Centre for Banking Research
Bayes Business School (formerly Cass)
City, University of London

Loan Evergreening Through Banks' Lenses: Evidence from Credit Product-Level Data

Cecilia Dassatti

Francesc Rodriguez Tous

Rodrigo Lluberas

October 2021

Centre for Banking Research Working Paper Series

WP 02/21

Loan evergreening through banks' lenses: Evidence from credit product-level data*

Cecilia Dassatti † Francesc Rodriguez-Tous ‡ Rodrigo Lluberas §

October 20, 2021

Abstract

Banks' incentives to implement a policy of forbearance in order to avoid increasing their loan loss reserves leads to loan "evergreening", through which they grants additional credit to firm when it faces repayment difficulties. Exploiting granular data of different types of corporate loans, we identify banks' loan evergreening strategies as instances when firms receive bullet loans of a similar amount to their contemporary amortizing loan repayment. We study the determinants of these strategies and their consequences. The main bank-level determinant is solvency: lower solvency leads to more loan evergreening. When a bank provides loan evergreening to a firm, it tends to also increase amortizing credit to it in the following months. Firms receiving loan evergreening are more likely to end up delinquent, especially when provided by banks with low solvency. On the other hand, when firms borrow from two or more banks, they are more likely to become delinquent with the bank that did not provide loan evergreening. Finally, we find some evidence of crowding-out credit to other firms.

JEL: G21, G28, E44.

Keywords: banks, credit, loan evergreening, regulatory arbitrage.

*The views expressed in this article are the sole responsibility of their authors and do not compromise the institutional position of the Central Bank of Uruguay. We are extremely grateful to the Central Bank of Uruguay for providing the data for this study. We thank Eugenia Andreasen (discussant), Fernando Borraz, Felipe Carozzi, Julio Crego, Angela Gallo, Julio Garín, Gerardo Licandro, Jorge Ponce, and Francisco Urzua for the helpful comments. We also want to thank Pablo Bazerque, Germán Ezquerra, Silvia Mayer, Alejandro Pena, Rossanna Díaz and Sandra Libonatti for their insights on the topic. A previous version of this paper was circulated with the title "Zombie lending: How many wondering souls are there?"

†Banco Central del Uruguay; cdassatti@bcu.gub.uy

‡Bayes Business School (formerly Cass); Francesc.Rodriguez-Tous@city.ac.uk

§Banco Central del Uruguay; rlluberas@bcu.gub.uy

1 Introduction

Banks' reluctance to realize losses when their borrowers experience financial distress may lead to what is known as *loan evergreening*, i.e., to extend the maturity of or roll over the credit to troubled firms. This allows banks to postpone the recognision of losses and improves their capital position and profits in the short-run, at the expense of allocating lending to more healthy firms.

This type of lending behavior has been suggested as an important factor in Japan's Lost Decade (Peek and Rosengren (2005), Caballero et al. (2008)) and Europe's poor performance after the financial crisis (Acharya et al. (2019), Blattner et al. (2019), Tracey (2019)). The mechanism underlying these claims states that misdirected lending depresses innovation, investment, employment, and productivity by steering lending towards less productive firms and thwarting healthy competition.

Understanding when, how, and why banks engage in this practice, then, is crucial for policymakers in general and bank supervisors in particular. However, observing which strategies banks might use to avoid realising losses in the short term, as well as their regulatory incentives, is empirically challenging: one needs very granular-level data and a reasonable certainty of the motives of the bank to follow this lending practice.

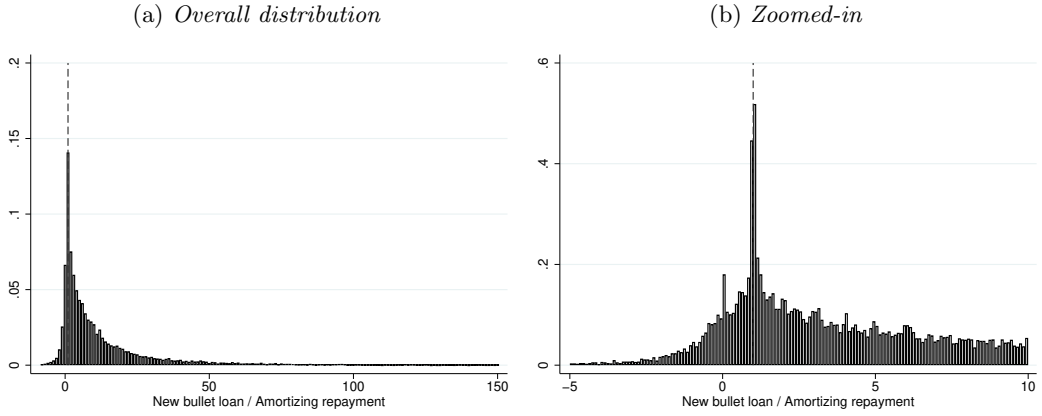
In this paper, we study loan evergreening strategies that arise from banks' incentives to delay loan-loss provisions. When firms are late in their loan repayments, loan-loss provisions—profits that banks have to set aside to cover expected loan losses—increase in a convex way. Banks thus have an incentive to prevent firms from becoming delinquent. One way to do so is engaging in regulatory arbitrage: granting bullet loans—which only require interest payments before maturity—to those firms in order to bring the repayment back on schedule—or to avoid the delay altogether. This strategy to delay loan-loss recognition is the one we study in this paper; we refer to this as a loan evergreening strategy.

We thus depart from much of the existing literature that concentrates on firms' profitability and instead look at the loan products that banks offer to firms. We do so by using the Uruguayan

credit register which provides a monthly exhaustive record of all loans granted in the financial system with detailed information at credit-product level. In particular, we can see how much a firm is borrowing across different credit products—such as different types of loans—from each bank at the end of each month, as well as whether the firm is late on its repayments. This data offers unique insights about banks' behaviour, and it is available for a several years; we focus on the period 2006–2018.

We compare the amount of a new bullet loan received by a firm with the amount of amortizing loan repaid in the same month to the same bank. Bullet loans are very common: around 25% of firms with amortizing loans also have a bullet loan in our sample. To identify the loan evergreening motive, we focus on cases where firms use the bullet loan to repay the amortizing loan. To do so, we compare the amount received by a particular borrower from a particular bank at a particular month with the amount of amortizing loan repaid on the same month by the same borrower to the same bank. We plot the ratio of these two quantities in Figure 1. We can observe an "excess" mass around 1: in many instances, the new bullet loan and the amount repaid of the existing amortizing loan are very similar. In order to capture the loan evergreening motive, we focus on these cases.

Figure 1: ***New bullet loans as proportion of amortizing loan repayment***



This figure shows the distribution of the ratio of new bullet loans as a proportion of monthly amortizing loan repayments. The left panel shows the distribution between the 10th and the 90th percentile; the right panel shows the distribution more focused around the values of interest. The vertical dashed line corresponds to the value 1, which is when the new bullet loan amount is exactly equal to the repayment of the amortizing loan in that particular month.

The proportion of loan evergreening cases in the economy is counter-cyclical, with a correlation with GDP growth of -0.55. To further test our measure, we analyse the proportion of loan evergreening to the dairy sector around 2014, when it suffered a large negative external shock. The proportion of cases increases significantly around this period, substantially more than for the overall economy and for the livestock sector.

We then proceed to analyse the loan- and bank-level determinants of this type of loan evergreening strategy by using linear probability models and a rich set of fixed effects. The granularity of the data allows us to saturate the analysis with Firm×Month fixed effects, which controls for firm characteristics, and hence allows for a better causal interpretation of which bank and loan characteristics drive this strategy. Among several bank-level characteristics, solvency—defined as capital over risk-weighted assets—is the only one consistently relevant; in particular, lower solvency is associated with a higher likelihood of engaging in loan evergreening. Economically, a one-standard deviation lower solvency implies a 50% increase in the probability of engaging in this type of loan evergreening.

The importance of solvency varies through the cycle: interestingly, it becomes more important during booms. Since this loan evergreening strategy is countercyclical, this suggests that in good times less solvent banks use this strategy to manage capital, while in bad times everyone does. This is in contrast with previous literature which has suggested that it is precisely in bad times when weak banks gamble by pushing current losses further in the future. A reason for this difference might be the fact that the loan evergreening strategy that we study is more flexible and hence can be applied earlier in the process of deterioration of the firm.

Loan-level characteristics are also important for determining who obtains loan evergreening. Initial loans below one year of maturity and a higher percentage of USD-denominated credit are more likely to obtain bullet loans to repay them. Moreover, longer bank-firm relationships are more likely to engage in loan evergreening, and this strategy is more likely to be provided by the main bank of the firm.

In general, current loan performance does not affect the probability of receiving loan evergreening. However, after introducing Firm×Month FE, the coefficient for delinquency turns negative and marginally (at 10 or 11%) significant. This tells us that once we focus on a particular firm at a particular month, this firm is *more* likely to receive loan evergreening from the lender where the loan is being paid *on time*, rather than the lender where the loan is already delinquent. Crucially, due to the existence of a public credit registry, all banks can see whether a borrower is delinquent with other banks or not.

We then explore what happens with amortizing credit after a firm receives loan evergreening. Loan evergreening is associated with around 7 percentage points higher amortizing credit growth from the same bank in the following 12 months. The result is quantitatively similar when we extend the window up to two years, although standard errors increase significantly and it is no longer statistically significant. Interestingly, receiving loan evergreening does not change the probability of loan relationship ending in the next year or two.

What happens to future loan performance? We study the likelihood that the firm becomes delinquent a year after receiving an evergreen loan. Without controlling for Firm×Month FE, we find that firms receiving loan evergreening are more likely to be delayed in their repayments after a year. Importantly, with Firm×Month FE, the result reverses: a firm with two or more lending relationships is *less* likely to be delayed in its loan repayment with the bank that previously provided loan evergreening. This change is partly driven by the different sample of firms (from positive to not significant coefficient) and the addition of the fixed effects (from no significance to negative). This difference hints at very different dynamics and motives behind this strategy depending on whether the firm has a single or multiple banking relationships.

The positive association between loan evergreening and subsequent non-performance—when not using Firm×Month FE—is stronger when solvency is low. In other words, weakly capitalised banks seem to provide loan evergreening to ex-post worse firms. Moreover, this association is even stronger when the firm is already non-performing at the moment of receiving the loan evergreening.

This result is mostly concentrated on firms with single banking relationships.

We also explore whether banks might be using this strategy based on the prospect of the borrower obtaining additional lending from other banks, in a mechanism similar to Hu and Varas (2021), since all banks in Uruguay can see the loan performance of borrowers due to the public nature of the credit register. We find some evidence of this phenomenon: a year and a half after obtaining loan evergreening, single-relationship firms are significantly *more* likely to obtain credit from a second bank.

Finally, we ask whether, as a result of this strategy, other firms receive less credit. In order to do so, we study how the level of loan evergreening of a bank in a particular industry affects credit to firms not receiving loan evergreening in the same industry. When looking at 4-digit industries, we find evidence that banks with more loan evergreening in a particular industry are more likely to break existing lending relationships with firms not receiving loan evergreening from the same industry.

Our paper contributes to several strands of the literature. It relates to the broader literature of misdirected credit and zombie lending by studying the underlying workings of this type of behaviour. This literature starts with the seminal papers of Peek and Rosengren (2005) and Caballero et al. (2008) studying the case of Japan. Peek and Rosengren (2005) show that the incentives to avoid realizing losses lead banks, especially weakly-capitalised, to extend credit to troubled borrowers. Caballero et al. (2008) explore the implications of this phenomenon for firm productivity and competition. Empirically, they show that industries with a higher share of troubled (zombie) firms exhibit lower productivity and investment.

Since around the time of these two papers, a series of articles have further explored the Japanese case (Gianneti and Simonov (2013), Hoshi (2006), Fiordelisi et al. (2021)) and suggested similar phenomena in Europe (Acharya et al. (2019), Acharya et al. (2020), Andrews and Petroulakis (2019), Homar et al. (2015), Steinkamp et al. (2017), Storz et al. (2017), Tracey (2019)) and other countries (Adalet McGowan et al. (2017), Jorda et al. (2020)). There is, however, some debate about

whether the increase in misdirected lending can be clearly linked to low productivity (Schivardi et al. (2020), Schivardi et al. (2021)).

A more recent strand of the literature utilizes granular data to understand the lending behaviour of banks and the causes and consequences of loan evergreening. Bonfim et al. (2020) use the Portuguese credit register and find that both low profitability and a solid and more exclusive lending relationship with the borrower make a bank more likely to refinance troubled borrowers, although supervisory inspections prevent some of these cases. Mourad et al. (2020) study delinquent loans in Brazil and assess the likelihood of loan restructuring—what is known as forbearance. Most restructurings happen soon after the loans become delinquent, and they are more likely to happen when the loan has no collateral or when the bank has other—non-delinquent—loans with the firm. Tantri (2021) investigates agricultural loans by a government-owned bank in India and focuses on instances where loans are renewed quickly by the same loan officer that provided the previous one. The study finds that these loans tend to default after the loan officer has shifted branches, consistent with loan officers providing loan evergreening in order not to realize losses. Bergant and Kockerols (2020) study the Irish credit register and focus on cases where the bank grants forbearance to loans by increasing the maturity or the available credit. More capital-constrained banks tend to forbear more to riskier borrowers, and this is effective at preventing default but only in the short run.

Our paper adds to the literature an exhaustive understanding of when, how and why banks engage in loan evergreening without incurring in regulatory costs. The strategy of loan evergreening—providing bullet loans to repay existing amortizing loans—provides better regulatory flexibility, since other measures of loan evergreening, such as restructuring a loan, come with increased provisioning in our setting. Moreover, given the granularity of the data, we study the determinants of the strategy, its consequences in terms of credit supply, loan performance, and access to new lenders, as well as for firms that do not receive it. Our findings are important especially to inform banking supervision and avoid misdirected lending and its consequences for the real economy.

We also shed some light to the theoretical debate about the determinants of loan evergreening.

Bruche and Llobet (2014), for instance, emphasize the gambling-for-resurrection motive to engage in loan evergreening. Our results suggest that while bank capital is an important determinant, it is less so during recessions, and this is a practice that banks substantially above the regulatory minimum engage in. On the other hand, Hu and Varas (2021) suggest that loan evergreening and even zombie lending are a consequence of relationship lending: for borrowers with sufficient reputation, banks will roll over loans to camuflage their problems with the expectation that these borrowers will obtain funding from the market. Our findings point to this mechanism as one of the reasons to engage in loan evergreening, especially for single-banking relationship firms.

Organization. The outline of the paper is the following. Section 2 describes the data. Section 3 describes how we identify instances of loan evergreening. Section 4 describes our empirical approach. Section 5 focuses on the results. Finally, section 6 concludes.

2 Data

We use two databases from the Central Bank of Uruguay in its role as banking regulator and supervisor. Both datasets cover the period from January 2006 to December 2018 and are available on a monthly basis.

The first dataset is the Credit Registry of the Central Bank of Uruguay ("Central de Riesgos Crediticios"), which is an exhaustive record of all loans granted in the system with detailed information at the loan level.[1] It contains information about the identity of the borrower, the country of residence, the economic sector to which the firm belongs, all the financial institutions which it has a loan with, the amount of the loan, the currency of the loan, its maturity, and whether the firm is delinquent.

The second dataset contains balance sheet and income statement information, such as total assets, capital, liquid assets, and profitability, of all the financial institutions operating in the

[1] At the beginning of our sample, the Registry had a minimum reporting threshold of 60,000 Uruguayan Pesos (approximately USD 2,000); this threshold was removed on June, 2013. As we focus on loans to firms, we observe virtually all lending.

Uruguayan financial system.

Our dataset includes 1,950,189 observations of amortizing loans granted by 14 banking institutions to a total of 39,698 firms during the period from 2006 to 2018. During this period, there are some mergers and acquisitions between institutions which are treated as if they occurred at the beginning of the year when they took place.[2] There are other financial institutions that have been excluded from the sample because they have private or institutional sources of funding and focus on lending to households.

3 Identifying loan evergreening

3.1 Loan evergreening strategy

A rather basic loan evergreening is to provide bullet loans—that is, loans where the principal is repaid at maturity and not during the life of the loan—to repay part or all the existing amortizing loans. This typically leads to extending the duration of the total credit exposure without changing the exposure. Identifying these cases, however, is challenging as it requires very disaggregated data.

Our approach is to identify all the instances where a new bullet loan is granted. We then match these instances to existing amortizing loans, and create a ratio of the amount of the new bullet loan over the repayment of the amortizing loan. The data is at bank-firm-month level, which means that we compare new bullet loans with the repayment of amortizing loans by the same firm to the same bank in the same month. We plot two histograms of this ratio in Figure 1. The left panel shows the distribution from the 10th to the 90th percentiles, while the right panel focuses on values between -5 and 10.

In both cases, there is an "excess" mass around 1; 1 corresponds to a situation where the amount of new bullet loan and the amount of amortizing loan repaid in the same month perfectly coincides.

[2]The exact dates are the following: April 2011, acquisition of Crèdit Agricole by BBVA; December 2012, merger of ABN AMRO with Santander; December 2013, acquisition of Lloyds Bank by Banque Heritage; November 2015, acquisition of Discount Bank by Scotiabank.

The general distribution makes sense: it is skewed to the right, as in some cases the amount of amortizing loan repaid is very small; there are some negative values, as sometimes there is also a new amortizing loan at the same time as the bullet loan (i.e., the amount repaid is negative); nevertheless, most values are above 0. The excess mass around 1, however, can only be explained as a loan evergreening strategy with the objective of extending the duration without increasing the total credit. We classify these cases—in particular, cases that fall between 0.5 and 1.5—as loan evergreening and keep them with this classification for the duration of the bullet loan.[3]

Banks have an incentive to engage in this type of strategy if they believe that the firm might be late in their repayments. The reason is that loan repayment delays carry a cost in terms of loan-loss provisioning; moreover, this cost increases non-linearly as the delays carry on. Therefore, banks might provide bullet loans to alleviate potential repayment problems of their borrowers, and hence save the cost of capital associated to provisions by engaging in regulatory arbitrage. In Appendix Section B, we provide some numerical examples about how the repayment delays translate into higher capital costs.

The legality of this loan evergreening strategy is difficult to categorise. It is somehow against the spirit of the regulation. If a borrower faces difficulties to repay the loan, the bank should restructure it. Restructuring the loan, however, imposes increased provisioning to the bank. The problem lies on the fact that there are many different reasons why banks could provide a bullet loan, so on an individual basis it is difficult to prove that the only reason to provide a loan in a particular circumstance is to avoid restructuring. In some particular instances of a bank following this strategy, the supervisor has told the bank to restructure a loan. Nevertheless, the thread of supervisory action might not be enough to deter banks. We provide a stylised model in Appendix Section C that shows how banks might balance this trade-off.

For our identification, however, we rely on the significant number of cases in which a new bullet loan coincides with the amortizing loan repayment; therefore, we are confident that the

[3] 70% of bullet loans have a maturity of 181 days or less, while less than 0.5% of bullet loans have a maturity over a year.

vast majority of cases that we select are indeed instances of loan evergreening. We might miss other loan evergreening cases—for instance, when banks provide a bigger bullet loan—but their identification is nearly impossible with the available data. Misclassification will in general bias our results downwards.

We plot the quarterly percentage of loan evergreening instances for our sample period in Figure 2. To calculate the percentage, we compare the number of different bank-firm relationships where we observe a loan evergreening strategy and we divide this by the number of bank-firm relations in the amortizing loan market. The figure also shows the annual GDP growth of the economy (right vertical axis). The two variables are negatively related: the correlation is -0.5493 and highly statistically significant. There is also a substantial increase in loan evergreening during the 2007-09 global financial crisis, coinciding with a sharp drop in GDP growth—in fact, this is the fastest increase in the sample, tripling the rate from mid-2007 to beginning of 2010. Latter in the period, GDP growth has been lower than average, and at the same time loan evergreening has increased. By the end of our sample, 2% of the amortizing loan observations are receiving loan evergeening.

These numbers—between 0.5% and 2% of the cases—are low compared to the literature on zombie lending, which estimates figures around 10%. It is important to emphasize that we are capturing a particular type of strategy that, as we show in the empirical section, is not necessarily restricted to firms under a strong financial distress. It is a way for banks to engage in regulatory arbitrage and avoid temporary increases in provisioning and hence negative pressures on their capital ratios. Therefore, the two numbers are difficult to compare because they measure different things.

3.2 The dairy sector

We test our measure of loan evergreening by studying the dairy sector around the year 2014. During those years, the sector—which ranks at the top in terms of exports in Uruguay—suffered a substantial negative shock due to a combination of external factors, such as China's economic

slowdown and the economic crisis in Venezuela.[4] If our measure of loan evergreening captures the types of situations that we have explained, we would expect an increase in loan evergreening for the dairy sector coinciding with the negative shocks due to more firms in this sector suggering financial difficulties.

We show the evolution of the loan evergreening cases in Figure 3. In Panel (a), we compare it to that of the whole economy; in Panel (b), we compare it to the livestock sector, which is very similar to the diary sector but was isolated from the shock. These industries are defined at the 4-digit level. The values are normalised to 2013q4. As the Figure shows, there is a substantial increase in loan evergreening in the dairy sector, well above that for either the whole economy or, more importantly, the livestock sector. Loan evergreening in the livestock sector, in fact, remains quite constant from 2014 onwards, while it more than doubles for the dairy sector. These stylised facts are consistent with our measure capturing loan evergreening behaviour by banks.

4 Empirical Strategy

4.1 Descriptive Statistics

In Table 1 we report descriptive statistics of the key control variables. Panel (a) shows the loan-level variables; Panel (b) shows bank-level variables.[5] The table provides the summary stats for the whole sample as well as for the sample of loan evergreening.

Most amortizing loans have maturities of over one year: only 14.3% of observations have maturities below one year. The number is somehow higher in the sample receiving loan evergreening. Most loan observations are denominated in USD, and in the case of loan evergreening observations, more than 75% have all the credit in USD. Unsurprisingly, most of the observations (over 85%) belong to the top bank of the firm, and this number increases to 90% for loan evergreening instances. In the sample, the average continuing bank-firm amortizing lending relationship is 13.7

[4] We provide more details on the situation in Online Appendix Section D.
[5] Online Appendix Section A details the definitions of these variables.

months (2.618 in logarithms) while the length is much higher when the firms are receiving loan evergreening: 31.5 months (3.450 in logarithms). Finally, around 7.4% of cases have repayment delays over 60 days, and, importantly, this percentage is almost identical (7.8%) for the sample of loan evergreening. In other words, this strategy is also used for firms that are not (yet) delinquent.

Moving on to Panel (b), bank solvency is on average 13.5%, only slightly higher (13.9%) when banks engage in loan evergreening. Size is, on average, higher for the sample of loan evergreening observations, while credit and liquidity are slightly lower. Provisions and return on assets, on the other hand, are lower for the total sample, compared to the loan evergreening sample.

4.2 *Determinants of loan evergreening*

We start our analysis looking at the determinants of loan evergreening. We do so by estimating specification 1.

$$Loan\ Evergreening_{b,i,t} = \beta_0 + \beta_1 X_{b,t-3} + \beta_2 Y_{b,i,t} + fe_b + fe_{i,t} + \varepsilon_{b,i,t} \tag{1}$$

The dependent variable takes the value of 1 if firm i that gets a bullet loan from bank b in month t is classified, according to our definition, as loan evergreening, and 0 otherwise. As we use the variation at bank-borrower-month level, we are able to saturate the specification with bank and Firm×Month FE. The variables of interest are $X_{b,t-3}$ (bank-level) and $Y_{b,i,t}$ (loan-level and bank-firm-month) variables. In particular, we focus on Solvency, Size, Credit (over assets), Liquidity, Provisions, and Return on Assets as important bank characteristics determining loan evergreening. Previous literature analysing incentives of banks to extend credit to distressed firms finds that low bank capital is an important determinant of such incentives. Therefore, we expect the coefficient of Solvency—the ratio of regulatory capital over risk-weighted assets—to be negative and statistically significant. Bank variables are lagged three months.

We also introduce loan-level information that could be relevant in providing loan evergreening. We control for whether the amortizing loan is short-term (up to one year), the percentage of credit

denominated in USD, a dummy for the bank providing the highest amount of credit to the firm, the length of the banking relationship, and whether the firm is delayed in the repayment of the loan to the bank by more than 60 days (i.e., delinquent). When focusing on loan-level information only, we further saturate the specification with Bank×Month FE.

We run additional tests—for instance, we seek to understand whether the importance of Solvency varies through the cycle, or whether it is intermediated by loan-level characteristics—based on this specification. Moreover, we test the robustness of the coefficients of the bank-level variables by running the most-saturated specification with every combination of the rest of the controls. In the analysis, we show the results by progressively adding controls and fixed effects.

4.3 *Intensive margin: Lending*

After understanding the determinants of loan evergreening, we look at whether loan evergreening leads to more or less credit in the future, particularly by the bank providing loan evergreening. We explore this issue using specification 2.

$$\Delta Log(Credit_{b,i,t+12}) = \beta_1 Loan\ Evergreening_{b,i,t} + \beta_2 Y_{b,i,t} + fe_{b,t} + fe_{i,t} + \varepsilon_{b,i,t} \tag{2}$$

Where the dependent variable is the change in (the logarithm of) amortizing credit between month t and month $t+12$ provided by bank b to firm i. We use the same controls as in the model of loan evergreening determinants. Importantly, we are able to saturate the regression not only with Firm×Month FE—and hence control for credit demand—but also use Bank×Month FE, thus controlling for any time-varying bank heterogeneity.

We only focus on amortizing credit, so the credit obtained via bullet loans is not considered. Moreover, we run the same regression with a different dependent variable: a dummy variable equal to 1 if credit goes up in the following twelve months, 0 otherwise. In both cases, we show graphically the coefficient of interest for time horizons from one to twenty-four months.

A positive β_1 would suggest that banks provide more credit to firms even after these firms receive

a bullet loan to repay existing amortizing loans. Note that these are firms that have received credit in the form of a bullet loan; therefore, without any other motives, these firms should be less likely to receive new credit in the following year.

4.4 *Extensive margin: End of banking relations*

The previous specification studies the intensive margin of lending; specification 3 focuses on whether banking relationships that engage in loan evergreening are more or less likely to terminate.

$$End_{b,i,t+12} = \beta_1 Loan\ Evergreening_{b,i,t} + \beta_2 Y_{b,i,t} + fe_{b,t} + fe_{i,t} + \varepsilon_{b,i,t} \tag{3}$$

The dependent variable is a dummy variable that equals 1 if the existing relationship between bank b and firm i terminates in twelve months, 0 otherwise. We can saturate the regression in the same way as in the intensive margin case. A negative β_1 would suggest that banks are more likely to keep lending relationships once they provide loan evergreening.

4.5 *Loan performance*

How do firms perform after receiving loan evergreening? We explore this question by using specification 4.

$$Delinquent_{b,i,t+12} = \beta_1 Loan\ Evergreening_{b,i,t} + \beta_2 Y_{b,i,t} + fe_{b,t} + fe_{i,t} + \varepsilon_{b,i,t} \tag{4}$$

The dependent variable, $Delinquent_{b,i,t+12}$, is a dummy variable that equals 1 if firm i is delayed by over 60 days in its loan repayment to bank b in twelve months, 0 otherwise. We add the same controls as before—including bank-level variables when we are not saturating with Bank×Month FE—with the difference that the current repayment status of firm i to bank b is always included.

A positive β_1 would suggest that firms receiving loan evergreening are more likely to end up having trouble to repay the loans. The addition of Firm×Month FE changes the interpretation as

it explores the within-firm variation: it shows whether a firm with two banking relationships—to keep it simple—that receives loan evergreening from one bank but not from the other is more or less likely to be in loan repayment delay in twelve months *with the bank from which it received loan evergreening.*

4.6 *Banking relationships*

Are firms receiving loan evergreening more likely to subsequently gain access to credit from more banks? Given the fact that banks can look at the credit register to see whether a firm has been performing in the past or not, loan evergreening might allow a momentary boost in performance which may lead other banks to provide new credit. We explore this question by using specification 5.

$$MultipleRel_{b,i,t+x} = \beta_1 Loan\ Evergreening_{b,i,t} + \beta_2 Y_{b,i,t} + fe_{b,t} + fe_{i,t} + \varepsilon_{b,i,t} \tag{5}$$

The dependent variable, $MultipleRel_{b,i,t+12}$, is a dummy variable that equals 1 if firm i obtains lending by more than one bank in $t+x$, 0 otherwise. This specification is run for different values of x and only for firms that, at t, receive amortizing loan from only one bank. We add the same loan controls as before and saturate the specification with Firm, Industry×Time, and Bank×Month FE.[6] A positive β_1 would suggest that firms receiving loan evergreening are more likely to obtain funding from additional banks in the future.

4.7 *Credit displacement*

After exploring what happens to bank-firm relationships when bank provides loan evergreening, we move to study what happens to firms that do not receive this assistance. In particular, we use specification 6 to study whether these firms receive less credit as a result.

[6] We cannot use Firm×Month FE because of the single-banking relationship sample but industries are defined at 5-digit level; we have around 300 different industries.

$$\Delta Log(Credit_{b,i,j,t+12}) = \beta_1 \%Loan\ Evergreening_{b,j,t} + \beta_2 Y_{b,i,t} + fe_{b,t} + fe_{i,t} + \varepsilon_{b,i,t} \quad (6)$$

The dependent variable, $\Delta Log(Credit_{b,i,t+12})$, is the same as in specification 2. However, in this regression we look at the subsample of bank-firm relations not engaging in loan evergreening. The variable of interest is $\%Loan\ Evergreen_{b,j,t}$, which is the percentage of credit (amortizing loans) for loan evergreening relationships that bank b is providing to broad sector / industry j at month t. β_1 would indicate that when banks engage in this type of lending, they reduce credit supply to the other firms. We use three different definitions of the variable of interest: one at bank level, the second one at bank-broad-sector level, and the third one at bank-5-digit industry level. As banks tend to specialise in giving credit to specific sectors, if they provide a higher amount of loan evergreening then this might result in less credit for the other firms in a given sector.

5 Results

5.1 *Determinants of loan evergreening*

Table 2 shows the results of estimating equation 1. In this table, we focus on $\text{Solvency}_{b,t-3}$ as the main variable of interest. In Column 1, we show the coefficient only using Bank FE: it is equal to -6.578 and significant at 5%. Economically, this implies that a one standard deviation decrease in the solvency ratio (which is 0.083, or 8.3pp) increases the likelihood of engaging in loan evergreening by 0.546pp. Given that the average prevalence of this strategy throughout the sample is just shy of 1%, this implies an increase of over 50% relative to the unconditional probability.

In columns 2 to 4 we subsequently introduce additional FE: Month, Firm, and Firm×Month. The coefficient stays negative and significant. We add other important bank controls in column 5, and loan controls in column 6. The coefficient of $\text{Solvency}_{b,t-3}$ appears very stable. Moreover, we go from explaining 0.7% of the variation to 45.5%, and the coefficient is very similar. Applying the

technique in Oster (2019) shows that the bias-adjusted coefficient for an R-squared of 1 is -5.556.[7] The δ needed for the coefficient to be 0 when the R-squared is 1 would be 10.9; in other words, the unobservable variables would need to be 11 times more correlated to $\text{Solvency}_{b,t-3}$ than the observable controls.

Interestingly, the other bank variables are not significant in determining loan evergreening, except for $\text{RoA}_{b,t-3}$. To study the robustness of the coefficients of the bank variables, we use the approach suggested by Brodeur et al. (2020): we regress each of the six bank controls with every possible combination of all the other controls (five bank controls and five loan controls) using the fixed effects in columns 4 to 6. This means that for each bank variable we run $2^{10} - 1 = 1,023$ different specifications. We plot the distribution of the resulting t-statistics in Figure 4, where the vertical dotted lines correspond to a significance level of 10%.

This figure shows that only the coefficient of $\text{Solvency}_{b,t-3}$ is consistently significant (it is also always negative) at least at 10%. $\text{Size}_{b,t-3}$, $\text{Credit}_{b,t-3}$, $\text{Liquidity}_{b,t-3}$, and even $\text{Provisions}_{b,t-3}$ never or almost never cross the threshold. $\text{RoA}_{b,t-3}$ has an important mass at t-statistics below 1, hence suggesting that the statistical significance found in Table 2 is not very robust. Importantly, this figure confirms the hypothesised motives for engaging in loan evergreening strategies: low-capital banks are the ones more likely to engage in it.[8]

Does the importance of bank solvency for loan evergreening depend on the state of the economy? In order to answer this question, we augment the previous specification by adding a double interaction of $\text{Solvency}_{b,t-3}$ and two different variables: the de-meaned quarterly GDP growth and a dummy variable equal to 1 in quarters with below-the-median GDP growth, 0 otherwise. The results are presented in Table 3.

$\text{Solvency}_{b,t-3}$ is a stronger determinant of loan evergreening when the economy is growing. As

[7] This is calculated as $\beta^* = \tilde{\beta} - \delta(\beta - \tilde{\beta})\frac{R_{max} - \tilde{R}}{\tilde{R} - R}$, where β and R are the coefficient and R-squared of the regression with the least controls (column 1), $\tilde{\beta}$ and $\tilde{R}$ are the equivalent for the regression with the most controls, R_{max} in this case would be 1, and δ is the relative degree of selection on observed and unobserved variables, set to 1 as well.

[8] In unreported results, we run a Probit model with the same dependent variable and bank and firm FE, and the coefficient of Solvency is also negative and significant.

the results in Panel (a) indicate, when GDP growth is at its average level (c. 4%), the coefficient for $\text{Solvency}_{b,t-3}$ is -5.267; a standard deviation increase in GDP growth (c. 2.6pp) is associated with a coefficient of $-5.267 - 0.729 \times 2.6 = -7.138$. The same intuition is presented in Panel (b): the coefficient when the economy is growing faster than the median is stronger in absolute value than in the baseline regressions. The interaction with the Low growth_t dummy is positive and significant; in fact, the p-value of the coefficient for $\text{Solvency}_{b,t-3}$ when GDP growth is low is 0.26 (column 5).

Next, we study the loan determinants of loan evergreening. Table 4 shows the results of the same specification 1 but now keeping the loan variables in each column as we add more fixed effects and controls—including Bank×Month FE in column 5.

The coefficients are fairly consistent—except for $\text{Delinquent}_{b,i,t}$, which we discuss later. Banks are more likely to engage in loan evergreening if the existing loan is short-term, that is, with a maturity below one year. This is consistent with banks engaging in this strategy to make sure the firm is not late in their repayments in the short-term: if the maturity is very long, then the risk of late payment ex-post even if providing loan evergreening is higher. Economically, the probability of loan evergreening is 0.7pp higher for existing short-term amortizing loans. A higher share of the existing lending in USD is also associated to a higher likelihood of loan evergreening, with a very similar magnitude: going from 0% to 100% of USD credit increases the probability by 0.8pp.[9] The bank providing the highest amortizing loan to the firm—in columns 3 to 5 the focus is on firms that obtain credit from two or more banks—is more likely (0.65pp) to engage in loan evergreening. Loan relationships that have existed for longer are also more likely to receive a bullet loan to help with the repayment.[10]

The coefficient for $\text{Delinquent}_{b,i,t}$ varies depending on the specification. This variable identifies loans with more than 60 days of delay in their repayment. For the first two columns, it is not

[9] Having all amortizing credit as USD is not a rare feature for Uruguayan firms.

[10] The correlation between $\text{ST}_{b,i,t}$ and $\text{Log}(\text{months}_{b,i,t})$ is negative but not very strong: -0.21. We repeat the same regression as in column 5 but adding the interaction of these two variables, and the coefficient is positive.

significant and rather low. Once we include Firm×Month fixed effects, however, the coefficient becomes negative, larger in absolute value, and significant at least at 11%. This suggests that, on average, firms that are currently paying on time their loans are not more or less likely to receive loan evergreening; however, when comparing the same firm at the same time, this firm is more likely to receive loan evergreening from the bank that is currently not delinquent with. This again speaks about the motives of this strategy: preventing repayment delays. In this case, the strategy is used to avoid ending up in the same situation as the other bank(s) lending to the firm.

Given the importance of bank solvency and loan variables for engaging in loan evergreening, we ask whether the effect of solvency is heterogeneous depending on the different loan variables. The results are presented in Table 5; all regressions include Firm×Month FE and we add Bank×Month FE in the last column. From all the interactions, only the coefficient for Solvency$_{b,t}$×Top bank is significant: the effect of solvency appears to be especially relevant for the bank providing the highest amount of amortizing credit to the firm.

Summing up, the results on the determinants of loan evergreening show the special relevance of bank solvency, as well as other characteristics of the lending relationship and the existing loan. We proceed then to study whether receiving loan evergreening translates into obtaining more credit in the future.

5.2 *Intensive Margin: Lending*

We show the results of specification 2 in Table 6. The results suggest that credit grows faster a year later among firms that receive loan evergreening than among firms that do not. Quantitatively, loan evergreening is associated with over 7% higher credit twelve months later; the median change in amortizing credit is -26%, so the effect is quantitatively important. This result is not driven by the bullet loans, since they are not included. We only focus on the amount of amortizing loans.

In order to understand this result further, we use a different dependent variable, D(ΔCredit$_{b,i,t+12} >$ 0). This allows us to study instances of actual credit increase and also make sure that the previous

results are not driven by outliers. The results are shown in Table 7. Consistent with the previous table, and even statistically stronger, we find that firms receiving loan evergreening are more likely to see their amortizing loan increase in the next 12 months. The effect is economically strong: on average, we observe an increase in credit 32% of the time (this is for continuing loan relationships only; we study the probability of ending relationships later), and loan evergreening is associated with a 7.5pp higher likelihood, that is, a 23.4% increase with respect to the average.

But what are the dynamics of this result? We answer this question by running the most saturated specification (column 6) for both $\Delta\text{Credit}_{b,i,t+x}$ and $\text{D}(\Delta\text{Credit}_{b,i,t+x} > 0)$ for $x = 1, ..., 24$. In other words, we look at the effect from one month to two years in the future. We plot the results in Figure 5. For the change in lending, the positive effect of loan evergreening seems to plateau after 16 months, and even though the coefficient stays relatively constant after that, the standard errors increase substantially, rendering the effect statistically insignificant after 19 months.

Looking at the probability of obtaining more credit in the near future (Panel b), the magnitude of the coefficient of loan evergreening is highest after 6–8 months; then the coefficient decreases and becomes not statistically significant after 20 months. It becomes statistically insignificant both because the coefficient is smaller and because standard errors are larger. In both cases extending the analysis for a longer horizon increases standard errors since we are removing more observations; when looking at $x = 24$, for instance, we do not look at loan evergreening in 2017 or 2018.

These results show that loan evergreening is associated with higher credit for firms—without taking bullet loans into account. This is in line with the literature on zombie lending that highlight that zombie firms receive more bank credit and hence this can be detrimental for the rest of the firms and potentially the productivity of the industry. That said, in these regressions we have analysed the intensive margin; that is, situations where after 12 or 24 months of loan evergreening the bank is still lending to the firm. We analyse next whether loan evergreening makes it more or less likely to break banking relations after some time.

5.3 *Extensive margin: End of banking relations*

The results of specification 3 are presented in Table 8. The coefficients in the three first columns suggest that when banks provide loan evergreening to firms they are less likely to break the relation off; this result, however, does not survive the introduction of loan controls, and the coefficient becomes positive but very small and highly statistically insignificant. The main reason is the introduction of Top bank$_{b,i,t}$, since the top bank is at the same time more likely to provide loan evergreening and less likely to break the banking relation off. This result is not particular of the 12-month window: in unreported results, the coefficient for different time horizons is consistently centered around 0. In other words, loan evergreening does not seem to affect the likelihood of keeping or breaking a lending relationship.

5.4 *Loan performance*

We next proceed to analyse the loan performance of firms receiving loan evergreening compared to firms that do not receive it. In particular, we ask whether upon receiving loan evergreening a firm is more or less likely to be delayed in its loan repayments to that bank 12 months later.[11] We can investigate, therefore, whether the probability of being more than 60 days late in the loan repayment is different for firms receiving loan evergreening after 12 months.

We present the results of specification 4 in Table 9. From columns 1 to 5, the coefficient for loan evergreening is positive and significant, which suggests that after receiving loan evergreening, firms are more likely to be delayed in their loan repayments twelve months later. This is not driven by differences in loan performance at the moment when banks provide loan evergreening, since each regression includes whether the loan is delinquent or not at t as a control. Economically, the coefficient in column 4 implies that obtaining loan evergreening is associated with 1.1pp higher probability of delinquency in the future. This is not a trivial effect, since the unconditional mean

[11] Throughout the analysis, we have excluded firms with delays over 6 months.

of the dependent variable is below 8% (4.4% if not currently delayed, 57% if currently delayed).[12]

When we introduce Firm×Month FE, however, the coefficient changes its sign: it is now negative and significant. In other words, even though in general loan evergreening is associated with higher probability of repayment delays, once we look at a particular firm at a particular month obtaining loan evergreening from one of its banks but not the other, it is actually less likely to be delinquent in the future with the bank that does provide loan evergreening. In columns 7 and 8 we look into whether the change of the sign is driven by the different sample—Firm×Month FE means that the regression only considers firms receiving loans from at least two banks at the same time—or by the addition of fixed effects alone. Column 7 restricts the specification of column 4 but adding 4-digit-industry×Month FE for single-banking-relationship firms: the results are actually *stronger* than those in column 4. Column 8 repeats the specification but only for multiple-banking-relationship firms: the coefficient is no longer positive, but it is not significant and very small. Therefore, the negative coefficient in column 6 is driven by Firm×Month FE.

We explore these results further. In Table 10, we study the role of Solvency in intermediating the positive association between loan evergrening and future delinquency when using Firm and Industry×Month FE. In columns 1 and 2, we see that this positive association is smaller when solvency is higher. In particular, as solvency is de-medianed, the results mean that for the median bank, providing loan evergreening to a firm is associated to 1.1pp higher probability of repayment delays in 12 months; in contrast, for a bank one standard deviation above the median in terms of solvency, providing loan evergreening is associated with 0.6pp *lower* probability of future repayment delays, although the result is not statistically significant. This hints to a difference on the type of borrowers that more or less solvent banks choose to provide loan evergreening to.

Figure 6 shows the coefficients for specifications analogous to column 2 of this table but focusing only on single bank relationship firms and changing the time horizon. Both the coefficient for Loan evergreening$_{b,i,t}$ and for Loan evergreening$_{b,i,t}$×Solvency$_{b,t-3}$ become stronger in absolute value as

[12]That is, the unconditional probability of being delinquent in 12 months is 8%, and the probability of being delinquent in a year conditional on (not) being currently delinquent is 57% (4.4%).

we increase the time: they peak at around 16 months. In other words, providing loan evergreening is associated to 2pp higher probability of repayment delays 16 months later; the result is null—if anything, 0.6pp lower probability—for banks one standard deviation above the median in terms of solvency.

In columns 3 and 4, we add a triple interaction with $\text{Delinqent}_{b,i,t}$, which equals 1 if the borrower is currently delayed in their repayments, 0 otherwise. This can tell us whether the previous effect is driven by ex-ante performing or non-performing borrowers. As the results show, the effect is driven by both, but to a different degree. The double interaction retains its sign and significance—although the magnitude is slightly smaller; in other words, the result is there for currently performing firms. The triple interaction is also negative and significant, which means that the result is even stronger for currently non-performing firms. Put it differently, more and less solvent banks provide loan evergreening to different firms—at least judged by their future performance—and this is especially true for the pool of borrowers that have repayment delays at the moment of receiving loan evergreening.

In columns 5 and 6 we split the sample in the same fashion as before: column 5 focuses on single-banking relationship firms, column 6 focuses on multiple-banking relationship firms. The results are the same for single-relationship borrowers. For multiple-relationship firms, however, we do not find significant results—even though the p-value for the triple interaction is around 15% and the magnitude is even stronger than in the previous columns.

5.5 *Banking relationships*

An additional motive to engage in loan evergreening from the point of view of the bank is to get the firm to obtain more funding from other banks. Since loan performance is known among banks via the credit register, loan evergreening can be used to maintain a good record in the short run. We show the results of Equation 5 in Figure 7. We plot the coefficient of $\text{Loan evergreening}_{b,i,t}$ in a regression where the dependent variable is whether the firm has more than one banking relationship in the future or not. Since the sample is restricted to single-relationship firms, this tells us whether

the firm is able to increase the number of banks.

The results suggest that after 18 months firms that received loan evergreening are more likely to obtain credit from other banks. Additional unreported analysis show that this coefficient is significant only for borrowers that are performing when they receive loan evergreening. In other words, the loan evergreening might allow them to continue repaying on time and this is associated with future access to other bank lending. This is hence another reason for banks to make sure that their borrowers do not become delinquent.

5.6 *Credit displacement*

What do the previous results, especially the results on credit supply, mean for borrowers that do not receive loan evergreening? We present the results of Equation 6 in Table 11. Panel (a) shows the intensive margin of credit supply, while Panel (b) focuses on the extensive margin. Columns 1 and 2 show the coefficient for a variable capturing the percentage of credit by a bank to firms with whom it is also providing loan evergreening. None of the coefficients appears to be significant, thus suggesting that banks more engaged in loan evergreening do not reduce lending to other borrowers as compared to banks less engaged in loan evergreening.

In columns 3 to 5, we refine the key independent variable by defining it at bank and broad sector level: in other words, the variable captures the percentage of credit by a bank to loan evergreening firms in a particular sector. In columns 6 to 8, we do the same but using a more disaggregated 5-digit industry definition. The intuition is that banks might have internal capital allocation methods that focus on industries; alternatively, some industries might be regionally clustered, and hence when some bank branches are more engaged in loan evergreening they might need to pull back on credit to other borrowers.

We do not find any significant impact on our credit supply variables when the percentage of loan evergreening is defined at bank-broad sector level. Nevertheless, when we look at the percentage of loan evergreening at bank-5-digit industry, we find that banks engaged in more loan evergreening

are more likely to cut existing loan relationships with firms that do not receive this help. These results suggest that although credit misallocation and distorted competition might not be an issue on the aggregate with this type of loan evergreening, it can still create distortions when looking at narrowly-defined industries.

6 Conclusion

This paper studies a type of loan evergreening strategy where banks provide a bullet loan to a firm in order to cover payments of amortization loans, hence avoiding the identification of these as problematic loans. Our results suggest that bank solvency is the single most important bank determinant of this type of strategy. Moreover, the importance of solvency increases during booms, which suggest that the motives have less to do with gambling-for-resurrection and more to avoid reductions in capital ratios in the short-run.

Importantly, whether the amortizing loan is currently performing or not does not appear to be an important determinant. Crucially, however, when analyzing firms with multiple banking relationships, banks are more likely to provide loan evergreening when the borrower is delinquent *with a different bank*.

Credit supply increases for borrowers receiving loan evergreening, even excluding the bullet loan, but only on the intensive margin. The results are quantitatively important, and show an increase in credit of 7.3pp after receiving loan evergreening.

Receiving loan evergreening, however, is also associated to a higher probability of loan delinquency, although this result is restricted to single-bank firms and it is muted for banks with higher solvency ratios. In other words, lower-solvency banks provide loan evergreening to ex-post worse firms, even when controlling for ex-ante loan performance. Moreover, this effect is more pronounced when firms are currently delinquent. The results for multiple-banking-relationship firms, however, is the opposite: these firms are less likely to become delinquent with the bank that is providing the loan evergreening vis-a-vis the bank that does not provide it.

An additional motive to provide loan evergreening appears to be that the borrower will be more likely to obtain credit from other banks in the future. Our results suggest that, for single-relationship firms, firms receiving loan evergreening are more likely to obtain funding from a new bank in the future.

Finally, we do not find strong evidence of credit displacement to other firms; that is, we do not observe in general that banks engaging more in loan evergreening decrease lending to other firms. Nevertheless, we find that banks with a higher percentage of loan evergreening in a particular 5-digit industry are more likely to completely cut and not renew credit to other firms in that same industry.

Our results serve as a useful early warning indicator for the central bank supervisors, shedding light on mechanisms through which banks engage in loan evergreening. These tools become even more important after the global pandemic has put even more firms under financial difficulties.

References

Acharya, V. V., M. Crosignani, T. Eisert, and C. Eufinger (2020). Zombie credit and (dis-)inflation: Evidence from europe. NBER Working Paper 27158.

Acharya, V. V., T. Eisert, C. Eufinger, and C. W. Hirsch (2019). Whatever it takes: The real effects of unconventional monetary policy. *The Review of Financial Studies 32*(9), 3366–3411.

Adalet McGowan, M., D. Andrews, and V. Millot (2017). The walking dead? zombie firms and productivity performance in oecd countries. OECD Economics Deparetment Working Paper 1372.

Andrews, D. and F. Petroulakis (2019). Breaking the shackles: zombie firms, weak banks and depressed restructuring in europe. *ECB Working Paper*.

Bergant, K. and T. Kockerols (2020). Forbearance patterns in the post-crisis period. IMF Working Paper WP/20/140.

Blattner, L., L. Farinha, and F. Rebelo (2019). When losses turn into loans: The cost of undercapitalized banks. *ECB Working Paper 2228*.

Bonfim, D., G. Cerqueiro, H. Degryse, and S. Ongena (2020). On-site inspecting zombie lending. *CEPR Discussion Paper 14754*.

Brodeur, A., N. Cook, and A. Heyes (2020). A proposed specification check for p-hacking. *AEA Papers and Proceedings 110*, 66–69.

Bruche, M. and G. Llobet (2014). Preventing zombie lending. *The Review of Financial Studies 27*(3), 923–956.

Caballero, R. J., T. Hoshi, and A. K. Kashyap (2008). Zombie lending and depressed restructuring in japan. *The American economic review 98*(5), 1943–77.

Fiordelisi, F., N. Radić, and T. Weyman-Jones (2021). Detecting zombie banks. *The European Journal of Finance, forthcoming.*

Gianneti, M. and A. Simonov (2013). On the real effects of bank bailouts: Micro evidence from japan. *American Economic Journa: Macroeconomics 5*(1), 135–167.

Homar, T., H. Kick, and C. Salleo (2015). What drives forbearance–evidence from the ecb comprehensive assessment.

Hoshi, T. (2006). Economics of the living dead. *The Japanese Economic Review 57*(1), 30–49.

Hu, Y. and F. Varas (2021). A theory of zombie lending. *The Journal of Finance LXXVI*(4), 1813–1867.

Jorda, O., M. Kornejew, M. Schularick, and A. M. Taylor (2020). Zombies at large? corporate debt overhang and the macroeconomy. NBER Working Paper 28197.

Mourad, F. A., R. F. Schiozer, T. R. dos Santos, et al. (2020). Bank loan forbearance: evidence from a million restructured loans. Technical report.

Oster, E. (2019). Unobservable selection and coefficient stability: Theory and evidence. *Journal of Business & Economic Statistics 37:2*, 187–204.

Peek, J. and E. S. Rosengren (2005). Unnatural selection: Perverse incentives and the misallocation of credit in japan. *The American Economic Review 95*(4), 1144–1166.

Schivardi, F., E. Sette, and G. Tabellini (2020). Identifying the real effects of zombie lending. *The Review of Corporate FInance Studies 122*(1), 569–592.

Schivardi, F., E. Sette, and G. Tabellini (2021). Credit misallocation during the european financial crisis. *Economic Journal*.

Steinkamp, S., A. Tornell, and F. Westermann (2017). The euro area's common pool problem revisited: Has the single supervisory mechanism ameliorated forbearance and evergreening?

Storz, M., M. Koetter, R. Setzer, and A. Westphal (2017). Do we want these two to tango? on zombie firms and stressed banks in europe.

Tantri, P. (2021). Identifying ever-greening: Evidence using loan-level data. *Journal of Banking & Finance 122*, 105997.

Tracey, B. (2019). The real effects of zombie lending in europe. Bank of England Staff Working Paper 783.

Table 1: ***Summary Statistics***

(a) ***Loan level***

Total sample

Variable	count	mean	sd	min	p25	p50	p75	max
$ST_{b,i,t}$	1,950,189	0.143	0.350	0	0	0	0	1
% $USD_{b,i,t}$	1,950,189	73.641	43.433	0	2.638	100	100	100
Top $bank_{b,i,t}$	1,950,189	0.858	0.349	0	1	1	1	1
Log($months_{b,i,t}$)	1,950,189	2.618	1.102	0	1.946	2.773	3.434	5.050
$Delinquent_{b,i,t}$	1,950,189	0.074	0.261	0	0	0	0	1
Sample of loan evergreening								
$ST_{b,i,t}$	18,935	0.211	0.408	0	0	0	0	1
% $USD_{b,i,t}$	18,935	88.124	31.407	0	100	100	100	100
Top $bank_{b,i,t}$	18,935	0.903	0.296	0	1	1	1	1
Log($months_{b,i,t}$)	18,935	3.450	0.772	0	2.944	3.526	4.025	5.050
$Delinquent_{b,i,t}$	18,935	0.078	0.268	0	0	0	0	1

(b) ***Bank level***

Total sample

Variable	count	mean	sd	min	p25	p50	p75	max
$Solvency_{b,t-3}$	1,950,189	0.135	0.048	0.019	0.100	0.117	0.151	0.636
$Size_{b,t-3}$	1,950,189	25.351	1.283	10.307	24.529	25.558	26.283	27.052
$Credit_{b,t-3}$	1,950,189	0.378	0.098	0.056	0.311	0.359	0.439	0.623
$Liquidity_{b,t-3}$	1,950,189	0.585	0.163	0.333	0.489	0.558	0.614	3.253
$Provisions_{b,t-3}$	1,950,189	0.064	0.028	0.010	0.040	0.066	0.080	0.415
Return on $Assets_{b,t-3}$	1,950,189	0.006	0.023	-0.276	0.001	0.008	0.017	0.162
Sample of loan evergreening								
$Solvency_{b,t-3}$	18,935	0.139	0.043	0.082	0.111	0.122	0.149	0.406
$Size_{b,t-3}$	18,935	26.091	1.053	20.980	25.828	26.446	26.872	27.052
$Credit_{b,t-3}$	18,935	0.335	0.077	0.087	0.292	0.315	0.335	0.623
$Liquidity_{b,t-3}$	18,935	0.566	0.124	0.349	0.507	0.570	0.592	1.442
$Provisions_{b,t-3}$	18,935	0.076	0.022	0.020	0.071	0.078	0.087	0.160
Return on $Assets_{b,t-3}$	18,935	0.011	0.021	-0.276	0.003	0.011	0.021	0.136

This table presents the summary statistics based on loan-level (Panel a) and bank-level (Panel b) variables for the period 2006-2018. The frequency is monthly. Online Appendix Section A shows the definition of the control variables.

Table 2: ***Determinants of loan evergreening***

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	← Loan evergreening$_{b,i,t}$ →					
Solvency$_{b,t-3}$	-6.578**	-4.394*	-5.235**	-6.385*	-6.222**	-6.117**
	(3.137)	(2.237)	(2.574)	(3.315)	(2.826)	(2.706)
Size$_{b,t-3}$					-0.099	-0.100
					(0.412)	(0.384)
Credit$_{b,t-3}$					-0.050	-0.146
					(1.041)	(1.009)
Liquidity$_{b,t-3}$					-0.567	-0.545
					(0.591)	(0.604)
Provisions$_{b,t-3}$					4.983	6.388
					(4.817)	(4.833)
RoA$_{b,t-3}$					3.472*	3.770**
					(1.791)	(1.792)
ST$_{b,i,t}$						0.717***
						(0.213)
% USD$_{b,i,t}$						0.008**
						(0.003)
Top bank$_{b,i,t}$						0.655***
						(0.152)
Log(months$_{b,i,t}$)						0.629***
						(0.175)
Delinquent$_{b,i,t}$						-0.578*
						(0.344)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Month FE		Yes	Yes	Yes	-	-
Firm FE			Yes	-	-	-
Firm×Month FE				Yes	Yes	Yes
Observations	1,950,189	1,950,189	1,949,503	496,981	496,981	496,981
R-squared	0.007	0.007	0.219	0.452	0.452	0.455

This table presents the results of specification 1. The dependent variable is a dummy variable equal to 1 if firm i receives a bullet loan from bank b at month t of a quantity that is similar to the amortizing loan repayment to the same bank at the same month. The sample spans from January 2006 to December 2018. Online Appendix Section A shows the definition of the control variables. All regressions are estimated using ordinary least squares. Fixed-effects are included ("Yes"), spanned by other fixed-effects ("-"), or not included. Robust standard errors clustered at bank-broad sector level and reported in parentheses. ***: Significant at 1% level; **: significant at 5% level; *: significant at 10% level.

Table 3: ***Determinants of loan evergreening: Solvency over the cycle***

(a) ***Continuous variable***

VARIABLES	(1)	(2)	(3)	(4)	(5)
$\text{Solvency}_{b,t-3}$	-3.494*	-4.387*	-5.278	-5.387*	-5.267*
	(1.978)	(2.339)	(3.209)	(2.771)	(2.697)
$\text{Solvency}_{b,t-3}\times\text{GDP growth}_t$	-0.628**	-0.629**	-0.866**	-0.715*	-0.729*
	(0.296)	(0.287)	(0.419)	(0.421)	(0.414)
Bank FE	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	-	-
Firm FE		Yes	-	-	-
Firm×Month FE			Yes	Yes	Yes
Bank controls				Yes	Yes
Loan controls					Yes
Observations	1,950,189	1,949,503	496,981	496,981	496,981
R-squared	0.007	0.219	0.452	0.452	0.455

(b) ***Dummy variable***

VARIABLES	(1)	(2)	(3)	(4)	(5)
$\text{Solvency}_{b,t-3}$	-5.289**	-6.171**	-8.201**	-8.017**	-8.022***
	(2.451)	(2.761)	(3.649)	(3.098)	(2.938)
$\text{Solvency}_{b,t-3}\times\text{Low growth}_t$	2.861*	2.803**	5.360**	4.833**	5.128***
	(1.481)	(1.308)	(2.076)	(1.998)	(1.904)
Bank FE	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	-	-
Firm FE		Yes	-	-	-
Firm×Month FE			Yes	Yes	Yes
Bank controls				Yes	Yes
Loan controls					Yes
Observations	1,950,189	1,949,503	496,981	496,981	496,981
R-squared	0.007	0.219	0.452	0.452	0.455

This table presents the results of specification 1, adding an interaction term between $\text{Solvency}_{b,t-3}$ and two different variables: in Panel (a), GDP growth_t, the de-meaned GDP growth for that quarter; in Panel (b), a dummy variable equal to 1 if the GDP growth for that quarter is below the median, 0 otherwise. The dependent variable is a dummy variable equal to 1 if firm i receives a bullet loan from bank b at month t of a quantity that is similar to the amortizing loan repayment to the same bank at the same month. The sample spans from January 2006 to December 2018. Online Appendix Section A shows the definition of the control variables. All regressions are estimated using ordinary least squares. Fixed-effects are included ("Yes"), spanned by other fixed-effects ("-"), or not included. Robust standard errors clustered at bank-broad sector level and reported in parentheses. ***: Significant at 1% level; **: significant at 5% level; *: significant at 10% level.

Table 4: ***Determinants of loan evergreening: loan-level variables***

VARIABLES	(1)	(2)	(3)	(4)	(5)
	← Loan evergreening$_{b,i,t}$ →				
ST$_{b,i,t}$	0.800***	0.347***	0.720***	0.717***	0.696***
	(0.283)	(0.048)	(0.214)	(0.213)	(0.204)
%USD$_{b,i,t}$	0.008***	0.004***	0.008**	0.008**	0.008**
	(0.002)	(0.001)	(0.003)	(0.003)	(0.003)
Top bank$_{b,i,t}$	0.196*	0.569***	0.658***	0.655***	0.648***
	(0.116)	(0.100)	(0.156)	(0.152)	(0.146)
Log(months$_{b,i,t}$)	0.591**	0.490**	0.625***	0.629***	0.634***
	(0.244)	(0.192)	(0.175)	(0.175)	(0.175)
Delinquent$_{b,i,t}$	0.112	-0.020	-0.558†	-0.578*	-0.554†
	(0.109)	(0.105)	(0.336)	(0.344)	(0.340)
Bank FE	Yes	Yes	Yes	Yes	-
Month FE	Yes	Yes	Yes	-	-
Firm FE		Yes	-	-	-
Firm×Month FE			Yes	Yes	Yes
Bank controls				Yes	-
Bank×Month FE					Yes
Observations	1,950,189	1,949,503	496,981	496,981	496,937
R-squared	0.013	0.221	0.455	0.455	0.457

This table presents the results of specification 1 adding bank-month FE in the last column. The dependent variable is a dummy variable equal to 1 if firm i receives a bullet loan from bank b at month t of a quantity that is similar to the amortizing loan repayment to the same bank at the same month. The sample spans from January 2006 to December 2018. Online Appendix Section A shows the definition of the control variables. All regressions are estimated using ordinary least squares. Fixed-effects are included ("Yes"), spanned by other fixed-effects ("-"), or not included. Robust standard errors clustered at bank-broad sector level are reported in parentheses. ***: Significant at 1% level; **: significant at 5% level; *: significant at 10% level; †: significant at 11% level.

Table 5: ***Determinants of loan evergreening: heterogeneous effect of solvency***

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	← Loan evergreening$_{b,i,t}$ →					
Solvency$_{b,t}$	-6.977**	-7.418**	-3.480	-6.188**	-6.294**	
	(3.076)	(3.707)	(2.706)	(2.906)	(2.787)	
Solvency$_{b,t}$×ST$_{b,i,t}$	4.201					4.542
	(3.503)					(3.278)
Solvency$_{b,t}$×% USD$_{b,i,t}$		0.017				0.007
		(0.041)				(0.037)
Solvency$_{b,t}$×Top bank$_{b,i,t}$			-5.820***			-4.155**
			(1.805)			(1.731)
Solvency$_{b,t}$×Log(months$_{b,i,t}$)				-0.186		0.867
				(1.315)		(1.524)
Solvency$_{b,t}$×Delinquent$_{b,i,t}$					1.663	1.630
					(3.295)	(3.402)
Bank FE	Yes	Yes	Yes	Yes	Yes	-
Firm×Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	-
Loan controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank×Month FE						Yes
Observations	496,981	496,981	496,981	496,981	496,981	496,937
R-squared	0.455	0.455	0.455	0.455	0.455	0.457

This table presents the results of specification 1, adding interaction terms between Solvency$_{b,t-3}$ and the loan-level variables as well as bank-month FE in the last column. The dependent variable is a dummy variable equal to 1 if firm i receives a bullet loan from bank b at month t of a quantity that is similar to the amortizing loan repayment to the same bank at the same month. The sample spans from January 2006 to December 2018. Online Appendix Section A shows the definition of the control variables. All regressions are estimated using ordinary least squares. Fixed-effects are included ("Yes"), spanned by other fixed-effects ("-"), or not included. Robust standard errors clustered at bank-broad sector level are reported in parentheses. ***: Significant at 1% level; **: significant at 5% level; *: significant at 10% level.

Table 6: ***Intensive margin: Credit growth***

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
			$\leftarrow \Delta\text{Credit}_{b,i,t+12} \rightarrow$			
Loan evergreening$_{b,i,t}$	0.132***	0.142**	0.058	0.070*	0.072*	0.073**
	(0.012)	(0.068)	(0.041)	(0.037)	(0.037)	(0.035)
ST$_{b,i,t}$				0.423***	0.424***	0.430***
				(0.029)	(0.029)	(0.028)
% USD$_{b,i,t}$				0.000	0.000	0.000
				(0.000)	(0.000)	(0.000)
Top bank$_{b,i,t}$				-0.158***	-0.158***	-0.157***
				(0.015)	(0.015)	(0.016)
Log(months$_{b,i,t}$)				0.056***	0.056***	0.057***
				(0.007)	(0.007)	(0.007)
Delinquent$_{b,i,t}$				-0.021	-0.019	-0.013
				(0.023)	(0.023)	(0.023)
Solvency$_{b,t-3}$					0.661***	
					(0.218)	
Size$_{b,t-3}$					-0.073*	
					(0.042)	
Credit$_{b,t-3}$					-0.150	
					(0.173)	
Liquidity$_{b,t-3}$					-0.049	
					(0.069)	
Provisions$_{b,t-3}$					-0.249	
					(0.437)	
RoA$_{b,t-3}$					-0.189	
					(0.257)	
Month FE	Yes	-	-	-	-	-
Firm×Month FE		Yes	Yes	Yes	Yes	Yes
Bank FE			Yes	Yes	Yes	-
Bank×Month FE						Yes
Observations	1,268,357	278,535	278,535	278,535	278,535	278,484
R-squared	0.009	0.479	0.484	0.502	0.502	0.508

This table presents the results of specification 2. The dependent variable is the change in the logarithm of the amount of amortizing loan provided by bank b to firm i between t and $t+12$. The sample spans from January 2006 to December 2018. Loan evergreening$_{b,i,t}$ is a dummy variable equal to 1 if firm i receives a bullet loan from bank b at month t of a quantity that is similar to the amortizing loan repayment to the same bank at the same month, 0 otherwise. Online Appendix Section A shows the definition of the control variables. All regressions are estimated using ordinary least squares. Fixed-effects are included ("Yes"), spanned by other fixed-effects ("-"), or not included. Robust standard errors clustered at bank-broad sector level are reported in parentheses. ***: Significant at 1% level; **: significant at 5% level; *: significant at 10% level.

Table 7: ***Intensive margin: Increasing credit***

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	$\leftarrow$ D(ΔCredit$_{b,i,t+12} > 0$) $\rightarrow$					
Loan evergreening$_{b,i,t}$	0.138***	0.144***	0.080***	0.074***	0.076***	0.075***
	(0.015)	(0.045)	(0.021)	(0.019)	(0.019)	(0.018)
Month FE	Yes	-	-	-	-	-
Firm×Month FE		Yes	Yes	Yes	Yes	Yes
Bank FE			Yes	Yes	Yes	-
Bank×Month FE						Yes
Observations	1,268,357	278,535	278,535	278,535	278,535	278,484
R-squared	0.009	0.479	0.484	0.502	0.502	0.508

This table presents the results of specification 2. The dependent variable is a dummy variable that equals 1 if the change in the logarithm of the amount of amortizing loan provided by bank b to firm i between t and $t+12$ is positive, 0 otherwise. The sample spans from January 2006 to December 2018. Loan evergreening$_{b,i,t}$ is a dummy variable equal to 1 if firm i receives a bullet loan from bank b at month t of a quantity that is similar to the amortizing loan repayment to the same bank at the same month, 0 otherwise. Online Appendix Section A shows the definition of the control variables. All regressions are estimated using ordinary least squares. Fixed-effects are included ("Yes"), spanned by other fixed-effects ("-"), or not included. Robust standard errors clustered at bank-broad sector level are reported in parentheses. ***: Significant at 1% level; **: significant at 5% level; *: significant at 10% level.

Table 8: ***Extensive margin: End of banking relations***

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
			← End$_{b,i,t+12}$ →			
Loan evergreening$_{b,i,t}$	-0.052***	-0.053**	-0.022*	0.001	0.002	0.005
	(0.008)	(0.022)	(0.012)	(0.011)	(0.012)	(0.011)
ST$_{b,i,t}$				0.121***	0.121***	0.119***
				(0.010)	(0.010)	(0.010)
% USD$_{b,i,t}$				0.000**	0.000**	0.000**
				(0.000)	(0.000)	(0.000)
Top bank$_{b,i,t}$				-0.123***	-0.123***	-0.123***
				(0.004)	(0.004)	(0.004)
Log(months$_{b,i,t}$)				0.017***	0.017***	0.016***
				(0.002)	(0.002)	(0.002)
Delinquent$_{b,i,t}$				0.045***	0.044***	0.039***
				(0.010)	(0.010)	(0.009)
Solvency$_{b,t-3}$					0.074	
					(0.113)	
Size$_{b,t-3}$					0.001	
					(0.027)	
Credit$_{b,t-3}$					-0.088	
					(0.071)	
Liquidity$_{b,t-3}$					0.069	
					(0.047)	
Provisions$_{b,t-3}$					0.419**	
					(0.204)	
RoA$_{b,t-3}$					-0.238	
					(0.160)	
Month FE	Yes	-	-	-	-	-
Firm×Month FE		Yes	Yes	Yes	Yes	Yes
Bank FE			Yes	Yes	Yes	-
Bank×Month FE						Yes
Observations	1,950,189	496,981	496,981	496,981	496,981	496,937
R-squared	0.246	0.681	0.689	0.711	0.711	0.724

This table presents the results of specification 3. The dependent variable is a dummy variable equal to 1 if bank b is not lending an amortizing loan to firm i at $t+12$, 0 otherwise. The sample spans from January 2006 to December 2018. Loan evergreening$_{b,i,t}$ is a dummy variable equal to 1 if firm i receives a bullet loan from bank b at month t of a quantity that is similar to the amortizing loan repayment to the same bank at the same month, 0 otherwise. Online Appendix Section A shows the definition of the control variables. All regressions are estimated using ordinary least squares. Fixed-effects are included ("Yes"), spanned by other fixed-effects ("-"), or not included. Robust standard errors clustered at bank-broad sector level are reported in parentheses. ***: Significant at 1% level; **: significant at 5% level; *: significant at 10% level.

Table 9: ***Delinquency***

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	← Delinquent$_{b,i,t+12}$ →							
Loan evergreening$_{b,i,t}$	0.014***	0.014***	0.012***	0.011***	-0.019*	-0.020*	0.014***	-0.008
	(0.004)	(0.004)	(0.004)	(0.004)	(0.011)	(0.011)	(0.004)	(0.008)
Month FE	Yes	Yes	Yes	Yes	-	-	-	-
Firm FE	Yes	Yes	Yes	Yes	-	-	Yes	Yes
Bank FE		Yes	Yes	Yes	Yes	-	-	-
Loan controls			Yes	Yes	Yes	Yes	Yes	Yes
Bank controls				Yes	Yes	-	-	-
Firm×Month FE					Yes	Yes		
Bank×Month FE						Yes	Yes	Yes
Industry×Month FE					-	-	Yes	Yes
Observations	1,267,499	1,267,499	1,267,499	1,267,499	278,535	278,484	931,896	323,452
R-squared	0.438	0.438	0.439	0.439	0.683	0.686	0.516	0.444

This table presents the results of specification 4. The dependent variable is a dummy variable equal to 1 if firm i is delayed by over 60 days in the loan repayment to bank b at time $t+12$, 0 otherwise. The sample spans from January 2006 to December 2018. Loan evergreening$_{b,i,t}$ is a dummy variable equal to 1 if firm i receives a bullet loan from bank b at month t of a quantity that is similar to the amortizing loan repayment to the same bank at the same month, 0 otherwise. Online Appendix Section A shows the definition of the control variables. All regressions are estimated using ordinary least squares. Fixed-effects are included ("Yes"), spanned by other fixed-effects ("-"), or not included. Robust standard errors clustered at bank-broad sector level are reported in parentheses. ***: Significant at 1% level; **: significant at 5% level; *: significant at 10% level.

Table 10: ***Delinquency and bank solvency***

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
			$\leftarrow$ Delinquent$_{b,i,t+12}$ $\rightarrow$			
Loan evergreening$_{b,i,t}$	0.012**	0.011**	0.011**	0.011*	0.017***	-0.009
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.007)
Solvency$_{b,t-3}$	-0.062		-0.052			
	(0.048)		(0.077)			
Loan evergreening$_{b,i,t}$×Solvency$_{b,t-3}$	-0.199**	-0.202**	-0.132*	-0.136*	-0.159***	0.167
	(0.088)	(0.088)	(0.073)	(0.073)	(0.041)	(0.191)
Loan evergreening$_{b,i,t}$×Delinquent$_{b,i,t}$			0.010	0.010	0.019	0.022
			(0.019)	(0.019)	(0.023)	(0.054)
Loan evergreening$_{b,i,t}$×Solvency$_{b,t-3}$			-1.176***	-1.144***	-0.997**	-1.953
×Delinquent$_{b,i,t}$			(0.424)	(0.428)	(0.397)	(1.348)
Industry×Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	-	Yes	-	-	-
Loan controls	Yes	Yes	Yes		Yes	Yes
Bank×Month FE		Yes		Yes	Yes	Yes
Observations	1,262,216	1,262,190	1,262,216	1,262,190	931,896	323,452
R-squared	0.459	0.461	0.459	0.461	0.516	0.444

This table presents the results of specification 4. The dependent variable is a dummy variable equal to 1 if firm i is delayed by over 60 days in the loan repayment to bank b at time $t+12$, 0 otherwise. The sample spans from January 2006 to December 2018. Loan evergreening$_{b,i,t}$ is a dummy variable equal to 1 if firm i receives a bullet loan from bank b at month t of a quantity that is similar to the amortizing loan repayment to the same bank at the same month, 0 otherwise. Online Appendix Section A shows the definition of the control variables. All regressions are estimated using ordinary least squares. Fixed-effects are included ("Yes"), spanned by other fixed-effects ("-"), or not included. Robust standard errors clustered at bank-broad sector level are reported in parentheses. ***: Significant at 1% level; **: significant at 5% level; *: significant at 10% level.

Table 11: ***Loan level: Credit displacement***

(a) ***Intensive margin:*** $\Delta Log(Credit_{b,i,t+12})$

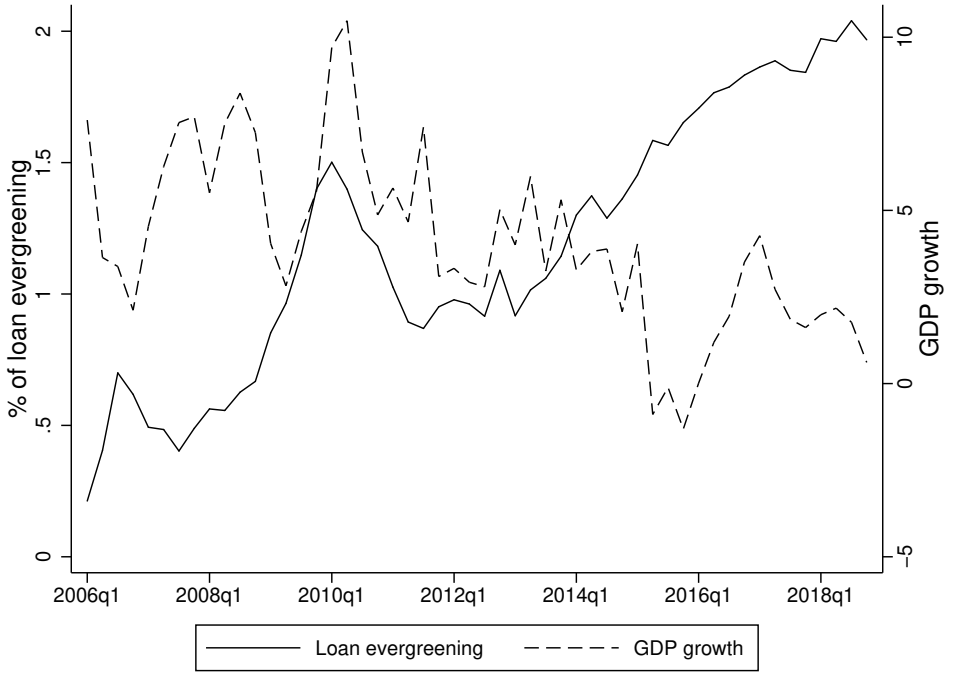
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	← Bank-level →		← Bank-broad sector →			← Bank-5-digit-industry →		
% of Loan evergreening$_{b,j,t}$	0.050	-0.012	0.274	0.248	0.341	0.080	0.047	0.026
	(0.359)	(0.349)	(0.311)	(0.300)	(0.319)	(0.111)	(0.118)	(0.113)
Bank FE	Yes	Yes	Yes	Yes	-	Yes	Yes	-
Firm×Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls		Yes		Yes	-		Yes	-
Loan controls		Yes		Yes	Yes		Yes	Yes
Bank×Month FE					Yes			Yes
Observations	273,364	273,364	273,364	273,364	273,313	273,364	273,364	273,313
R-squared	0.489	0.507	0.489	0.507	0.513	0.489	0.507	0.513

(b) ***Extensive margin:*** $End_{b,i,t+12}$

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	← Bank-level →		← Bank-broad sector →			← Bank-5-digit-industry →		
% of Loan evergreening$_{b,j,t}$	-0.151	-0.089	-0.078	-0.044	-0.037	0.080***	0.066***	0.072***
	(0.131)	(0.107)	(0.069)	(0.070)	(0.071)	(0.025)	(0.025)	(0.027)
Bank FE	Yes	Yes	Yes	Yes	-	Yes	Yes	-
Firm×Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls		Yes		Yes	-		Yes	-
Loan controls		Yes		Yes	Yes		Yes	Yes
Bank×Month FE					Yes			Yes
Observations	487,734	487,734	487,734	487,734	487,692	487,734	487,734	487,692
R-squared	0.688	0.710	0.688	0.710	0.723	0.688	0.710	0.723

The dependent variables are: in Panel A, $\Delta Log(Credit_{b,i,t+12})$ is the change in the logarithm of amortizing loan amount provided by bank b to firm i from t to $t+12$; in Panel B, $End_{b,i,t+12}$ is a dummy variable that equals 1 if an existing relationship between bank b and firm i in month t has disappeared by month $t+12$, 0 otherwise. The sample period is from 2006m1 to 2018m12. The sample is restricted to bank-firm relationships not engaged in loan evergreening at t. % of Loan evergreening$_{b,j,t}$ is defined as follows: in columns 1-2, it is the % of amortizing lending that bank b provides to loan-evergreening firms in month t; in columns 3-5, it is the % of amortizing lending that bank b provides to loan-evergreening firms in broad sector j at month t (we define six broad sectors: agriculture, manufacturing, services, construction, retail, and other); in columns 6-8, it is the % of amortizing lending that bank b provides to loan-evergreening firms in 5-digit industry j at month t. All regressions are estimated using ordinary least squares. Loan and bank controls, as well as fixed-effects are either included ("Yes"), spanned by other fixed effects ("-"), or not included. Online Appendix Section A shows the definition of the control variables. Robust standard errors clustered at bank-broad sector are reported in parentheses. ***: Significant at 1% level; **: significant at 5% level; *: significant at 10% level.

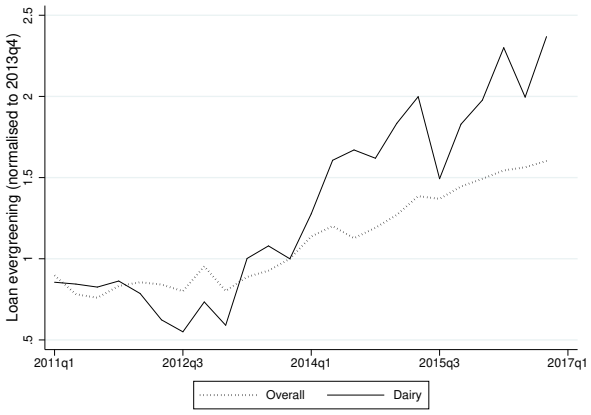
Figure 2: ***Evolution of loan evergreening***



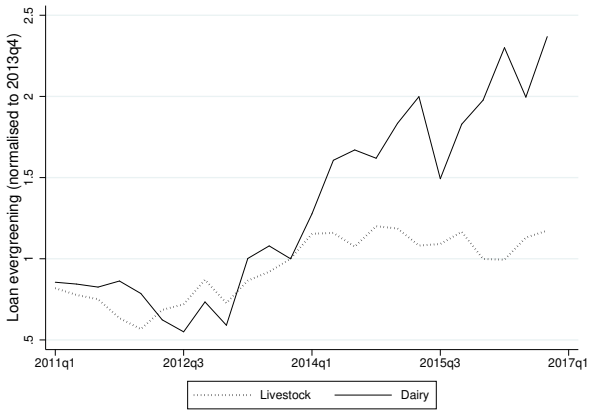
This figure shows the quarterly percentage of loan evergreening cases (right axis) and the GDP growth compared to the same quarter in the previous year (left axis).

Figure 3: ***Loan evergreening in the dairy industry***

(a) *Dairy vs. overall*

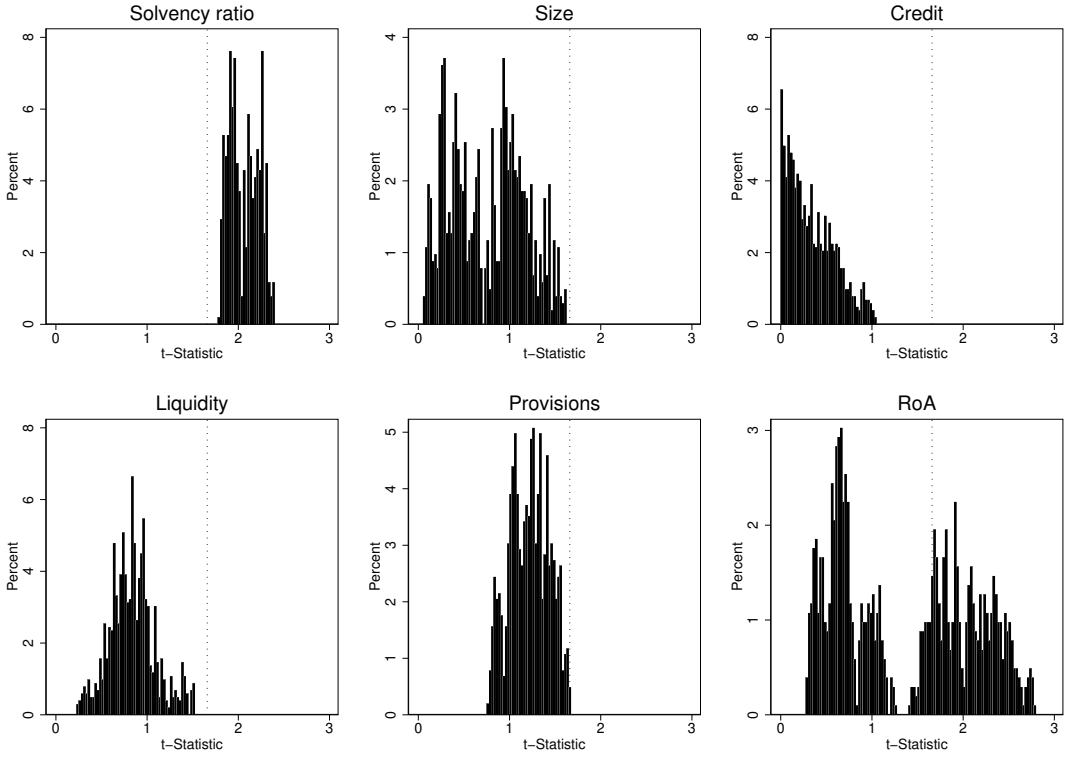


(b) *Dairy vs. Livestock*



This figure shows the quarterly % of loan evergreening cases in the dairy industry compared to the overall economy (Panel a) and the livestock industry (Panel b).

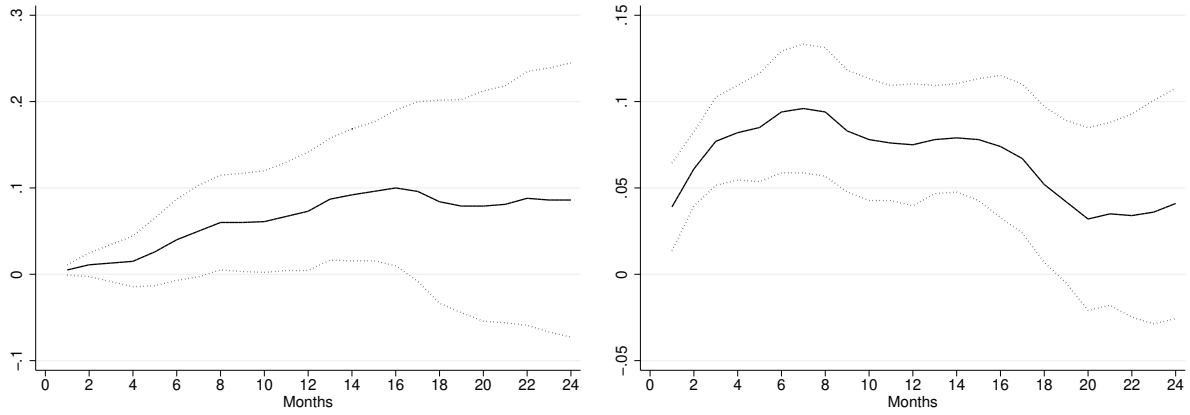
Figure 4: ***Determinants of loan evergreening: t-statistics of bank variables***



This Figure shows the distribution of the t-statistic for the six bank variables for all the possible combinations of controls $X_{b,t}$ (minus the corresponding variable) and $Y_{b,i,t}$ using specification 1; these are $2^{10} - 1 = 1,023$ regressions for each bank variable. The vertical line indicates the value 1.65, which corresponds to a 10% significance level in a two-tailed test. We use a modified version of the Stata algorithm provided by Brodeur et al. (2020).

Figure 5: ***Loan evergreening coefficient for intensive margin specifications***

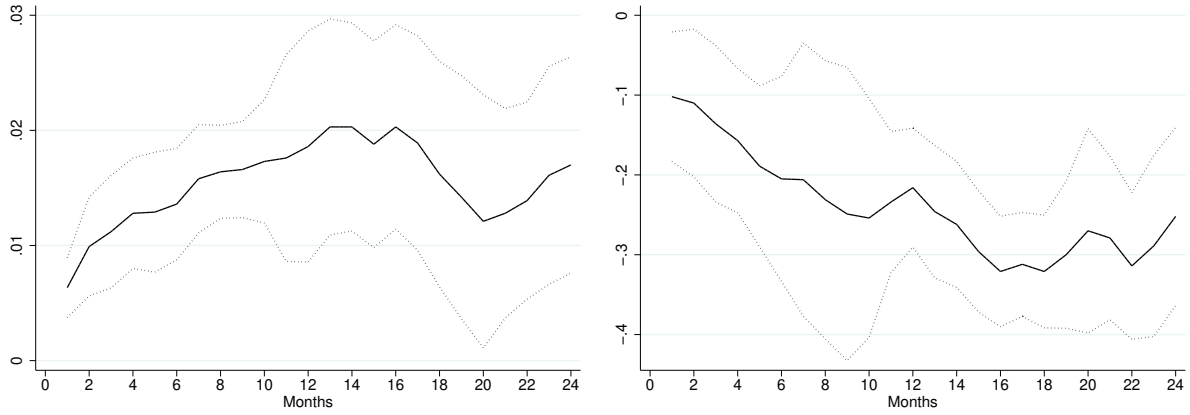
(a) *Coefficient for* $\Delta Credit_{b,i,t+x}$ (b) *Coefficient for* $D(\Delta Credit_{b,i,t+x} > 0)$



This figure shows the coefficients of the variable Loan evergreening$_{b,i,t}$ in regressions where the dependent variable is ΔCredit$_{b,i,t+x}$ (Panel a) or D(ΔCredit$_{b,i,t+x} > 0$) (Panel b). These correspond to specifications 2. x is shown in the horizontal axes: $x = 1$ is the change between t and $t + 1$, while $x = 24$ is the change between t and $t + 24$. The solid line corresponds to the coefficient, while the dotted lines show the 95% confidence interval bands.

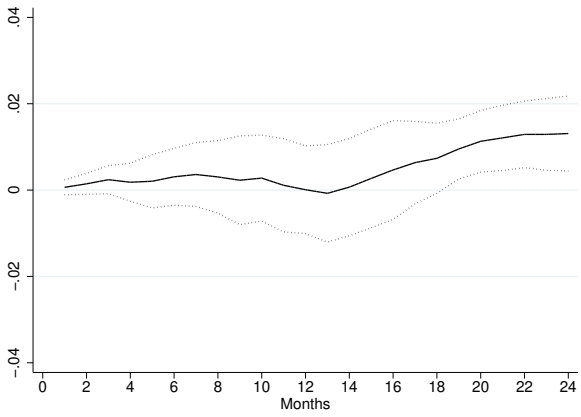
Figure 6: ***Loan evergreening coefficient for delinquency specifications***

(a) *Loan evergreening*$_{b,i,t}$ (b) *Loan evergreening*$_{b,i,t}$×*Solvency*$_{b,t-3}$



This figure shows the coefficients of the variable Loan evergreening$_{b,i,t}$ (Panel a) and Loan evergreening$_{b,i,t}$×Solvency$_{b,t-3}$ (Panel b) in regressions where the dependent variable is Non-performing$_{b,i,t+x}$ for the sample of single-relationship firms. These correspond to specifications 4 analogous to Table 10, Column 2. x is shown in the horizontal axes. The solid line corresponds to the coefficient, while the dotted lines show the 95% confidence interval bands.

Figure 7: ***Loan evergreening coefficient for multiple relations specification***



This figure shows the coefficients of the variable Loan evergreening$_{b,i,t}$ in regressions where the dependent variable is Multiple rel$_{b,i,t+x}$ for the sample of single-relationship firms. These correspond to specifications 5. The solid line corresponds to the coefficient, while the dotted lines show the 95% confidence interval bands.

INTERNET APPENDIX

Loan evergreening through banks' lenses: Evidence from product-level data

A Definition of the variables

Table A.1: ***Loan-level variables***

Variable	Description
ST	Dummy variable identifying amortizing loans with initial maturity up to one year
% USD	Percentage of total amortizing credit denominated in USD
Top bank	Dummy variable identifying the bank that provides the highest amount of amortizing credit to a firm
Log(months)	Logarithm of the number of uninterrupted months that a bank is providing amortizing lending to a firm
Delinquent	Dummy variable identifying borrowers with repayment delays over 60 days

Source: Authors' computation based on data from the Credit Registry of the Central Bank of Uruguay ("Central de Riesgos Crediticios").

Table A.2: ***Bank-level variables***

Variable	Description
Solvency	Capital over risk-weighted assets
Size	Logarithm of total assets
Credit	Total credit (net of provisions) over total assets
Liquidity	Liquid assets (less than 30 days) over liquid liabilities (less than 30 days)
Provisions	Provisions over total loans
RoA	Annualized return on assets

Source: Supervisory data from the Central Bank of Uruguay.

B Provisioning in Uruguay

According to Uruguayan regulation, borrowers are classified with a rating scale that reflects their payment capacity. The amount of provisioning that banks have to set aside depends on these ratings. The rating scale is the following:[13]

- Rating 1A: back-to-back loans, that is, loans fully covered by very liquid collaterals.
- Rating 1C: borrowers with strong payment capacity (i.e. less than 10 days past due).
- Rating 2A: borrowers with an adequate payment capacity (i.e. less than 30 days past due).
- Rating 2B: borrowers with potential problems in their payment capacity (i.e. less than 60 days past due).
- Rating 3: borrowers with a compromised payment capacity (i.e. less than 120 days past due).
- Rating 4: borrowers with a very compromised payment capacity (i.e. less than 180 days past due).
- Rating 5: unrecoverable borrowers (more than 180 days past due).

In the paper, we define delinquent loans as those with ratings 3 and 4, since these indicate a compromised payment capacity and over 60 days of delay—a usual definition of delinquent loan. Moreover, we exclude loans in rating 5 from the analysis since the vast majority of these cases are situations where there is no additional lending by the bank.

We proceed to provide a stilized example of how provisions depend on the rating of the borrower. For a loan of 1,000 Uruguayan Pesos, a bank has to compute provisions according to the following expression:

$$Provisions_i = [Risk_i - Collateral_i] * \%Prov \tag{A.7}$$

Assuming a collateral of zero, the loan loss provision requirement will depend on the total risk associated to the operation (in this simple example, 1,000 Uruguayan Pesos) and the percentage of provisions required, which is a function of the risk rating of the borrower.

Risk Rating	**Days past due**	**% Provisions**
1C	At most 10 days	[0.5% ; 1.5%)
2A	Between 10 and 30 days	[1.5% ; 3%)
2B	Between 30 and 60 days	[3% ; 17%)
3	Between 60 and 120 days	[17% ; 50%)
4	Between 120 and 180 days	[50% ; 100%)
5	Over 180 days	100%

Then, the capital requirement associated to this particular loan is calculated as the risk weighted asset (where the weight is given by the parameter Ω) and the standard requirement of 8%.

[13] For more detail: Comunicación N^o 2019/001, Superintendencia de Servicios Financieros, BCU.

$$KRequirement_i = [Risk_i - Provisions_i]\Omega_i * 8\% \tag{A.8}$$

As can be noted from the above expressions, as the rating quality of the asset deteriorates[14], the loans loss provision requirement increases while the capital requirement decreases. The total capital consumption is the sum of the provisions and capital requirements.

The possible levels of capital consumption associated to each strategy can be summarized in the following table:

Table A.3: *Banks' motivation for zombie lending*

Rating	K. Req.	Provisions	K. Consumption
$1C$	79.6	5	84.6
$2A$	78.8	15	93.8
$2B$	77.6	30	107.6
3	66.4	170	236.4
4	40	500	540
5	0	1,000	1,000

An alternative action when the borrower becomes financially distress is to restructure the loan, that is, to change the terms of the contract. This could be done by extending maturity, lowering the loan rate, or other terms. This, however, carries a penalty in terms of provisioning: banks have to set a rating which is higher than if the borrower had not been delayed in its loan repayments. Therefore, our loan evergreening strategy carries less capital consumption than even restructuring the loan.

C Theoretical model

In this section, we present a very stylized framework to understand the problem of the bank.[15] The basic workings can be seen in Figure A.1. The bank finds out that the borrower is troubled, in the sense that it has recently received a negative productivity shock and on expectations it is not able to repay the full loan. One possibility is to restructure the loan. This, however, implies taking an immediate loss R. This restructuring can also be part of a loan evergreening strategy if the bank does it in order to keep the firm "artificially" alive, for instance by charging a significantly lower loan rate than similar borrowers.[16] But even if that is the case, the bank would face an immediate cost from restructuring.

[14] The best possible rating correspond to the category *1C*, while the worst possible rating corresponds to the category *5*.

[15] We thank Jorge Ponce for his suggestions on this model.

[16] The restructuring can also be done by applying a haircut or extending the maturity.

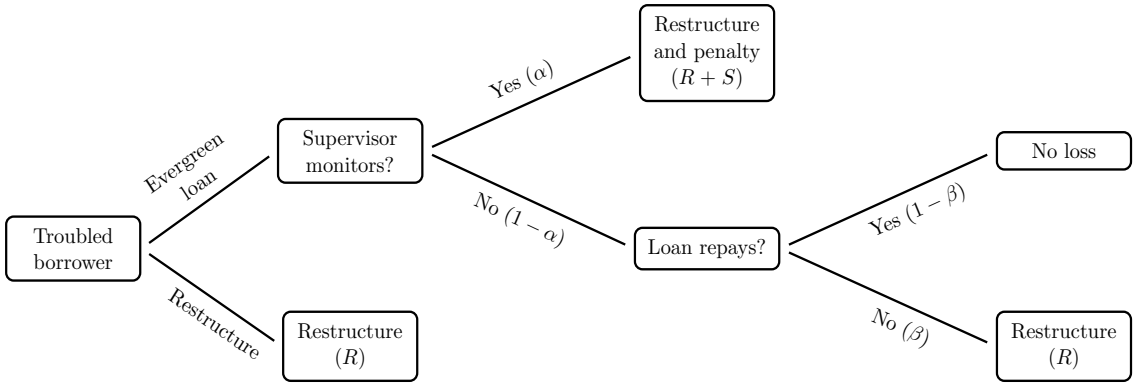
The bank can also choose to provide the borrower with an evergreen (bullet) loan. If the bank does so, however, there is a probability $\alpha \in (0,1)$ that the supervisor identifies this operation as "loan evergreening". This would lead the supervisor to impose the restructuring of the loan as well as a supervisory penalty S, for instance in the form of asking for more documentation on other loans or a more stringent monitoring.

We do not model here how the supervisor chooses α and S. For our purposes, it suffices that $\alpha < 1$ and S is sufficiently small. $\alpha < 1$ would almost certainly be the case if supervisors face a cost of information acquisition. As for S, the supervisory penalty typically entails an increased supervisory scrutiny in the near future, which while important might not be an effective deterrent if α is low.

If the supervisor does not monitor the bank, then there is a possibility $1-\beta$ (with $\beta \in (0,1)$) that the borrower ends up repaying. There is some lower bound to β; in particular, the probability of default needs to be sufficiently high so that the borrower is indeed troubled. If the borrower ends up repaying, then the bank does not suffer any loss (we could include here an additional interest payment for the bullet loan but for simplicity we leave it out). If the borrower defaults anyway, the bank needs to restructure the loan, suffering the cost R.

Therefore, a bank will choose the loan evergreening strategy if the costs are lower than outright restructuring. That is, if $R > \alpha(R+S)+(1-\alpha)(\beta R) \implies R > \frac{\alpha}{(1-\alpha)(1-\beta)}S$. This condition is less likely when a. $\alpha \to 1$ (supervisor catches the bank very often), and/or b. $\beta \in 1$ (the loan almost certainly needs to be restructured).

Figure A.1: ***Stylized model for the decision to loan evergreen or restructure***



This figure presents the decision tree for the stylized model that studies the incentives for banks to engage in loan evergreening versus outright restructuring of a loan.

D Dairy sector

In 2014 the dairy sector was negatively affected by the accumulation of stocks from the main global importers (China, Russia, Venezuela), which resulted in an increasing excess supply. The main factor explaining the reduction of the international demand was given by China's economic

slowdown (during 2014 and 2015, Asian imports of powder milk and whole and skim milk declined approximately 53% and 33%, respectively).

In addition, the international demand was also affected by the decrease in oil price, having a direct effect on the dairy imports from countries whose main export product was oil (such as Venezuela and Russia). On top of that, the restrictions on European imports imposed by Russia also had a negative effect on the global trade of dairy products, resulting on a new factor that contributed to the excess supply of these products.

Uruguayan dairy exports accounted for 8.3% of Uruguay's total sales of goods in 2014, ranking as the largest export product after soy, beef and cereals. In April and May of 2014, the price of dairy products abroad reached an all-time high, being China's purchases of milk powder one of the factors explaining the strong demand enjoyed by the Uruguayan dairy industry.[17]

Figure A.2: *Price of dairy products exports*

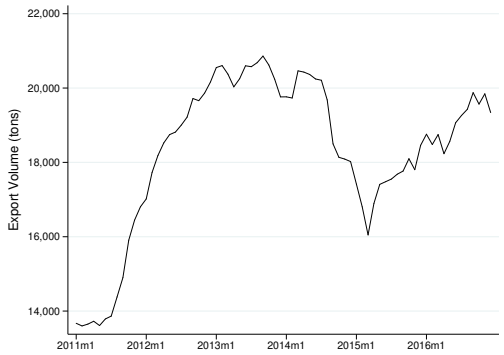


Figure A.3: *Volume of dairy products exports*

In March 2015 the main prices of the dairy sector fell by an average of between 15% and 20% with respect to December 2014, mainly due to the situation of Venezuela and Brazil.[18] Although according to Fonterra auctions, the international price of milk had been declining since the beginning of 2014, the impact on Uruguayan prices started on June 2014 (due to agreed prices prior to the collapse of the international price). From that moment on, the average prices of Uruguayan dairy exports began to follow the same trend that had been registering on the international market (the June and July FOB prices of dairy products situated below the average reference from Fonterra).

The decrease in the price of milk threatened the financial viability of the Uruguayan dairy industry, since many firms were producing without even recovering costs and having the need for funding. In addition, the significant decrease in the price of New Zealand's dairy products determined the lost of China as a destiny for Uruguayan exports of powder milk in the second semester of 2014, while Venezuela added new uncertainties to its economic situation and Brazil's

[17] By the end of 2012, China had been a secondary market, but since then its purchases were increasingly important. It began increasing its purchases during 2013, from 5% in the second semester to 22% in the last quarter of 2014. In the first quarter of 2014 China's purchases represented 35% of the milk powder produced in Uruguay, taking Venezuela's first place. Nonetheless, while China was the main market for large-scale enterprises (milk powder), Venezuela continued buying the vast majority of Uruguayan cheese. In addition, Russia was the main market for Uruguayan butter.

[18] In 2014, the main markets for Uruguayan dairy products were Venezuela with 32% of exports, Brazil with 24%, Russia with 10% and China with 8%.

slowdown consolidated.

In the beginning of 2015, with the ceasing of activities of the Peruvian economic group Gloria (Ecolat),[19] the situation of the Uruguayan dairy sector worsened. In addition, the compromised economic situation of Venezuela translated into lower values and quantities of dairy products delivered from Uruguay to that country. In June 2015, the Uruguayan dairy sector declared itself on state of emergency, given the new falls in the reference prices and the effect of the drought registered during the first half of 2015. A month later, Schreiber Foods announced the ceasing of operations, after five years of activities in Uruguay and having employed around 170 workers.

In July 2015 the Uruguayan and Venezuelan economies signed a trade agreement, by which Uruguay would sell 44.000 tons of powder milk and 12.000 tons of cheese while Venezuela would pay through Bandes Bank in Uruguay (with a trust that would work as a guarantee of immediate collection against the sale of each product); Conaprole would export the powder milk, while Claldy, Calcar and Pili would export cheese.[20] In practice, even though Uruguay delivered several shipments of powder milk and cheese, at the end of 2015 Venezuela owed USD 100 millions because the trust in Bandes was not yet operative. In November 2015, Venezuela paid USD 50 millions and made new payments of USD 30 millions in April 2016 (paying the debt with Claldy, Calcar and Pili but still being indebted with Conaprole) and of USD 27 millions (from sells previous to the trade agreement) in September 2016. As of December 2018, Venezuela still has a debt with Conaprole.

Finally, in an attempt to give support to the sector, the Uruguayan government approved the regulations of the Dairy Financing Fund (FFAL III). The first disbursement would be of US$ 45 millions, distributed at a rate of approximately 2 cents per liter sent to the industry during 2014. The money would come from a bridge loan granted by the state-owned bank, Banco República (BROU), that would enable the local producers to face the debts contracted and to have liquidity in order to work for next season's production.

[19] Leaving 400 employees out of work.

[20] The origin of the agreement was an old debt of oil that Uruguay (ANCAP) had with Venezuela (PDVSA). With the new agreement, Uruguay would canceled out the debt and the payment would serve as a guarantee to pay Uruguayan producers for future deliveries of alimentary products from Uruguay to Venezuela.