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The Transmission Channels of Unconventional Monetary Policy: Evidence from a Change in Collateral Requirements in France

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Highlights

- We examine the effects of a change in collateral requirements in the French credit market in 2012.
- We use a bank-firm level credit registry combined with firm-level balance sheet data.
- Credit increased after the liquidity injection, exclusively driven by supply.
- There was strategic risk-taking by a group of banks, an unintentional implication of the policy.

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Abstract

Using a bank-firm level credit registry combined with firm-level balance sheet data we establish the presence of heterogeneity in the effects of unconventional monetary policy transmission. We examine the consequences of a loosening in the collateral eligibility requirement for credit refinancing in France. The policy was designed to affect bank lending positively. We expect a linear increase in lending and an additional increase in loans to firms with newly acceptable rating. We find a large heterogeneity of the monetary policy transmission including the unexpected reduction of lending by the banks benefiting the most from the policy. These are small, risk-averse banks whose foremost concern after the recession was to strengthen their balance sheets. Banks least affected by the policy respond with a reduction in credit to low risk borrowers in reaction to the change in the market structure. Last we document heterogenous effects of the policy on firms depending on their size.

Keywords

Unconventional Monetary Policy, Transmission Channels, Corporate Finance, Real Effects of Monetary Policy, Individual Data.

JEL

C55, C58, E44, E52, E58, G21, G28, G30, G32.

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RESEARCH AND EXPERTISE ON THE WORLD ECONOMY

"Banks are facing problems in raising longer-term funding in financial markets. The resulting shortening of their funding leads in turn to maturity mismatches on balance sheets of the kind that caused the financial crisis. At the same time, shortages of collateral are beginning to emerge in some segments of the financial system especially for the small and medium sized banks. ... [Additional Credit Claims intervention] will allow banks to use loans as collateral with the Eurosystem, thereby unfreezing a large portion of bank assets. It should also provide banks with an incentive to abstain from curtailing credit to the economy and to avoid fire-sales of other assets on their balance sheets."

Mario Draghi, President, European Central Bank,
Berlin, December 15th 2011

We quantify the impact of a lowering in the collateral-eligibility requirement for refinancing with the ECB on corporate credit supply in France. The overnight re-classification of some loans on banks' balance sheets as eligible collateral by the ECB creates an ideal setting to understand the presence of a causal effect. Banks that ex-ante hold more such loans on their lending portfolios experience a higher positive revaluation of the asset-side of their balance sheets ex-post. This should affect their lending outlook positively compared to banks that hold fewer such loans. Providing banks access to cheaper credit through a loosening of collateral requirement by the ECB aims at increasing credit volume in the aggregate. The premise is that credit volume is driven by supply, implying that liquidity and capital injection in the banking sector can offset credit shortage. But the interaction with low demand can mitigate and even distort the effect of liquidity injection. The paper reports an increase in credit volume after the policy, but extensive heterogeneity in the transmission of this shock on banks portfolio and firms credit access, depending on creditor-specific and borrower-specific characteristics.

The introduction of the Additional Credit Claims (ACC) framework in February 2012 as part of the unconventional monetary policy measures implemented by the European Central Bank (ECB) brought down by one notch the minimum borrower credit rating required for a bank loan to be eligible as collateral in exchange for liquidity with the central bank. This had a positive impact on banks' refinancing capacities on the supply-side of the credit market, a bank lending channel. On the demand-side, it increased the attractiveness of a subset of firms whose credit rating was now eligible to be considered as collateral for accessing liquidity with the central bank: the ACC policy was meant to improve credit market conditions for these borrowers compared to borrowers that still remained below the eligibility threshold. This is the firm balance sheet channel. In sum, we expect a linear increase in lending, along with an additional increase in newly-acceptable loans consistent

with the idea that collateral is endogenously produced.

Ex-ante banks' balance sheets were exposed to different volumes of loans that were newly eligible as collateral under the ACC policy. Exploiting bank-level heterogeneity according to the amount of newly eligible collateral held on their lending portfolios, we are able to naturally isolate banks that benefited from a sudden and exogenous increase in their capacity to borrow money from the central bank. Banks that were actively issuing such loans prior to the policy would enjoy greater refinancing capacity under the ACC framework. We classify these banks as treated and compare them to control banks that have been less active in issuing the targeted loans. We cumulate all loans made by banks and calculate the share of ACC targeted loans in their lending portfolio for each month. We then sort banks by increasing order of shares of newly eligible collateral in their overall lending portfolios. Treated banks are those whose share has been above a pre-determined threshold for a continuous duration prior to policy implementation.

It is standard in the literature to consider treatment for observations above the median share (i.e. banks that have a share above the median are classified as treated). We consider several thresholds ranging from the 50^{th} to 95^{th} percentiles to study whether the intensity of exposure to the shock correlates positively with the lending decision by banks. We initially define banks as treated if the share of treated over total loans on their balance sheets is above the inter-bank median. We proceed to tightening the definition from being above the median to being above the third quartile, ninth decile and the top five percentile share across all banks, respectively. Our approach allows for detailed discussion of how banks were affected. Theoretically, we would expect linearity in the response by banks to the policy: increasing the share of ACC targeted loans in a bank's lending portfolios should reflect an increase in refinancing capacity and an ultimate increase in credit supply, controlling for bank-specific characteristics.

A second objective of our paper is to examine the firm balance sheet channel and the potential heterogeneity in the real effects of the policy. To achieve this, we combine our analysis of treated and control banks with borrower-specific characteristics. Then we study the impact of policy-induced variations in credit supply on credit market conditions for different categories of firms characterized by their risk profile and size. We employ a comprehensive credit registry administered by the Banque de France comprising data on corporate borrowers with total exposure (debt and guarantees) above 25,000 EUR toward financial intermediaries operating in France. We observe all credit lines extended by each bank to each firm every month, from January 2011 to December 2013. We focus on loans

with maturities longer than a year, for which capital has to be committed, and collateral is therefore needed most.

We analyze the impact of treatment on credit supply by banks, and allocation of that credit across risky/less-risky firms or large/small-and-medium sized enterprises. Among others, we isolate the subset of firms that have a marginally lower external finance premium after the ACC. Identification relies on variation across time (before and after the policy), variation across banks in their incentives to extend credit (depending on the share of newly eligible collateral on their balance sheets), and variation across firm characteristics (based on firms' risk rating and size) that potentially influence banks' allocation of credit. We are able to quantify reactions by both treated and control banks to the policy, which is a departure from models that rely on a bank $\times$ month level identification.

Our results are as follows. First, we observe large heterogeneity in banks' lending decisions to firms upon a relaxation in collateral eligibility. We find that banks that fall in the most affected bracket tend to reduce credit supply compared to moderately affected banks. While moderately affected banks (i.e. those above the 50^{th} and 75^{th} percentiles) increase lending by 6-8%, highly affected banks (i.e. those above the 90^{th} and 95^{th} percentiles) reduce credit by 2-4% after the shock. This is a new finding. Highly affected banks are smaller banks who first and foremost need liquidity. After a surprise change in the status of these loans, such banks had a sudden injection of liquidity on their balance sheets. Still, they did not keep their credit supply constant, which would have been sufficient to restore liquidity. The evidence suggest the shock actually increased their demand for liquidity. To understand why, we decompose credit supply by highly affected banks across low and high risk firms. We find no significant change in credit supply to low risk firms. However, these banks contract lending to high risk firms after the introduction of ACC policy. This could be an income effect due to the positive effect of ACC on the value of existing high risk loans.

Second, we document responses by both treated and control group banks across different categories of firms. We find that moderately treated banks (i.e. those above the 50^{th} and 75^{th} percentiles) increase their issuance of loans to low risk firms relative to control banks. More specifically, their credit to low risk firms increases by 6.5% after the ACC policy, while keeping their supply of credit to high risk firms unchanged after ACC. Overall, these banks increase credit. In contrast, control banks reduce lending to low risk firms and increase it to high risk firms. Market competition changes as treated banks enjoy higher refinancing capacity and focus lending to low risk firms, and crowd out control banks whose lending capacity barely changes. We also find a rise in credit by treated

banks to large firms after ACC, and an increase in loans to SMEs by less affected banks. This is consistent with portfolio switching as just discussed.

In total, we identify separately the two channels of the policy on corporate lending. We find evidence of a bank lending channel with an increase in credit supply driven by some of the treated banks. On the other hand, our finding that targeted firms are getting more credit, but only from a sub-group of banks suggests no evidence supporting the firm balance sheet channel.

For our results to be causal, we need the treatment to be uncorrelated with the selection of banks into treated and control groups. One pitfall of identification is that the composition of treated and control changes in response to treatment: banks can respond to the ACC policy by altering their lending portfolio. In the 13-months prior to the ACC policy, banks had a probability of remaining treated in successive months of 6.7% (25.1%) conditional on bank-month fixed effects, if the share of ACC targeted loans in their portfolio was above the 50^{th} (95^{th}) percentile, respectively. This implies that assignment into the treatment group was close to random prior to the policy intervention. Before ACC, banks rarely display a persistent trend in extending ACC targeted loans in consecutive months. This picture changes after the implementation of the ACC policy. Banks remained in the treated group in successive months with significantly higher probabilities, ranging from 49% (57.4%), respectively. To account for possible endogeneity, we measure our treatment variable prior to policy implementation (February 2012). Provided the ACC policy was unexpected for banks, bank lending prior to policy implementation would have no reason to be motivated by an anticipation of the ACC - thus making our assignment of banks into treated and control groups orthogonal to the ACC policy.

In addition, we employ a specification that allows for analysis at a bank $\times$ firm $\times$ month level. We control for unobserved variation at firm $\times$ month level, which captures any time-varying demand-side effects accruing from firm-specific business cycles. Since the ACC policy increased the attractiveness of a certain subset of firms, controlling for firm $\times$ month fixed effect is crucial to control for policy induced changes in firms' credit demand for each firm in each month.

We contribute to the literature on the effects of unconventional monetary policy on credit and on the transmission channels of monetary policy. Several papers use national credit registry to quantify the effect and identify the transmission channels.[2] Among them, a few papers examine a relaxation of

[2]For cross-country examination of the ECB unconventional monetary policy effects, see Daetz et al. (2018), De

the ECB's collateral eligibility requirement. The heterogeneous exposure of the Euro-area members to the sovereign debt crisis has implied different questions and findings. For peripheral countries, Crosignani and Carpinelli (2016) examine the ECB expansion of eligible collateral in Italy and find that banks used the facility differently depending on whether they were more or less affected by the dry-up of the wholesale market.[3] In the core countries, banks did not face a similar dry-up. Van Bekkum, Gabarro, and Irani (2018) examine a relaxation for residential mortgage-backed securities (RMBS) in the Netherlands. They report an increase in credit supply and a moderate reduction on interest rates for newly eligible collateral. They also find a worse repayment performance for loans with state guarantees possibly due to policy-induced risk-taking. As far as the French experience is concerned, Mésonnier, O'Donnell, and Toutain (2017) and Cahn, Duquerroy, and Mullins (2017) previously evaluated the impact of the ACC policy. Both papers conduct a within-bank difference-in-difference analysis to study the effect of the policy on credit supply to 4-rated treated firms vs. closely-comparable controls.[4] Here, in contrast, we use the cross-bank and cross-firms dimension to study the role played by differences in banks' credit supply, and its effects on credit to all firms. By exploiting variation across banks and firms, we document a large heterogeneity of the monetary policy transmission including the unexpected reduction of lending by the banks benefiting the most from the policy as well as heterogeneous effects of the policy on firms depending on their size.[5]

Jiménez et al. (2017) evaluate the presence of firm balance sheet and bank lending channels using corporate loan application data for Spain from 2002 till 2010. They separate their sample into "good" pre-crisis and "bad" post-crisis times, identifying August 2007 as the start of the crisis. They find that both the balance sheet channel and the bank lending channel are more significant during crisis times. Our work also separates demand from supply-side factors but at a dis-aggregated level. By exploiting cross-banks and cross-firm differences, we find that credit indeed increased after the ACC shock but it was exclusively driven by supply. We also document strategic risk-taking by a group of banks, an unintentional implication of the shock.

The rest of the paper is structured as follows. Section 1 describes the backdrop for the Additional

Marco (2019), Breckenfelder et al. (2016). As for the American experience, QE1 and QE2 have been thoroughly dissected by Krishnamurthy and Vissing-Jorgensen (2011), Chakraborty, Goldstein, and MacKinlay (forthcoming), Maggio, Kermani, and Palmer (2016), Foley-Fisher, Ramcharan, and Yu (2016), Fuster, Lo, and Willen (2017).

[3] Garcia-Posada and Marchetti (2016) and Alves, Bonfim, and Soares (2016) examined the effects of the NLTRO liquidity provisions on credit for the Spanish and Portuguese cases respectively.

[4] Also on France, Andrade et al. (2015) examined the effects of LTRO liquidity injections on bank lending.

[5] The mirror question of heterogeneous transmission of unconventional monetary policy on households has recently been examined in Cloyne, Ferreira, and Surico (forthcoming).

Credit Claims intervention. Section 2 introduces the data. Section 3 elaborates on the identification strategy and empirical equations used in our model. Section 4 presents our findings, with robustness checks presented in section 5. Section 6 concludes.

1. Institutional Setting and Policy Intervention

Since the Global Financial Crisis (GFC) in 2008, the main Central Banks have adopted non-standard monetary measures in order to provide economic and financial stimulus to their economies. These unconventional measures have included unprecedented money-market support actions, special loan programmes, and large-scale asset purchases, which have triggered an unprecedented expansion of the Central Banks' balance sheets in a relatively short time period. Through its two Long-Term Refinancing Operations (LTROs) conducted across a period of three months from December 2011 to February 2012, the ECB injected over 1 trillion euros to the economy. The first round of LTROs provided 489 billion EUR to 523 banks while the second one allotted 530 billion EUR to 800 institutions. The total liquidity injection increased the size of the Eurosystem's balance sheet by more than a fifth and amounted to 80% of the monetary base in the Euro Area, 20% of total bank credit to Euro Area firms and almost 11% of the Area's nominal GDP. In addition to the expansion of credit, the maturity of LTROs – originally for a period of 3 months – was lengthened to 6 months, 12 months, and eventually, to a maturity of 36 months. Later, from 2014 to 2017, an additional series of four-year targeted LTROs was launched to refinance European banks at very low interest rates and to encourage them to extend credit to the real economy. The operations were targeted because the amount counter-parties could borrow from the ECB was linked to their loans to non-financial corporations and households, and was directly aimed at facilitating lending to the real economy, rather than solely improving the liquidity condition of credit institutions.

All of the Eurosystem's monetary policy credit operations are secured by the Eurosystem collateral framework (ESCF). The ESCF has played a key role in the implementation of monetary policy since the Euro was launched in 1999. It also played a vital role in stabilising financial markets and institutions during the financial crisis. The collateral framework created by the ECB is applied by the National Central Banks (NCBs) of participating countries, thereby allowing collateral quality to be determined by recognized credit rating agencies at a country-level. Eligible collateral must meet appropriate quality standards in accordance with harmonized EU requirements and is in turn subject to valuation and haircuts. These haircuts depend on market, credit and liquidity risk characteristics of the assets. Naturally, haircuts applicable to collateral decrease in the credit risk rating of collateral, within the set of assets considered eligible as collateral.

As part of a broader set of unconventional monetary policy measures, the ECB announced on December 8th 2011 that it would allow NCBs to accept additional credit claims (ACC) as collateral from borrowing banks. The introduction of ACC framework in February 2012 necessitated the specification of two types of eligible credit claims: standard and temporary. The standard claims that were eligible prior to the intervention had a low default probability of below 0.4% at a 1-year horizon, in line with the criteria put forward by the Basel requirements. The newly eligible claims were labelled the temporary ones (since the ACC was initially scheduled to be implemented for a 2-year period between 2012-2014). They carried a higher risk of default between 0.4% and 1%.

The Banque de France annually assigns a rating to around 240,000 non-financial French companies. The rating has two components: a turnover rating and a credit rating. The credit rating has 12 possible scales which are (in order of increasing risk): 3++ (safest firm), 3+, 3, 4+, 4, 5+, 5, 6, 7, 8, 9, P (bankrupt firm). An additional 0 rating is given for firms whose credit ratings are unknown[6]. Under the ACC intervention, loans to firms with credit rating 4 were made eligible as collateral, while the earlier eligibility cut off at 4+. An asset with a rating of 4 on BdF's scale can approximately be described as having a Fitch rating of BB- (whereby firms' debt is considered speculative), corresponding to a 1-year default probability between 0.4% and 1%. Bignon et al. (2016) estimate that the ACC intervention immediately created a positive shock to the nominal value of the pool of eligible assets held by French banks of around 90 billion EUR (an increase of more than 30 %), highlighting the potential importance of 4-rated firms to French banks' loan portfolios.

In this paper, we present the ACC shock as a natural experiment to evaluate the impact of the policy on banks, based on their exposure to the policy. We measure this exposure based on the shares of newly eligible collateral, i.e., loans to 4 rated firms, held on banks' lending portfolios prior to the intervention.

[6]Detailed description available in the Banque de France's section on French Credit Rating.

2. Data

2.1. French Credit Registry (CCR)

Our main data source is the French Central Credit Registry (CCR) administered by Banque de France. The credit registry contains data on corporate borrowers with total exposure (debt and guarantees) above 25,000 EUR toward financial intermediaries operating in France. Over the span of January 2011 till December 2013, the registry reports a monthly average of 2.5 million bank-firm observations of end-of-month total outstanding credit granted (for both drawn and undrawn credit). The credit database provides information on all existing lines of credit of any type. For the purpose of our analysis, we aggregate credit lines into two brackets: medium-and-long-term loans (MLT) and total credit (a combination of all channels of credit). The database also contains information on the geographical location of borrowers, the type of sector they belong to and the nature of ownership (private or public entities). Each bank and firm in the data is uniquely identified throughout the data based on anonymous identifiers (CIB for banks and SIREN for firms). These identifiers allow us to match firms in the credit registry one-to-one to firm balance sheet data reported in the FIBEN individual company database.

Credit rating information comes from the FIBEN internal credit rating database at Banque de France. The national central bank attributes credit ratings to around 270,000 companies on an annual basis. Information on a firms' riskiness is updated annually using firm accounting information, provided it is made available[7]. To compute the share of 4-rated loans - newly eligible as collateral under the ACC - we consider all credit lines (short-medium-and-long term loans and off-balance sheet credit) extended to every firm. Since we are interested in the share of targeted loans over the entire lending portfolio of banks, we include lending to any firm by a bank, regardless of whether the firm is listed on the FIBEN database. We then exclude firms whose financial information has not been updated since 23 months or more. These firms have a rating of "X0" on the FIBEN database and constitute a large portion of aggregate credit. We also exclude inter-bank lending[8]. Dropping inactive firms and lending to financial and insurance sector firms reduces our monthly bank-firm observations to a monthly average of around 750,000 observations out of 2 million observations.

[7] Ratings are also updated throughout the year should there be an incident confirming the firms' inability (or ability) to deliver on its financial commitments.

[8] Interbank lending refers to lending to other financial or insurance companies, especially between banks from the same banking group. These comprise a large share of credit volumes (about a third of short-term credit).

2.2. Firm Yearly Financial Statement Data (FIBEN)

The data on firm balance sheets comes from a database on fiscal performance of companies compiled by Banque de France. The database includes all firms whose turnover in a fiscal year is at least equal to 750,000 EUR. The cut-off of 750,000 EUR is inclusive of all but the smallest firms. The statistical notion of an enterprise is defined under the French Law of Modernization of the Economy (LME) published in 2008. As per the LME, SMEs are firms with fewer than 250 employees, with turnover of less than 50 million EUR or total assets less than 43 million EUR. Mid-tier enterprises (MTEs) are enterprises that are not in the small and medium-sized enterprise category, have fewer than 5,000 employees, turnover of less than 1.5 billion EUR or total assets of less than 2 billion EUR. All other enterprises are defined as large. FIBEN internal credit rating applies to all firms whose balance sheet data is available with the Banque de France. We use balance sheet data to classify SMEs in our data.

3. Identification Strategy and Estimating Equations

3.1. Variable Construction and Identification

We seek to evaluate the impact of the ACC on bank-firm level credit supply through two channels. Firstly, the ACC policy implies that loans to 4-rated firms that were sitting idle on the asset side of the banks' balance sheets are suddenly more valuable due to their ability to act as collateral. This creates a positive externality for all firms - provided that a bank chooses to use the new collateral to access liquidity from the ECB - since banks can lend additional credit to all firms. Secondly, after the ACC policy, a subset of firms - the 4-rated firms - have a marginally lower external finance premium since bank loans to these firms assets can be used for refinancing purposes.

We study these effects over a three-year period between January 2011 and December 2013, with the policy announcement made in December 2011 and the intervention occurring in February 2012. We classify banks into treated and control groups as follows. We construct monthly shares of loans to 4-rated firms over the entire lending portfolio for each bank. We sort banks every month in an increasing order of the share of 4-rated loans in their lending portfolio. We classify a bank as treated when its share of 4-rated loans has continuously been above the sample-median for 3 months (6 months) before the ACC intervention date (announcement date). We create 4 definitions of treatment in such a manner, with the baseline definition defined as banks above the sample-median continously for 3-months prior to February 2012. In order to allow heterogeneity in lending be-

haviours of banks depending on their level of exposure to the policy, we test alternative thresholds, as defined above the inter-bank monthly 75th, 90th and 95th percentiles.

The decision by banks to hold more or less 4-rated loans on their balance sheet is likely endogenous to the ACC-treatment. We verify this by estimating the probability of banks holding a share of 4-rated loans above the threshold at time t, conditional on them holding a share above the threshold prior to time t, as follows:

(Conditional) Linear Probability Estimation:

$$P(above_{b,t} = 1 \mid above_{b,t-1} = 1) = \gamma_1 above_{b,t-1} + \alpha_b + \alpha_t + \varepsilon_{b,t} \quad (1)$$

$$P((above_{b,t} = 1 \ \& \ above_{b,t-1} = 1) \mid above_{b,t-2} = 1) = \gamma_1 above_{b,t-2} + \alpha_b + \alpha_t + \varepsilon_{b,t} \quad (2)$$

where estimations are separated into before and after the ACC intervention.[9] Table 1 suggests that, prior to the ACC intervention, banks who had a share of 4-rated loans in their overall lending portfolio above the inter-bank median in month $t-1$ (and $t-2$) remained above the median in month t with a 6.7% probability (5.1% resp.).The probability is at most as 25.1% for banks whose shares of 4-rated loans are on the far right end of the distribution. The low conditional probability indicates the relative indifference that banks have towards granting target loans prior to the intervention, which allays concerns of banks anticipating the collateral-based intervention and endogenizing it into their lending behaviour. In fact, there was limited information over which banks would be affected by the policy change, which suggests the policy is fairly exogenous.

[9]The model includes fixed-effects at bank-level, α_b, and month-level, α_t, to control for bank-level characteristics and homogeneous time-shocks. Standard errors are clustered at a bank-level.

Table 1 – Do Banks Respond To Incentives?

Conditional Probability of Remaining Treated

	Before ACC		***After ACC***	
	(1)	(2)	(3)	(4)
Panel A: 50th Percentile				
$Previous\ Treated_{b,t-1}$	0.067^{***} (0.019)		0.527^{***} (0.037)	
$Previous\ Treated_{b,t-2}$		0.051^{***} (0.016)		0.412^{***} (0.037)
Panel B: 75th Percentile				
$Previous\ Treated_{b,t-1}$	0.217^{***} (0.029)		0.501^{***} (0.041)	
$Previous\ Treated_{b,t-2}$		0.163^{***} (0.026)		0.397^{***} (0.010)
Panel C: 90th Percentile				
$Previous\ Treated_{b,t-1}$	0.112^{***} (0.010)		0.574^{***} (0.043)	
$Previous\ Treated_{b,t-2}$		0.062^{***} (0.040)		0.436^{***} (0.047)
Panel D: 95th Percentile				
$Previous\ Treated_{b,t-1}$	0.251^{***} (0.059)		0.490^{***} (0.069)	
$Previous\ Treated_{b,t-2}$		0.132^{**} (0.064)		0.065^{***} (0.369)
Bank FE	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
Observations	6,219	9,822	6,219	9,822
Number of Banks	502	480	502	480

Note:
1. (1) and (3) estimate the probability (before and after) of being in the treated group in month t conditional on being treated in the preceding month. (2) and (4) estimate the probability (before and after) of being the treated group in month t and $t-1$ conditional on being treated in $t-2$.
2. Standard errors are clustered at bank-level.

Columns (3) and (4) tell another story. They report the same estimations as the previous two columns, but for the time period after the policy. We notice an increase in banks conditional probability of remaining in the treated group in successive months from less than a tenth to almost half of the time.

The ACC policy affected the way in which banks built up lending to 4-rated firms on their balance sheets. This raises concerns of the treatment being endogenous: we therefore define treatment as a bank-level time-invariant variable: banks with a share of 4-rated loans above the threshold over the 3 months period prior to the implementation of the ACC policy, i.e., February 2012, are fixed as treated throughout the sample. As discussed earlier, we also define treatment using the announcement date in December 2011, rather than the policy change in February 2012, along with testing a period of 6 instead of 3 months. Our results are robust to alternative definitions, and are presented in section 5.

Another concern is that the Additional Credit Claims policy was implemented between two Long Term Refinancing Operations (LTROs) by the ECB. For the LTROs to bias our results, they would

have to influence banks' lending decisions differently in the control and treated groups. Since LTROs extended liquidity to banks in a homogeneous manner, we do not think that it is realistic. To be sure, we control for bank-specific characteristics that could determine their decision to participate in the LTROs.

A positive feedback could exist between banks' supply of credit to firms and the firms' ratings if a firm's credit ratings is affected after access to additional credit. Credit ratings are revised at an annual frequency, and credit received is just one component of firms' financial strength. It is unlikely that credit supply shocks would drastically improve the credit rating scores of a significant portion of firms within the 3-year period of our analysis.

Table 2 – Credit Variables

Percentile	**Bank Group**	**Mean Credit (million EUR)** MLT	Total Credit
50^{th} percentile	Treated	63.8	116.9
	Control	72.4	258.4
75^{th} percentile	Treated	18.8	64.8
	Control	92.9	205.7
90^{th} percentile	Treated	1.43	46.7
	Control	78.7	175.7
95^{th} percentile	Treated	2	76
	Control	66.8	155.5

Note: Percentile shares are calculated over the total lending portfolio of banks. Treated banks are over the percentile for 3 months continuously as of January 2012.

In order to absorb firm-specific changes in credit demand, we restrict our sample to firms borrowing from more than one bank following Khwaja and Mian (2005). This selection reduces out monthly bank-firm pairs by around 30%, but allows us to include firm $\times$ month fixed effects. As a robustness check, we alternatively consider the effect on all firms, arguing that those estimators are a lower bound on the real effects. Our analysis including the sample of all firms shows significant results with similar orders of magnitude.

Lastly, we would like for our results to be driven by an increase in credit supplied by banks, rather than by a rising number of banks in our sample. The ACC policy should encourage existing banks to lend more, which should reflect in our results. Figure 1 confirms that for our period of analysis, there is no observable increase in the number of banks, therefore allaying concerns of an upward bias in our results.

Table 2 provides summary statistics of average credit (in million EUR) by treated and control banks along alternative threshold definitions. As we approach the right tail of the distribution, the mean credit volumes reduce drastically, a fact suggesting that the banks most exposed to the policy intervention were, in fact, smaller and had lesser market share over corporate credit supply.

3.2. Estimating Equations

We first test whether banks respond differently to the shock based on their exposure; we then investigate whether they respond differently across different groups of borrowers.

Baseline:

$$Credit_{b,f,t} = \beta_1 \cdot (Treated_b \times ACC_t) + \beta_2 \cdot ACC_t + \beta_3 \cdot Treated_b + \alpha_b + \alpha_{f,t} + \varepsilon_{b,f,t} \quad (3)$$

where $Credit_{b,f,t}$ is the volume (in log) of credit by bank b to firm f in month t. $Treated_b$ is a bank-specific variable that is equal to 1 if a bank has been an active issuer of 4-rated loans 3 month prior to the Additional Credit Claims policy. ACC_t is a binary step function defined as:

$$ACC_t = \begin{cases} 0, & \text{if } t < T \\ 1, & \text{if } t \geq T \end{cases}$$

with T the date of ACC intervention (announcement), i.e. February 2012 (December 2011). The interaction term is our variable of interest, which equals 1 for all time periods after the ACC policy for treated banks. Its coefficient, β_1, captures the impact of ACC on corporate credit supply by treated banks.

In equation (3), we control for bank and firm×month fixed effects. The term α_b controls for bank-

level unobserved characteristics that influence credit supply by individual banks[10]. This minimizes concerns that other bank-level shocks - such as the LTROs - drive the results of this estimation. We also control for fluctuations in credit demand over the course of each individual firm-level business cycle through $\alpha_{f,t}$, as in Khwaja and Mian (2005)[11]. In the presence of fixed effects, equation (3) is akin to a difference-in-difference estimator.[12] While the interaction term captures variation at a bank×month level, the (explained) credit variable is at a bank×firm×month level. The error term $\varepsilon_{b,f,t}$ can therefore be correlated at a bank-level across different bank-firm observation pairs. In order to allow for robust estimation of the variance-covariance matrix of residuals, standard errors are clustered by bank×month and sector[13].

Extended Baseline:

We allow for heterogeneous borrower-specific effects by estimating the following regression:

$$\begin{aligned} Credit_{b,f,t} = \beta_1 \cdot (Treated_b \times ACC_t \times FirmSpec_{f,t}) \\ +\beta_2 \cdot (Treated_b \times ACC_t) + \beta_3 \cdot (FirmSpec_{f,t} \times ACC_t) \\ +\beta_4 \cdot (Treated_b \times FirmSpec_{f,t}) \\ +\beta_5 \cdot FirmSpec_{f,t} + \beta_6 \cdot Treated_b + \beta_7 \cdot ACC_t \\ +\alpha_b + \alpha_{f,t} + \varepsilon_{b,f,t} \end{aligned} \tag{4}$$

with $FirmSpec_{f,t}$ capturing borrower-specific characteristics. $FirmSpec_{f,t}$ is a categorical variable defined on the basis on the risk profile and turnover of firms as $LowRisk_{f,t}/HighRisk_{f,t}$ and $firmSME_{f,t}/firmLARGE_{f,t}$, respectively. $LowRisk_{f,t}/HighRisk_{f,t}$ is a binary variable that separates firms based on whether or not banks can use loans to these firms as eligible collateral for refinancing with the ECB after the ACC, with a value of 1 indicating firms with loans eligible as collateral. This is important since firms that fall in the low-risk bracket can essentially benefit from a lower external finance premium. If they demand more credit after the reduction in their borrowing cost, then we should observe that they borrow more from all banks. The firms x month fixed-effects control for average time-varying demand-side effects, originating from all firms and not only those that benefit from a putative decrease in the cost of borrowing.

[10]We refer to the smallest unit - an individual bank rather than a banking group. There are 512 unique banks in the database, out of which 481 have multiple borrowers.

[11]143218 unique firms (out of a total 280310 in the database) have multiple lenders.

[12]Fixed effects have absorbed terms that do not vary at a bank×month level, i.e. our estimations will not report β_2 and β_3.

[13]See Bertrand, Duflo, and Mullainathan (2003) and Angrist and Pischke (2009).

The binary variable $firmSME_{f,t}/firmLARGE_{f,t}$ separates firms into large enterprises and micro, small and medium enterprises, with a value of 1 for SME firms, which were supposed to be the targeted beneficiaries of the ACC.

The main coefficient of interest is β_1. In the context of low-risk being the firm characteristic, β_1 measures the average treatment effect of the ACC policy on the lending by treated banks to low-risk firms.[14]

4. Empirical Results

4.1. Bank-level heterogeneity

Table 3 reports the estimation results of Eq. (3). First, we observe the expected positive effect of the ACC policy on lending volume by the largest (second largest) group of treated banks: they increased credit by 4.8% (7.2%) after January 2012 compared to control banks. Second, this effect is heterogeneous among banks. Most affected banks - those above the 90th and 95th percentiles - contract their supply of credit after the ACC policy by 2.8% (4%) percent, respectively.

Table 3 – Bank-level heterogeneity in the ACC policy effects on credit

Dependent variable:	***Log(MLT Credit)***							
	3-month lag				**6-month lag**			
	50^{th}p	75^{th}p	90^{th}p	95^{th}p	50^{th}p	75^{th}p	90^{th}p	95^{th}p
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Treated_b \times ACC_t$	0.048^{**} (0.045)	0.072^{*} (0.043)	-0.028^{**} (0.013)	-0.040^{***} (0.003)	0.057^{**} (0.024)	0.078^{*} (0.043)	-0.024^{*} (0.013)	-0.040^{***} (0.003)
$Treated_b$	(omitted)				(omitted)			
ACC_t	(omitted)				(omitted)			
Bank FE	Y	Y	Y	Y	Y	Y	Y	Y
Firm × Month FE	Y	Y	Y	Y	Y	Y	Y	Y
N	15,539,544	15,539,544	15,539,544	15,539,544	15,539,544	15,539,544	15,539,544	15,539,544
R^2	0.548	0.548	0.548	0.548	0.548	0.548	0.548	0.548

Note:
Standard errors are clustered at bank × month-level and sector-level. Results are robust to clustering at bank × month-level as well.
3. Fixed effects at month and bank level absorb $Treated_b$ and ACC_t.

Why would they? These banks are smaller in size and have a significantly lesser share of the credit market. Upon provision of additional liquidity in the form of newly eligible collateral, they will presumably hoard additional credit because they first and foremost need liquidity. But that does not

[14]Refer to the Appendix for a discussion on the interpretation of the coefficients.

explain a *fall* in credit. To go further, the next section investigates whether this fall in lending is homogeneous across firms.

4.2. Bank-level and firm-level heterogeneity

This section presents results of Eq. (4). We exploit variation across creditor and debtor characteristics. Tables 4 to 6 present the results for lending to firms based on their credit ratings, while Table 7 presents the same for firms based on turnover size.

Low risk firms are those eligible for collateral, i.e., firms with a credit rating of 4 or better after the ACC policy. We find that in response to the ACC policy, treated banks increase credit supply to low risk firms by 6.5%. And that same group of firms gets 0.9% less credit from the control banks ($\beta_3 = 0,09$). This differentiated response suggests that the observed credit increase is driven by supply-side factors only. If firms with a lower borrowing cost had increased credit demand, there is no reason why they would have targeted banks holding relatively more 4-rated loans in their portfolio. The major supply of credit to low risk firms only partly compensates for the depressed credit to low risk firms by these banks before the ACC ($\beta_4 = -0.184$). In turn, riskier firms do not experience a significant increase in their post-ACC level of medium-and-long-term credit supply by treated banks (β_2 is not significant even at a 10% significance).

Table 4 – Heterogeneity in Risk Taking by Banks
Treated banks are above 50th percentile

Dependent variable:	***Log(MLT Credit)***
$Treated_b \times ACC_t \times LowRisk_{f,t}$	0.065^{***}
	(0.023)
$Treated_b \times ACC_t$	0.007
	(0.030)
$ACC_t \times LowRisk_{f,t}$	-0.090^{**}
	(0.038)
$Treated_b \times LowRisk_{f,t}$	-0.184^{***}
	(0.057)
$LowRisk_{f,t}$	0.154^{***}
	(0.050)
Bank FE	Y
Firm × Month FE	Y
N	15,539,544
R^2	0.548

Note:
Standard errors are clustered at bank × month-level and sector-level. Results are robust to clustering at bank × month-level as well.

Control banks respond by contracting credit to low risk firms after the policy as can be seen by a negative and significant β_3. Interestingly, a positive and significant β_5 suggests that in the period prior to the ACC policy, control banks were positively lending to low risk firms. This is indicative of portfolio switching by banks after the policy. We would like to explore further the evolution of credit by control banks but we cannot estimate the effect that the ACC policy had on the credit supply to high risk firms by control banks directly given the inclusion of time-FE. Therefore, we plot the credit volume (in log) along the different banks and firms dimensions (Figure 2). It indicates that control banks switched gears in their portfolio and increased their lending to high risk firms after the ACC while treated banks were reducing their exposure to this market segment. We see two possible explanations for this risk-shifting. The first one is a change in market competition. Control banks could be responding by portfolio switching in favour of high risk firms because they face the new competition of banks benefiting from the ACC policy on the segment of low risk firms. In other words, the sudden "injection" of eligible collateral into treated banks allowed them to increase lending to low risk firm at the expense of control banks, which reacted by turning to high risk firms. The alternative explanation is a voluntary risk-shifting strategy by control banks in search for higher interest rate returns via risk premium.[15] Such behaviour could be motivated by increasing profit-shares to compete with banks that benefited from the ACC policy.

Table 5 – Heterogeneity in Risk Taking by Banks
Treated banks are above 95th percentile

Dependent variable:	***Log(MLT Credit)***
$Treated_b \times ACC_t \times LowRisk_{f,t}$	0.044
	(0.038)
$Treated_b \times ACC_t$	-0.021^{**}
	(0.009)
$ACC_t \times LowRisk_{f,t}$	-0.037
	(0.038)
$Treated_b \times LowRisk_{f,t}$	-0.233^{***}
	(0.063)
$LowRisk_{f,t}$	0.014
	(0.026)
Bank FE	Y
Firm × Month FE	Y
N	15,539,544
R^2	0.548

Standard errors are clustered at bank × month-level and sector-level. Results are robust to clustering at bank × month-level as well.

[15]Indeed recent work by Cahn, Girotti, and Salvadè (2018) report that the average rating class 3 firm demands a 6.019 loan rate (in pp) while rating class 4 and 5 firms pay higher loan rates of 6.531 and 6.908, respectively.

Table 5 focuses on banks that had the highest concentration of 4-rated loans (95% percentile). The estimated coefficient β_1 is not significant, suggesting that credit supply by these banks to low risk firms does not experience any significant change with the policy shock. In addition, the estimated coefficient of β_2 indicates that this group of banks respond to the policy by contracting credit by 2.1% for riskier firms. The result of a reduction of credit by this category of banks commented previously is therefore entirely driven by their loans to riskier firms. In sum, in the tail of the distribution, banks did not react to the policy as expected. Instead of expanding their balance-sheet, they used the policy shock as a positive income effect to reduce the level of risk of their portfolio: given the sudden higher value of 4-rated loans, they could maintain the value of their portfolio and reduce the amount of higher risk loans.

Table 6 displays results for banks above the 90^{th} percentile. These banks contract credit supply to high risk firms while they increase it to low risk firms, albeit in a small magnitude.

Expanding credit supply to SMEs was one of the core motivations behind the ECB allowing National Central Banks to accept lower rating securities as collateral. Table 7 shows the impact of ACC policy on credit supply to SMEs and medium-and-large-scale enterprises by treated and control banks. The significant and negative sign on β_1 in Table 7 suggests that after ACC credit, treated banks decrease credit supply by 17.6% to SMEs. By contrast, they lend more to larger firms after the ACC policy, indicated by the significant and positive sign on β_2. Larger enterprises usually have lower default probabilities owing to their ability to access alternate channels of financing (Bretscher, Schmid, and Vedolin (2018)). In other words, the finding that treated banks responded to the ACC policy with a decrease in credit to SMEes is consistent with their reduced lending to high risk firms.[16]

[16]Cahn, Girotti, and Salvadè (2018) present results linking firm size with their risk profile: while the average rating class 3 firm has total assets worth EUR 8.623 million, firms rated 4 have average total assets worth EUR 6.293 million and those rated 5 have average total assets worth EUR 4.265 million

Table 6 – Heterogeneity in Risk Taking by Banks
Treated banks are above 90th percentile

Dependent variable:	***Log(MLT Credit)***
$Treated_b \times ACC_t \times LowRisk_{f,t}$	0.028^{*}
	(0.017)
$Treated_b \times ACC_t$	-0.038^{*}
	(0.020)
$ACC_t \times LowRisk_{f,t}$	-0.039
	(0.037)
$Treated_b \times LowRisk_{f,t}$	-0.319^{***}
	(0.044)
$LowRisk_{f,t}$	0.069
	(0.033)
Bank FE	Y
Firm × Month FE	Y
N	15,539,544
R^2	0.548

Note: 1. Treated banks are defined using the baseline definition, i.e. 90th percentile over total credit with a three-month continuous lag as of January, 2012.
2. Standard errors are clustered at bank × month-level and sector-level. Results are robust to clustering at bank × month-level as well.

In total, we find: i) heterogeneous reaction across treated banks depending on the concentration of newly eligible collateral in their portfolio; ii) heterogeneous effect on credit across firms depending on their size and risk profile. The ACC did not stimulate credit to SMEs contrary to the advertized purpose of the program. Our findings suggest capital injection to banks when firm demand is low can have unexpectedly distortionary effects, like strategic risk-taking by some banks and subsequent changes in market structure.

Table 7 – Does ACC Benefit SMEs?
Treated banks are above 50th percentile

Dependent variable:	***Log(MLT Credit)***	***Log(Total Credit)***
	(1)	(2)
$Treated_b \times ACC_t \times firmSME_{f,t}$	-0.176^{**}	-0.342^{**}
	(0.068)	(0.136)
$Treated_b \times ACC_t$	0.200^{***}	0.375^{***}
	(0.073)	(0.142)
$ACC_t \times firmSME_{f,t}$	0.145	0.348^{***}
	(0.115)	(0.131)
$Treated_b \times firmSME_{f,t}$	0.0255	0.351^{***}
	(0.083)	(0.115)
$firmSME_{f,t}$	-0.210^{*}	-0.515^{***}
	(0.121)	(0.103)
Bank FE	Y	Y
Firm × Month FE	Y	Y
N	15,539,544	15,539,544
R^2	0.548	0.504

Note:
1. Treated banks are defined using the baseline definition, i.e. 50th percentile over total credit with a three-month continuous lag as of January, 2012. Results are robust to other definitions.
2. Standard errors are clustered at bank × month-level and sector-level. Results are robust to clustering at bank × month-level as well.

5. Robustness Checks

In order to check the robustness of our results, we tested several alternative definitions of treatment and model specifications:

- Alternate definitions of treatment: The Additional Credit Claims policy was announced in December 2011 and implemented 2 months later in February 2012. There is room for argument that private banks could change their lending portfolio in the interim period to benefit from the policy change. Therefore we test the robustness of our results by defining banks as treated if their portfolios are exposed to ACC targeted 4-rated loans for a continuous period prior to the announcement (December 2011). In addition, we test a 6 month duration instead of 3 month. In all, treatment has 4 possible definitions. We confirm heterogeneous effects across treated banks and firms. We provide detailed results in a separate online appendix.
- Alternate standard errors clustering: at bank×time, bank×time and sector levels. Results hold for both levels of clustering.

6. Conclusion

Using a bank-firm level credit registry combined with firm-level balance sheet data we establish the presence of heterogeneity in the effects of unconventional monetary policy transmission. We examine the consequences of a loosening in the collateral eligibility requirement for credit refinancing in France. The policy was designed to affect bank lending positively. We expect a linear increase in lending and an additional increase in loans to firms with newly acceptable rating. We find that the banks most affected by the policy respond by cutting credit. These are small, risk-averse banks whose foremost concern after the recession was to strengthen their balance sheets. As expected, moderately affected banks respond by expanding credit. Banks least affected by the policy respond with a reduction in credit to low risk borrowers in reaction to the change in the market structure triggered by the policy. None of these results overturn the overall expansion in credit expected from loose unconventional monetary policy. But they do illustrate the fundamental heterogeneity in response across banks, in response to accompanying changes in market structure. Not all banks increased credit, and not all risky firms had improved access to credit. There could in fact exist a distribution of banks portfolio under which the policy could end up lowering aggregate credit supply, and heterogeneity would matter in the aggregate to a first order.

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Appendix

Main Graphs

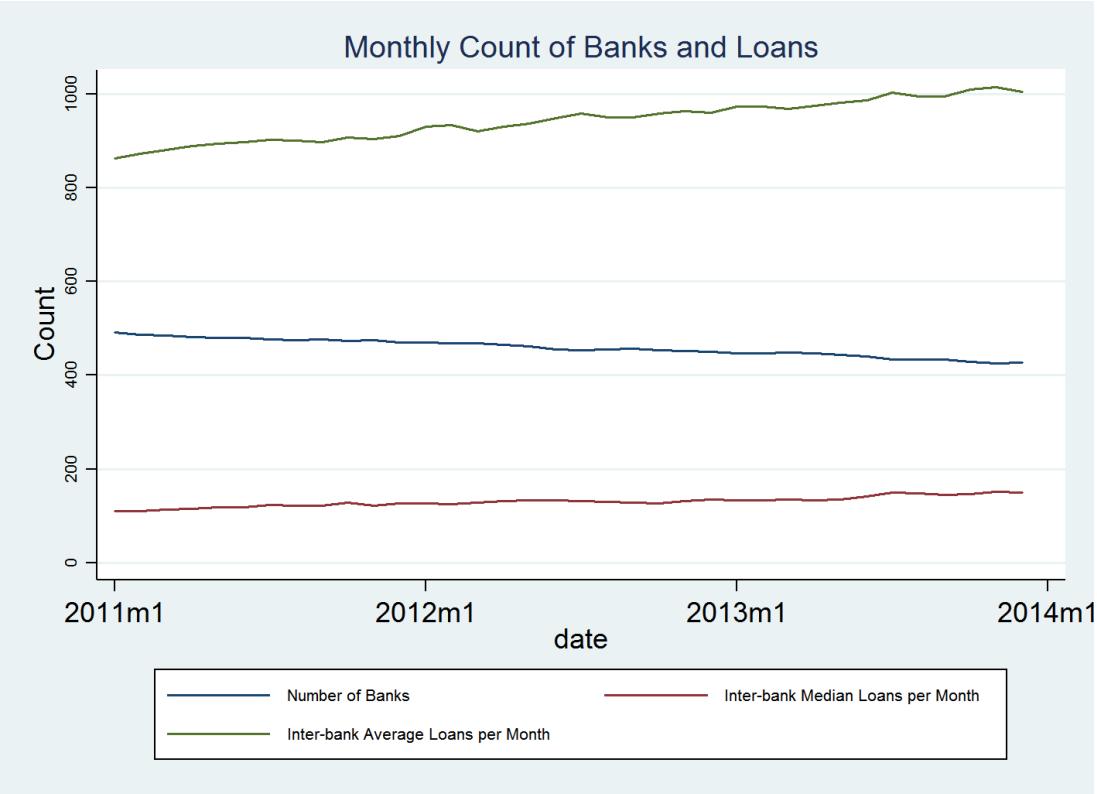

Figure 1 – Monthly Count of Banks and Loans

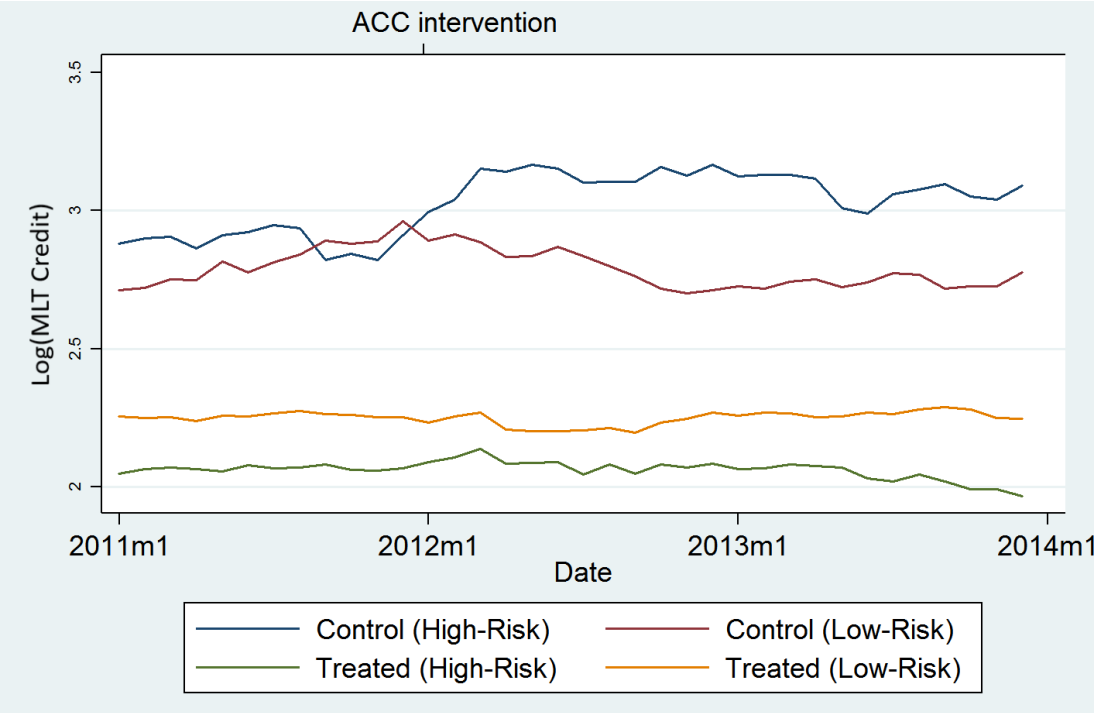

Figure 2 – Evolution of Log (MLT Credit) across Treated and Control across Low and High Risk Firms (Treated: above 50th percentile for 3 months as of January, 2012)

Interpreting Triple Interaction Coefficients

This section is meant to facilitate the interpretation of a difference-in-differences-in-differences estimation. We shall look at each coefficient individually as well as at pairs of coefficients to interpret the results. We shall consider the extended baseline (i.e. equation (4)). To simplify our understanding, we shall replace $FirmSpec_{f,t}$ with $LowRisk_{f,t}$, a dummy that takes a value 1 whenever a firm in a bank-firm pair is a low-risk firm and 0 if it is a high-risk firm.

$$\begin{aligned} Credit_{b,f,t} = \beta_1 \cdot (Treated_b \times ACC_t \times LowRisk_{f,t}) \\ +\beta_2 \cdot (Treated_b \times ACC_t) + \beta_3 \cdot (LowRisk_{f,t} \times ACC_t) \\ +\beta_4 \cdot (Treated_b \times LowRisk_{f,t}) \\ +\beta_5 \cdot LowRisk_{f,t} + \beta_6 \cdot Treated_b + \beta_7 \cdot ACC_t + \alpha_b + \alpha_{f,t} + \epsilon_{b,f,t} \end{aligned}$$

Interpreting coefficients individually:

β_1: Effect of the policy on "treated" banks' lending to low-risk firms
β_2: Effect of the policy on "treated" banks' lending to high-risk firms
β_3: Effect of the policy on "control" banks' lending to low-risk firms
β_4: Lending by "treated" banks to low-risk firms in period(s) without the policy (these could be before and/or after the policy, if the policy lasts for a specific duration in the data)
β_5: Lending by "control" banks to low-risk firms in period(s) without the policy (these could be before and/or after the policy, if the policy lasts for a specific duration in the data)
In the presence of time and bank fixed effects, the following coefficients will be omitted:
β_6: Lending by "treated" banks to high-risk firms in period(s) without the policy (these could be before and/or after the policy, if the policy lasts for a specific duration in the data)
β_7: Effect of the policy on "control" banks' lending to high-risk firms

Interpreting pair-wise coefficients:

$\beta_1 + \beta_2$: Effect of the policy on "treated" banks' lending to both low- and high- risk firms, i.e. across-the-board lending by "treated" banks after the policy
$\beta_1 + \beta_3$: Difference in credit supply by "treated" and "control" banks after the policy to low-risk firms, i.e. heterogeneity in bank response to the policy
$\beta_1 + \beta_4$: Effect of the policy on "treated" banks' lending to low-risk firms relative to the pre-policy period
$\beta_3 + \beta_5$: Effect of the policy on "control" banks' lending to low-risk firms relative to the pre-policy period
$\beta_4 + \beta_5$: Difference in credit supply by "treated" and "control" banks before the policy to low-risk firms, i.e. credit market conditions for low-risk firms prior to the policy
In the presence of time and bank fixed effects, we will be unable to draw the following interpretations:
$\beta_2 + \beta_6$: Effect of the policy on "treated" banks' lending to high-risk firms relative to the pre-policy period
$\beta_2 + \beta_7$: Difference in credit supply by "treated" and "control" banks after the policy to high-risk

firms, i.e. heterogeneity in bank response to the policy
$\beta_3 + \beta_7$: Difference in lending by "control" banks to low- and high- risk firms after the policy, i.e. search-for-yield by "control" banks after the policy
$\beta_4 + \beta_6$: Difference in lending by "treated" banks to low- and high- risk firms in the pre-policy period