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# **COMMERCIAL REAL ESTATE LOANS IN EUROPE: DOES LOAN-TO-VALUE AT ORIGINATION PREDICT DEFAULT RISK?**

by Federica Ciocchetta\*, Raffaella Pico\* and Ivan Quaglia\*

## **Abstract**

This paper analyses bank financing for commercial real estate (CRE), focusing on Italy and comparing it with a sample of other euro-area countries. The analysis is based on the European AnaCredit database. The study examines loan characteristics, their riskiness and the relationship between loan-to-value at origination (LTV-O) and default probability, providing insights into the potential effectiveness of LTV-O limits as a macroprudential tool. The analysis reveals notable differences across countries in CRE exposure levels, CRE lending practices and credit risk, with Italy having limited exposure, high reliance on commercial property as collateral and a significant use of additional guarantees for large LTV-O loans. The econometric results confirm a link between LTV-O and default probability in Italy and Spain, highlighting the importance of tailored macroprudential policies in enhancing financial stability.

**JEL Classification:** G21, R33.

**Keywords:** bank lending, commercial real estate, default probability.

**DOI:** 10.32057/0.QEF.2025.905

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## 1. Introduction and main results<sup>1</sup>

Real estate markets have received and continue to receive substantial attention from macroprudential policy makers as they can play a significant role in systemic financial crises (Crowe *et al.*, 2013, Hartmann, 2015). The interconnections between the real estate sector and the broader financial system can have important financial stability implications. Indeed, in advanced economies financial crises often begin with a serious overvaluation of real estate markets. In particular, the commercial real estate (CRE) market tends to be more cyclical than other economic sectors (Baum, 2001). Moreover, the impact of a weakening CRE market could be exacerbated by poor quality lending to the sector and excessive credit growth, funded by sometimes highly leveraged lenders (Gaudencio *et al.*, 2019 and BIS, 2017). Monitoring the growth and quality of CRE loans (see Section 2 for definitions and details) therefore is essential for promptly activating the appropriate instruments to address vulnerabilities stemming from this sector. Such instruments include lender-based and borrower-based measures.

One of the key borrower-based measures<sup>2</sup> is the imposition of limits ('caps') on the loan-to-value ratio at contract origination (henceforth LTV-O). Caps affect the availability of lending as well as the terms and conditions of granted loans, thereby helping to moderate the financial cycle (Ampudia *et al.*, 2021). LTV-O caps also serve to contain bank losses when borrowers default, since the caps increase the likelihood that the recovered value of the collateral will be sufficient to cover the losses.

Another channel through which LTV-O caps can increase the resilience of banks is through the effect on the borrower's probability of default. High LTV-O loans may be correlated with higher default because of the *ex ante* selection of borrowers who are less liquid or more financially constrained. Moreover, borrowers with high LTV-O loans could be more likely to become 'underwater' (i.e. the value of the collateral is lower than the residual debt), which may increase the probability of strategic default.

While there is abundant empirical evidence that the LTV-O is a good predictor of riskiness for residential real estate (RRE) loans, the evidence is scarce for CRE loans. In the case of the RRE sector, a number of works show that higher LTV-O is associated with greater default risk (Otero-González *et al.*, 2016, Kelly *et al.*, 2019, Gaudêncio *et al.*, 2019, Ampudia *et al.*, 2021). An analogous result, but for CRE loans, is shown by Mokas and Nijskens (2019) for the Netherlands. Jiminez and Saurina (2003) confirm the existence of a similar relationship for Spain, showing that fully collateralized loans (i.e. loans with LTV-O lower than 100 per cent) to non financial corporations have lower default risk than partially collateralized loans (with LTV-O greater than 100 per cent). However, the presence of collateral is associated with a higher default probability with respect to unsecured exposures.

The purpose of this paper is twofold. First, it provides an overview of banks' CRE loan portfolios in a sample of eight euro area countries (Italy, France, Germany, Spain, Austria, Belgium, the Netherlands, and Greece), exploiting AnaCredit data<sup>3</sup> for the period March 2019 to June 2023. This granular and very detailed dataset allows us to compare various factors, such as the size of CRE exposures, loan characteristics (including LTV, interest rate type, additional protection and type of collateral), and credit quality, across countries using data from a harmonized source. Second, this paper contributes to the literature by presenting a country-level regression analysis on the empirical relationship between LTV-O and the probability of default, controlling for borrower and loan

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<sup>1</sup> We would like to thank Alessio Anzuini, Emilia Bonaccorsi di Patti, Alessio De Vincenzo and Gwyneth Schaefer for their helpful comments and suggestions.

<sup>2</sup> Macroprudential instruments also encompass a set of capital requirements that increase the loss absorption capacity of banks and prevent excessive risk-taking.

<sup>3</sup> AnaCredit ('analytical credit datasets') is a dataset containing detailed information on individual bank loans in the euro area, harmonised across all Member States.



characteristics at origination. The regression analysis focuses on the four largest euro area countries (France, Germany, Italy and Spain).

Only a few studies have exploited AnaCredit data in a cross-country analysis (Ryan *et al.*, 2022 and Horan *et al.*, 2022) and, to the best of our knowledge, no published country-level study is available.

Our evidence can be summarised as follows:

- **The share of CRE loans in banks' NFC loan portfolios varies significantly across the countries** examined: as of June 2023, it was around 20 per cent in Italy and Spain, 50 per cent in Germany, 60 per cent in Austria, and around 30 per cent in the remaining countries.
- **The composition of CRE loans is heterogeneous:** the share of loans collateralized by real estate property ranges from around 70 per cent in France, Belgium and Spain to 95 per cent in Greece. Differences also can be observed in the type of collateral posted. In Italy, Greece and the Netherlands the collateral is almost entirely commercial real estate; in Spain and France commercial collateral remains predominant (almost 80 per cent). Instead, in Belgium, Austria and Germany a large share of CRE loans (50, 40 and 34 per cent, respectively) is backed by residential property, which generally has a lower riskiness than other categories of real estate.
- **Between 2019 and 2023, the average LTV-O was about 50 per cent for the main euro area countries, with the exception of France,** where it was about 70 per cent. About 10 per cent of loans were issued with LTV-Os equal or above 80 per cent in most countries; in France the share was higher (about 30 per cent).
- **The NPL ratio for CRE loans is generally higher than for all other types of loans granted to non-financial corporations,** but there is a wide dispersion across countries. Italy and Spain rank as those with the highest NPL ratio for CRE loans after Greece (gross of loan provisions: 11.2, 7.9 and 14.1 per cent, respectively; and net of provisions: 6.4, 5.4 and 9.3 per cent, respectively). High LTV-O loans have a higher NPL ratio than other CRE loans in Italy and Spain, but not in Germany and France.
- **The regression analysis shows that for Italy and Spain there is a positive and significant relationship between default and the LTV-O,** controlling for contract and borrower features, while for Germany and France there is no significant relationship in the data. In Italy, given a baseline default rate of 3 per cent, loans with LTVs between 80 and 100 per cent have a 130 basis point higher probability of deterioration than similar loans with LTVs below 60 per cent, while those between 60 and 80 per cent are not much riskier. For loans with an LTV above 100 per cent, the probability of deterioration increases by 180 basis points.
- **In Italy, high LTV-O loans typically feature variable interest rates and long maturities but often also have additional protection** (mostly financial guarantees), which can mitigate risks. Additional protection also is common in Spain, though to a lesser degree than in Italy.

The paper is structured as follows. In Section 2, we describe in detail the dataset and the definitions used in our analysis. Section 3 presents a cross-country analysis of the main characteristics of CRE loans, investigates the relationship between LTV-O and NPLs, and explores the key attributes of loans with high LTVs. Section 4 provides a regression analysis of the relationship between default and LTV-O.

## 2. Data and definitions

The analysis refers to CRE loans as defined by the European Systemic Risk Board (ESRB), i.e. loans granted to legal entities either collateralized by CRE property (i.e. any income-producing real estate,



either existing or under development, including rental housing; or real estate used by the owners of the property for conducting their business, purpose or activity, either existing or under construction; and includes social housing) or whose purpose is acquiring a real estate property. In this context CRE property also includes residential buildings, if they are owned by legal entities.

We use AnaCredit, a harmonised and granular database of bank loans granted to legal entities in the euro area countries. AnaCredit contains detailed information on collateral not available from other data sources. This information is useful for computing the LTV ratio, a crucial indicator for assessing the risk of CRE loans. The data are collected at the instrument (loan)-level, which makes it possible to gather information on the distribution of each indicator. Moreover, the reporting threshold is low, providing a very high coverage of borrowers.<sup>4</sup> Last but not least, AnaCredit allows us to use common definitions ensuring high comparability across countries and permitting analyses that could not be otherwise performed. That said, the dataset is relatively new and cross-country comparisons still could be affected by differences in reporting across time and institutions (ESRB Report 2023).

We focus on loans granted to nonfinancial corporations (NFCs)<sup>5</sup> and include three types of instruments out of all those available in AnaCredit: finance leases; credit lines other than revolving; and other loans.<sup>6</sup> The selected instruments represent the majority of CRE exposures, even though some heterogeneity across countries can be observed (e.g. in Italy, 8.9 per cent of CRE loans to NFCs are finance leases; in the other countries, the use of this instrument is basically marginal; for details, see Table A.1).

In the following Section, we provide descriptive evidence on all CRE loans for a set of 8 countries (Italy, France, Germany, Spain, Austria, Belgium, the Netherlands, and Greece).<sup>7</sup> Our regression analysis focuses on the subset of these loans for which LTV-O information is available (those granted since September 2018) and on four countries (France, Germany, Italy and Spain), as these four account for about 80 per cent of the CRE loans recorded in AnaCredit. In future work, as the time series become longer, we aim to extend the analysis to other countries.

### **3. Overview of CRE loans in the euro area**

CRE loans are an important share of loans to NFCs in the eight euro-area countries under consideration (Figure 1), ranging from the highest levels recorded in Germany and Austria (between 50 and 60 per cent) to those in Italy and Spain (around 20 per cent). Notably, for Italy, Greece and Spain the share of CRE loans over total NFC loans has constantly declined over time.

In Italy, a high share of CRE loans is collateralized by real estate property (85 per cent; Figure 2, panel a), in line with Germany, Austria and Belgium but higher than in Spain and France. The share of unsecured CRE loans is the lowest (2 per cent) in Italy. Among collateralized loans, it also is important to distinguish between those guaranteed by residential real estate and those by commercial real estate, as the underlying property markets could have very different trends and expose the borrower to different risks. In Italy, an in-depth analysis of real estate collateral shows that a major share is comprised of commercial real estate, as in Greece and the Netherlands (Figure 2, panel b). Quite differently, in Belgium, Germany and Austria a large part of real estate collateral is composed

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<sup>4</sup> AnaCredit is employed for monitoring risks arising from CRE exposures in the euro area banking sector (see for instance, Ryan et al, 2022) as it includes variables to identify CRE loans in compliance with the ESRB Recommendation on real estate data gaps. Using AnaCredit data, the ESRB definition of CRE loans can be implemented by using two attributes of the instrument: the purpose and the protection. In regard to the purpose, we consider either residential or commercial real estate purchase or construction investment; in regard to the protection we take in consideration residential real estate, offices and commercial premises, other commercial real estate.

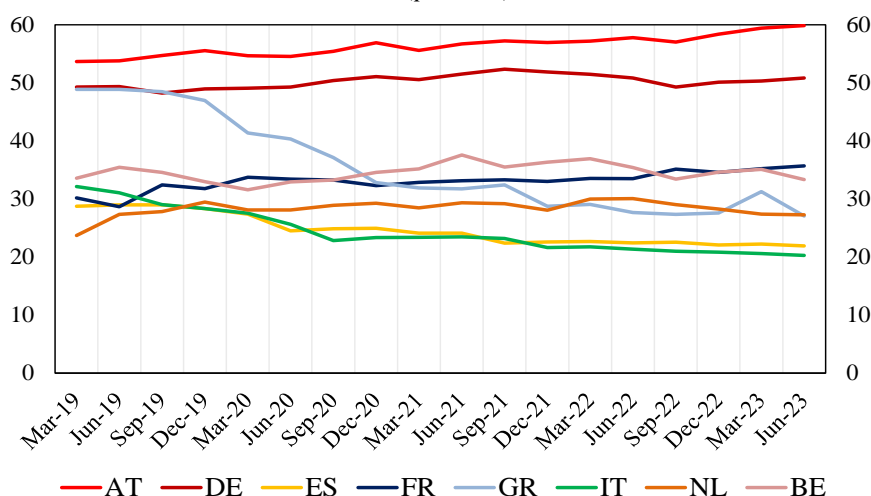
<sup>5</sup> CRE loans to non-financial corporations account for 80 to 95 per cent of the total CRE loans in all the considered countries (after data quality checks). See the Annex A.1 for a more details.

<sup>6</sup> The selection excludes all revolving and self-liquidating categories. Note that according to ESRB Recommendation CRE loans exclude overdrafts. For most countries the category 'other loan' is not residual but includes the vast majority of loans (for instance in the case of Italy, fixed-term loans).

<sup>7</sup> AnaCredit collection started in September 2018 but, for the descriptive analysis only, we decide to exclude data for Q3 2018 and Q4 2018 following a prudential approach on data quality; data include securitizations but results do not change much if we exclude them.

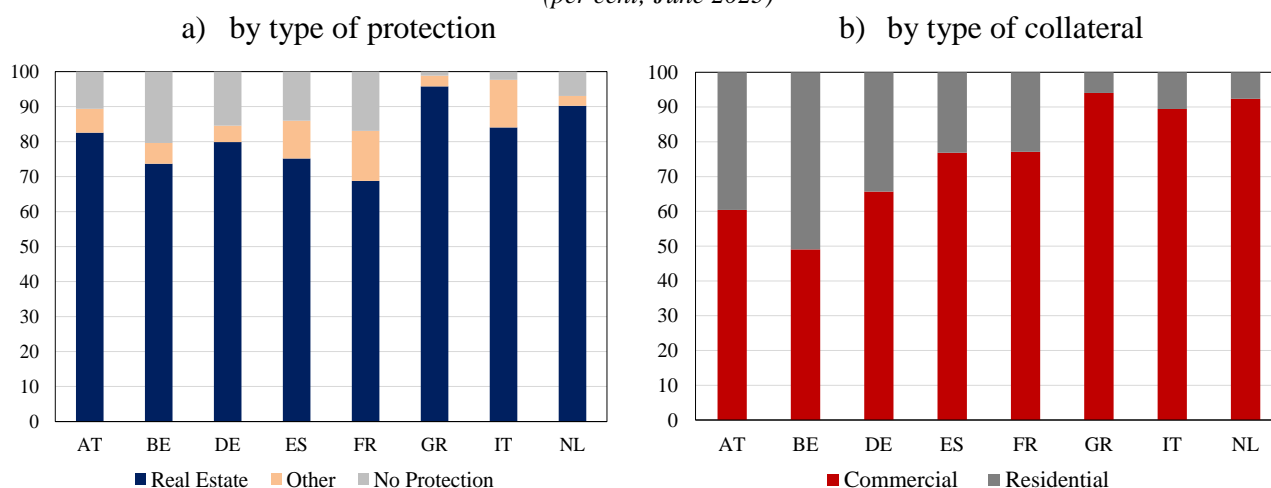
of residential property, a feature which may mitigate the riskiness of the high CRE loan shares in those countries.

**Figure 1: share of CRE loans over total loans to NFCs**  
(per cent)



Source: AnaCredit. Note: quarterly data. Data include securitizations.

**Figure 2: CRE loan composition**  
(per cent; June 2023)



Source: AnaCredit. Note: Further details are reported in the Annex A.2 (figures A.1 and A.2).

Cross-country heterogeneity also is evident in terms of other loan characteristics such as interest-rate type and maturity at origination. In Italy, a significant portion of CRE loans is variable rate (80 per cent; Figure 3, panel a), similar to that for total loans to NFCs. Variable-rate loans are also common in Spain (75 per cent) and in Greece (97 per cent), while in Germany and France fixed rate CRE loans are predominant. Other things being equal, borrowers with a variable-rate loans are more exposed to an increase in interest rates.

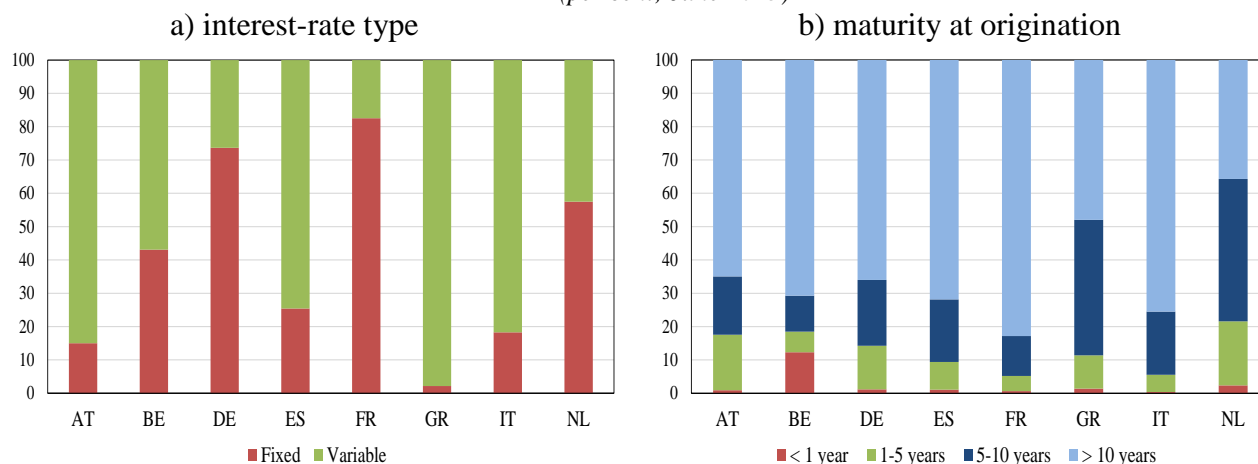
About 75 per cent of the CRE loans granted by Italian banks has a maturity at origination longer than 10 years (Figure 3, panel b). The maturity structure is similar for most of the main euro area countries, though in Greece and the Netherlands the share is lower for these longer maturities.

The ratio of non-performing loans to total loans (NPL ratio) provides some indication of the credit quality of banks' CRE loan portfolios, although it depends on past NPL dynamics and the

effectiveness of the banks' NPL-disposal procedures. As observed in the ESRB Report (2023), in all eight countries the CRE segment has a higher share of NPLs than other sectors.

**Figure 3: CRE loans by interest rate and maturity**

(per cent; June 2023)

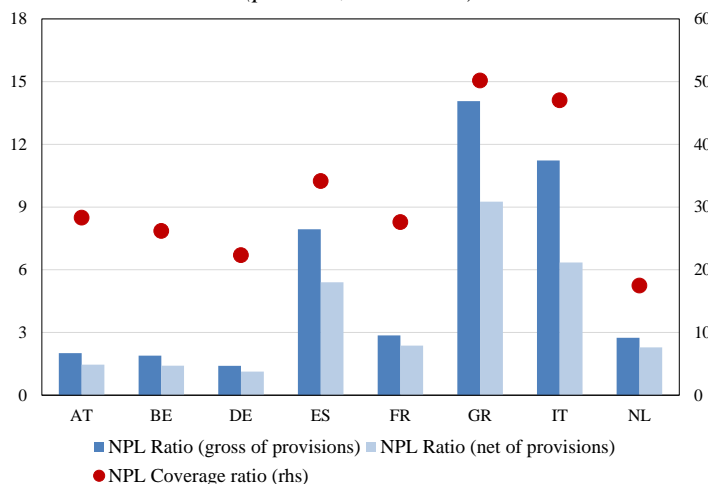


Source: AnaCredit.

In June 2023, the level of the indicator was widely dispersed across countries, with Italy and Greece ranking as the countries with the highest share of NPLs: gross of loan provisions, the NPL ratio was 11.2 and 14.1 per cent, respectively; and net of provisions, it stood at 6.4 and 9.3 per cent (see Figure 4). In Italy, however, it is worth noting that the NPL ratio has progressively shrunk (from 16 per cent in the first quarter of 2022) and it is offset by the second-highest coverage ratio (47.0 per cent in Italy) among all the countries in the sample.

**Figure 4: NPL and coverage ratios**

(per cent; June 2023)



Source: AnaCredit. Note: The coverage ratio is calculated as the ratio of loan provisions for NPLs and NPLs.

### 3.1 Loan-to-value (LTV) and descriptive evidence of the relation with NPLs

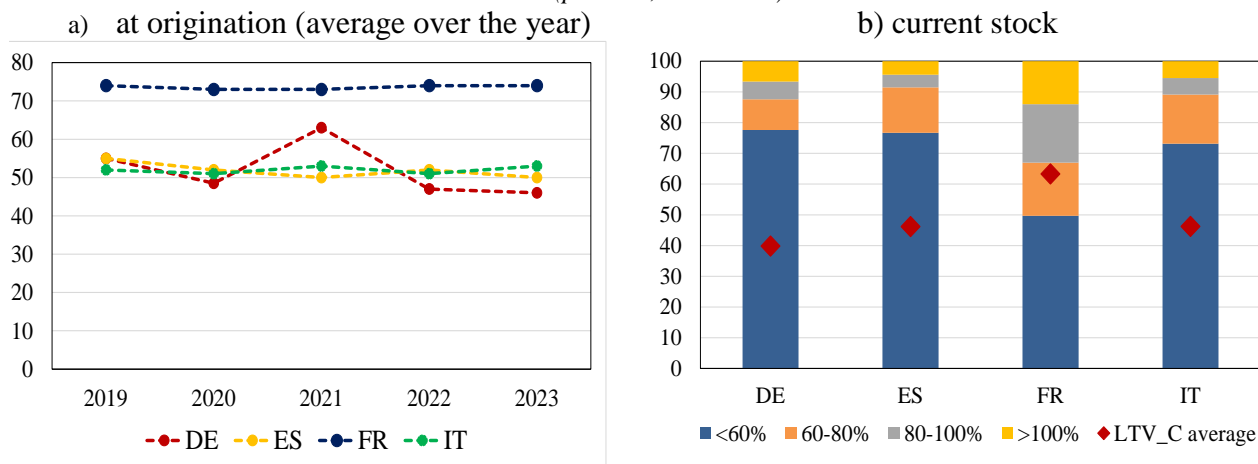
For the subset of collateralized CRE loans originated since September 2018, we can calculate the LTV either at the origination of the contract (LTV-O) or for the stock on a given date (LTV current or LTV-C). During the analysis period the Italian banks have maintained stable supply conditions for new CRE loans (Figure 5, panel a). France has an average LTV-O higher than other countries; moreover, a slight downward trend is noticeable for Germany (with the exception of a peak in 2021).

Similar trends can be observed for the LTV-C, calculated for the loan stocks in June 2023 (Figure 5, panel b). In Italy the weighted mean of the LTV-C is overall comparable with the other main euro

area countries (about 47 per cent).<sup>8</sup> Loans with an LTV-C above 80 per cent, generally considered riskier, represent around 11 per cent of the total in Italy, corresponding to an exposure of 10 billion euros, in line with Germany and Spain but much lower than in France (33 per cent; 97 billion).

**Figure 5: LTV at origination and current**

(per cent; June 2023)

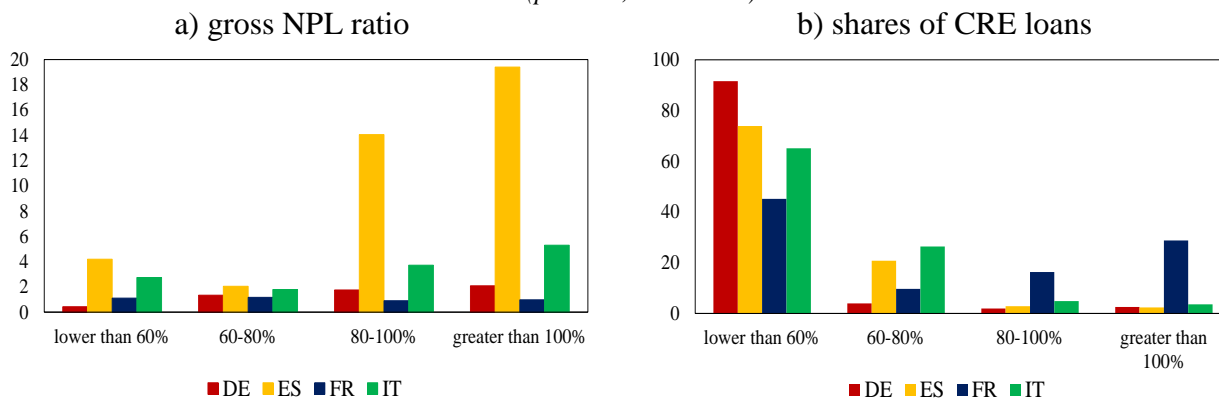


Source: AnaCredit. Note: LTV is defined as the ratio of the gross amount of the loan to the value of the collateral. For LTV-O average value over the year for 2019-2022, over the first two quarters for 2023. For more details about the calculation of LTV see the Annex A.3.

Figure 6 (panel a) shows empirical evidence on the relationship between the LTV-O and default. In Italy, the highest share of NPLs is for loans with LTV-O in the last two classes (LTV-O above 80 per cent), but the total amount of CRE in such classes is limited (Figure 6, panel b). A similar pattern can be observed for Spain, where the NPL ratios for the last two classes are higher than in Italy. Germany and France have a more stable NPL ratio by LTV-O classes than other countries. Analysis based on the correlation between two dummies identifying a high LTV-O and a non-performing status shows that there is a positive relation in Italy and Spain.<sup>9</sup>

**Figure 6: CRE loans and gross NPL Ratio by LTV-O classes**

(per cent; June 2023)



Source: AnaCredit. Note: loans granted since September 2018

<sup>8</sup> If we consider an alternative definition of LTV (where the allocated protection value is used at the denominator instead of the protection value; see the note of the Figure A.3 and the Annex A.3), the average LTV-C is 56 per cent and the share of loans with a high LTV is 12 per cent.

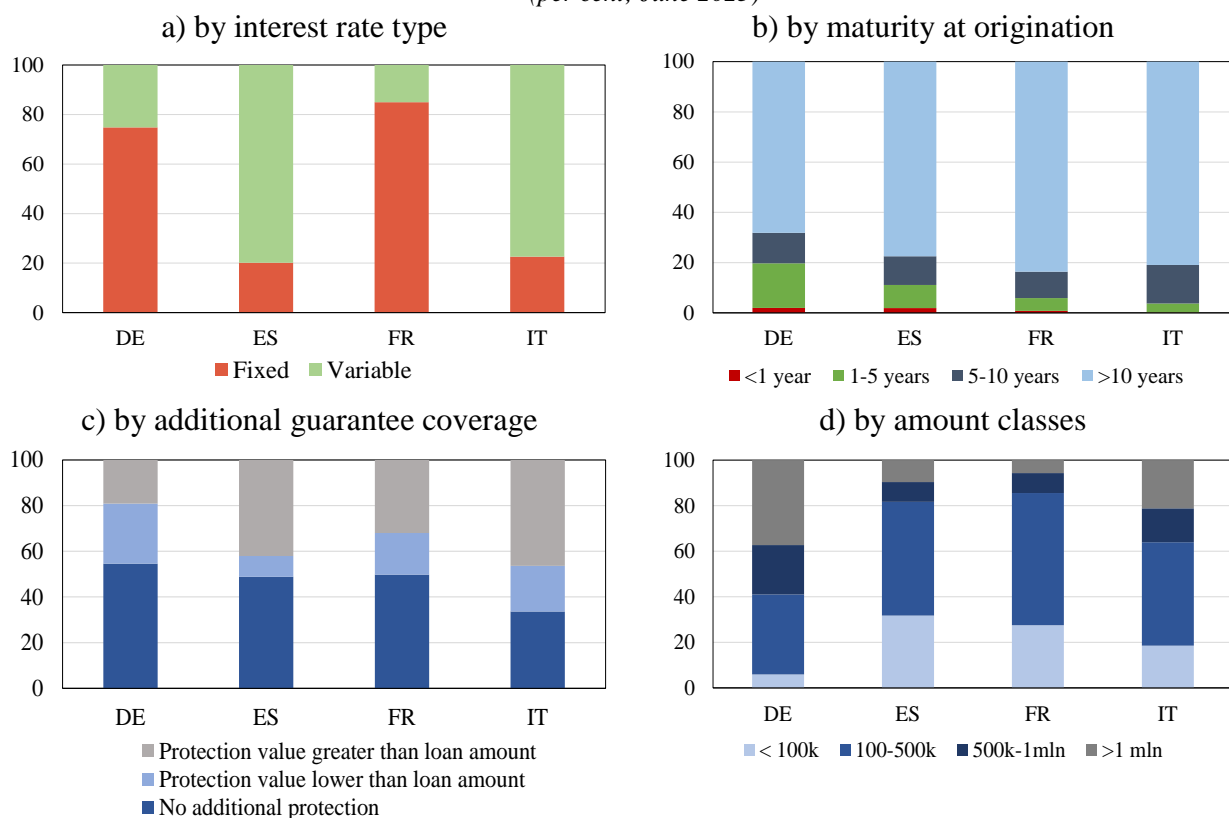
<sup>9</sup> We have defined two dummy variables: 1) LTV-O high: being 1 for loans having LTV-O greater than 80 per cent, and 0 otherwise; 2) NPL dummy: being 1 for non-performing loans, and 0 otherwise. As a statistical correlation measure we use the Kendall rank correlation coefficient: as expected, Spain and Italy show a positive correlation between the two quantities (even if pretty weak, around 5-10 per cent for both countries), while for Germany and France the two variables seem to be not correlated.

### 3.2 The characteristics of loans with high LTV-O

Given the trends observed above for Italy and Spain, we analyze the characteristics of loans with a high LTV-O to better understand their overall riskiness. We focus on attributes that could amplify or mitigate vulnerabilities for banks, also in term of potential losses, including the type of interest rate, maturity at origination, loan size, and additional guarantees. On one hand, variable rate loans are more exposed to an increase in interest rates with possible negative effects on borrowers' ability to service their debt, whereas large size loans can lead to greater losses in the case of default. Also, long maturity loans are associated with higher risks in the literature (with few exceptions as in Jiminez and Saurina, 2003). On the other hand, additional guarantees can reduce potential losses.

**Figure 7: High-LTV-O CRE loans**

(per cent; June 2023)



Source: AnaCredit.

Our results indicate that high LTV-O loans are generally riskier in Italy and Spain, all else being equal. In Italy, these loans typically feature variable rates, long maturities, and large sizes (Figure 7). However, a significant portion of these high LTV loans in Italy - over 65 per cent - has additional protections, such as financial, personal, or state guarantees (including those introduced during the pandemic). In Spain, the situation is similar but the proportion of loans with additional protections is lower. In Germany, the primary concern is the large size of these loans. In all the cases the vast majority of loans have maturity at origination greater than 10 years.

In order to gain a clearer understanding of the actual riskiness of high LTV-O loans in terms of default, we analyze the connection within a multivariate framework. The results of this analysis are presented in the next Section.

## 4. Regression analysis: Do LTV-Os predict default?

We perform a multivariate regression analysis to explore the relationship between LTV-O and default, considering other loan characteristics at origination, borrower attributes, and bank category (significant or less significant). The analysis is conducted at the loan-by-loan level, using data from

all collateralized CRE loans originated since September 2018 and observed up to June 2023. The target variable is the performing status in June 2023 and regressors are selected from the possible variables in AnaCredit. We focus on the four largest countries (France, Germany, Italy and Spain) as they account for approximately 80 per cent of the CRE exposures recorded in AnaCredit.

A number of theoretical works study the relationship between the degree of collateralization and credit risk. Collateral can be conceived as an attempt to compensate for ex-ante asymmetric information or as a means to reduce ex-post incentive problems between borrowers and lenders.<sup>10</sup> The results reported in Berger *et al.* (2011) suggest that the ex-post theory of collateral is empirically dominant, although the ex-ante theory is also valid for customers with short borrower–lender relationships who are relatively unknown to the lender. Berger *et al.* (2016) find that collateral<sup>11</sup> has an important role in mitigating losses and reducing risk-taking incentives, consistent with ex-post theory. Overall, testing the different hypotheses is not straightforward and the empirical findings presented in these papers are mixed. Our analysis can contribute to give some insights on this relationship.

We estimate the probability that loan  $i$  granted by bank  $k$  to firm  $j$  is in the status of NPL ( $NPL_{ijk}$ ) at the reference date  $t$  (June 2023) by using the following logit specification, being linear in the log-odds of NPL:

$$P(NPL_{ijk} = 1 | X^1, X^2, \theta^k) = f(X_{ijk0}^1, X_{j0}^2, \theta^k) = p$$

$$\log\left(\frac{p}{1-p}\right) = \alpha + \beta_1 * X_{ijk0}^1 + \beta_2 * X_{j0}^2 + \gamma\theta^k + \varepsilon_{ijk}$$

$P$  stands for probability;  $X^1$  are loan characteristics at the time the loan was granted ( $t=0$ ), including LTV class at origination, interest rate type, loan cohort (year of issuance), the purpose of the loan (specifically a dummy for construction investment as these loans are deemed to be riskier than others), and loan type and size;  $X^2$  are firm characteristics, such as total bank debt (as a proxy for the level of indebtedness and firm size), the borrower’s PD and the economic sector;  $\theta_k$  is the bank category (significant or less significant) and  $\varepsilon_{ijk}$  is the error term. The PD reported in AnaCredit is the probability of default of the debtor at loan origination, over one year, determined in accordance with the Capital Requirements Regulation (CRR);<sup>12</sup> we use it as a proxy of firm specific characteristics that are not available in the database and that may have an impact on riskiness.

A list of the variables used in the model and a brief description are reported in Table 1. Other variables such as the maturity at origination, the presence of other collateral, the firm size, and the type of real estate collateral are included in alternative specifications of the model for robustness checks.

In Table 2 we report the average marginal effects (AMEs) for the model estimated for each country separately. AME is the standard measure to evaluate the effect of a single independent variable in a non-linear modelling framework; indeed in the logit model we use, it helps the reader to understand the effects in terms of predicted probability. In the summary below, AMEs show how much a certain variable shifts the probability for a loan to fall into non-performing status. For completeness, in the Annex we report the parameter estimations (Table A.3, in Annex A.4).

<sup>10</sup> According to the ex-ante theory collateral arises from information gaps between borrowers and lenders before the granting of the loan. Specifically, (unobservably) safer borrowers pledge collateral to gain lower risk premiums and therefore collateral acts as a signal enabling the bank to reduce the adverse selection problem. On an empirical level, one would expect a negative relationship between collateral and default. On the other hand, the ex-post theory predicts that observably riskier borrowers are more likely to be required to pledge collateral in order to attenuate moral hazard problems. Consistent with the ex-post theory is a positive relationship between the collateral incidence and the borrower risk. For further discussions see Jimenez and Saurina (2003), Berger *et al.* (2011), Berger *et al.* (2016).

<sup>11</sup> In this work the collateral includes both real estate properties and other types of guarantees, such as bonds. The related variable is simple dummy of whether the loan was collateralized or not (no information of the collateral value).

<sup>12</sup> This information is available only when the bank does not have to determine its estimate in accordance with the IRB approach.

**Table 1: variables list and description**

<b>Variables</b>	<b>Description</b>
<b>Dependent variable</b>	
<i>NPL dummy</i>	Equals one if loan status is not performing and zero otherwise
<b>Independent variables</b>	
<b>Loan characteristics</b>	
<i>LTV_O_class_1: &lt;60</i>	Equals one if LTV-O is lower than 60 per cent and zero otherwise
<i>LTV_O_class_2: 60_80</i>	Equals one if LTV-O falls between 60 and 80 per cent and zero otherwise
<i>LTV_O_class_3: 80_100</i>	Equals one if LTV-O falls between 80 and 100 per cent and zero otherwise
<i>LTV_O_class_4: &gt;100</i>	Equals one if LTV-O is larger than 100 per cent and zero otherwise
<i>type_intrate</i>	Equals one if a variable interest rate (or an interest rate with a fixation period shorter than 1 year) applies to the loan and zero otherwise (MIR definition)
<i>constr_investment</i>	Equals one if the loan purpose is 'construction investment' and zero otherwise
<i>log(loan orig)</i>	Logarithm of loan outstanding nominal amount at origination
<i>Loan type</i>	Set of dummy variables controlling for loan type (according to AnaCredit classification); there are three 3 loan types: <i>Credit Lines no revolving, Finance Leases, Other Loans</i>
<i>Loan vintage</i>	Set of dummy variables controlling for the time of loan origination; there are 5 categories: <i>&lt;6 months, between 6 months and 1 year, between 1 year and 2 years, between 2 and 3 years, more than 3 year.</i>
<b>Firm characteristics</b>	
<i>pd_class_1: &lt;0.5%</i>	Equals one if the debtor's probability of default at loan origination is lower than half per cent and zero otherwise
<i>pd_class_2: 0.5-2%</i>	Equals one if the debtor's probability of default at loan origination falls between half and two per cent and zero otherwise
<i>pd_class_3: 2-5%</i>	Equals one if the debtor's probability of default at loan origination falls between two and five per cent and zero otherwise
<i>pd_class_4: &gt;5%</i>	Equals one if the debtor's probability of default at loan origination is larger than five per cent and zero otherwise
<i>pd_class - missing</i>	Equals one if no information on the debtor's probability of default is available and zero otherwise
<i>log(total debt)</i>	Logarithm of overall firm's debt to the banking system at loan origination
<i>Firm's economic activity</i>	Set of dummy variables controlling for the firm's industry (NACE); there are 5 categories ( <i>Manufacturing, Construction, Real estate services, Other services, Others</i> )
<b>Other variables</b>	
<i>SSM significance</i>	Dummy variable controlling for the credit institution significance; 1 for <i>Significant (SI)</i> , 0 for <i>Less Significant (LSI)</i>

The results show a positive and significant correlation between high LTV-O and the probability of the loan subsequently becoming non-performing in Italy and Spain, for the period considered and controlling for other variables. This finding is consistent with the ex-post theory of the relationship between collateral and credit risk, where a higher degree of collateralization (a lower LTV) reduces default risk (see footnote 10). In particular, this relationship holds when the bank's ex ante estimate of risk (variable PD) is held constant.

In Italy, given a baseline default rate of 3 per cent, loans with LTVs between 80 and 100 per cent have a probability of deterioration 130 basis points (bps) higher than similar loans with LTVs below 60 per cent. For loans with an LTV above 100 per cent, this figure increases by 180 bps with respect to the baseline. In Spain, the difference is more pronounced with an increased deterioration probability of around 170 bps. for loans with LTVs between 80 and 100 per cent, and 360 bps for those with LTVs greater than 100 per cent (the baseline default rate in Spain is 4.8 per cent).

In Germany and France we find no statistically significant relation between the LTV-O level and default: this may be due to the limited number of loans in NPL status, which are fairly evenly distributed across the LTV-O classes in the two countries.



**Table 2: Average marginal effects (AMEs) and significance across countries**

<b>Dependent variable:</b>	<b>Italy</b> NPL status	<b>Germany</b> NPL status	<b>Spain</b> NPL status	<b>France</b> NPL status
<b>Loan Characteristics</b>				
<i>LTV_O_class_1: &lt;60</i>	baseline	baseline	baseline	baseline
<i>LTV_O_class_2: 60_80</i>	not significant	not significant	not significant	not significant
<i>LTV_O_class_3: 80_100</i>	0.013	not significant	0.017	not significant
<i>LTV_O_class_4: &gt;100</i>	0.018	not significant	0.036	not significant
<i>type_intrate</i>	not significant	0.012	0.021	0.001
<i>constr_investment</i>	0.004	not significant	-0.027	not significant
<i>log(loan orig)</i>	-0.140	not significant	-0.100	-0.170
<i>loan type: credit line non revolving</i>	baseline	baseline	baseline	baseline
<i>loan type: leases</i>	not significant	0.004	not significant	not significant
<i>loan type: other loans</i>	not significant	not significant	0.022	0.004
<i>loan vintage: &lt;6mths</i>	baseline	baseline	baseline	baseline
<i>loan vintage: 6mths_1yr</i>	0.014	0.009	0.026	0.011
<i>loan vintage 1-2yrs</i>	0.026	0.017	0.018	0.018
<i>loan vintage: 2-3yrs</i>	0.032	0.021	0.030	0.023
<i>loan vintage: &gt;3yrs</i>	0.042	0.024	0.034	0.026
<b>Firm Characteristics</b>				
<i>pd_class_1: &lt;0.5</i>	baseline	baseline	baseline	baseline
<i>pd_class_2: 0.5-2</i>	0.012	not significant	not significant	not significant
<i>pd_class_3: 2-5</i>	0.018	0.011	not significant	0.007
<i>pd_class_4: &gt;5</i>	0.029	0.020	0.037	0.012
<i>pd_class - missing</i>	0.019	0.009	0.006	0.008
<i>log(total debt)</i>	0.002	not significant	0.002	0.001
<i>economic activity: manufacturing</i>	baseline	baseline	baseline	baseline
<i>economic activity: construction</i>	not significant	-0.011	-0.023	-0.003
<i>economic activity: real estate services</i>	not significant	-0.015	-0.031	-0.013
<i>economic activity: other services</i>	not significant	-0.006	-0.017	not significant
<i>economic activity: other</i>	-0.013	-0.008	-0.027	-0.005
<b>Other variables</b>				
<i>SSM significance: LSI</i>	not significant	0.006	-0.017	not significant

This evidence on the relationship between LTV-O and default is consistent across a range of alternative specifications tested for each country, despite some differences in magnitude. The AME range for LTV-O in Italy and Spain on the basis of different models is shown in Table 3. In Italy the probability of deterioration increases, relative to the baseline, by 70 to 130 basis points for loans with LTVs between 80 and 100 per cent and by 120 to 180 basis points for loans with higher LTVs. In Spain the two intervals are 170 to 210 bps for the first group and 360 to 380 bps for the second.

**Table 3: AME for LTV-O class under different model specifications**

	<b>Italy</b>	<b>Germany</b>	<b>Spain</b>	<b>France</b>
<i>LTV_O_class_1: &lt;60</i>	baseline	baseline	baseline	baseline
<i>LTV_O_class_2: 60_80</i>	not significant	not significant	not significant	not significant
<i>LTV_O_class_3: 80_100</i>	0.007 - 0.013	not significant	0.017 - 0.021	not significant
<i>LTV_O_class_4: &gt;100</i>	0.012 - 0.018	not significant	0.036 - 0.038	not significant

In addition to LTV-O, other factors also can explain default (Table 2). Consistent with the literature (see for instance, Bonaccorsi di Patti and Felici, 2008), the probability of default increases with the time since the contract was signed ('vintage of the loan') for all the countries under consideration. The size of the loan negatively impacts credit riskiness in all cases except for Germany, where it is not significant; this possibly can be explained by the idea that large-sized firms, which are generally

granted large loans,<sup>13</sup> may have low probability of default or that large-sized loans are subject to in-depth screening and credit-risk assessment (Jimenez and Saurina, 2003).

Among firm characteristics, the PD attributed by the lender based on its internal model has a positive and significant coefficient, as expected, since it measures ex-ante credit risk. In every country, the trend aligns with expectations: the higher the ex-ante PD (estimated by the lender at origination), the higher the probability of actual default. This probability reaches its maximum level (e.g. an increase of 290 basis points for Italy) if the ex-ante PD is over 5 per cent. Another significant factor is the total indebtedness of the firm, with higher debt levels associated with a higher probability of default: this result is valid for all the countries under consideration, with the exception of Germany and France (for which it is not significant).

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<sup>13</sup> The variable corresponding to the size of the enterprise is not available in this version of the paper.

## References

- Ampudia, M., M. Lo Duca, M. Farkas, G. Pérez-Quirós, M. Pirovano, G. Rünstler, E. Tereanu (2021). *On the effectiveness of macroprudential policies*, ECB working paper, N. 2559, May 2021.
- Baum, A. (2001). *Evidence of Cycles in European Commercial Real Estate Markets — and Some Hypotheses*. In: Brown, S.J., Liu, C.H. (eds) *A Global Perspective on Real Estate Cycles*. The New York University Salomon Center Series on Financial Markets and Institutions, Vol 6. Springer, Boston, MA.
- Berger, A.N., W.S. Frame, V. Ioannidou (2016). *Reexamining the empirical relation between loan risk and collateral: The roles of collateral liquidity and types*. *Journal of Financial Intermediation* Vol. 26: 28-46.
- Berger, A.N., M.A. Espinosa-Vega, W.S. Frame, N.H. Miller (2011). *Why do borrowers pledge collateral? New empirical evidence on the role of asymmetric information*, *Journal of Financial Intermediation* Vol. 20(1): 55-7.
- BIS (2017). ‘Resolution of Non-performing Loans – Policy Options’, *FSI Insights on Policy Implementation*, N. 3.
- Crowe, C. W., G. Dell’Ariccia, D. Igan and P. Rabal (2013). *How to Deal with Real Estate Booms: Lessons from Country Experiences*. *Journal of Financial Stability*, Vol. 9: 300–319.
- ESRB Recommendation on closing real estate data gaps, ESRB/2016/14, emended by ESRB/2019/03.
- ESRB Report (2023). ‘Vulnerabilities in the EU commercial real estate sector’.
- Ganong, P. and P. Noel (2023). *Why do Borrowers Default on Mortgages?*, *Quarterly Journal of Economics*.
- Gaudêncio, J, A. Mazany and C. Schwarz (2019). *The Impact of Lending Standards on Default Rates of Residential Real-Estate Loans*, ECB Occasional Paper N. 220; ISBN 978-92-899-3685-9, Available at SSRN: <https://ssrn.com/abstract=3356407>
- Lang, J.H., M. Pirovano, M. Rusnák and C. Schwarz (2020). *Trends in residential real estate lending standards and implications for financial stability*, ECB FSR May 2020.
- Hartmann, P. (2015). *Real Estate Markets and Macroprudential Policy in Europe*. *Journal of Money, Credit and Banking*, Vol. 47 (s1).
- Horan, A. B. Jarmulska and E. Ryan (2022). *Understanding banks’ response to collateral value shocks – insights from AnaCredit and the COVID-19 shock in commercial real estate (CRE) markets*. ECB Macroprudential Bulletin, October 2022.
- Kelly, J., J. Le Blanc, and R. Lydon (2019). *Pockets of risk in European housing markets: then and now*, ECB working paper N. 2277.
- Jimenez, G. and J. Saurina (2003). *Loan characteristics and credit risk*, Proceedings 857, Federal Reserve Bank of Chicago.
- Mokas, D. and R. Nijskens (2019). *Credit Risk in Commercial Real Estate Bank Loans: The Role of Idiosyncratic versus Macro-Economic Factors*. De Nederlandsche Bank Working Paper No. 653, Available at SSRN: <https://ssrn.com/abstract=3448455> or <http://dx.doi.org/10.2139/ssrn.3448455>.
- Otero-González, L. P. Durán-Santomil, R. Lado-Sestayo and M. Vivel-Búa (2016). *The impact of loan-to-value on the default rate of residential mortgage-backed securities*. *Journal of Credit Risk* Vol. 12(3), 1–13.
- Ryan, E., A. Horan, A. and B. Jarmulska (2022). *Commercial real estate and financial stability – new insights from the euro area credit register*, Macroprudential bulletin BCE, issue 19, October 2022.

## Annex

### A.1 Preliminary analysis

In Table A.1, we analyse the instrument type distribution of CRE loans to NFCs. The three categories (credit lines - no revolving, finance leases) are about than 95 per cent of CRE loans in each country. The proportions of the three categories vary considerably between countries (e.g. Italian share on credit lines is almost null, while in Germany is predominant): this could be due to the reporting way adopted by each country, since the difference in the meaning of the two loan types in AnaCredit are not well defined, leaving some flexibility to banks in the reporting phase. The residual category amount consists mainly of overdrafts; we exclude them from the definition of CRE loans as proposed in the ESRB Recommendation on ‘closing real estate data gaps’.

**Table A.1: CRE loans outstanding nominal amount (ONA) to NFCs by loan type**  
(€ billion and per cent; June 2023)

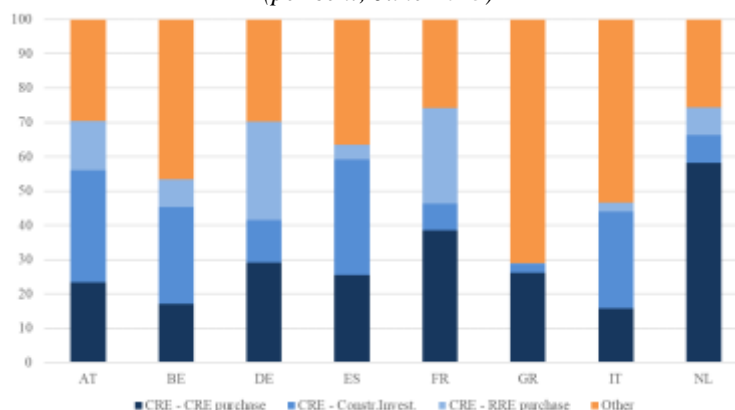
	Germany		Spain		France		Italy	
	ONA	share	ONA	share	ONA	share	ONA	share
Deposits	-	-	-	-	-	-	-	-
Finance Leases	0.6	0.1%	3.5	3.3%	20	5.6%	12	8.9%
Credit Lines (no revolving)	391	67.6%	19.5	18.1%	92.5	25.7%	0.5	0.3%
Other Loans	157	27.1%	81	74.4%	240	66.5%	118.5	86.6%
Residual: Overdrafts, Credit Card, Trade Receivables, Revolving Credit	30	5.1%	4.5	4.1%	8	2.3%	5.5	4%
<b>Total</b>	<b>578</b>	<b>100%</b>	<b>108</b>	<b>100%</b>	<b>361</b>	<b>100%</b>	<b>137</b>	<b>100%</b>

Source: AnaCredit.

### A.2 CRE market in euro area countries

There are large differences across countries for what concerns loan purposes (Figure A.1) and the type of collateral (Figure A.2) of CRE loans.

**Figure A.1: CRE loans by purpose**  
(per cent; June 2023)



Source: AnaCredit. Note: The purposes starting with prefix ‘CRE’ (blue in different grades bars) are related to real estate market and include: residential real estate purchase, commercial real estate purchase or construction investment. The other purposes (orange bar) come from loans having a real estate collateral (second condition for a loan to be considered CRE) despite its purpose.

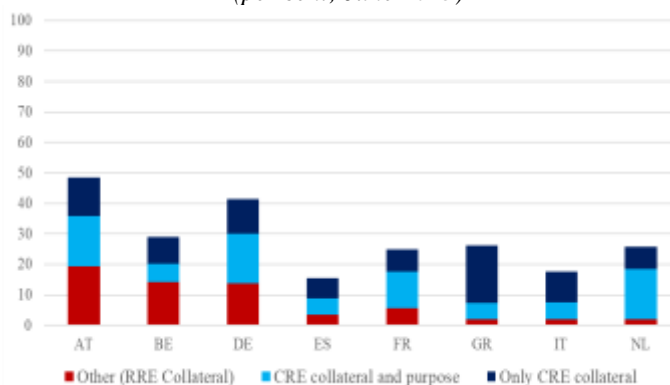
Italy shows one of the lowest loan amount with CRE related purposes (46 per cent, Figure A.1).<sup>14</sup> Among those, it is interesting to note that the share of construction investment is quite high (28 per

<sup>14</sup> This phenomenon is due to the reporting approach followed by Italian banks: the intermediaries report ‘Other purposes’ for the vast majority of loans coming with a real estate collateral pledged.

cent): on this segment Austria, Belgium and Spain are very close to Italy, while in Germany and France construction investment seems to be less important.

Figure A.2 reports the composition of CRE loans across countries. On the basis of the definition used in the note, CRE loans include: 1) those collateralized by offices, commercial premises and other CRE and without a real estate related purpose ('only CRE collateral'); 2) those collateralized by a CRE property and a real-estate related purpose ('both CRE collateral and purpose'); 3) other loans (including those related to a housing property and those unsecured).

**Figure A.2: CRE loans by type of collateral**  
(per cent; June 2023)



Source: AnaCredit. Note: We considered only collateralized loans. The bars represent the shares of CRE loans over total NFC loans, by different components: 'only CRE collateral', 'CRE collateral and purpose', 'other (RRE collateral)'. 'Only CRE collateral' are loans associated with a collateral including offices, commercial premises and other commercial but without a real-estate related purpose; 'CRE collateral and purpose' loans that have both a CRE collateral and purpose; 'other (RRE collateral)' are loans associated with a RRE collateral.

Loans with only CRE collateral are the vast majority of CRE loans in Italy, Greece and The Netherlands; the RRE collateral is an important component in Germany, Austria and Belgium.

### A.3 Different approaches for the calculation of the LTV

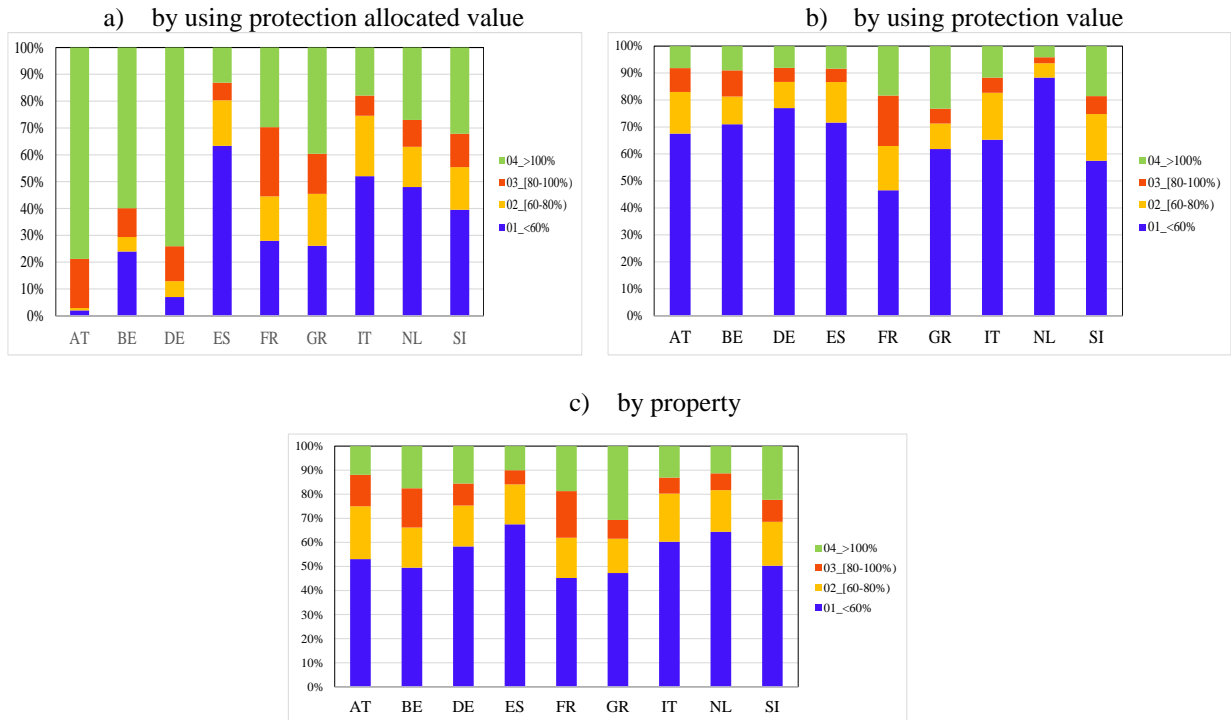
A main advantage of AnaCredit is the availability of information on collateral to calculate LTV. There are different ways to calculate this indicator. The most common ones are:

- loan-by-loan ratio of outstanding nominal amount (ONA) over protection allocated value (PAV), that is the maximum amount of the protection that can be considered as credit protection by the bank for the instrument in the case of default;
- loan-by-loan ratio between ONA and protection value (PV);
- by property, assigning the proportion of amount according to the ONA of each instrument linked to a specific real estate protection pledged as collateral and then using PV at the denominator.

The ratio can be calculated both at the origination of the contract or at the current time.

For Italy, the three approaches lead to very consistent results (Figure A.3). Approach a) gives a higher LTV than approaches b) and c), but this straightforwardly comes from the fact that protection allocated value is by definition lower than protection value. In this analysis we focus on approach b), as it relies on PVs, which is useful in the case of cross country comparison. Nevertheless, for the assessment of CRE Italian market we consider a) as PAVs have a prudential perspective and can give an indication of possible loss coverage in the case of default. We discard approach c) as it focuses on properties and we run a loan-by-loan analysis.

**Figure A.3: approaches for LTV-C calculation**  
*ONA share (in percentage)*



Source: AnaCredit. Note: We considered only collateralized loans.

#### A.4 Logit model and coefficients

**Table A.3: Parameters Estimates, reference model (1)**

Dependent variable:	Italy NPL status	Germany NPL status	Spain NPL status	France NPL status
<b>Loan Characteristics</b>				
<i>LTV_O_class_1: &lt;60</i>	baseline	baseline	baseline	baseline
<i>LTV_O_class_2: 60_80</i>	not significant	not significant	not significant	not significant
<i>LTV_O_class_3: 80_100</i>	0.75	not significant	0.55	not significant
<i>LTV_O_class_4: &gt;100</i>	1.09	not significant	1.13	not significant
<i>type_intrate</i>	not significant	1.47	0.65	0.08
<i>constr_investment</i>	0.22	not significant	-0.85	not significant
<i>log(loan orig)</i>	-0.14	not significant	-0.10	-0.17
<i>loan type: credit line non revolving</i>	baseline	baseline	baseline	baseline
<i>loan type: leases</i>	not significant	0.54	not significant	not significant
<i>loan ype: other loans</i>	not significant	not significant	0.69	0.44
<i>loan vintage: &lt;6mths</i>	baseline	baseline	baseline	baseline
<i>loan vintage: 6mths_1yr</i>	2.00	2.38	1.76	1.39
<i>loan vintage 1-2yrs</i>	2.70	3.40	1.53	2.21
<i>loan vintage: 2-3yrs</i>	3.06	3.90	2.19	2.89
<i>loan vintage: &gt;3yrs</i>	3.68	4.35	2.21	3.17
<b>Firm Characteristics</b>				
<i>pd_class_1: &lt;0.5</i>	baseline	baseline	baseline	baseline
<i>pd_class_2: 0.5-2</i>	0.69	not significant	not significant	not significant
<i>pd_class_3: 2-5</i>	1.06	1.43	not significant	0.91
<i>pd_class_4: &gt;5</i>	2.42	2.49	1.42	1.48
<i>pd_class - missing</i>	1.15	1.20	0.18	1.00
<i>log(total debt)</i>	0.09	not significant	0.06	0.05
<i>economic activity: manufacturing</i>	baseline	baseline	baseline	baseline
<i>economic activity: construction</i>	not significant	-1.45	-0.73	-0.38
<i>economic activity: real estate services</i>	not significant	-1.90	-1.63	-1.57
<i>economic activity: other services</i>	not significant	-0.74	-0.54	not significant
<i>economic activity: other</i>	-0.77	-0.96	-0.86	-0.58
<b>Other variables</b>				
<i>SSM significance: LSI</i>	not significant	0.77	-0.54	not significant