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RECENT DEVELOPMENTS IN FINANCING AND BANK  
LENDING TO THE NON-FINANCIAL PRIVATE SECTOR  
2019 H2

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## ABSTRACT

In the final stretch of 2019, the funds raised by households and non-financial corporations grew at very moderate rates, somewhat below those recorded in the first half of the year. This occurred against a setting of weak demand for funds, in which credit standards for bank loans had tightened slightly, although the cost of credit declined again, in keeping with the more accommodative monetary policy stance. Deposit institutions' loan portfolios continued to contract, albeit at a more moderate pace, while their average quality improved, with further reductions in the NPL ratio and in foreclosed assets.

**Keywords:** finance, credit, households, non-financial corporations, deposit institutions, NPLs, diversification.

**JEL classification:** E44, E51, G21, G23.

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### Introduction

This article examines recent developments in funds raised by the Spanish non-financial private sector (second section) and resident deposit institutions' credit exposure to this sector (third section). Developments in these variables will not necessarily coincide, since households and non-financial corporations do not only receive funding from these financial intermediaries. Households, in particular, may also receive consumer loans from specialised lending institutions, while non-financial corporations may issue debt in the capital markets.<sup>1</sup> The last section focuses on the quality of the credit on deposit institutions' balance sheets, paying special attention to non-performing loans and foreclosed assets. The article concludes with a box which analyses the diversification of deposit institutions' loan portfolios in the 2000-2017 period.

### Funds raised by the non-financial private sector

Since early last summer, in keeping with the more accommodative monetary policy stance, interest rates applied to new loans fell across all segments, to historically low levels in December<sup>2</sup> (the latest available figure). The cost of corporate debt issuance, which had been falling since early 2019, reversed its trend in August, in line with the increase in long-term sovereign debt yields observed in most of the advanced economies, resulting mainly from the expectations of no future policy interest rate cuts. In any event, in January 2020 (the latest available figure), the average cost of financing for firms in debt securities markets remained below the levels recorded before the summer (see Chart 1.1).

Conversely, according to the Bank Lending Survey (BLS), in 2019 Q4, lending standards tightened in all credit segments (see Chart 1.2), for the first time since 2013

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1 For a more detailed analysis of the differences between the two approaches and other statistical aspects, see Box 1 in "Recent developments in financing and bank lending to the non-financial private sector", Analytical Articles, *Economic Bulletin*, 3/2019, Banco de España.

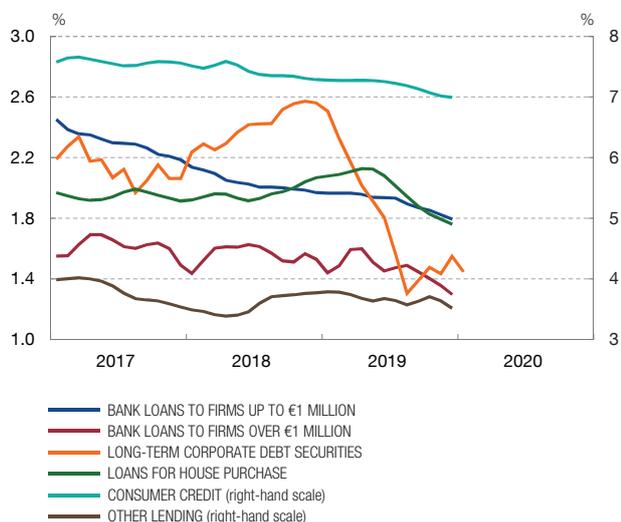
2 For a more detailed explanation of the developments in financing costs in recent months, see Box 4 "Changes in financial conditions in the Spanish economy in view of the ECB's communication and decisions in recent months", Quarterly report on the Spanish economy, *Economic Bulletin*, 4/2019, Banco de España.

Chart 1

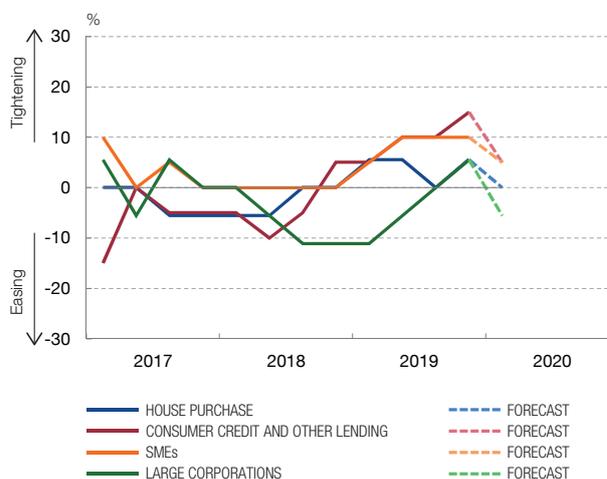
**FINANCING COSTS ARE VERY LOW, BUT THE SUPPLY OF BANK CREDIT HAS TIGHTENED MODERATELY, WHILE THE DEMAND FOR FUNDS DECLINES**

The financing costs of households and non-financial corporations remain very low, with additional falls in bank lending rates since the summer. However, credit standards for loans tightened moderately in 2019 H2, while SMEs perceived that their access to bank loans improved, albeit at an increasingly slower pace. The demand for credit declined in all segments in the last six months of 2019.

1 COST OF FINANCING (a)



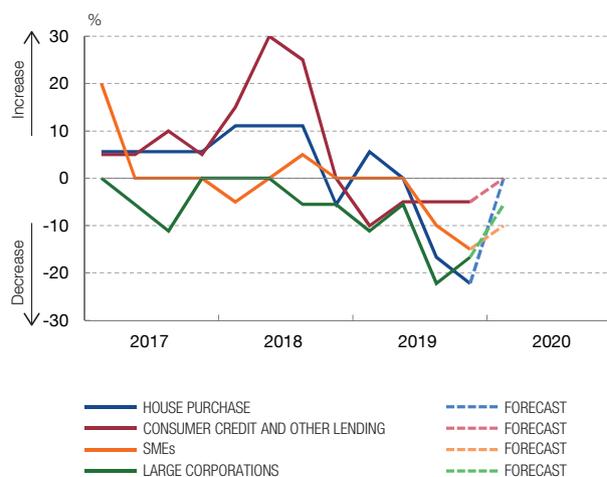
2 BLS: CHANGE IN CREDIT STANDARDS (b)



3 SAFE: CHANGE IN SMEs' ACCESS TO BANK LOANS (c)



4 BLS: CHANGE IN LOAN DEMAND (d)



**SOURCES:** Thomson Reuters, European Central Bank and Banco de España.

- a Bank lending rates are NDER (narrowly defined effective rate), adjusted seasonally and for the irregular component, that is, they are cycle-trend interest rates.
- b Bank Lending Survey. Indicator = percentage of banks that have tightened their credit standards considerably  $\times$  1 + percentage of banks that have tightened their credit standards somewhat  $\times$  1/2 - percentage of banks that have eased their credit standards considerably  $\times$  1 - percentage of banks that have eased their credit standards somewhat  $\times$  1/2.
- c Percentage of firms that report an improvement minus the percentage of firms that report a deterioration.
- d Bank Lending Survey. Indicator = percentage of banks reporting a considerable increase  $\times$  1 + percentage of banks reporting some increase  $\times$  1/2 - percentage of banks reporting some decrease  $\times$  1/2 - percentage of banks reporting a considerable decrease  $\times$  1.



Q1. This trend was also observed in the consumer credit and other lending segment in 2019 Q3 (mainly owing to the decline perceived in borrowers' creditworthiness), and in lending to SMEs (chiefly due to the worsening outlook for this type of firm and for economic activity in general). Nevertheless, most of the Spanish SMEs taking part in the ECB's Survey on Access to Finance of Enterprises in the euro area (SAFE) noted that, between April and September 2019, they had continued to perceive an improvement in their access to bank loans, although the relative percentage of these firms was lower than in previous rounds of the survey<sup>3</sup>, and the outlook for the coming months suggests that this trend will not continue (see Chart 1.3). The BLS also showed further increases in the proportion of rejected consumer loan applications in 2019 H2, and in loans for house purchase, in 2019 Q3<sup>4</sup>.

Despite the low financing costs, in a context of a worsening macroeconomic outlook, the demand for bank loans was estimated to have fallen across all segments in 2019 H2, according to the BLS (see Chart 1.4).

These developments in the supply and demand for bank financing led to weak lending growth in 2019 H2, although it picked up slightly in the final months of the year in all segments. Thus, in lending to households, new consumer loans grew moderately (although quickening in the final months of the year) and new lending for other purposes contracted until November, while lending for house purchase began to recover in August, following the first few months of adaptation to the entry into force of the new real estate credit law<sup>5</sup> (see Chart 2.1). In the case of lending to non-financial corporations, the volume of loans of up to €1 million declined in year-on-year terms between July and November, but showed positive growth in December. The more volatile segment of loans over €1 million rose in late 2019, partly as a result of base effects (see Chart 2.2).

These developments in the flows of bank financing led to weak growth of outstanding amounts. Lending to households grew, but at a more moderate pace in year-on-year terms than in mid-2019 (0.2% in December, according to the latest available figure), as a result of the slowdown in consumer credit (which showed year-on-year growth of 9.5% at end-2019, 0.9 pp less than six months earlier), the slightly faster decline in lending for house purchase (fall of 1.2% in December, 0.2 pp more than in June), and the sharper fall in other lending (1.9% at end-2019 - see Chart 2.3). In turn, total financing to non-financial corporations grew by 0.5% at end-2019 in year-on-year terms, at the same pace as in mid-2019. This was mainly due to the slower decline in credit obtained from resident institutions (0.6% in December, 0.6 pp less than six

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3 For a more detailed analysis of the results of the ECB's Survey on the Access to Finance of Enterprises in the euro area, see Box 5 "[Recent developments in Spanish SMEs' access to external finance according to the ECB's six-monthly survey](#)", Quarterly report on the Spanish economy, *Economic Bulletin*, 4/2019, Banco de España.

4 For a more detailed analysis of the results of the Bank Lending Survey, see "[Bank Lending Survey in Spain: October 2019](#)", Analytical Articles, *Economic Bulletin*, 4/2019, Banco de España, and "[Bank Lending Survey in Spain: January 2020](#)", Analytical Articles, *Economic Bulletin*, 1/2020, Banco de España.

5 [Law 5/2019](#), of 15 March, regulating real estate credit agreements, which entered into force on 17 June 2019.

Chart 2

## NEW LENDING INCREASED IN THE FINAL STRETCH OF 2019 AND TOTAL FINANCING TO THE NON-FINANCIAL PRIVATE SECTOR GREW MODERATELY

New lending showed greater dynamism in the final stretch of the year, after several months of weak demand. In terms of outstanding balances, lending to households grew at a somewhat more moderate pace as a result of the slowdown in consumer credit, a slightly stronger contraction of loans for house purchase and a sharper fall in other lending. Financing to non-financial corporations grew steadily, since the slower pace of contraction of credit obtained from resident institutions offset the moderation in the growth of funding from corporate debt issuance and the greater decline of financing from abroad.

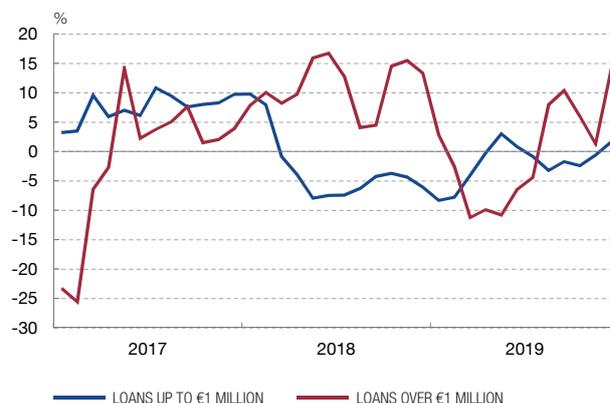
1 NEW LENDING TO HOUSEHOLDS

Year-on-year rates of 3-month cumulative flows



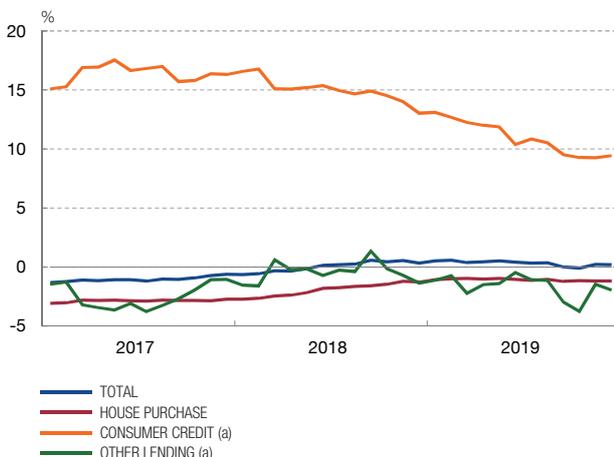
2 NEW LENDING TO NON-FINANCIAL CORPORATIONS

Year-on-year rates of 3-month cumulative flows



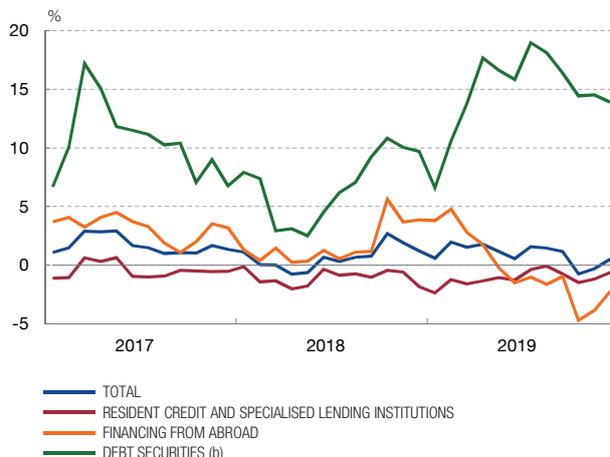
3 LENDING TO HOUSEHOLDS

Year-on-year rate



4 FINANCING OF NON-FINANCIAL CORPORATIONS

Year-on-year rate



SOURCE: Banco de España.

- a Does not include securitised loans in these segments.
- b Includes issuance by resident subsidiaries.



months earlier), which offset the more moderate rate of growth of financing from corporate debt issuance (13.9% at end-2019, 1.9 pp less than in June) and the sharper contraction of financing from abroad, although the latter was largely influenced by base effects<sup>6</sup> (see Chart 2.4).

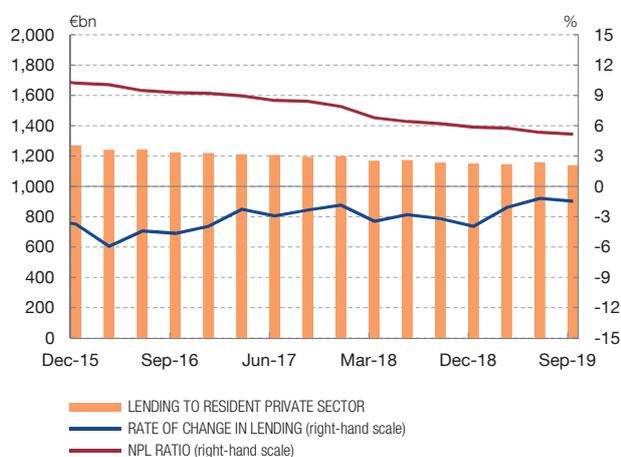
6 In October 2018, financing from abroad rose sharply, as a result of a sizeable, one-off transaction.

Chart 3

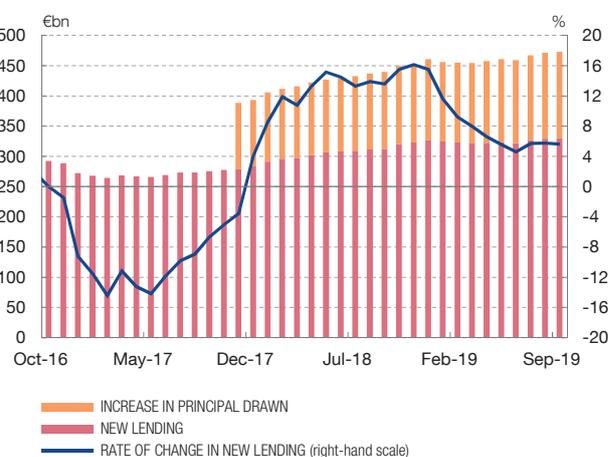
### THE STOCK OF BANK LOANS TO THE PRIVATE SECTOR CONTINUES TO DECLINE, BUT NEW LENDING INCREASES

Total lending continued to decrease, down to €1,139 billion at September 2019, while the year-on-year decline again picked up slightly to -1.5%. The NPL ratio fell by an additional 20 bp in the last quarter. The year-on-year rate of growth of new lending in the last 12 months held steady at around 5.6%.

1 VOLUME OF LENDING, YEAR-ON-YEAR RATE OF CHANGE AND NPL RATIO



2 VOLUME OF NEW LENDING IN THE LAST 12 MONTHS AND YEAR-ON-YEAR RATE OF CHANGE (a)



SOURCE: Banco de España.

a Before December 2016 information was not available on the increase in the principal drawn down in existing loans. Consequently, the first data for this series, accumulated over twelve months, is represented in November 2017. The rate of change shown only refers to new loans.



## Lending by the resident banking sector

Lending to households and non-financial corporations by deposit institutions in their business in Spain continued to contract in 2019 Q3<sup>7</sup>, with a year-on-year rate of change of -1.5% (see Chart 3.1). This decline was somewhat sharper than that observed in the bank financing to counterpart sectors described in the previous section, reflecting, inter alia, the derecognition of non-performing assets and write-offs from deposit institutions' balance sheets. The cumulative flow of new lending in the last 12 months to September 2019 grew by 5.6%, below the rate observed in September of the previous year (see Chart 3.2).

Lending by deposit institutions to non-financial corporations and households followed a divergent path. The balance of bank loans to non-financial corporations continued to fall, more markedly in September (by 2.7%) than in the resident private sector portfolio as a whole, as has come to be the pattern in recent years (see Chart 4.1). In lending to firms, the behaviour by sector of activity was very mixed. The decline in lending to the construction and real estate sectors moderated, although it held at high rates of decline; while lending to other sectors remained

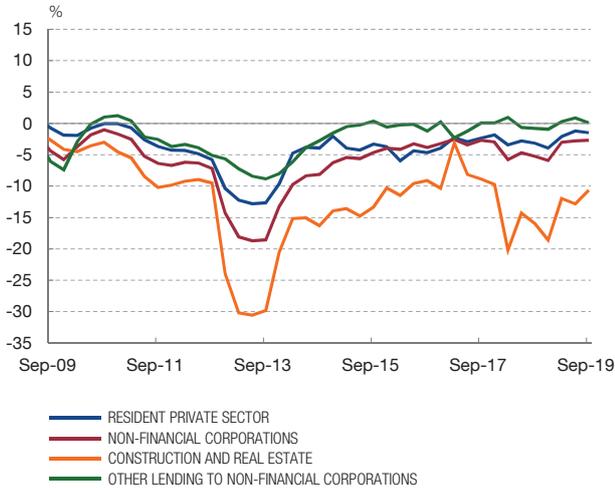
7 The 2019 Q4 data relative to deposit institutions' balance sheets will not be available until 23 March.

Chart 4

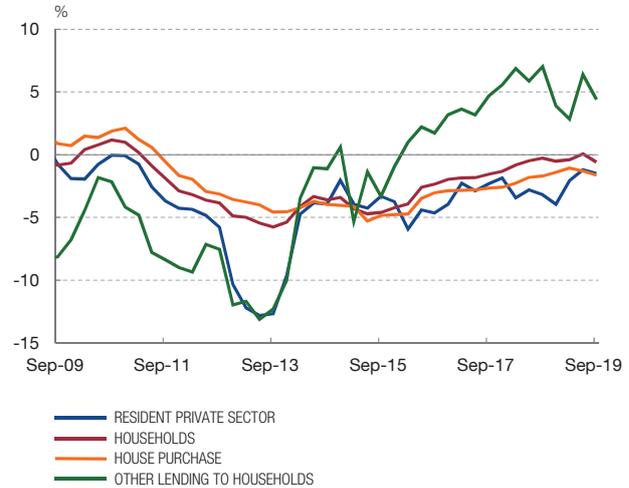
**SHARPER DECLINE IN BANK LENDING TO NON-FINANCIAL CORPORATIONS THAN FOR HOUSEHOLDS**

Lending to non-financial corporations declined more sharply than the total for all sectors, while lending to households decreased less than the total. However, in the last quarter, the fall in lending to firms moderated, and the rate of change of lending to households returned to negative territory, following the positive figures observed in June.

1 LENDING TO NON-FINANCIAL CORPORATIONS. YEAR-ON-YEAR RATE OF CHANGE



2 LENDING TO HOUSEHOLDS. YEAR-ON-YEAR RATE OF CHANGE



SOURCE: Banco de España.



relatively stable in 2019 Q3. The box accompanying this article analyses in depth the diversification of deposit institutions' loan portfolios, by customer type and by loan product. This analysis concludes that there has been a significant improvement in sectoral diversification in all institutions since the onset of the financial crisis in 2008.

The year-on-year growth rate of lending to households again turned slightly negative in September 2019, having been positive in the previous quarter (see Chart 4.2). This was due to the continued negative growth rates in lending for house purchase and a slowdown in the growth of lending for other purposes (4.4% in Q3, compared with 6.4% in the previous quarter).

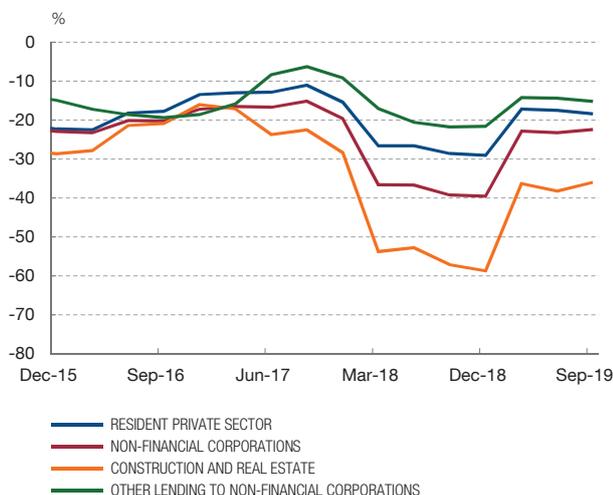
The growth rates of consumer lending to households by deposit institutions remained high (12.9%). However, it should be noted that such growth has, in the past year, been affected by the conversion of some specialised lending institutions in the consumer credit segment into deposit institutions, so that their on-balance sheet lending is now included in the total for all deposit institutions. At any rate, the overall stock of consumer credit on the balance sheets of deposit institutions and specialised lending institutions not affected by such conversions also maintained significant growth (8.4%), albeit more moderate than that observed in June.

Chart 5

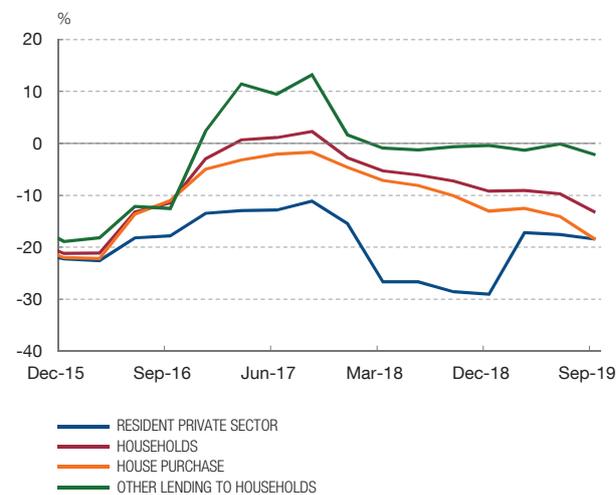
## NON-PERFORMING LOANS TO HOUSEHOLDS AND TO NON-FINANCIAL CORPORATIONS CONTINUED TO DECLINE

Non-performing loans continued to decline significantly last year, particularly in non-financial corporations, and specifically in the construction and real estate sectors. In the case of households, the decrease in non-performing loans was more pronounced for those extended for house purchase, and remained stable in the case of other lending to households.

1 NON-FINANCIAL CORPORATIONS, NON-PERFORMING LOANS, YEAR-ON-YEAR RATE



2 HOUSEHOLDS, NON-PERFORMING LOANS, YEAR-ON-YEAR RATE



SOURCE: Banco de España.



## Quality of bank lending

In September 2019, the stock of non-performing loans of deposit institutions amounted to €58.4 billion, that is, €13 billion less than a year earlier (a drop of 18.4%), continuing the downward trend of recent years. The NPL ratio also declined in this period from 6.2% to 5.1%. Over a longer timeframe, the volume of non-performing loans has decreased by approximately 70% from its peak at end-2013, when the aggregate NPL ratio for lending to the resident private sector was 14%.

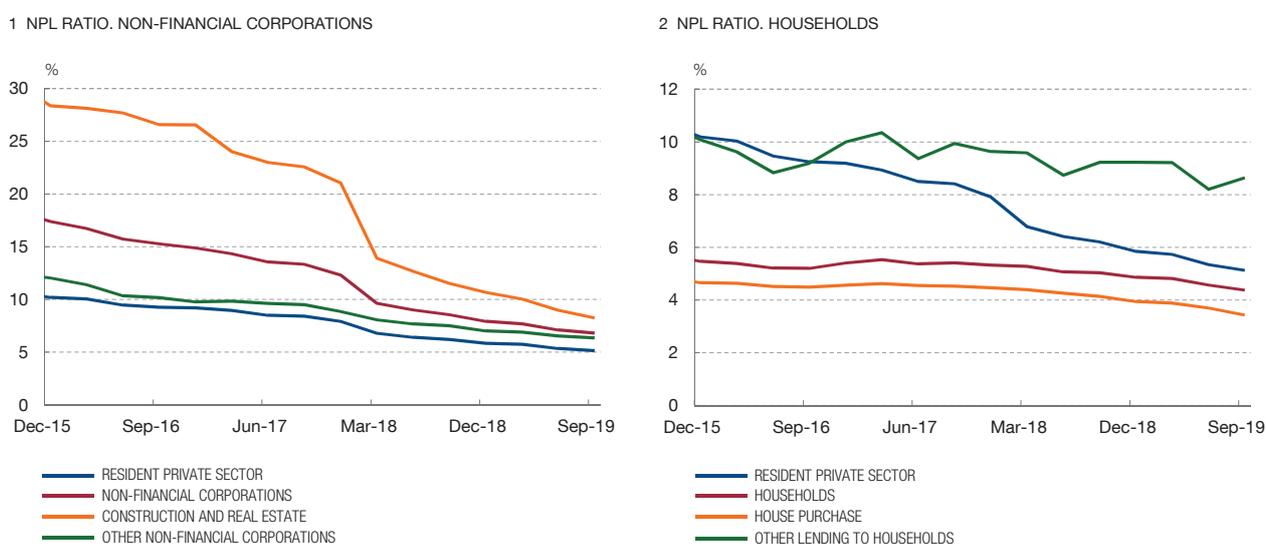
By institutional sector, the strongest decline in non-performing loans was in the segment of lending to non-financial corporations (22.5% in September), in keeping with the declines observed in previous quarters. In the case of households, although the year-on-year decrease in September 2019 was lower (13.3%) than that of non-financial corporations, it was notably more pronounced than in previous quarters (see Chart 5).

In lending to non-financial corporations, the fall in non-performing loans was far more marked in the construction and real estate sectors (36%), as observed in recent years. In the case of lending to households, the decline in non-performing loans was sharper for those extended for house purchase (18.5% year-on-year in September). Moreover, the fall was slightly more pronounced than in previous quarters. Non-

Chart 6

**THE RATIO OF NON-PERFORMING LOANS TO TOTAL BANK LOANS CONTINUED TO DECLINE**

The NPL ratio fell across the board, by institutional sector and by sector of activity, particularly in construction and real estate. The NPL ratio of lending to households other than for house purchase declined at a more moderate pace, holding at 8.6% in September 2019.



SOURCE: Banco de España.



performing loans to households for purposes other than house purchase also fell, albeit far more moderately (2.2%). This was due to the behaviour of non-performing consumer credit, which rose by 16.6% year-on-year for deposit institutions as a whole and by 16.7% taking into account specialised lending institutions.

The NPL ratio declined both in non-financial corporations and in households (see Chart 6). In the former, it fell by 1.7 pp down to 6.8%, from September 2018 to September 2019, while in the latter segment, the ratio dropped by 0.6 pp to 4.4%. By sector of activity, in non-financial corporations, the decline was sharper in the construction and real estate sectors (3.3 pp, down to 8.2%) than in other sectors (1.1pp, down to 6.4%). In the household segment, the decline was very similar in house purchase and other lending, with ratios of 3.4% and 8.6%, respectively, in September. However, in 2019 Q3, non-performing lending to households for purposes other than house purchase was higher than that of construction and real estate, which had recorded the highest non-performance levels since the onset of the crisis.

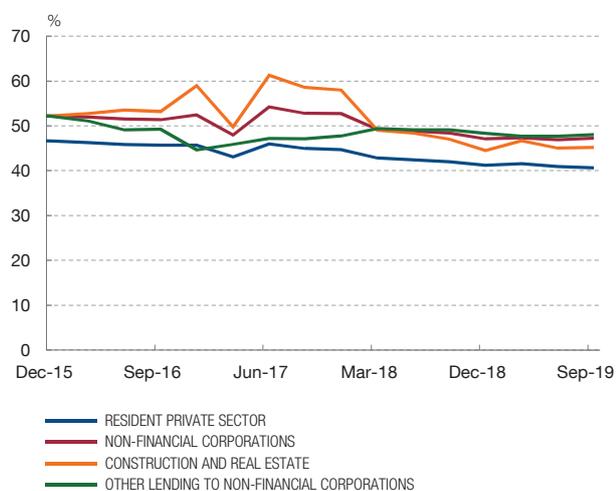
Forborne loans amounted to €61 billion in September 2019, accounting for 5.4% of total lending to the resident private sector at that date. Thus, in the last 12 months, up to 2019 Q3, the volume of such loans fell by 18.7% for deposit institutions overall. In June (the latest available figures), the volume of foreclosed assets was €40.1 billion, 7.2% less than in December 2018. However, the decline observed in the first

Chart 7

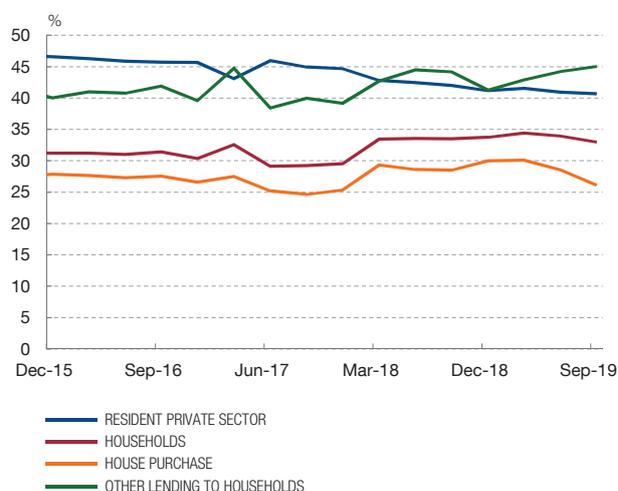
**THE COVERAGE RATIO OF THE DIFFERENT PORTFOLIOS REMAINED STABLE**

The coverage ratios for non-performing loans remained stable last year, the only notable differences being a fall in lending for house purchase and an equivalent increase in the case of non-performing loans for other lending to households.

1 COVERAGE RATIO OF NON-FINANCIAL CORPORATIONS' NPLs



2 COVERAGE RATIO OF HOUSEHOLDS' NPLs



SOURCE: Banco de España.



six months of 2019 was just €3.1 billion, far lower than that recorded in previous six-month periods.

The coverage ratio of the resident private sector's non-performing loans, defined as loan loss provisions, was 40.6% in September 2019, barely 1.3 pp lower than a year earlier. This ratio was higher in lending to non-financial corporations, as has been the trend in recent years, amounting to 47.2% in September (see Chart 7.1). In the case of households, the ratio stood at 33%, having declined by 0.5 pp (see Chart 7.2). By sector, there were few differences with respect to September 2018, noting only the decrease in the coverage ratio of non-performing loans for house purchase (2.3 pp to 26.1%), and an increase of 0.9 pp, to 45%, for other lending to households.

20.2.2020.

## SECTORAL DIVERSIFICATION IN SPANISH DEPOSIT INSTITUTIONS' CREDIT PORTFOLIOS

The high sectoral concentration of Spanish deposit institutions' assets in the real estate sector and, in particular, in the real estate development and construction lines of business, is one of the factors behind the strong impact of the financial crisis in Spain. In fact, the less diversified the portfolios, the less able institutions will be to absorb sectoral shocks. Consequently, assessing the degree of sectoral diversification of credit granted by Spanish deposit institutions to the private sector is essential in order to study its effect on each individual institution's risk profile and on that of the banking sector as a whole.

This box analyses this matter by distinguishing between seven credit portfolios defined by customer type and by loan product: construction, development, large firms (without construction or development business), SMEs (without construction or development business), sole proprietors, household mortgages and other loans to individuals. To do so, a standard model for loss distribution by sector (see technical annex) and information from the Banco de España's Forward-Looking Exercise on Spanish Banks (FLESB)<sup>1</sup> for the twelve institutions directly supervised by the European Central Bank (ECB) were used. These banks account for more than 85% of institutions' credit exposure in Spain.

For an empirical assessment of the level of diversification, parameters estimated within the aforementioned FLESB framework were used. Probability of default series were obtained for the 7 sectors taken into consideration over a sufficiently extensive period (2000-2017) featuring upswings and downturns so that the position in the economic cycle did not influence the findings. These series were used to estimate the standard deviation matrices (S) and the correlation matrices (Q) among the various portfolios for the period as a whole (see the annex to the box for the full technical formulation of the indicators calculated). This information was also used to calibrate a median loss given default (LGD) value. Lastly, the exposure was obtained for the credit portfolio in Spain<sup>2</sup> in various years of the sample, which indicates the behaviour over time of the diversification ratio.

Chart 1 shows the dispersion between 0% (minimum diversification) and 100% (maximum diversification) of the ratios obtained using the formulae detailed in the annex for the 12 institutions directly supervised by the ECB on two dates: 2008, at the beginning of the global financial crisis, and 2017, during the Spanish economy's ongoing recovery.

The main finding is the significant improvement in sectoral diversification in the sample as a whole. Thus, in 2008 the diversification ratio ranged from 1.7% to 3.2%, while in the last period of the sample it ranged from 2.6% to 4.6%. The median value has improved from 2.3% to 3.5%. Individually, all institutions have improved their diversification ratio.

The level of sectoral diversification can also be studied at the aggregate level by adding by sector the exposures of the 12 institutions. For each date studied, a vector is formed with the deposit institutions' total exposure by sector, duly applying the risk matrices. An aggregate measure of sectoral diversification is thereby obtained for the sample as a whole.

Chart 2 shows the time series of the aggregate diversification ratio. The right-hand axis of this chart shows the credit-to-GDP ratio of the deposit institutions. Sectoral diversification fell during the years of the credit expansion until reaching its lowest level at the onset of the crisis (from around 3.75% in 2001 to around 2.75% in 2008). During the crisis and subsequent upturn, sectoral diversification recovered, resuming values of around 3.75%. Between 2008 and 2017 there was an improvement of 1.1 pp.

The credit/GDP ratio trend, which is also tracked in Chart 2, reveals the negative relationship between this variable and sectoral diversification. This reflects that credit did not expand uniformly across the sectors in the 2000-2008 period (had it done so the diversification ratio would have held constant), but rather that it was concentrated in those sectors which drove the underlying economic expansion. This resulted in reduced sectoral diversification and, as an implicit consequence, greater unexpected

<sup>1</sup> The findings of these stress tests were last published in the *Autumn 2019 Financial Stability Report*.

<sup>2</sup> The scope of the analysis can be extended to consider the exposure outside Spain, which significantly increases the level of diversification of internationally active institutions. The empirical evidence shows that international diversification was a key factor in these institutions' resilience during the global financial crisis and the subsequent macrofinancial rebalancing of the Spanish economy. It is also possible to consider new loans rather than total loans, which makes it easier to identify more recent sectoral diversification trends.

**SECTORAL DIVERSIFICATION IN SPANISH DEPOSIT INSTITUTIONS' CREDIT PORTFOLIOS (cont'd)**

losses where difficulties were encountered. This link between sectoral diversification and credit cycle points to the former's importance as an indicator of systemic scope

and macroprudential use, which is of interest for detecting imbalances in the cross-sectoral distribution of the credit portfolio.

Chart 1  
DISPERSION OF SSM BANKS' DIVERSIFICATION RATIOS BEFORE AND AFTER THE CRISIS (a)

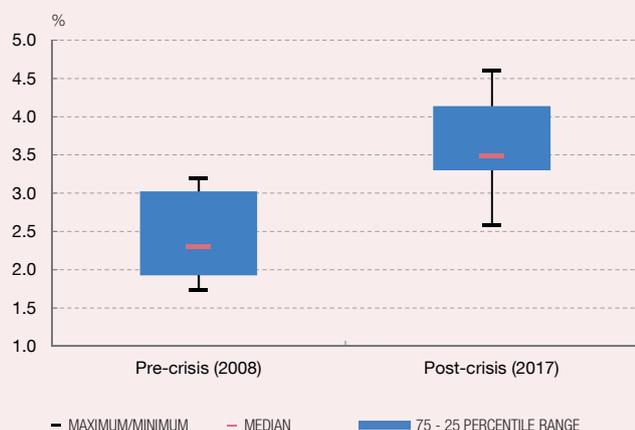


Chart 2  
AGGREGATE DIVERSIFICATION RATIO AND CREDIT/GDP RATIO (b)



SOURCE: Banco de España.

- a. The chart shows the maximum and minimum values, the range between the 75th percentile and the 25th percentile, and the median of the SSM Banks' diversification ratio in two periods: pre-crisis (2008) and post-crisis (2017).
- b. The aggregate diversification ratio is obtained for the 12 SSM banks as a whole. The credit/GDP ratio relates to total bank lending.

**SECTORAL DIVERSIFICATION IN SPANISH DEPOSIT INSTITUTIONS' CREDIT PORTFOLIOS** (cont'd)

The standard credit risk model for loss distribution assumes that the loss of institution  $i$  ( $L^i$ ) aggregates that institution's losses in each sector  $j$  ( $L^{ij}$ ). Thus:

$$L^i = \sum_{j=1}^N L^{ij} \quad [1]$$

where  $N$  is the total number of sectors considered.  $L^{ij}$  depends on the probability of default ( $pd^j$ ), the loss given default ( $lgd^j$ ) of sector  $j$  and the exposure of institution  $i$  to sector  $j$  ( $e^{ij}$ ). Therefore:

$$L^{ij} = pd^j \cdot e^{ij} \cdot lgd^j \quad [2]$$

Two important assumptions applied to formula [2] should be noted. Firstly, of its three components, randomness is only considered in  $pd^j$ . This assumption, identical to that applied in the Basel capital requirements, provides a framework that can be analysed more easily and involves focusing the analysis of the impact of sectoral diversification on credit risk via this channel.

Secondly, the formula's two risk parameters, probability of default ( $pd^j$ ) and loss given default ( $lgd^j$ ), are solely sector-dependent. This limits the possibility of a different make-up of credit quality levels between institutions tainting the diversification measure.

Each  $pd^j$  in formula [2] forms part of the random vector  $pd$ , defined as:

$$pd = (pd^1, \dots, pd^N) \quad [3]$$

This vector has a diagonal matrix of standard deviations  $S$  and a correlation matrix  $Q$ , such that the variance-covariance matrix of the  $pd$  vector  $C$  is determined as:

$$C = S \cdot Q \cdot S' \quad [4]$$

By defining the ultimate exposure of bank  $i$  to sector  $j$  as  $f^{ij} = e^{ij} \cdot lgd^j$ , the ultimate exposure vector of bank  $i$  is:

$$f^i = (f^{i1}, \dots, f^{iN}) \quad [5]$$

And the standard deviation  $\delta^i$  of the aggregate loss  $L^i$  of bank  $i$  can be obtained as:

$$\delta^i = \sqrt{f^i \cdot C \cdot f^{i'}} \quad [6]$$

The correlation matrix between the probability of default of each sector,  $Q$ , is the reason why sectoral diversification reduces the risk of the aggregate ultimate exposure. In usual cases where the inter-sector default correlations are below 1, not all sectors generate extreme losses in the same period, which allows the probability of extreme aggregate losses to be mitigated.

If, instead of  $Q$ , the counterfactual matrix  $Q^*$  were considered, in which all the elements were equal to 1 (i.e. the probabilities of default of all the portfolios move in unison), the loss volatilities across all sectors would be perfectly aligned, therefore eliminating the possibility of reducing the aggregate risk through sectoral diversification. On the basis of correlation matrix  $Q^*$ , the covariance matrix  $C^*$  can be determined, as follows:

$$C^* = S \cdot Q^* \cdot S' \quad [7]$$

As with formula [6], this counterfactual covariance matrix will give rise to the standard deviation of  $L^i$  with no diversification, which is defined as:

$$\delta^{i*} = \sqrt{f^i \cdot C^* \cdot f^{i'}} \quad [8]$$

Logically,  $\delta^i \leq \delta^{i*}$  must hold as, given an ultimate exposure vector, the greater the diversification (low inter-sector correlation), the lesser the loss variance. As a result, the diversification ratio of bank  $i$  can be defined as:

$$\theta^i = 1 - \delta^i / \delta^{i*} \quad [9]$$

This definition means that the greater the diversification, the greater the  $\theta^i$ , which always has a value of between 0% and 100%. If, for example, there were only two portfolios, this ratio would be maximised if the correlation were perfectly negative (-100%). A diversification ratio  $\theta^i$  with a higher value is associated with lower extreme losses, and it is therefore a very useful indicator for measuring the financial stability of the banking system.

The estimate of  $lgd$  and the matrices  $S$  and  $Q$  which characterise the volatility of  $pd$  are common for the whole period under study. As such, the time variation in the diversification ratios is attributable to the shifting distribution of exposure between the seven sectors and, specifically, the performance of the real estate development and construction sectors, whose weight, having peaked at the outset of the crisis, now accounts for a smaller proportion of deposit institutions' credit portfolios.

Similarly, differences between institutions' sectoral diversification ratios in a given period derive from differences in the distribution of their exposure. The specific sector in which an institution concentrates its exposures is also important. Indeed, in terms of sectoral diversification, it is riskier to concentrate in a sector that has a strong correlation with other sectors.

By way of example, let us consider two banks, A and B, and three sectors, X, Y and Z, such that the distribution of

**SECTORAL DIVERSIFICATION IN SPANISH DEPOSIT INSTITUTIONS' CREDIT PORTFOLIOS** (cont'd)

bank A's exposure is [50%, 50%, 0%] and bank B's exposure is distributed [0%, 50%, 50%], with the correlation matrix between the three sectors determined by matrix C,

$$C = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0.9 \\ 0 & 0.9 & 1 \end{pmatrix}$$

In this example, banks A and B have similar exposure concentration: their exposure is split between two of the

three possible sectors, and they are not exposed to the remaining sector. Indeed, any standard concentration measure that does not consider the correlation structure, such as the Herfindahl index, would give the same value for both banks. However, it is easy to see that their level of sectoral diversification is very different: bank A distributes its exposure between two sectors, X and Y, that have no inter-correlation, whereas bank B's exposure is distributed between sectors Y and Z, which do exhibit a high level of default correlation. As a result, bank A has achieved a much higher degree of sectoral diversification than bank B.