dummies. In columns 2-4, we report the three quartile breakpoints of these estimated dummies. In columns 5-8, we report regression statistics for each of these regressions. In column 5, we report the F statistic of joint significance of the dummies, and in column 6, the associated p value. In column 7, we report the R squared of the regression, and in column 8 the number of observations exploited.

## Table A.2: Loan-Level Dataset: Sample Splits

| | Mean | Median | Std Dev | Observations | Mean | Median | Std Dev | Observations | Mean equality |
|---|---|---|---|---|---|---|---|---|---|
| **Panel A: Multi-Bank vs Mono-Bank Relationships** | | | | | | | | | |
| | | **Firm borrows from several banks** | | | | **Firm borrows from only one bank** | | | |
| Change of loans over firm's asset | 0.021 | 0.003 | 0.080 | 387,620 | 0.011 | 0.000 | 0.103 | 33,940 | 0.000 |
| Change in capital charge | -0.020 | -0.020 | 0.017 | 387,620 | -0.023 | -0.025 | 0.018 | 33,940 | 0.000 |
| Post reform average rating | 3.545 | 4.000 | 1.007 | 387,620 | 3.223 | 4.000 | 1.218 | 33,940 | 0.000 |
| Pre reform log sales | 8.402 | 8.189 | 1.330 | 387,620 | 7.705 | 7.473 | 1.123 | 33,940 | 0.000 |
| Pre reform ROA | 0.151 | 0.131 | 0.297 | 387,620 | 0.158 | 0.135 | 0.562 | 33,940 | 0.000 |
| Pre reform rating | 3.360 | 4.000 | 1.150 | 387,620 | 3.112 | 3.000 | 1.299 | 33,940 | 0.000 |
| **Panel B: IRB vs Standard Banks** | | | | | | | | | |
| | | **Bank adopts standardized approach** | | | | **Bank adopts IRB approach** | | | |
| Change of loans over firm's asset | 0.017 | 0.001 | 0.081 | 106,618 | 0.022 | 0.003 | 0.083 | 314,942 | 0.000 |
| Change in capital charge | -0.016 | -0.020 | 0.013 | 106,618 | -0.021 | -0.024 | 0.018 | 314,942 | 0.000 |
| Post reform average rating | 3.611 | 4.000 | 0.956 | 106,618 | 3.488 | 4.000 | 1.051 | 314,942 | 0.000 |
| Pre reform log sales | 8.725 | 8.498 | 1.521 | 106,618 | 8.218 | 8.022 | 1.230 | 314,942 | 0.000 |
| Pre reform ROA | 0.143 | 0.123 | 0.299 | 106,618 | 0.155 | 0.134 | 0.335 | 314,942 | 0.000 |
| Pre reform rating | 3.421 | 4.000 | 1.113 | 106,618 | 3.312 | 4.000 | 1.180 | 314,942 | 0.000 |

Note: This Table replicates Table 1 using two different ways of splitting the sample. As in Table 1, the unit of observation is a bank-firm pairs. Panel A splits the sample of 421,560 bank-firm pairs into: pairs whose firm is linked with at least two different banks, and pairs whose firm is linked to only one bank. Panel B splits the sample into pairs where the bank adopts the IRB approach when Basel II becomes effective, and pairs whose banks adopts the standardized approach. The last column reports the p-value of the difference in means test.

**Table A.3: Transition to Basel II and Bank Lending - Focus on Small/Retail Firms**

| Dependent Variable | $\Delta Loan_{bf}$ / $asset_f$ | | | | |
|---|---|---|---|---|---|
| | All Observations | | | Multi-bank firms only | |
| | (1) | (2) | (3) | (4) | (5) |
| $\Delta r_{bf}$ | -0.19*** | -0.45*** | -0.69*** | -0.58*** | -0.63*** |
| | (0.058) | (0.068) | (0.071) | (0.067) | (0.091) |
| Firm-Level Controls | No | Yes | Yes | Yes | - |
| Bank FE | No | No | Yes | Yes | Yes |
| Firm FE | No | No | No | No | Yes |
| Observations | 165750 | 165750 | 165750 | 143110 | 143110 |
| R-squared | 0.001 | 0.008 | 0.041 | 0.042 | 0.381 |

Note: This Table re-runs the regression of Table 4, Panel A, on small firms only. Most of these firms are very likely to belong to the retail portfolio of the banks, and therefore the sample variation of capitals requirements mostly depends on the PD as we impute it from *Common Counterparties*. Column 1 includes no control and no fixed effect. Column 2 adds in the firm-level controls: changes and pre-period values of log sales, ROA, and firm bank of France rating. Column 3 further adds a bank fixed effect. Columns 4-5 restricts the sample to firms with multiple lenders. Column 4 repeats the specification of Column 3 on this subsample. Column 5 includes the firm fixed effect. Standard deviations are between parentheses. ***, **, * mean statistically significant at 1, 5 and 10%.

**Table A.4: Summary Statistics of the Firm-Level Dataset**

| Variable | Mean | Median | Std Dev | Observations |
|---|---|---|---|---|
| $\Delta Loan_f$ / $asset_f$ | 0.016 | 0.007 | 0.065 | 111,877 |
| $\Delta r_f$ | -0.022 | -0.024 | 0.015 | 111,877 |
| $\Delta$Bank $Debt_f$ / $asset_f$ | 0.014 | 0.000 | 0.115 | 111,877 |
| $\Delta$Fixed $Asset_f$ / $asset_f$ | 0.118 | 0.060 | 0.207 | 111,877 |
| $\Delta Employment_f$ / $asset_f$ | 0.000 | 0.000 | 0.003 | 111,877 |
| $log(sales_{f,pre})$ | 8.087 | 7.819 | 1.170 | 111,877 |
| $ROA_{f,pre}$ | 0.156 | 0.134 | 0.128 | 111,877 |
| $log(asset_{f,pre})$ | 7.707 | 7.443 | 1.297 | 111,877 |

Note: The unit of observation is a firm. We start from the loan-level data constructed in Section 3. " $\Delta Loan_f$ / $asset_f$" is the sum of all $\Delta Loan_{bf}$ / $asset_f$ for all banks *b* that are paired (i.e. lend at least once) with firm *f*. " $\Delta r_f$" is the average, across all banks *b* paired with *f*, of $\Delta r_{bf}$, weighted by the exposure of *b* to *f*. All other variables are firm-level variables: "$\Delta X_f$/$Asset_f$" is the difference between post- and pre-reform average X, normalized by average pre-reform total assets. The sample contains 111,877 firms.