Bank pricing of corporate loans

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Abstract
We analyze the pricing of firm loans originated by the largest banks operating in Portugal between September 2018 and December 2019. On average loans are overpriced in the short-run and underpriced in the long-run. Underpricing is lower in the subsample of loans originated in 2019. Loans with maturity longer than a year, loans to the construction, real estate, and transportation and storage sectors, and loans to high credit risk borrowers are on average underpriced. Loans to other borrowers are generally overpriced. Borrowers and sectors with underpriced loans are potential sources of fragility in the financial sector, especially in the medium to long-run. (JEL: G12, G21)

1. Introduction

From the end of the sovereign debt crisis to the end of 2019, bank credit to Portuguese firms fell and banks reported an increase in competition. Spreads on new loans decreased and bank profitability, while improving during this period, remained lower than its historical long term average. The combination of these dynamics raises concerns that banks were underpricing loans. In a bid to remain competitive, banks may have offered loan spreads lower than the level needed to compensate banks' equity holders for bearing risk. Underpriced loans can lead to fragilities in the financial system and pose a risk to financial stability. Banks originating underpriced loans are less able to build up capital by accumulating profits, are less attractive to outside investors, and are more likely to make losses if credit risk increases suddenly.

In this article we assess the pricing of firm loans. We analyze whether the net interest and fee income of loans to Portuguese firms is sufficient to cover loans' expected credit losses, operating costs, and capital costs. We then analyze the borrower and loan characteristics driving the differences in the pricing of firm loans.

We contribute to the literature on loan pricing with a new methodology. We compute the spreads that banks should charge based on loan, borrower, and bank characteristics,

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and compare them with observed spreads. This comparison allows us to determine whether loans are under, over, or fairly priced.

We assess loan pricing with a granular analysis of loans originated between September 2018 and December 2019. We compute the risk-adjusted return of each loan net of capital costs. The risk-adjusted return of each loan accounts for the loan's net interest and fee income, expected credit losses, and operating fees. The loan's capital costs accounts for the loan's contribution to a bank's capital. We estimate the risk-adjusted return and the loan's capital costs using loan, borrower, and bank data.

Results on the pricing of loans originated in 2018 and 2019 are mixed. On average loans are overpriced by 11 basis points if we focus on short-run loan returns. In the long-run, however, loans are underpriced by 29 basis points. While the absolute level of underpricing is seemingly small, it has a sizable effect on shareholders' return. An average underpricing of 29 basis points reduces shareholders' return on corporate loans by 6 percentage points compared to a setting with no underpricing. The underpricing we find when focusing on the long-run returns seemingly decreases over time. In the sample of loans originated in 2019, loan underpricing reduces to 7 basis points on average and the corresponding shareholders' return on corporate loans reduces only by 2.9 percentage points compared to a setting with no underpricing.

We find further evidence of over and underpricing when we analyze mispricing across different loan and borrower characteristics. First, loans with maturity longer than a year are generally underpriced. If banks keep on originating loans as in the sample period firm loan portfolios are unlikely to adequately compensate banks' equity holders in the medium to long-run. Second, loans to firms operating in the construction, real estate, and transportation and storage sectors are underpriced. To the extent that underpriced loans yield lower returns than fairly priced loans, this result highlights these sectors as potential sources of fragility to the financial system. It also raises questions about the strength of the recovery of these sectors from the 2008-2012 crisis. Third, loans to low credit quality firms are underpriced. They represent 17.7 percent of all loans originated between September 2018 and December 2019. This result suggests that the borrowers of some of these loans have a weak financial standing and are possibly more sensitive to a negative shock than similar borrowers with fairly priced loans. Lastly, and in contrast with these results, we find that loans to high credit quality borrowers, and loans to the manufacturing and to the wholesale and retail sectors are overpriced.

The overall effect on bank profitability of the mispricing that this article documents, is likely limited. The loans in the sample we analyze represent at most 16 percent of banks' stock of credit to firms and 5 percent of banks' total assets. We also note that the low equity returns on new firm loans that Portuguese banks are expected to earn in the medium to long-run is in line with the low profitability that euro area banks are experiencing since the financial crisis. Between 2008 and 2019, the yearly equity returns of euro area banks was never higher than 6 percent.

The existing literature on loan pricing of which Barbosa and Ribeiro (2007), Santos (2011), Antunes and Martinho (2012), Santos (2013), Gambacorta and Mistrulli (2014), Santos and Winton (2019) and Banco de Portugal (2016, 2017) are a few examples,

is mostly focused on explaining the cross-section variation in observed spreads. The methods used in the literature can determine whether certain loan, borrower, and bank characteristics matter for loan pricing but, in contrast with the method we use, they cannot determine whether a particular level of observed spread is sufficient to compensate banks' shareholders for their costs.

The next section describes the methodology and the data. Results from our granular analysis are in section 3. Section 4 concludes.

2. Risk-adjusted return net of capital cost

2.1. Method

We assess whether specific firm loans are mispriced by computing the risk-adjusted return of each loan net of the loan's capital cost. The risk-adjusted return net of capital cost is the sum of the loan's net interest and fee income minus the loan's expected loss rate, operating costs, and capital costs:

$$r = Net\,Interest\,Income - E\left[Loss\right] + Fees - Operating\,Costs - Capital\,Cost$$

The capital cost is the cost of equity of the bank originating the loan multiplied by the loan's contribution to the bank's capital, $Capital\,Cost = Cost\,of\,Equity \times Capital$.

The risk-adjusted return net of capital cost is the excess return earned by the shareholders of the bank originating the loan. It represents what is left to shareholders after paying all costs including the capital cost associated with the loan. The capital cost is the risk premium for bearing the part of the loan's default risk that is not diversified by the bank's portfolio. If the excess return is zero then shareholders are exactly compensated for the costs of originating and servicing the loan – the operating costs –, and for the costs of bearing default risk – the expected losses and the capital cost. Loans are underpriced if the risk-adjusted return net of capital cost is negative.

The risk-adjusted return net of capital cost is closely related to a metric practitioners use for banks' capital budgeting and for loan pricing. This metric is called risk-adjusted return on capital, or RAROC. We follow the description of RAROC in Saunders and Allen (2010), adjusted to partly address the shortfalls identified in Froot and Stein (1998). Following Froot and Stein (1998) we compute a loan's capital to reflect only the credit risk that cannot be hedged by the bank's portfolio.

In what follows we briefly describe how we compute each component of the risk-adjusted return net of capital cost. Details are available upon request. In the remainder of this article we will use the expressions 'risk-adjusted return net of capital cost' and 'excess return' interchangeably.

2.1.1. Net interest income

A loan's net interest income is the value that, once added to a cost of funds rate, discounts the sum of the loan's cash-flows to zero. The net interest income i solves the

following equation:

$$\sum_{t \in T} \frac{CF_t}{(1 + i + r_t)^t} = 0 \tag{1}$$

where t is the annualized time difference between the loan's cash-flow date and the loan's origination date, T is the set of these time differences for all cash-flow dates, and r_t and CF_t are the cost of funds rate and loan cash-flow at time t.

We can think about the loan's net interest income as the difference between the loan's nominal interest rate and a cost of funds rate. We use the Euribor as the cost of funds rate. For loans with maturities longer than a year we complement information on Euribor with information on interest rate swaps. To compute the net interest income we use the loan's contractual terms to generate cash-flows and to determine the tenor of the cost of funds rate. Loans' contractual terms are reported by banks to the Banco de Portugal's Central Credit Register.

Instead of using the Euribor as the cost of funds rate we could have used each bank's cost of new deposits to capture the effect of bank specific financing costs on loan excess returns. In section 3.2 we report the results obtained when using this alternative measure of banks' cost of funds.

2.1.2. Fee income

We estimate a loan's fee income as a proportion of the loan's net interest income. This proportion is the ratio of total fee income to total net interest income of the bank originating the loan. It changes quarterly. Data on total net interest income and total fee income come from FINREP reports. In our sample period the average across time and banks of the ratio of total fee income to net interest income is 50.5 percent (refer to Table 1).

2.1.3. Expected loss rate

The expected loss rate is the rate that, once subtracted from the loan's net interest income and cost of funds rate, discounts to zero the sum of the loan's expected cash-flows. The loss rate is the value l that solves the following equation:

$$\sum_{t \in T} \frac{E_0 \left[CF_t\right]}{(1 + i + r_t - l)^t} = 0 \tag{2}$$

where variables t, CF_t, r_t, and i, and the set T have the same meaning as in equation (1). The expectation operator $E_0 \left[\cdot\right]$ is the expectation with respect to the loan's origination date.

We can think of the loss rate as the annualized expected loss on the loan per euro of exposure. The computation of loss rate and net interest income are similar. But to calculate the net interest income we use the contractual cash-flows, while the loss rate is computed using expected cash-flows. Expected cash-flows are equal to contractual cash-flows minus expected losses.

The expected loss in each period between consecutive cash-flow dates is the product of the loan's exposure at default, default probability, and loss given default.

The default probability between any two cash-flow dates is computed using a term structure of default probabilities from the origination to the maturity of the loan. We derive the term structure of default probabilities using estimates of a borrower's default probability and rating from Banco de Portugal's in-house credit risk assessment system, henceforth Banco de Portugal ICAS, together with the rating transition matrix in Antunes *et al.* (2016). Estimates of default probabilities available from Banco de Portugal ICAS are also based on Antunes *et al.* (2016).

We use loss given default estimates available at the Financial Stability Department of Banco de Portugal. The loss given default estimates vary by sector and firm size and are based on the regulatory loss given default reported by banks to the Banco de Portugal's Central Credit Register. They incorporate the effect of collateral and guarantees but they do so on average. They do not reflect the collateral or guarantees of a specific loan.

2.1.4. Operating costs

To estimate a loan's operating cost we combine loan and bank data. Specifically, we multiply the sum of a loan's net interest income and fees by the ratio of total operating costs to total loan income of the bank originating the loan. This ratio is computed in the quarter in which the loan is originated. Total operating costs are the sum of wages, depreciation, and general and administrative expenses. Total loan income is the sum of a bank's total fee and total net interest income. We extract these variables from banks' consolidated income statements in FINREP reports.

2.1.5. Capital costs

The capital cost of a loan is the loan's contribution to the capital of the bank multiplied by the bank's cost of equity.

Anecdotal evidence based on the CAPM puts the cost of equity of some Portuguese banks at around 8 percent, and this is the value we use. This value is consistent with the cost of equity range of 8 to 10 percent reported by European banks in the European Banking Authority Risk Assessment Questionnaire of June 2019.

The contribution of a loan to the bank's capital is the difference between (i) the loan's loss when the losses of the bank's credit portfolio equal the 99.9th percentile of the loss distribution of the same portfolio and (ii) the loan's expected losses, both terms divided by (iii) the outstanding amount of the loan. Implicitly, we are defining the bank's capital as the difference between the 99.9th percentile losses of the bank's portfolio of loans at a one-year horizon and the expected losses of the same portfolio. This definition of capital is usually referred to as economic capital. Economic capital does not correspond to the accounting equity value of the bank and it does not match the bank's regulatory capital. Nonetheless it is conceptually similar to regulatory capital and the choice of the 99.9th percentile follows from the underpinnings of Basel regulation.

To determine the contribution of a loan to the capital of the originating bank, we first compute the distribution of losses of the originator's loan portfolio. We obtain

the distribution of losses by simulating the default or non-default state of every single borrower in the originator's portfolio at a one-year horizon. We use a multi-factor model of default risk to simulate default and non-default states. The multi-factor model splits default risk into systemic and idiosyncratic risk, and allows for the existence of multiple systemic risk factors. The model captures default correlation across borrowers through their exposure to systemic risk factors, and through the correlation between those factors.[1] In each simulation trial we compute the loss associated with each loan based on whether the borrower defaulted or not. We then aggregate losses to obtain portfolio losses in a single simulation trial. We simulate many different trials to arrive at a distribution of portfolio losses. From the distribution of portfolio losses we then compute the 99.9th percentile of losses, and we identify the simulation trials associated with this level of loan losses. We then compute the mean of each loan's loss in these simulations trials and use the result to calculate the loan's contribution to the bank's capital.

In what follows we will briefly describe the portfolio and the source of the input parameters used to simulate portfolio losses. Details of the model, simulation, loss computation, and estimation of input parameters are available upon request.

Portfolio. The portfolio we use to compute the capital contribution of a specific loan is the credit portfolio of the originator in the month in which the loan is originated. The credit portfolio includes new and existing loans to households and firms, and new and existing credit securities – such as commercial paper and bonds – issued by firms. Loans and securities from borrowers deemed to be in default are excluded. We aggregate household loans into two exposures. One exposure aggregates mortgage loans and the other aggregates consumer loans. Data on household and firm loans comes from the Banco de Portugal's Central Credit Register. Data on banks' holdings of credit securities comes from Banco de Portugal's Securities Statistics Integrated System.

A few comments are in order. First, the portfolios we use to compute the capital contribution of loans are largely representative of banks' assets. Household and firm exposures represent an average of 71 percent of banks' financial assets in 2018 and 2019. The most significant assets not included in the portfolios are sovereign exposures. Depending on the bank, sovereign exposures represent anywhere between 13 percent to 38 percent of banks' financial assets. The exclusion of sovereign exposures may affect results since the capital contribution of a loan is portfolio dependent.

Second, the fact that we use the portfolio of the month of origination of the loan to compute capital over a year means that we implicitly assume no variation in the bank's portfolio of that month. That is we assume that the portfolio of the bank in a given month stays constant over the following twelve months. In practice, portfolios do vary over time and this variation can affect the actual contribution of a loan to a bank's capital. In our setting we expect that the effect of portfolio variation to be of little significance, though. In a separate analysis we observe that banks' household and corporate credit

1. Our multi-factor model is a discrete time adaptation of the copula model described in Benzschawel (2012). We use a multivariate normal copula.

portfolios vary little over any given 12-month period both in terms of exposure and credit risk profile.

Third, we aggregate household loans for convenience. Since we do not have default probability estimates for individual borrowers, and since we assume household loans have no idiosyncratic risk, it makes no difference whether we aggregate household exposures or consider them individually. For more on the assumption of no idiosyncratic risk for household loans see the paragraph on simulation.

Portfolio parameterization. To compute capital we need a default probability and correlation parameters for each counterparty in the portfolio, and a loss given default for each exposure. We need, in addition, estimates of the correlation between the factors of our multi-factor model.

We use default probability estimates from Banco de Portugal ICAS for firm counterparties in the portfolio. For the household counterparties we use default probabilities estimates available at the Financial Stability Department of Banco de Portugal.

The loss given default of each exposure is the same as the one used to compute the expected loss in section 2.1.3. It varies by firm size and sector. The loss given default of each of the two household exposures is estimated using the regulatory LGD that IRB banks report in the for their mortgage and consumer loans.

Correlation parameters include correlations between the systemic factors of our multi-factor model and the loading of each borrower on those factors. Our multi-factor model has thirteen industry factors and two household factors. We use Santos and Silva (2019) estimates of the thirteen industry factor correlations and of firm factor loadings. We estimate the correlation among the two household systemic factors and between the household factors and industry factors using a similar approach to Santos and Silva (2019). To estimate the systemic factor loadings of the household exposures we exploit time variation in the volatility of the default rates of mortgage loans and consumer loans.

Simulation. When simulating defaults we treat firms individually and simulate a default event for each firm. As mentioned earlier, for the two household aggregate exposures, we assume there is no idiosyncratic risk. This assumption implies that what we simulate is, in effect, a default rate for each of these two exposures rather than a default state. Assuming no idiosyncratic risk is the same as assuming that the household portfolio is large and loans are reasonably homogeneous. In the data, the household portfolio for any given month, bank, and loan type – mortgage loan or consumer credit – is indeed large, with the number of loans ranging between 50 000 and 800 000. Each of these portfolios is not homogeneous with respect to loan amount. The loan amount is concentrated on a small share of loans, especially in the consumer credit portfolios. The top 1 percent of loans with highest loan amount represent between 17 percent and 40 percent of total credit in the consumer credit portfolios and between 5 percent and 7 percent of total credit in the mortgage loan portfolios. The lack of homogeneity in the household portfolios may render the assumption of no idiosyncratic risk for household exposures unappealing. We carry on with this assumption, though, noting that a small share of a large number of loans is still a sufficiently large number.

	Fixed Int. Rate	Spread	Average Maturity	ICAS PD	LGD	Capital	Loan Fees	Oper. Costs
Unit	%	%	Months	%	%	%	%	%
Mean	3.3	2.3	29.6	3.3	38.1	2.7	61.3	50.6
Std. Dev.	2.9	1.2	34.7	6.3	4.2	7.3	9.2	8.5
Min	0.0	0.1	0.1	0.0	31.2	-16.9	47.9	40.1
P10	1.0	1.0	1.6	0.2	33.2	-1.2	48.6	43.5
P25	1.5	1.5	3.0	0.5	36.1	-0.5	51.0	45.0
Median	2.5	2.0	18.7	1.3	38.2	-0.2	62.7	47.4
P75	4.0	3.0	43.5	3.4	38.9	4.2	68.9	56.9
P90	6.9	4.0	78.2	8.1	45.3	9.4	72.4	59.8
Max	45.0	33.0	639.7	80.6	50.5	46.1	76.7	79.0
Obs. (#)	187195	111354	298549	298549	298549	298549	42	42

TABLE 1. Summary statistics of key variables.

Source: Banco de Portugal and authors' calculations.
Notes: This table contains exposure-weighted statistics of the following variables of interest: 'Fixed Int. Rate' is the interest rate of loans with fixed interest. 'Spread' is the spread of loans with variable interest rate. 'Average Maturity' is the average loan maturity in months. 'ICAS PD' is the default probability of the firm obtaining the loan. It is estimated according to Antunes *et al.* (2016) and available from Banco de Portugal ICAS. 'LGD' is the loss given default of the loan. 'Capital' is the loan's capital per euro of exposure. This table also has non-weighted statitics of banks' quarterly operating costs and loan fees between September 2018 and December 2019. 'Loan Fees' are banks' total fee income as a fraction of net interest income. 'Oper. Costs' are banks' operating costs as a fraction of loan income. The statistics are computed with the sample of loans used in the analysis of section 3.

2.2. Data

In this article we use detailed loan level data from Banco de Portugal's Central Credit Register, together with data in FINREP and COREP reports, market data, and other internal databases of Banco de Portugal. The Credit Register data provides information on all lending relationships between Portuguese credit institutions and firms. From September 2018 onward there was a substantial increase in the scope and the granularity of the data: The number of variables available increased from 24 to around 180 and they are now reported at loan level rather than borrower level. Our analysis takes advantage of this increased scope and granularity. The richness of the data includes several loan specific characteristics of interest such as loan amount, performing status, origination date, maturity, amortization schedule, purpose and type of contract, interest rate, spread, type of interest rate – fixed or floating, – and the reference rate if the interest rate is floating.

Our data consists of loans to non-financial firms originated from September 2018 to December 2019 by the seven largest banks operating in Portugal. We exclude from the data loans in default. We also exclude loans with incomplete or inconsistent data except in cases in which we can fill in the missing data by making reasonable assumptions. We expect our assumptions to be of minimal consequence for the final results. The resulting sample covers approximately two thirds of the number of loans and loan amount in the data. When we split the sample by relevant loan and firm characteristics we see a seemingly high coverage. For further details refer to Table A.1 in the Appendix.

We now briefly summarize the data and data sources already mentioned in section 2.1. We extract data on Euribor rates and Euribor interest rate swaps from Refinitiv. From FINREP reports we get net interest income, fee income, and operating costs. From Banco de Portugal internal databases we obtain firm features such as size, sector of economic activity, and firm credit ratings and firm default probabilities. Firm default probabilities were obtained from Banco de Portugal in-house credit assessment system and were estimated in accordance with the methodology presented in Antunes *et al.* (2016). Data on banks' holdings of credit securities are available on Banco de Portugal's Securities Statistics Integrated System. We report summary statistics of key variables in Table 1.

3. Results

3.1. Main analyses

In what follows we present two different averages of loans' excess returns. One average measures the short-run effects and the other measures the long-run effects of newly originated loans. The first average uses the loan's amount to weight excess returns. We interpret it as the one-month annualized excess return of the portfolio of newly originated loans. The second average weights excess returns with the product of the loan's amount by the loan's average time to maturity. The loan's average time to maturity is the average of the time elapsed between origination and cash-flow dates weighted by the contractual cash-flow at each date. We interpret this second measure as the excess return of the portfolio of loans a bank will end up with if it keeps on originating loans as it did during the sample period. This measure implicitly accounts for the rolling over or replacement of short-term loans by other loans with the same maturity, excess return, and amount.

To grasp intuition on the link between the excess return of a bank's long run portfolio and the weighting of loans by amount and maturity consider the following example. Suppose a bank originates 1-month and 5-year loans with the same face value at the beginning of every month. For simplicity assume that the principal is payable at maturity. At the end of the first month of operation this bank has two loans in its portfolio, one 1-month loan that is maturing and one 5-year loan. At the end of the second month it has three loans, one 1-month loan that is maturing and two 5-year loans. Iterating this reasoning forward, at the end of the sixtieth month, this bank has one 1-month loan that is maturing, one 5-year loan that is also maturing, and fifty nine 5-year loans. From this month onward the bank's portfolio of loans is always the same. Every month it has 61 loans, 60 of those with 5-years original maturity and one with 1-month original maturity. This is the bank's long-run portfolio. The weight the 1-month and 5-year loans have on the bank's long-run portfolio is $1/61$ and $60/61$. These are the same weights as the ones we would obtain if weighting by amount and maturity the bank's new loans in any given month.

There's mixed evidence of under and overpricing. Our results show that, on the one hand, the exposure weighted average of excess returns is positive and around 11 basis points, leading to a return of 12.2 percent on new firm loans to banks' equity holders. On the

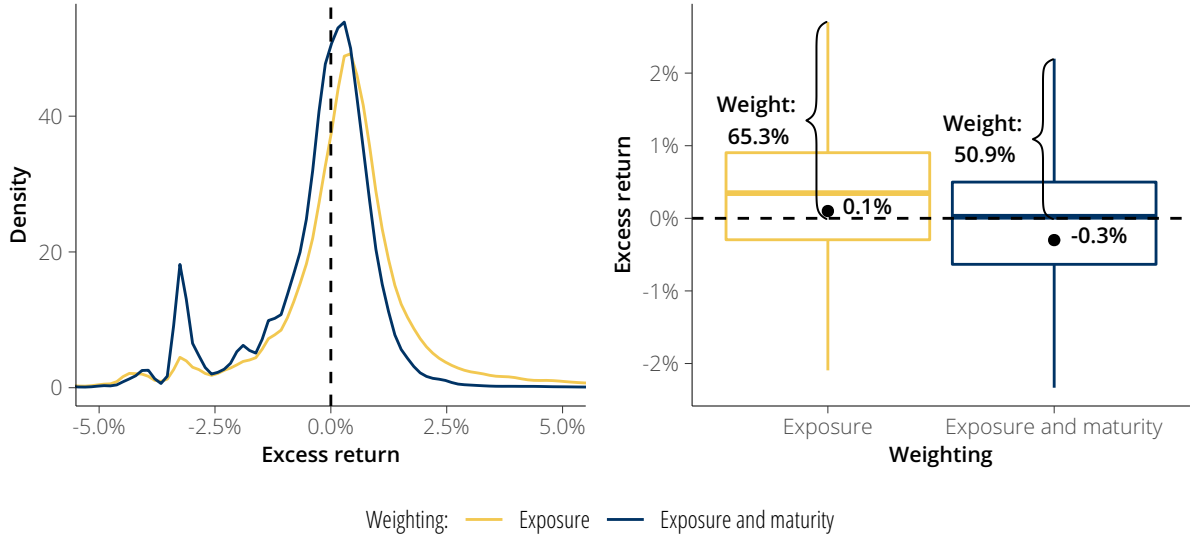

FIGURE 1: Density (left) and boxplot (right) of excess returns on loans to firms originated between September 2018 and December 2019.

Source: Banco de Portugal and authors' calculations.
Notes: The left plot has estimates of two probability density functions of excess returns, each corresponding to a different weighting of excess returns. Excess returns are either exposure-weighted or exposure and maturity weighted. Excess returns extend beyond the range shown in the x-axis and go all the way from -39 percent to 30.7 percent. The weight of the region not shown is less than 3.9 percent when excess returns are exposure weighted and less than 0.7 percent when excess returns are exposure and maturity weighted. The plot on the right has boxplots of excess returns, each corresponding to a different weighting of loans. The top, middle, and bottom line in each boxplot correspond to the 75th, 50th, and 25th quantile of distribution of excess returns. The whiskers are 1.5 times larger than the 25th-75th inter-quantile range. The circles inside each boxplot are the weighted average of excess returns. The weight of non-negative excess returns in the distribution is next to the curly brackets. The weight of the region of excess returns not shown is 13.5 percent when excess returns are exposure weighted and less than 11 percent when excess returns are exposure and maturity weighted.

other hand, the exposure and maturity weighted average of excess returns is negative and around -29 basis points, leading to a return of 2 percent on new firm loans to banks' equity holders.

It is reassuring to see in Figure 1 that most of the weight of the distribution of excess returns is on returns higher than the mean. In addition, more than 65 percent of the new loans' exposure has a positive excess return. On the flip side, around 35 percent of exposure and a little less than 50 percent of the maturity-weighted exposure have negative excess returns. Underpricing is common.

It is also reassuring to see in Figure 2 that excess returns are positive in most months of the sample period, and that excess returns are positive or only slightly negative after April 2019. These results suggest that, in the sample period, loan underpricing is the exception rather than the rule, and that loan underpricing is seemingly decreasing overtime. In contrast, if banks were to continue originating loans as they did in 2019, they would generate a return of 5.1 percent to banks' equity holders in the long-run.

Short-term loans tend to be overpriced and long-term loans tend to be underpriced. We now turn our attention to loan mispricing across borrower and loan characteristics. We start

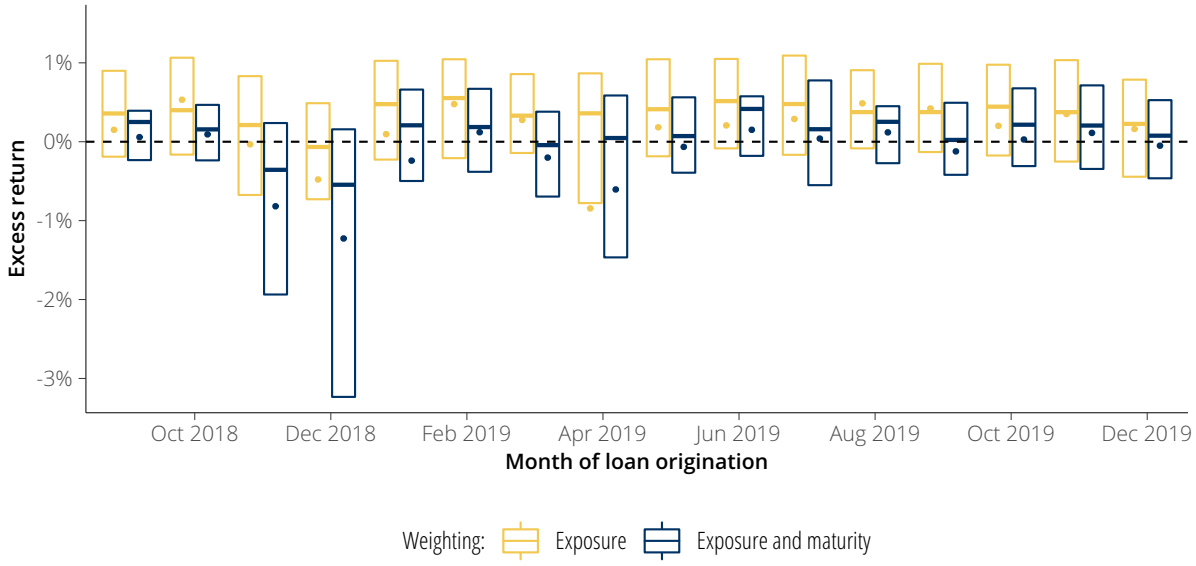

FIGURE 2: Quartiles and average excess returns on loans to firms by month of loan origination.

Source: Banco de Portugal and authors' calculations.
Notes: The plot represents quantiles and mean excess returns of loans split by month of loan origination. In each month there are two boxes, each corresponding to a different weighting of the loans. The top, middle, and bottom line in each box correspond to the 75th, 50th, and 25th quantile of distribution of excess returns. The circles inside each box are the weighted average of excess returns.

by dividing loans into maturity buckets and computing the exposure-weighted average of loans' excess returns for each maturity bucket. Figure 3 shows that loans with a maturity longer than a year are underpriced, while loans with shorter maturities are overpriced.

The effect of this result on loans' excess returns and on the return to banks' equity holders at different horizons can be seen in Figure 4. Average excess returns on new loans are positive for horizons shorter than six months and negative otherwise. If banks keep on originating loans as they did during the sample period, equity holders are expecting to earn average capital returns higher than 8 percent on new loans only at short horizons. At horizons longer than three-months the capital return falls below 8 percent. For example, at the six-months, one-year, and two-years horizon equity holders expect to earn a return of 6.4, 5.1, and 4.3 percent on new loans.

Equity holders' returns are consistently higher when we focus our attention on loans originated in 2019. Still, they fall short of the 8 percent mark at horizons equal to or longer than one year. If banks keep on originating loans as they did in 2019, then at the six-months, one-year, and two-years horizon, equity holders should expect to earn a return of 8.8, 7.5, and 6.7 percent.

These results suggest that the interest rates on firm loans are sufficient to compensate banks' equity holders in the short-run, but not in the long-run even after accounting for the roll-over of short-term loans. If interest rates of new long-term loans do not increase going forward, firm loan portfolios are unlikely to adequately compensate banks' equity holders.

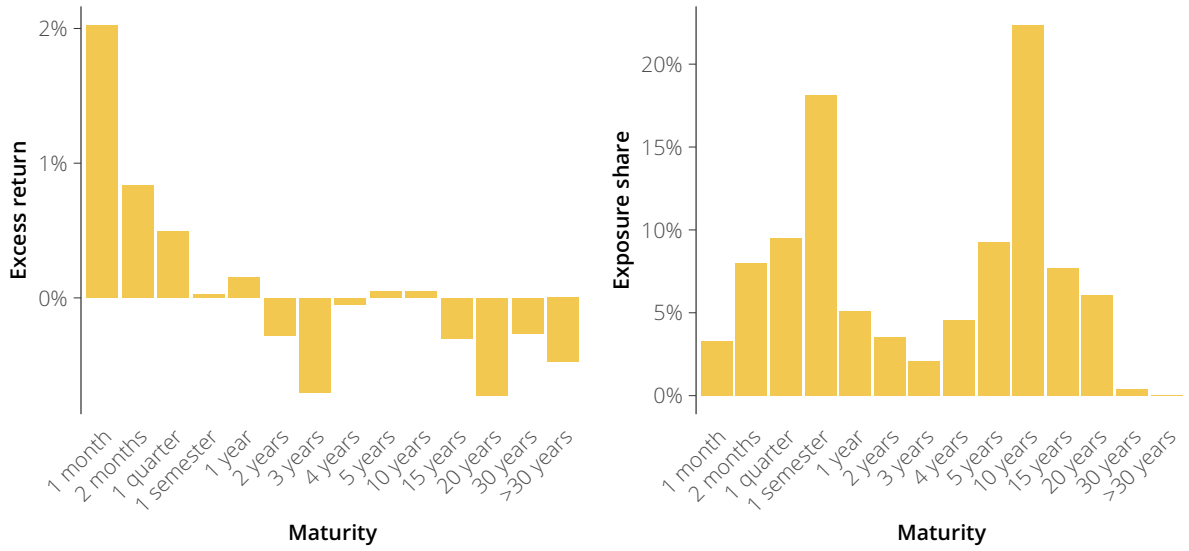

FIGURE 3: Loan excess returns (left) and loan exposure (right) by loan maturity.

Source: Banco de Portugal and authors' calculations.
Notes: The plot on the left shows the exposure-weighted average of excess returns by maturity bucket of loans to firms originated between September 2018 and December 2019. Each maturity bucket contains loans with a maturity at origination shorter than the maturity of the bucket and longer than the maturity of the preceding bucket. For example, bucket "2 months" has all loans with maturity shorter than two months and longer than one month. There are more than 1000 observations in each bucket except in buckets '30 years' and '> 30 years', which have 159 and 5 observations. The plot on the right has the share of total exposure of loans in each bucket.

Low credit quality loans have negative excess returns. A casual observation of the Portuguese credit market may lead to the conjecture that intense bank competition for high credit quality borrowers is driving the spreads on these borrowers' loans below the level commensurate with an adequate compensation for risk. Our evidence does not support this conjecture. Figure 5 shows that average excess returns are positive for loans to borrowers with credit rating CR1&2, i.e., borrowers with highest credit quality. In fact, excess returns are negative only for loans to borrowers with the lowest credit quality. These borrowers have higher default probabilities than other borrowers and their loans contribute to capital more than other loans. But they are charged a spread only moderately higher than what is charged to other borrowers. A similar result was also observed in the euro area significant institutions over the same period of our analyis as reported in European Central Bank (2020).

It is worth highlighting that loans to low credit quality borrowers represent a substantial part of banks' new credit to firms and banks stand to make losses on them. In our sample loans to borrowers with credit rating CR8 represent more than 17 percent of new credit, and their expected return to banks' equity holders is either -18.2 percent or -3.2 percent depending on whether they are exposure or exposure and maturity weighted.

The fact that low credit quality borrowers receive loans with negative excess returns on loans suggests some of these borrowers are unlikely to survive without bank support.

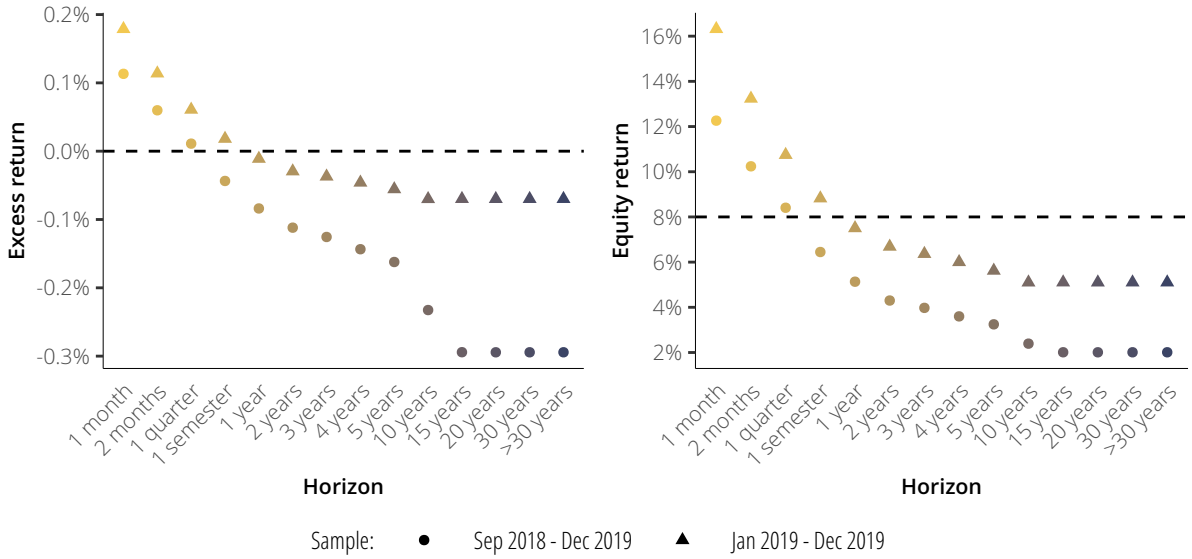

FIGURE 4: Average excess returns (left) and average equity holders' return (right) on new loans at different horizons.

Source: Banco de Portugal and authors' calculations.
Notes: This figure depicts average excess and equity holders' returns at different horizons. The average equity return is the ratio of average excess returns to average capital contributions. These averages are computed assuming that until the end of the horizon under consideration, banks originate loans as they did during the sample period. To this end, excess returns and capital contributions are weighted by the product of the loan's amount with the minimum between the horizon and the loan's average maturity. The interpretation of this weighting is similar to the interpretation of the wheighting by loan amount and maturity. Each plot has two series, one which uses all available data and another that focus on loans originated between January 2019 and December 2019.

They may be receiving loans at rates lower than what would be commensurate to risk because that is all they can afford. When faced with a negative shock these borrowers may not be able to afford the underpriced spreads they are being charged and banks may experience substantial losses as a result.

Construction, real estate, and transportation and storage sectors have the worst excess returns. Looking now at loans' excess returns by sector in Figure 6 it is not surprising to see that loans to the construction, real estate, and transportation and storage sectors have significantly negative excess returns. These were the sectors most affected by the financial and sovereign debt crises of 2008-2012. Some borrowers in these sectors were left with a large debt and are likely facing a protracted recovery. On this topic see, for example, Azevedo *et al.* (2018).

Compared to other sectors, the low excess returns in the construction, real estate, and transportation and storage sectors are explained by the higher default probabilities of their borrowers. The low excess returns in the construction and real estate sectors are also explained by the high exposure of banks to these sectors which, combined with high default probabilities, leads to high loan capital contributions.

Note the significant discrepancy between the exposure-weighted and the exposure-and-maturity-weighted average excess returns for the construction sector. It is suggestive that short-term loans have lower excess returns than long-term loans in this

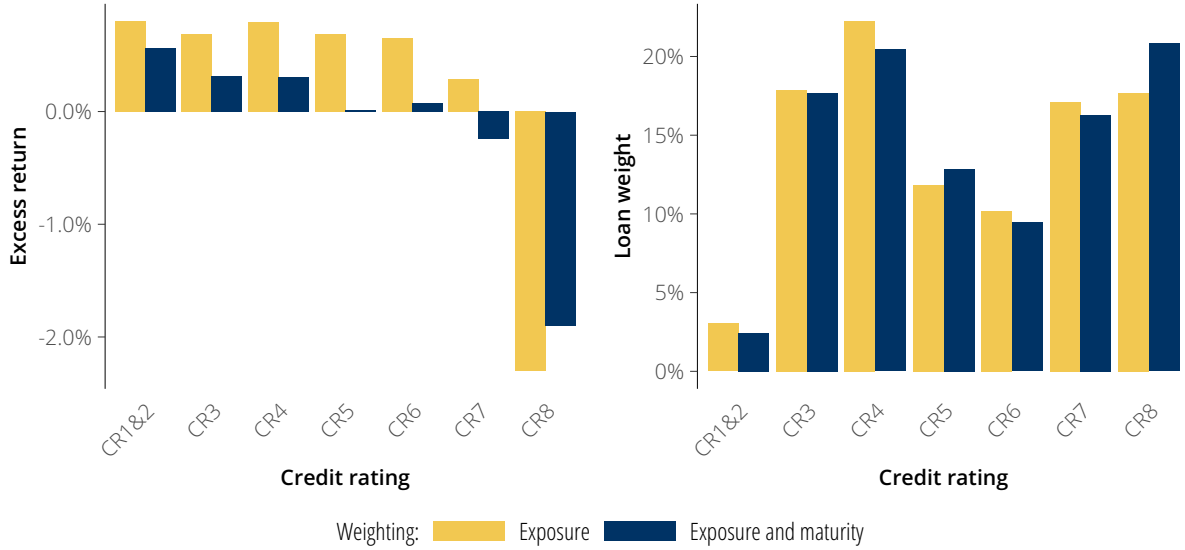

FIGURE 5: Loan excess returns (left) and loan weight (right) by borrower credit rating.

Source: Banco de Portugal, ECB, and authors' calculations.
Notes: The plot on the left shows the average of loans' excess returns by borrower credit rating. The average is both exposure-weighted and exposure and maturity-weighted. The sample comprises loans to firms originated between September 2018 and December 2019. Borrower credit ratings are obtained through the Eurosystem mapping between default probabilities and credit quality steps, using probability of default estimates from Banco de Portugal ICAS. The Eurosystem credit quality steps mapping has eight credit ratings numbered from 1 to 8 to which we attach the prefix 'CR'. Lower numbers mean higher rating. Few firms are classified in credit rating 1 and so we pool them with firms rated in 2. For further details on the credit quality steps please refer to Antunes *et al.* (2016). The plot on right has the weight in the full sample of loans in each credit rating.

sector. In contrast, in all other sectors, short-term loans command a higher excess return than long-term loans.

New loans to large firms are typically underpriced. The observation that stands out from Figure 7 is that loans to large firms are typically underpriced. Otherwise, there is no clear pattern in the relation between excess returns and firm size. When we weight loans by exposure, excess returns are positive for all other firm size categories. But once we weight excess returns by maturity and exposure, excess returns are positive only for small firms and holdings.

Long-term loans, loans to low credit quality firms, loans to large borrowers, and loans to firms operating in the construction sector have negative excess returns. Results thus far are based on a univariate analysis of the relation between excess returns and loan and borrower characteristics. A point of concern is whether these relations are independent or driven by a common factor. Are the negative excess returns we observe in the construction sector driven by borrowers in this sector having low credit quality?

To address this concern we complement the univariate analysis with a multivariate regression of excess returns on the same loan and borrower characteristics used in the univariate analysis. The results reported in Table 2 largely confirm the outcome of the univariate analysis: Loans with longer maturities, loans offered to large firms,

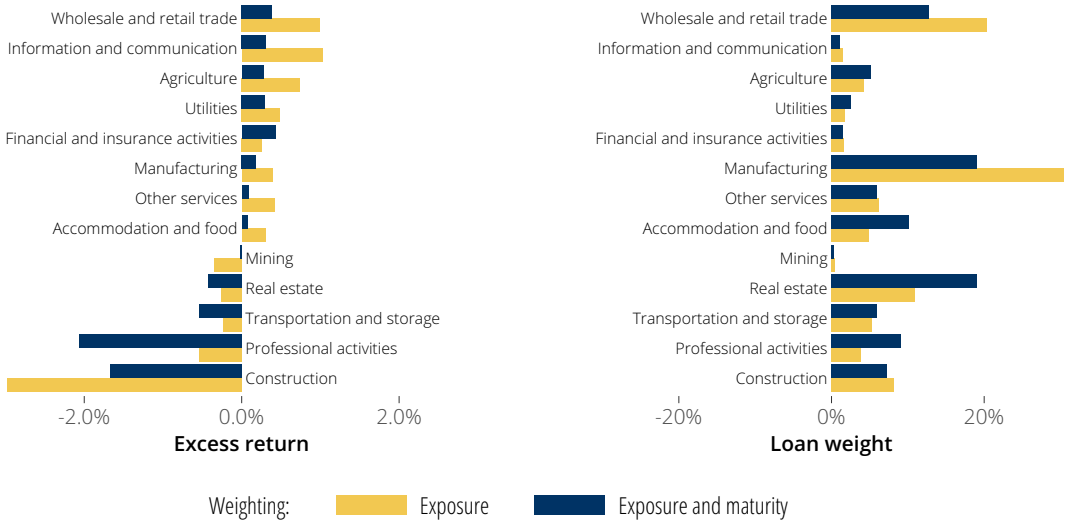

FIGURE 6: Loan excess returns (left) and loan weight (right) by borrower sector.

Source: Banco de Portugal and authors' calculations.
Notes: The plot on the left shows the average of loans' excess returns by borrower sector. The average is both exposure-weighted and exposure and maturity-weighted. The sample comprises loans to firms originated between September 2018 and December 2019. Each borrower's sector is determined according to NACE Rev.2 sector classification. Sectors are aggregated at section level. Sector 'Utilities' comprises borrowers classified in sections 'D - Electricity, gas, steam and air conditioning supply' and 'E - Water supply; sewage; waste management and remediation services'. Sector 'Professional activities' corresponds to section 'M - Professional, scientific and technical activities'. The plot on right has the weight in the full sample of loans in each sector.

loans to low credit quality firms, and loans to borrowers operating in the construction sector tend to have low excess returns in comparison with other loans. Sector-by-sector and bank-by-bank regressions similar to the ones in Table 2 and regressions with alternative specifications of the relation between excess returns and loan and borrower characteristics yield the same qualitative results.[2]

3.2. Additional analyses

We now assess whether results are driven only by highly indebted firms facing a protracted recovery from the financial and sovereign debt crises. We do this assessment by analyzing excess returns in two subsamples of interest. The first subsample comprises loans to firms created after 2013. The second subsample contains only loans to firms that before receiving the loan had no relation with the bank that originates it. In either of these two subsamples, the key results from the baseline analysis remain unchanged. However, there's evidence supporting the possibility that our baseline sample includes firms that are financially unsound and bank-dependent. The underpricing associated with the construction sector and with high credit risk firms is lower in the subsamples than in the full sample.

2. Details on our robustness analysis are available upon request.

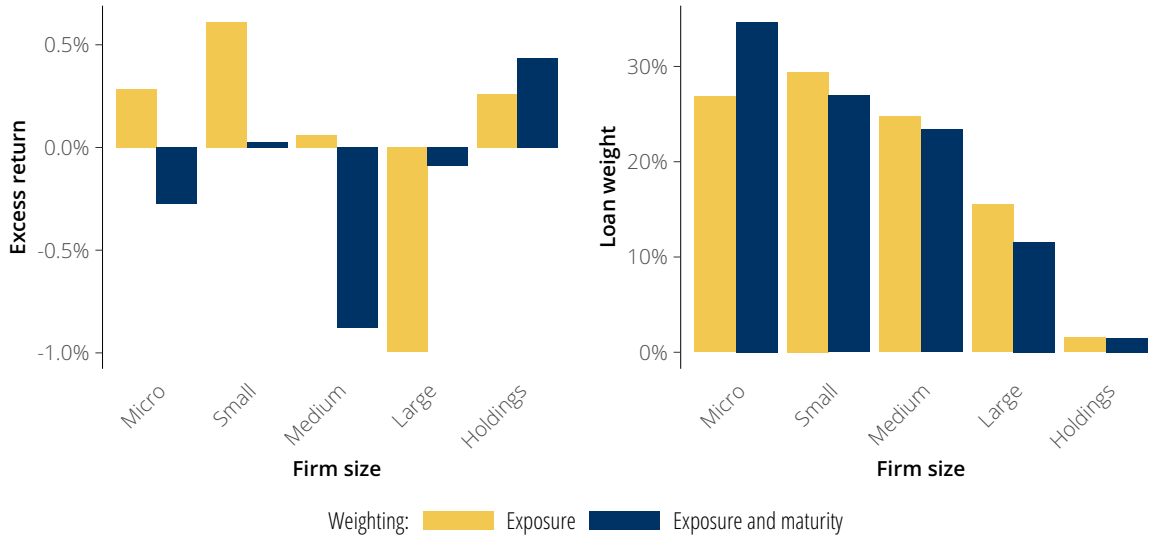

FIGURE 7: Loan excess returns (left) and loan weight (right) by borrower size.

Source: Banco de Portugal and authors' calculations.
Notes: The plot on the left shows the average of loans' excess returns by borrower size. The average is both exposure-weighted and exposure and maturity-weighted. The sample comprises loans to firms originated between September 2018 and December 2019. Borrower size is defined in 2003/361/EC: Commission Recommendation of 6 May 2003. The plot on right has the full sample weight of loans in each size bucket. Exposure and exposure and maturity weights do not sum up to 100 percent since no size is available for some firms. Firms without information on size amount to less than 2 percent of total exposure and of total exposure and maturity.

We also assess whether the previous section results are driven only by loans to group-affiliated firms. Our concern is that the default probabilities we use may not represent a comprehensive risk-assessment for group-affiliated firms.[3] We replicate the previous section analysis on the subsample of loans to firms that are not group-affiliated. We find that excess returns are on average higher, especially when weighting loans by exposure. Underpricig is mitigated in loans to firms in the construction sector and to high credit risk firms and aggravated in loans to firms in the real estate and transportation and storage sectors. We conclude that a more comprehensive assessment of the default risk of group affiliated firms is unlikely to change our key results, but it might mitigate some of the underpricing we identify in the previous section.

In our last analysis, we assess the impact of computing loan excess returns with another measure of banks' funding costs. In our baseline analysis, excess returns don't account for the heterogeneity of banks' funding costs or for the possibility that these costs are higher than Euribor rates. To assess the impact of this limitation, we repeat our analysis using banks' interest rates on new deposits as a measure of banks' cost of funding. Compared to the baseline analysis, excess returns are lower by 10 basis points

3. Banco de Portugal ICAS measures firms' default risk both as stand alone entities and as group-affiliated entities. We use the former measure because it is available for a larger set of firms.

Characteristic	Regressor	**Excess return** (%, Exposure weighted)	**Excess return** (%, Exposure and maturity weighted)
Sector	Agriculture	2.09^{***}	1.73^{***}
		(0.43)	(0.16)
	Mining and quarrying	1.64^{***}	1.33^{***}
		(0.33)	(0.17)
	Manufacturing	1.85^{***}	1.50^{***}
		(0.41)	(0.16)
	Utilities	2.37^{***}	1.84^{***}
		(0.48)	(0.18)
	Construction	Base category	Base category
		$(-)$	$(-)$
	Wholesale and retail trade	2.01^{***}	1.55^{***}
		(0.47)	(0.17)
	Transportation and storage	2.62^{***}	1.78^{***}
		(0.64)	(0.23)
	Accommodation and food	2.08^{***}	1.51^{***}
		(0.34)	(0.15)
	Information and communication	2.32^{***}	1.54^{***}
		(0.47)	(0.23)
	Real estate activities	1.94^{***}	1.24^{***}
		(0.32)	(0.15)
	Financial and insurance activities	2.37^{***}	2.01^{***}
		(0.49)	(0.22)
	Professional activities	1.29^{***}	-0.19
		(0.39)	(0.41)
	Other services	1.75^{***}	1.28^{***}
		(0.42)	(0.16)
Firm Size	Log of assets (in €)	-0.23^{***}	-0.12^{***}
		(0.03)	(0.02)
Credit Risk	Probability of default (in %)	-0.23^{***}	-0.10^{***}
		(0.06)	(0.03)
Maturity	Log of average maturity (in months)	-0.27^{***}	-0.16^{***}
		(0.05)	(0.04)
	Constant	3.49^{***}	1.34^{***}
		(0.54)	(0.33)
Bank	Bank fixed effects	Yes	Yes
N		297430	297430
R^2		0.57	0.55
adj. R^2		0.57	0.55
BIC		1141694	852499

TABLE 2. Regression of excess returns on loan and borrower characteristics.

Source: Banco de Portugal and authors' calculations.

Notes: The sample comprises loans to non-financial firms originated between September 2018 and December 2019. Construction is the base category for sector, thus the coefficients of the other sectors represent the discrete change from the construction sector. Since the discrete change is always positive, ceteris paribus, being in other sector is associated with a larger excess return. Sector 'Utilities' comprises borrowers classified in sections 'D - Electricity, gas, steam and air conditioning supply' and 'E - Water supply; sewage; waste management and remediation services'. Sector 'Professional activities' corresponds to section 'M - Professional, scientific and technical activities'. Results are robust to substituting the continuous variables 'log of assets', 'probability of default', and 'log of average maturity' by the discrete counterparts used in the previous analysis. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

on average for the whole sample and across loan maturities, borrowers' sectors, ratings, and firm sizes.

3.3. Limitations

The limitations of our analysis are mostly due to coarse and incomplete data.

First, due to incomplete data our results are based on a subsample of all the loans originated during the sample period. While the subsample is representative of the full sample, we cannot exclude the possibility that our conclusions may change if we have complete data on all the loans originated during the sample period.

Second, our data on fee income and operating costs is not granular. We use balance sheet data together with loan level data on net interest income to allocate fees and operating costs to loans. This allocation crucially depends on the relation between certain balance sheet variables also holding at the loan individual level. There is no guarantee that this relation actually holds, and our results are sensitive to it. If, for example, fee income is systematically higher in loans with low net interest income and vice-versa, we may end up observing little or no underpricing.

Third, banks may expect operating costs to decrease going forward and we do not account for such decrease. Back of the envelope calculations suggest that long-run average excess returns – those weighted by exposure and maturity – become positive if banks' operating costs fall by 15 percent or more.

Fourth, the default probability estimates we use have no qualitative overlays to account for soft information such as management quality or group structure. A more comprehensive credit risk assessment may change the default probability estimates and, as a result, some of our conclusions about loan underpricing.

4. Conclusion

We assess the pricing of firm loans originated by banks operating in Portugal between September 2018 and December 2019.

Results about the average pricing of loans suggest that banks' equity holders are being adequately compensated for bearing risk in the short-run. In the medium to long-run, however, banks' equity holders stand to make less than an 8 percent return, especially if banks keep on originating loans as in the sample period. This result is mitigated when we focus on the subsample of loans originated in 2019. Results also show underpricing in loans with maturities longer than a year, in loans to the construction, real estate, and transportation and storage sectors, and in loans to high credit risk borrowers.

Our analysis points to a couple of vulnerabilities in the Portuguese banking system with respect to corporate loans' pricing. First, banks' profitability and their ability to generate internal capital may decrease in the medium to long-run on account of loans with maturity longer than a year being underpriced. Second, the underpricing of loans to firms with high credit risk and to firms in the construction, real estate, and transportation and storage sectors, suggests these firms are not performing as strongly

as other firms and may thus be more sensitive to the business cycle. In a recession, they may be a source of loan losses for banks.

While results on loan underpricing point to vulnerabilities in the Portuguese banking system it is important to keep them in perspective. The sample we analyze represents a small fraction of bank's stock of credit to firms – less than 16 percent – and of bank's total assets – less than 5 percent. Thus, the overall effect on bank profitability of the loan underpricing that we document is likely limited. It is also worthwhile emphasizing that the low equity returns on new firm loans that Portuguese banks are expected to earn in the medium to long-run is in line with the low profitability that euro area banks are experiencing since the financial crisis. Between 2008 and 2019, the yearly equity returns of euro area banks was never higher than 6 percent.

Appendix

	Number of loans	Exposure
Total	**65%**	**67%**
Firm size - subtotal	**67%**	**71%**
Micro firms	63%	74%
Small firms	75%	76%
Medium-sized firms	69%	70%
Large firms	50%	61%
Rating class - subtotal	**73%**	**80%**
CR1&2	79%	73%
CR3	75%	79%
CR4	75%	81%
CR5	76%	85%
CR6	73%	79%
CR7	72%	78%
CR8	68%	78%
Sector - subtotal	**67%**	**71%**
Agriculture	74%	78%
Mining and quarrying	73%	66%
Manufacturing	73%	72%
Utilities	73%	69%
Construction	55%	70%
Wholesale and retail trade	71%	66%
Transportation and storage	61%	77%
Accommodation and food	48%	74%
Information and communication	57%	71%
Real estate activities	59%	77%
Financial and insurance ativities activities	34%	76%
Professional activities	59%	66%
Other services	52%	57%

TABLE A.1. Sample representativeness by loan and firm characteristics.

Source: Banco de Portugal and authors' calculations.
Notes: The table shows the share of new loans originated between September 2018 and December 2019 and the corresponding share of exposure that we end up using in our analysis. The total share of loans and exposure associated with each loan or firm characteristic is systematically higher than the total share of loans and exposure of the sample. This result is due to missing values in the data. We exclude loans with missing values in the data when we compute the share of loans and exposure for each loan and firm characteristic.

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