IMPACT OF FINAL BASEL III ON THE EU MORTGAGE SECTOR

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PREFACE

Scope of the study

The European Commission has recently released Banking Package 2021 with a proposal on how to implement the Final Basel III agreement in the EU.

The package deviates somewhat from the European Banking Authority's (EBA) proposed solution, leaving an increase in capital requirements of 6%-8% for the entire EU banking sector.[1] However, a heterogeneous impact across banks and portfolios can be expected, and there is currently no assessment of how the EU mortgage market will be impacted by the proposal.

Therefore, the EMF-ECBC has asked Copenhagen Economics to analyse the impact of the package on the EU mortgage market.

Throughout the study, we call the European Commission's proposal "Banking Package 2021" to distinguish it from the original Final Basel III package put forward by the Basel Committee.

We consider all lending secured by real estate, which we call the "mortgage portfolio", including corporate and small and medium-sized enterprise (SME) lending with collateral in real estate.

Our approach and data limitations

We have assessed the impact of Banking Package 2021 on 80 of the largest credit institutions in 13 major mortgage markets in the EU. Our country selection covers 93% of the total EU mortgage market.[2]

The EU-wide transparency exercise published by the EBA is our main data source. Comparing data for the mortgage market from the EBA transparency exercise with Hypostat, we find that our analysis covers around 85% of the mortgage market for the selected 13 countries. We expect the part not covered by our data to consist primarily of institutions on the standardised approach. Our results should be interpreted with that in mind.

Data from the EBA transparency exercise are supplemented with public data from national authorities and Pillar 3 reports, independent research reports, and other similar sources. All data sources are based on end 2020 data, implying that all regulatory changes implemented since e.g., the Targeted Review of Internal Models (TRIM) exercise are not accounted for. The fact that we only rely on public data sources limits the possible precision in our estimates compared to being based on confidential data received directly from the institutions; again, our results should be interpreted with that in mind.

To identify which institutions are bound by the output floor, we analyse the effects of Banking Package 2021 on a group level including all measures in the package (i.e., the impact of market risks,

1 Estimated by the European Commission in the impact assessment accompanying the proposal for the implementation of the Final Basel III Standard in an EU context.

2 Based on Hypostat 2021 (see Appendix B for data).

lower risk weights for rated corporates, etc.). This is important as the output floor is binding at the group level.

See full details of our methodological approach in the Appendix.

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LIST OF ABBREVIATIONS

CET1	Common Equity Tier 1
CRR	Capital Requirement Regulation
EBA	European Banking Authority
ECB	European Central Bank
EMF-ECBC	European Mortgage Federation - European Covered Bond Council
ESRB	European Systemic Risk Board
EU	European Union
EUR	Euro
GDP	Gross Domestic Product
IMF	International Monetary Fund
IRB	Internal ratings-based
LGD	Loss given default
LTV	Loan-to-value ratio
MM	Modigliani-Miller
PD	Probability of default
P2R	Pillar 2 Requirement
REA	Risk Exposure Amount
RW	Risk weight
SME	Small and medium-sized enterprise
STA	Standardised
S&P	Standard & Poor's
TRIM	Targeted Review of Internal Models

EXECUTIVE SUMMARY

This impact assessment focuses on the effect of the European Commission's Banking Package 2021 on the capital requirements for mortgage lending across the EU.

We find that capital requirements for the EU mortgage portfolios included in the EBA transparency exercise will increase by an estimated 18% compared to the end of 2020. This corresponds to EUR 22 billion in extra capital. Fully restoring capital ratios to the pre-package level would require an additional EUR 17 billion, leaving a total extra capital need of up to EUR 39 billion.

The reported results only include increases in capital requirements for mortgage portfolios, i.e., lending with collateral in real estate, covering around 28% of total EU credit assets. The analysis disregards any impact not directly related to the mortgages. [3]

The average impact includes substantial variation across institutions and depends crucially on which approach the institutions use today to model risks:

- Changes to the standardised approach will lead to a decline in capital requirements of around 6%, corresponding to EUR 8 billion.
- Implementation of the output floor for lenders using the internal ratings-based approach (IRB) will cause an increase in capital requirements of 27%, corresponding to around EUR 30 billion.

The impact relies on two key assumptions:

- **Risk weights are based on Banking Package 2021:** We assume that current national discretions will be removed when the new regulation enters into force. To the extent that additional national measures would still be in place, capital requirements could be higher than what we estimate.
- **The loan-splitting approach will apply:** This means that the exposures are split into several parts and each part designates a risk weight. This might not always be the case, for example, for secondary homes. To the extent that the whole-loan approach is used (i.e., no loan splitting takes place), the impact could be higher. For example, we find that if 10% of household mortgage exposures are on the whole-loan approach, the increase in capital requirements will be 22%.

Impact on different customer segments

Looking at different customer segments, we find substantial variations in impact; the **corporate** mortgage portfolio, with an average increase of 40% across the EU, will experience the highest increase in capital requirements. The primary reason is that lending with commercial real estate as collateral will receive a risk weight of 60% in the standardised approach (for exposures with loan-to-value (LTV) below 55%), whereas mortgage lending with residential real estate as collateral will receive a risk weight of 20%. In addition, IRB institutions bound by the output floor have to a greater extent large corporate portfolios.

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3 For example, disregarding higher market risks and Pillar 2 Requirement (P2R) buffer kept constant. Thus, our impact on capital requirements will be parallel to the increase in credit risk exposure amount (REA) for mortgages.

Capital requirements for **SMEs** follow the impact for corporates; although mitigated by the SME supporting factor, exposures are more evenly spread between STA and IRB institutions. This gives rise to an increase of 23%.

With an increase in capital requirements of 11%, **households** will experience the lowest impact of the three customer segments. The main reason is the preferential risk weight of 20% for residential exposures.

Change in capital requirement determination: LTV becomes the key risk parameter and default risk becomes secondary

The Banking Package 2021 increases the importance of loan-to-value (LTV) ratios for capital requirements and make default risk become secondary. Today, many institutions use internal models to determine their capital requirements, where Probability of Default (PD) and Loss Given Default (LGD) are key input factors. When the output floor is binding, institutions will instead be required to base capital requirements on the standardised approach, where LTV is the only input factor. Therefore, institutions with high LTVs, where capital requirements currently are low due to a low default risk, will see the biggest increases in capital requirements.

Transitional arrangements could neutralise the impact

We find that the transitional arrangement with lower risk weights for residential real estate under the output floor could neutralise the increase in capital requirements.

Implemented on top of fully-loaded capital requirements, we estimate a decline in capital requirements for the mortgage portfolios of around 3%, compared to an increase of 18% without the arrangement. The decline reflects that most lenders will not be bound by the output floor with the arrangement in place, leaving the decline in capital requirements for portfolios on the standardised approach to drive the impact.

If the exemption is extended to cover commercial real estate[4], we find a further reduction in capital requirements of an additional 4%-points.

To be able to apply the transitional arrangement requires credit institutions to pass a hard test, where losses for the exposures with an LTV below 55% should on average be lower than 0.25% for the past six years.

4 For commercial real estate, however, we assume that only the loan amounts with an LTV below 55% will achieve the same percentagewise reduction in capital requirements as residential real estate i.e., no discount for the loan amount with an LTV between 55% and 80%.

CHAPTER 1

IMPACT ON THE EUROPEAN MORTGAGE SECTOR

Banking Package 2021, published in October 2021, is the European Commission's proposal for how to implement the Basel Committee on Banking Supervision's Final Basel III Standard agreed upon in December 2017. This impact assessment analyses the impact of the European Commission's Banking Package 2021 on the European mortgage sector. Chapter 1 analyses the impact when Banking Package 2021 is fully implemented. Chapter 2 analyses the impact of making the transitional arrangements permanent.

In terms of the impact on the European mortgage sector, we estimate that the European mortgage lenders will have to hold, on average, 18% more Common Equity Tier 1 (CET1) capital than today[5] if Banking Package 2021 is implemented in its currently proposed format. This corresponds to an increase in capital requirements of EUR 22 billion. On top of this, lenders will experience an additional capital need to replenish capital buffers fully to restore current capital ratios.[6] This could lead to an additional capital need of around EUR 17 billion, providing a total capital need of EUR 39 billion.

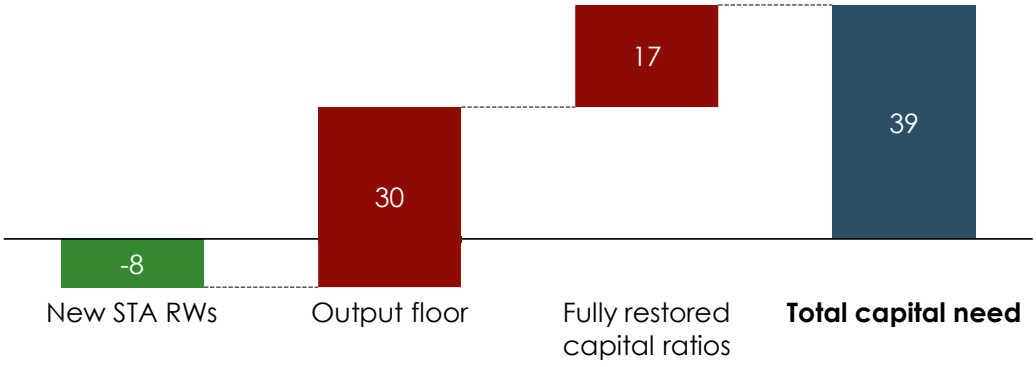
The impact per lender is driven by the current approach for modelling capital requirements:

- Lower capital requirements for the standardised approach ("New STA RWs" in Figure 1), will reduce the total EU-wide capital requirements for mortgage portfolios by around EUR 8 billion.
- The output floor will increase total capital requirements by EUR 30 billion.

5 We base our analysis on end 2020 data, implying the analysed increases in capital requirements should be seen compared to how they looked at the end of 2020.

6 Typically, institutions prefer to operate with a capital buffer on top of their required REA. When REA increases, the capital buffer on top of capital requirements is reduced (the denominator increases). To restore the capital buffer to its previous relative level, we find that an additional EUR 17 billion would be needed.

Figure 1
Estimated capital requirement (CET1) for the EU mortgage portfolio
EUR billion



Source: Copenhagen Economics (see Appendix A for a detailed explanation of data sources and methodology).

The remainder of this chapter explains how we have gone about estimating these impacts and provides further colour on the contours of the impact across different ways of segmenting the European mortgage sector. The chapter is structured as follows:

- Section 1.1 describes the background and policy context and explains the regulation put forward by the European Commission in Banking Package 2021.
- Section 1.2 describes our approach to estimating the impact on the European mortgage portfolios, i.e., our modelling framework and data sources.
- Section 1.3 sets out our results for the European mortgage portfolios while zooming in on portfolio-specific results, e.g., how the approach to estimating risk weights affects the impact, and results for specific customer segments.

1.1 BACKGROUND TO THE IMPACT ASSESSMENT

This subsection introduces the background and policy context for our impact assessment and introduces the key policy measures contained in Banking Package 2021. Section 1.1.1 will cover the background and policy context, Section 1.1.2 will introduce the key policy measures in Banking Package 2021, and Section 1.1.3 will provide the background of the two key policy tools in Banking Package 2021, i.e., risk weights and output floors.

1.1.1 Background and policy context

The third instalment of the Basel agreements, the original Basel III Standard, significantly increased capital requirements. It was developed in response to the 2008 financial crisis to increase the resilience of the financial sector by increasing bank capital requirements[7] (i.e., the amount of equity that institutions must hold). The original Basel III measures significantly reduced the risk of a financial crisis arising from insufficient capitalisation of the banking sector; average capitalisation in the EU increased from around 8% in 2007 to close to 15% in 2019.

7 A capital requirement is the amount of equity that a credit institution is required to hold, based on the riskiness of its assets. This requirement is put in place to reduce or avoid systemic risk in the event of a crisis.

In December 2017, the Basel Committee on Banking Supervision agreed on a revised regulatory framework to finalise the reforms. This framework is the 'Final Basel III Standard.'

Amongst others, a key element of the Final Basel III Standard is the concept of an output floor. The output floor sets a minimum level of capital that lenders must hold for each type of asset, regardless of the lender's estimate of the riskiness of the assets. The motivation behind the output floor is to create a backstop for excessively low modelled capital requirements compared to a realistic assessment of risks and to enhance comparability between institutions.

Since its introduction, the Final Basel III Standard has been subject to much debate. In Europe, extensive consultations and several impact assessments have been performed by the EBA.

In October 2021, the European Commission came forward with a proposal on how to implement the Final Basel III Standard in the EU – 'Banking Package 2021'. The package proposes that the output floor will be implemented as proposed by the Basel Committee. In addition, the proposal contains some measures that reduce the impact on capital requirements in comparison to the original Final Basel III Standard. These include an 'extra' SME discount known from the current regulation[8], special treatment of operational risk and lower risk weight for some exposures on the standardised approach. As we will lay out in this chapter, the latter also reduces the impact of the output floor.

The European Commission's proposal for implementation will now be subject to negotiation with the European Parliament and Member States.

1.1.2 The main elements of Banking Package 2021

As detailed in Section 1.1.3, the key driver of the amount of capital a lender must hold for each loan they advance is the risk weight attached to that loan. Risk weights can be set in two ways:

- **The standardised approach** involves regulatorily-set risk weights for each loan. These risk weights vary by the type of the loan, the size of the loan relative to the value of the asset the lending is done against (LTV), and the type of borrower. The standardised approach is the default approach to setting risk weights, and any lender can use it.
- **The IRB approaches** involves the lender using its internal risk models to rate each loan, thereby determining the appropriate risk weighting for each loan. These models can be complex and have relatively intensive data requirements. The relevant supervisory authority must approve the models. Using an IRB approach typically leads to lower capital requirements than a standardised approach. IRB approaches are typically used by larger lenders.

For mortgage portfolios, Banking Package 2021 contains two key changes compared to the regulatory regime today, one for each of the two approaches to setting risk weights:

8 I.e., the extra SME discount on 76.19% applies to loan amounts below the threshold of EUR 2.5 million. The "normal" discount in the Basel regulation of 85% applies to loan amounts above the threshold of EUR 2.5 million.

1) **New risk weights for exposures on the standardised approach[9]:** This measure involves changes to how risk weights for exposures are set in the standardised approach. As a default, exposures in the standardised approach will be allowed to use the loan-splitting approach. This means that a loan will be split into different LTV buckets, each of which receives different risk weights. As a result, significantly lower risk weights than in the current regulation will apply to some types of lending, most notably for residential real estate with an LTV below 55%. In general, portfolios in the standardised approach will experience a decline in capital requirements.
2) **The output floor under the IRB approach:** The output floor sets a minimum risk weight for each category of assets. By doing so, the output floor acts as a backstop for low internally estimated risk weights. This means that banks will have to apply a minimum risk weight to each category of assets (e.g., household mortgages, corporate mortgage lending) instead of applying a risk weight to each asset based on the estimated risk of that asset using internal models.

These elements and the concepts of risk weights and output floor are explained in Section 1.1.3.

As a result of these measures, the package gives LTV a more prominent role in determining capital requirements. The standardised approach has always had LTV as the decisive element for capital requirements. However, for the IRB approach, the LTV is just one input to the rating, with the borrower's estimated PD and the loan's estimated LGD being the two other main inputs.

When the output floor becomes binding for IRB lenders, they will have to apply "floored risk weights" that are aligned to the standardised approach risk weights and based on LTVs. As a result, the importance of LTVs in determining capital requirements will increase across the sector. This means that the PD will have a more limited impact on capital requirements. Its primary role will become determining whether the output floor is binding. This implies a loss of risk sensitivity; risk weights will only be sensitive to default risk, if the output floor is not binding, i.e., IRB modelled risk weights for mortgage portfolios are higher than "floored risk weights."

For LTV, some risk sensitivity will remain. Risk weights will gradually increase as the LTV moves above a threshold of 55%, meaning that capital requirements will be sensitive to LTV changes for exposures with an LTV above 55%. However, exposures with an LTV below 55% will receive the same risk weight, meaning no sensitivity to changes in leverage. For example, the same risk weight will apply for exposures with an LTV of 10% as for a loan with an LTV of 50%.

The fact that LTV will become the main risk indicator means that *ex ante*, we would expect to observe the highest impact for institutions that are characterised by relatively high LTVs. For lenders that use IRB approaches, the effect of high LTVs on capital requirements can be currently mitigated by low historical credit losses. This is because IRB approaches use data on the lender's past credit performance in setting risk weights.

On the other hand, institutions with lower LTVs are less likely to experience an increase in capital requirements, as lower LTVs result in lower RWs on the standardised approach. This implies that 1) institutions are less likely to be bound by the output floor and 2) even if the output floor is binding, the resulting capital requirements will be lower.

9 See Appendix A for further details.

Specifically, the share of mortgages with an LTV below 55% will be of high importance when bound by the output floor, as these mortgages will obtain preferential risk weights. The share of mortgages with an LTV above 55% will be treated as unsecured exposures, obtaining significantly higher counterparty risk weights in the standardised approach. For the EU average we find that around 81% of the exposure amount for household mortgages and around 86% of the exposure amount for corporate mortgage lending will have an LTV below 55%. In this average we do not take Belgium into account, due to the regulatory treatment of the mortgage mandates that are idiosyncratic to the Belgian mortgage market.

1.1.3 Risk weights and the output floor

To understand how the output floor can set a lower bound on the required capital, it is important to look at the riskiness of the institutions' business activities, as required capitalisation is determined not only by the value of exposures held but also by their risk. The level of risk of each exposure is identified by its risk weights. Today, many large institutions determine the risk weights applied to their exposures by the IRB approach, as explained in Box 1. An alternative is the standardised approach.

Box 1 What is the output floor?

Banks and other lenders take on risks by lending funds to borrowers. Fundamentally, not all borrowers will pay back their loans. As a result, any lending activity will involve some degree of credit loss. The lenders are, for the most part, merely financial intermediaries. The lenders themselves borrow the funds they lend out. As the lenders must be able to pay back their borrowing, they need to hold a buffer against the credit losses and other risks they suffer.

This buffer is made up of various types of capital instruments such as equity. The minimum level of the buffer is set by regulation. This regulatory capital amount is determined by the total exposures (effectively, lending) and the level of risk in these exposures. For example, holding a EUR 100,000 unsecured corporate loan entails a larger risk than holding a EUR 100,000 government bond.

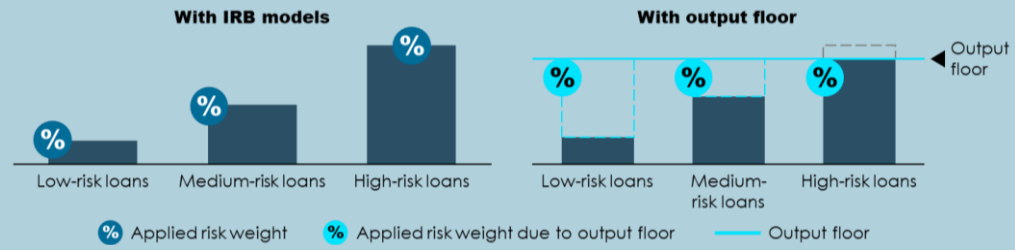
The level of risk of each exposure is identified by its risk weight. Today, there are two ways in which lenders can determine the risk weights for their exposures in two ways.

- **The standardised approach[10]:** The risk weights are fixed, and all lenders using the standardised approach must use the same risk weights for each class of exposure. For mortgage lending, the exposures are categorised by the type of borrower and the size of the loan relative to the value of the real estate used as collateral for the loan (loan-to-value ratio, commonly abbreviated LTV). For example, residential loans with an LTV below 80% currently receive a risk weight of 35%.
- **The IRB approach:** The risk weights are estimated for each loan using the lender's internal models. These models would typically use estimated risk parameters of the loan as inputs. Such parameters include the probability of the loan defaulting (PD) and the credit loss that would materialise if the loan were to default (LGD). The design of the models is highly regulated, and they rely on substantial analysis of the lender's loan portfolios' historical credit performance. The models must be approved by the competent supervisory authority.

The proposed **output floor** imposes a minimum level of risk weight applied to lenders' risk-weighted assets. The output floor is based on the standardised approach. Concretely, the intention is that capital requirements for IRB lenders cannot go below 72.5% of what the capital requirements would have been if the lenders had used the standardised approach.

The output floor is binding at an aggregated group level and not for individual portfolios, thereby reducing the risk sensitivity of the underlying assets. This means that risk weights for most assets are likely to increase if the output floor is binding, but some assets could experience a reduction as illustrated in Figure B.1.

Figure B.1
Illustration of application of the output floor
Estimated level of risk



Note: The output floor is one floor applied on the totality of risk weights of risk-weighted assets held by an institution. However, in practice, it has a different impact on different categories of assets as illustrated in the figure above.

1.2 OUR APPROACH

This section describes how we have explored the effects of Banking Package 2021 on the European mortgage sector:

- Section 1.2.1 explains the scope of the study, which is to provide an assessment of the contribution of the mortgage portfolio to total CET1 requirements.
- Section 1.2.2 describes our sample and the data sources used in our estimations.
- Section 1.2.3 describes our approach to assessing the output floor.

A detailed description of our modelling approach is set out in Appendix A.

1.2.1 The scope: EU mortgage portfolios

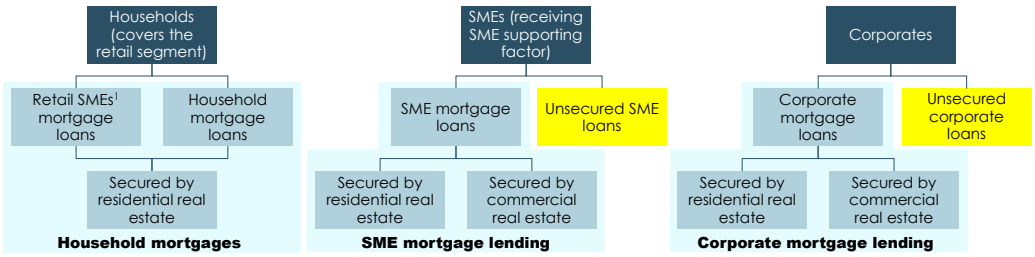
We seek to explore the effects of Banking Package 2021 on the European mortgage sector. We do this by estimating **the contribution of the mortgage portfolio** to lenders' total capital requirements. This means that an estimated decline or increase in capital requirements does not indicate that we expect an overall decline or increase in capital requirements for the lenders, merely that we expect a reduction or increase in capital requirements for the mortgage portfolio viewed in isolation. This is because a mortgage lender will typically have many other exposure types outside of mortgages. Many of these other exposures will likely see an increase in capital requirements due to Banking Package 2021, for example, due to higher risk weights for unrated corporates, market risk, and operational risk.

Our impact assessment covers three types of mortgage portfolios: households, SMEs, and corporates. Throughout the report, we use the following definitions, as illustrated in Figure 2:

[10] According to the regulation today in the CRR.

- **Household mortgages** are mortgages advanced to the retail segment consisting of household mortgage loans and retail SME[11] mortgage loans. The mortgage loans can be secured by residential real estate only.
- **SME mortgage lending** covers mortgage lending for SMEs receiving the SME supporting factor under the corporate segment.[12] Mortgage loans can be secured by both commercial and residential real estate.
- **Corporate mortgage lending** covers mortgage lending for corporates. Mortgages can be secured by both commercial and residential real estate.

Figure 2
Illustration of the three mortgage portfolios



1.2.2 Sample and data sources

We have explored the impact of Banking Package 2021 on the capital requirements for the mortgage portfolio for a total of 80 of the largest credit institutions in 13 EU countries that cover 93% of the total EU mortgage market.[13]

Our main source for data on capital requirements and the lenders' balance sheets is the EBA transparency exercise.[14]

In addition, the impact assessment makes use of a range of different data points such as LTVs for the different portfolios, classification of lending (e.g., residential, or commercial), average size of the loan (to estimate the size of the SME discount) and share of rated corporates, as these determine the risk weights applicable to the different exposures in the regulation set forward in Banking Package 2021.

We primarily seek to use lender-specific data sourced from Pillar 3 reports and annual reports. Additionally, we have used lender-specific data sources from the cover pool database.[15]

11 SMEs are defined under the retail category if the loan amount is below EUR 1 million.

12 According to the European Commission, a corporate is defined as an SME if its annual revenue is below EUR 50 million. For loans to SMEs, a supporting factor of 76.19% applies to loan amounts below EUR 2.5 million and a supporting factor of 85% applies to loans above EUR 2.5 million, implying that the resulting risk weight applied to a loan will be the weighted average. The supporting factors apply for both unsecured lending and lending secured by real estate.

13 Based on Hypostat 2021; see Appendix B for data.

14 EBA (2020a).

15 Database provided by the covered bond label: see link.

When a specific datapoint is not available at the lender level, we use national-level data. These are sourced from national authorities, national statistics, independent research reports and similar sources.

In rare instances, even national-level data are not available. In these instances, we use the EU average as a proxy. This is most notably for LTVs for corporate exposures, where data were unavailable for some countries.

1.2.3 Output floor assessment

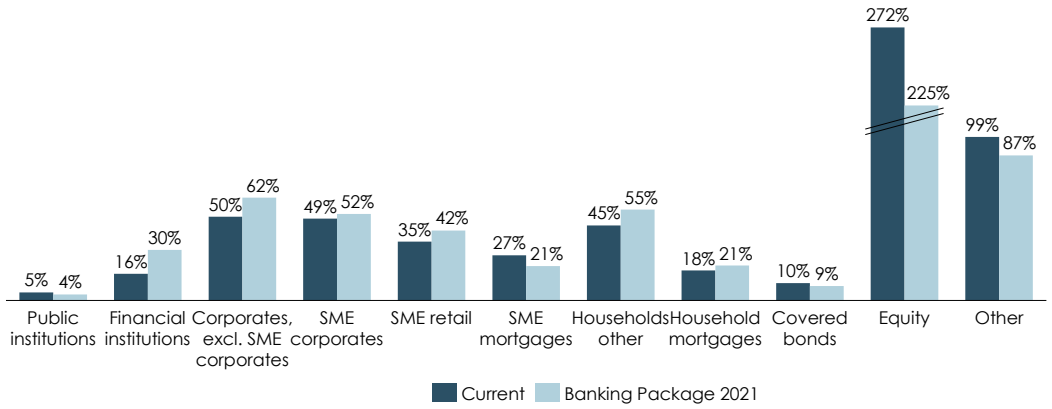
We examined the entire banking market to determine which institutions are bound by the output floor and thereby which risk weights will apply to the mortgage portfolios. The output floor is binding at an aggregated level. We therefore need to include the entire banking market (i.e., not limited to mortgage portfolios but also including unsecured lending, market risk, etc.) in our assessment of which mortgage portfolios are bound by the output floor. For each lender in our sample, we assess whether the output floor is binding in three steps:

1) We implement measures in Banking Package 2021 not related to the output floor e.g., changes to market risk, operational risk and credit valuation adjustment (CVA) as well as changes to the standardised approach and estimate change to Risk Exposure Amount (REA).
2) We estimate capital requirements under the output floor, including keeping the Pillar 2 requirement buffer constant, for the lender as a whole, including unsecured lending portfolios, market risk, operational risk, and CVA.[16]
3) If the capital requirements estimated in Step 2 are higher than unfloored capital requirements, the lender is said to be bound by the output floor. In this case, floored risk weights are applied to the mortgage portfolio.

Considering all exposures in our sample, we find that average risk weights for categories like corporates, SME corporates and all exposures to households (both mortgages and others) will increase when implementing Banking Package 2021; cf. Figure 3. Other categories like equity and public institutions will experience a decrease in their risk weights.

[16] And multiply this with the output floor factor of 0.725.

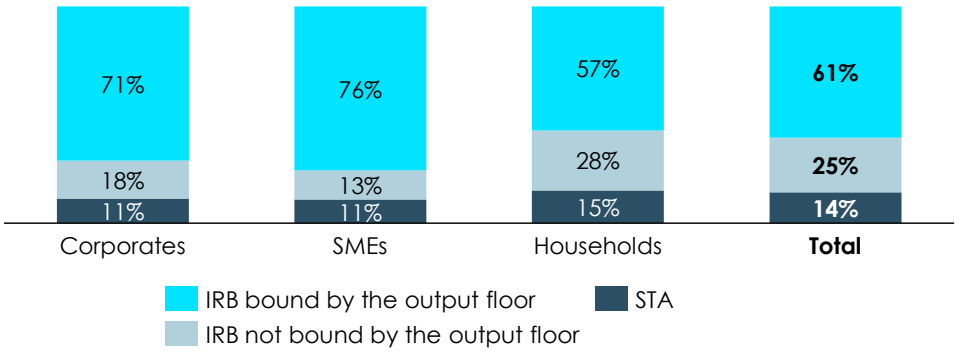
Figure 3
Current average RWs and estimated RWs under Banking Package 2021 for total EU banking market



Source: Copenhagen Economics (see Appendix A for a detailed explanation of data sources and methodology).

Based on estimated risk weights under Banking Package 2021 for all portfolios, we can determine whether institutions will be bound by the output floor or not. We find around two-thirds of IRB exposures on the mortgage market to be bound by the output floor, as shown in Figure 4.

Figure 4
Around two-thirds of IRB exposures will be bound by the output floor
Share of market mortgage exposures



Note: We only consider institutions and mortgage exposures included in the EBA transparency exercise, implying that we underestimate the share of STA exposures. The figure considers exposures, meaning an STA exposure in an IRB institution would be included in STA.
Source: EBA transparency exercise and own calculations.

1.3 OUR RESULTS

We estimate that, in absolute terms, implementing Banking Package 2021 will lead to an increase in capital requirements of 18%, corresponding to EUR 22 billion at an EU-wide level.[17] This estimate covers all EU countries i.e., we scale up the impact for the 13 countries included (corresponding to 93% of the EU mortgage market) in the analysis to cover all EU countries. In our EU estimate, we have taken into account country-specific conditions such as the regulatory treatment of the mortgage mandate in Belgium, mortgage floors in Sweden or state guaranteed mortgage loans in the Netherlands. See Appendix A for a detailed explanation.

In the following sections, we set out the results of our impact assessment:

- Section 1.3.1 explores the differences in impact between portfolios that currently use standardised and IRB approaches.
- Section 1.3.2 sets out our results by type of lending.
- Section 1.3.3 explores the impact of using the whole-loan approach instead of the loan-splitting approach.

1.3.1 Impact by approach to setting risk weights

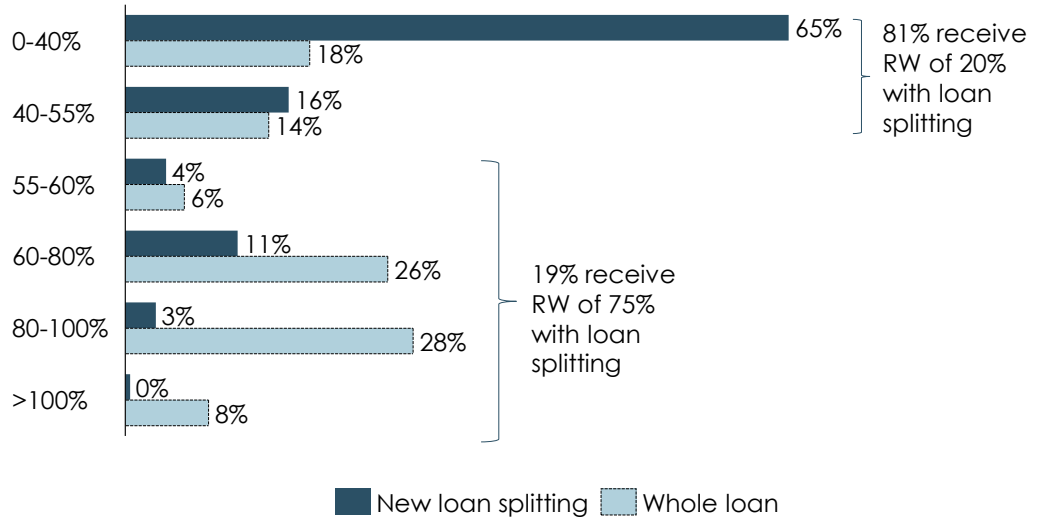
The impact on capital requirements varies significantly across institutions, depending on the approach primarily used by institutions to set risk weights.

In general, we find that lenders following the standardised approach typically experience a decline in capital requirements. This is a result of a new framework for calculating risk weights for the standardised approach with two new aspects:

1) **Lower risk weights:** Exposures with an LTV below 55% receive a risk weight of 20% when secured by residential real estate, compared to 35% before.
2) **Loan splitting:** In addition, in the standardised approach, institutions can use the loan-splitting approach as a starting point to estimate risk weights. This means that it is possible to split each loan into different LTV buckets. For example, a household mortgage loan with an LTV of 100% still receives a 20% risk weight on the part of the loan that has an LTV below 55%. The part of the exposures with an LTV above 55% receives the counterparty risk weight of 75%. However, with the loan-splitting approach, this is only 19% of total household mortgages exposure amounts for the average EU portfolio; see Figure 5.

[17] We define capital requirements for the mortgage portfolio as REA times the capital requirement ratio for the different banking groups.

Figure 5
Estimated average EU household LTV distribution following the loan-splitting and whole-loan approach



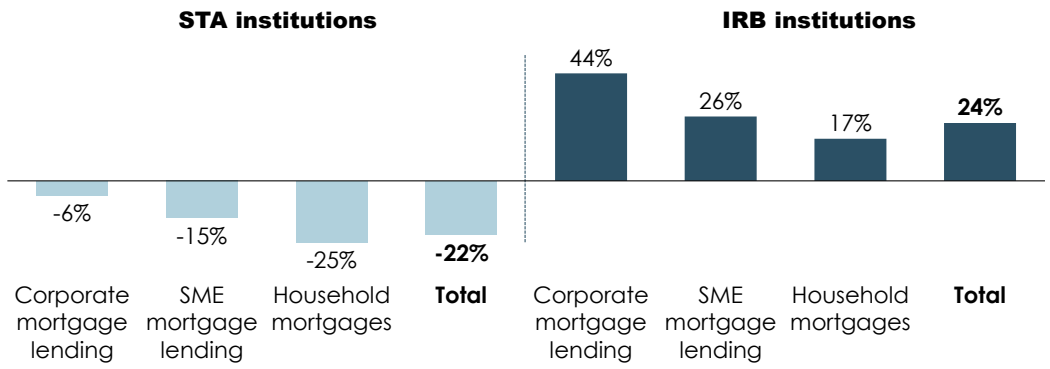
Source: Copenhagen Economics (see Appendix A for a detailed explanation of data sources and methodology).

We find that these new rules leave a decline in capital requirements for household mortgages for lenders using the standardised approach of 25% on average; see Figure 6.

At the same time, lenders that are currently using IRB approaches can experience an increase in the capital requirements for their mortgage portfolios. This is because if the lender is bound by the output floor, we would expect the resulting risk weights to be higher.

Figure 6 compares the estimated impact between lenders using a standardised approach and IRB approaches. Standardised approach lenders will experience a 22% *reduction* in their capital requirements, whereas IRB lenders will experience a 24% *increase* in their capital requirements.

Figure 6
Impact on capital requirements
% of original CET1 requirements



Note: We make the split based on the main method applied in the institution. An IRB institution can thereby also have exposures under the standardised approach.
Source: Copenhagen Economics (see Appendix A for a detailed explanation of data sources and methodology).

The reduction in capital requirements found in the standardised approach hinges crucially on the assumption of loan splitting and only happens if lenders can use the loan-splitting approach for all their exposures. This might not always be the case. For example, if a lender wants to use the loan-splitting approach for the secondary home, the lender needs to pass a so-called hard test, demonstrating low losses for an extended period. Concretely, losses in a given member state needs to be below 0.3% for the part of the exposures up to 55% of the property value.

1.3.2 Impact by type of lending

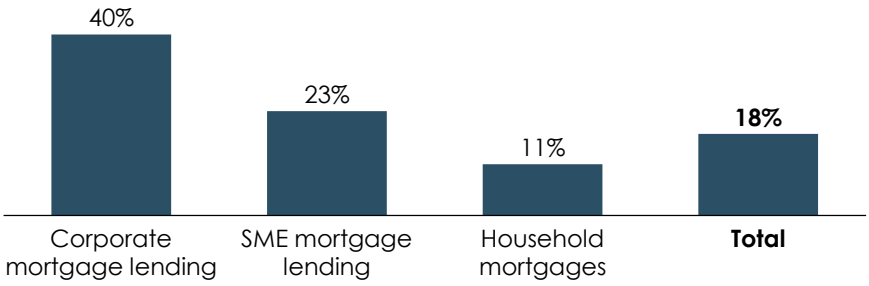
Looking at the impact of different types of mortgage lending, we find that corporate mortgage lending, with an average increase of 40% across the EU, will experience the highest increase in capital requirements. This is because in the standardised approach mortgage lending with commercial real estate as collateral receives a risk weight of 60% for exposures with an LTV below 55%, whereas mortgage lending with residential real estate as collateral receives a risk weight of 20%. The impact on corporate mortgage lending is mitigated by our assumption that around 50% of the exposure is backed by residential collateral.

The difference between corporate and SME lending reflects the SME supportive factor received by SME exposures.[18]

Figure 7 sets out the estimated impact by type of mortgage lending.

18 In Banking Package 2021, the current SME supportive factors are continued. Loan amounts above the threshold of EUR 2.5 million will receive the SME supporting factor of 85%, whereas loan amounts below EUR 2.5 million will receive the SME supporting factor of 76.19%. The SME supporting factors are applied to all loans, i.e., also to mortgage loans.

Figure 7
Increase in capital requirements for different portfolios
% of original CET1 requirements



Source: Copenhagen Economics (see Appendix A for a detailed explanation of data sources and methodology).

We note that the uncertainty in our estimates is generally higher for corporate and SME mortgage lending than for household mortgages for two reasons:

1) **Less information on corporate lending is available.** For example, we only have country-specific LTV data for five of the 13 countries in the sample; we assume that the rest of the countries have the EU average.
2) **We do not know starting risk weight for corporate mortgages.** In prudential disclosures, household mortgages have a separate category, and REA for households are directly retrievable. This is not the case for corporate mortgage lending, which is included in the general corporate (and SME) categories, meaning that, for this exercise, we had to estimate the likely starting REA. We have done this based on a generic IRB model with assumptions for LGD from CRR (see methodology in Appendix A). [19]

1.3.3 Impact with part of the mortgage portfolio under the whole-loan approach

If part of the mortgage portfolio is not applicable for the loan-splitting approach, it will instead be treated under the whole-loan approach, where capital requirements are higher.[20] Exposures treated under the whole-loan approach could be Income Producing Real Estate (IPRE) exposures or secondary homes not passing the hard test.[21] Today, however, most banks do not necessarily have data to determine whether the asset behind a mortgage is a primary or secondary residence, implying that it could be difficult for banks to prove which parts of their assets would be eligible for the milder loan-splitting approach.

To illustrate the potential impact of the whole-loan approach, in an alternative scenario we have assumed that around 10% of household mortgages would be treated under the whole-loan approach. All corporate and SME mortgage lending would still be under the loan-splitting approach.

19 We assume the same PD and maturity for corporate and SME exposures with and without collateral in real estate. Since IRB risk weights are a linear function of most risk parameters, our starting REA assumptions are unaffected by assumptions regarding PD and maturity. For LGD, we assume the input floors given in CRR.

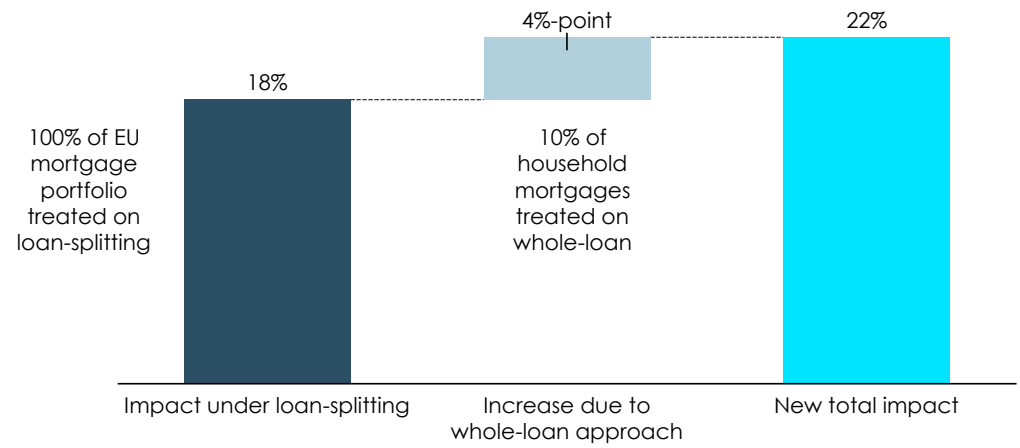
20 For RWs applied to exposures secured by mortgages on residential immovable property under the whole-loan approach see article 125 (2) in the EU Commissions proposal. For RWs applied to exposures secured by mortgages on commercial immovable property see article 126 (2).

21 See Article 124 in the EU Commission's proposal.

Here, we find the increase in capital requirements for the EU average to be around 22%, i.e., 4%-points higher than if the entire mortgage portfolio were on the loan-splitting approach. The higher impact is a result of higher average risk weights for institutions using the standardised approach, causing more institutions using IRB approaches today to be bound by the output floor.

Again, this increase can be divided into two effects. The lower risk weights for the standardised approach would lead to a decrease of 6% in capital requirements, the same level as before (note that the vast majority of the portfolio would still be under the loan-splitting approach in our scenario, causing the decline). The output floor would lead to an increase in capital requirements of 28%, compared to 27% before.

Figure 8
Impact on capital requirements for part of mortgage portfolio on whole-loan approach
% of original CET1 requirements



Note: The impact is modelled for a concrete case where we assume 10% of household mortgages (under the standardised approach or bound by the output floor) would be treated under the whole-loan approach whereas the remaining 90% of household mortgages and all corporate and SME mortgage lending would still be on the loan-splitting approach.
Source: Copenhagen Economics (see Appendix A for a detailed explanation of data sources and methodology).

CHAPTER 2

THE IMPACT OF TRANSITIONAL ARRANGEMENTS

Banking Package 2021 will, on average, lead to a significant increase in capital requirements for mortgage portfolios across Europe.

However, Banking Package 2021 can be implemented in ways that could mitigate the increase in capital requirements. For example, the European Commission has suggested a temporary exemption for mortgage loans secured by residential real estate, allowing institutions to apply significantly lower risk weights during a transition period.

In this chapter, we evaluate different options for implementing the Final Basel III package in a European context:

- Section 2.1 sets out the transitional arrangements for residential real estate and estimates the impact of the arrangements as if they were made permanent.
- Section 2.2 extends the transitional arrangements for residential real estate to cover mortgages secured by commercial real estate and presents the impact on capital requirements arising from this.

2.1 TRANSITIONAL ARRANGEMENTS FOR RESIDENTIAL REAL ESTATE

In Banking Package 2021, the European Commission has introduced temporary exemptions for low-risk portfolios in the output floor calculation e.g., mortgage loans secured by residential real estate, as mitigation. Furthermore, in the proposal, the European Commission has opened a door to making the exemption permanent.

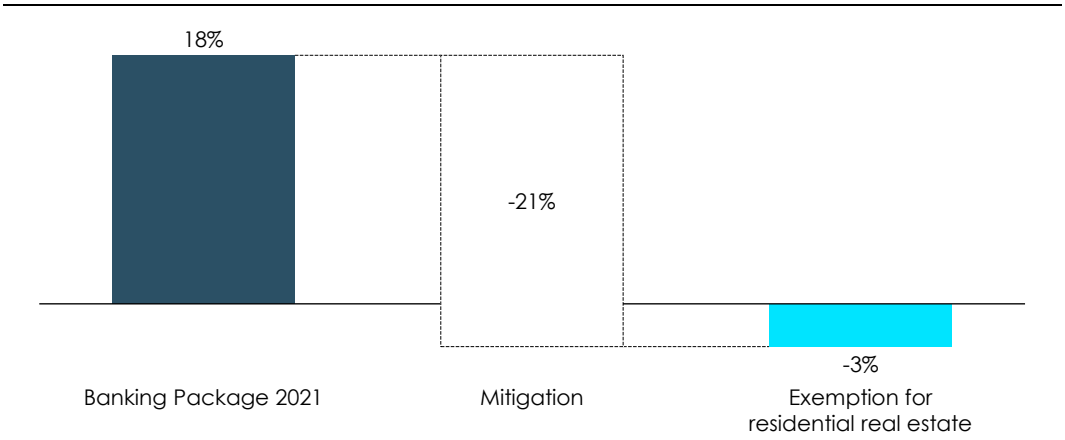
To have any significant impact on the capital need of institutions, we would expect that the exemption would have to be made permanent. Market participants typically expect credit institutions to be fully compliant with new permanent capital requirements shortly after a package is implemented. Furthermore, supervisory authorities could expect the institutions not to wait with increasing capitalisation until the capital requirements become binding.[22]

Concretely, the transitional arrangement implies that loan amounts with an LTV ratio below 55% under the standardised approach for loan splitting will be assigned a risk weight of 10%, whereas loan amounts with an LTV of 55-80% will be assigned a risk weight of 45%. Exposure amounts with an LTV greater than 80% will receive a counterparty risk weight. Note that the exemption only applies if an institution is bound by the output floor, i.e., it will not apply for exposures that are under the standardised approach today.

[22] This was exactly what happened after the implementation of the first Basel III agreement: Despite a long implementation period, most institutions had adjusted to comply with the package after two years.

Assessing the impact *on top of fully-loaded capital requirements*, we find a decline in capital requirements for the EU average mortgage portfolio of around 3%, compared to CET1 requirements today, as shown in Figure 9.

Figure 9
Change in capital requirements when exemption for residential real estate is in effect (on top of fully-loaded requirements), conditional on passing the hard test
% of original CET1 requirements



Source: Copenhagen Economics (see Appendix A for a detailed explanation of data sources and methodology).

With the exemption in place, few institutions will be bound by the output floor, meaning that the primary impact of the reform will be the lower risk weight for exposures under the standardised approach. Thus, IRB institutions will typically have unchanged capital requirements, whereas STA institutions will see a similar decline in capital requirements as in the main scenario described in Chapter 1.

The effect of the mitigation is conditional on the specific institutions passing a hard test, demonstrating that yearly loss rates for outstanding loans in the category do not exceed certain thresholds. Concretely, mortgage lending secured by residential real estate for a given lender cannot on average during the past six years have losses above 0.25% on the part of the exposures with an LTV below 55%.

We note that the estimated decline in capital requirements only covers the mortgage portfolios' contribution. As mentioned, mortgage portfolios are typically only a part of lenders' exposures. The exposures outside mortgage portfolios will likely see an increase in capital requirements due to higher risk weights for unrated corporates, market risk, and operational risk. Thus, the estimated decline in capital requirements does not indicate that we expect an overall decline in capital requirements for the banking markets analysed.

2.2 TRANSITIONAL ARRANGEMENT EXTENDED TO COMMERCIAL REAL ESTATE

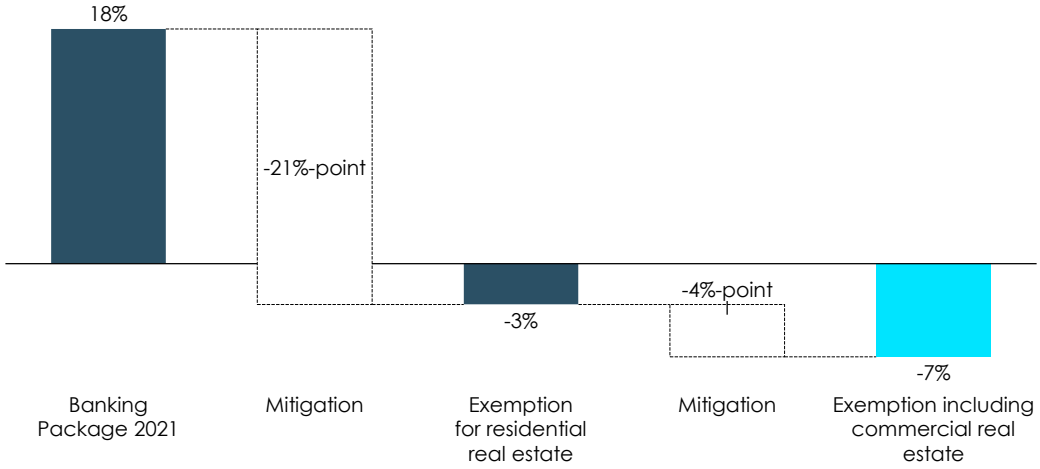
The current debate at the European Union level has considered whether the exemption provided by the transitional arrangements for residential real estate should be extended to commercial real estate. The reasoning for the proposal is that if residential exposures are deemed safe when the history of losses below a certain threshold is long, it would be reasonable to consider that commercial real estate – if meeting the same criteria of low losses – should be treated the same way.

With this debate in mind, we have explored the effect of extending the transitional arrangements to commercial real estate exposures. Here, we assume that the regulatory treatment of mortgage lending backed by commercial real estate would be treated similarly: a risk weight of 30% instead of the 60% currently suggested in Banking Package 2021. We have assumed no adjustment for loan amounts with an LTV above 55%.

We find a small additional relief in capital requirements if the exemption is extended to commercial real estate of 4%-points[23], leading to a decline in capital requirements of 7% compared to today; cf. Figure 10.

The reason for this small additional relief is that few banks were bound by the output floor with the exemption on residential real estate, so a further reduction in the output floor effect is limited. However, the distance to when the output floor becomes binding will increase for the IRB banks in the sample.

Figure 10
Change in capital requirements when exemption for residential and commercial real estate is in effect (on top of fully-loaded requirements)
% of original CET requirements



Source: Copenhagen Economics (see Appendix A for a detailed explanation of data sources and methodology).

[23] Compared to when the exemption only applied to residential real estate.

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APPENDIX A

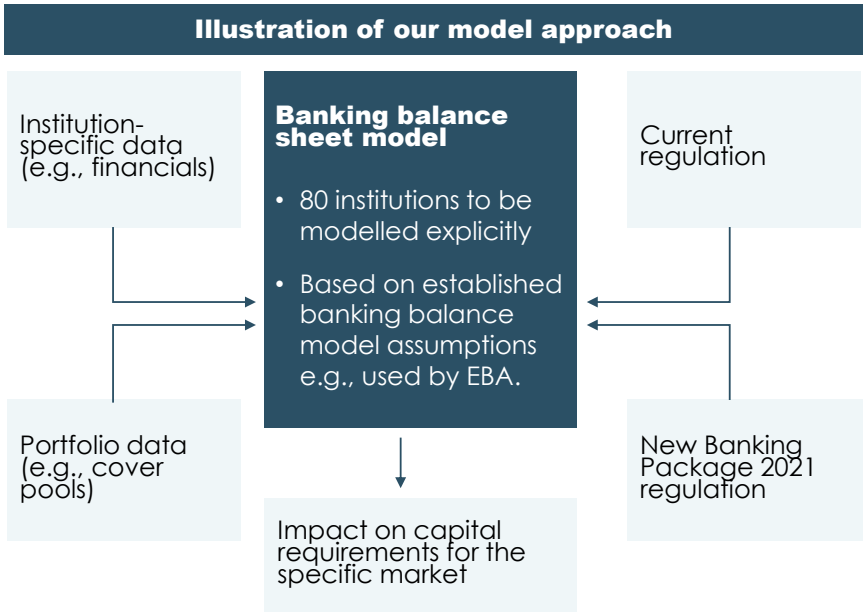
CAPITAL REQUIREMENT ESTIMATION: METHODOLOGY AND ASSUMPTIONS

In the following, we present our methodology when calculating the impact on capital requirements and the assumptions behind it. Our approach contains four steps:

1) First, we set up a model based on current and future regulation as it is today under the CRR2 and how it will be under Banking Package 2021.
2) Second, we gather data for all markets, as detailed as possible. We gather institution-specific data from e.g., Pillar 3 reports and portfolio data from, e.g., cover pools. We focus on mortgage portfolios but also gather data for, e.g., the share of rated corporates to use in our output floor assessment. Where data are not available, we make assumptions based on country or EU average data.
3) Third, we estimate risk weights for the mortgage portfolio and other portfolios. Both current risk weights and risk weights under Banking Package 2021 are based on the regulation and gathered data from Steps 1 and 2, respectively.
4) Fourth, we make an output floor assessment. We assess whether the output floor is binding at a group level, taking all portfolios, not only mortgage portfolios, into account. Having assessed whether the output floor is binding or not, we know which risk weights will apply to the mortgage portfolios on an institutional level under Banking Package 2021 and can thereby calculate the change in capital requirements.

Figure 11 illustrates our model approach. In the following sections, we present each step in more detail.

Figure 11
Illustration of our model approach



Definitions throughout the Appendix

Whole-loan vs loan-splitting reporting

Some countries report LTV distributions for mortgages according to the **whole-loan approach**. This implies that, for a loan with an LTV of 80%, the entire loan mass would be reported in the corresponding LTV bucket. In this analysis, we need the LTV distributions according to the **loan-splitting approach**, as this is the main approach applied under Banking Package 2021. Loan splitting implies that a loan with an LTV of 80% would be distributed into different LTV buckets i.e., loan amounts with an LTV from 0-20% would be placed in the corresponding bucket and so on.

We calibrate the LTV distributions according to the whole-loan approach to the loan-splitting approach. Concretely, we assume a uniform distribution of the loan mass within each LTV bucket. For a loan with an LTV of 80% according to the whole-loan approach, we assume that most of the loan mass would have an LTV below 55% i.e., 55%/80%=69%, whereas the remaining 31% would have an LTV above 55%.

Value at origin vs current market value

Today, LTV ratios are calculated differently depending on the country. In some countries, LTVs are based on the **value at the origin** of the mortgage loan; here, the loan amount is divided by the value of the property at the time the mortgage loan is given. The value of the property is not updated, implying that increasing or decreasing housing prices will not affect the LTV ratio.

In other countries, LTV ratios are based on the **current market value** of the underlying collateral; here, the loan amount of the mortgage is divided by the current market value of the property,

implying that property values are continuously updated. This further implies that increasing or decreasing housing prices will affect the LTV ratio.

Some wording throughout the Appendix
We will use the following terms according to the following definitions:

- **Total corporate mortgage lending** includes the entire corporate segment, i.e., both corporates mortgage lending and corporate SMEs mortgage lending.
- **The weighted country average** is the weighted average of all observations with institution-specific data in the given country.
- **The weighted EU average** is the weighted average of all countries with country-specific data. Here, each country has a weight of 1, implying that e.g., Germany as a country (with 19 institutions) weighs as much as Denmark (with four institutions).
- **The main scenario** is the fully implemented Banking Package 2021, i.e., how it would look in 2033.

STEP 1: REGULATION IN BANKING PACKAGE 2021

In this section, we go through the regulation as it would be under the standardised approach in Banking Package 2021 for each portfolio included in the EBA transparency exercise. This includes credit portfolios and, e.g., market risk and operational risk. Note that all described regulation is based on the loan-splitting approach, i.e., we do not go through how the regulation would look if the whole-loan approach were applied instead.

Household mortgages

Main scenario
Household mortgages are defined as retail exposure with a counterparty risk weight of 75% for exposures with an LTV above 55%. For exposures with an LTV below 55%, the risk weight for exposures secured by residential real estate is 20%. We assume that 100% of the mortgage exposures to households are for residential property.

Transitional arrangement for residential real estate
The European Commission has proposed an exemption for exposures with residential real estate collateral. In this scenario, we assume that the exemption is made permanent. Exposures with residential real estate collateral would under the exemption receive lower risk weights:

- A risk weight of 10% for the part of the exposure with an LTV below 55%.
- A risk weight of 45% for the part of the exposure with an LTV between 55-80%.
- Standard counterparty risk weight of 75% for exposures with an LTV above 80%.

Corporates

Main scenario
Corporates will receive different risk weights depending on whether they are rated or not and whether they are secured by real estate collateral or not.

For corporate mortgage lending, loan amounts with an LTV above 55% will receive a counterparty risk weight, i.e., equal to unsecured loans. Loan amounts with an LTV below 55% will be defined as being secured by real estate under the loan-splitting approach, receiving preferential risk weights. The risk weight depends on whether the mortgage is secured by residential or commercial property. For mortgage loans secured by residential real estate, a risk weight of 20% is applied. For mortgage loans secured by commercial real estate, a risk weight of 60% is applied.

For corporate exposures with an external rating from, e.g., Fitch, Standard & Poor's or Moody's, more preferential risk weights apply (depending on the credit rating):

- Credit quality step 1: Risk weight of 20%.
- Credit quality step 2: Risk weight of 50%.
- Credit quality step 3: Risk weight of 75%.
- Credit quality step 4: Risk weight of 100%.
- Credit quality step 5: Risk weight of 150%.
- Credit quality step 6: Risk weight of 150%.

Corporate exposures that are both unrated and unsecured will be assigned a standard risk weight of 100%.

Transitional arrangement for residential real estate
Assuming that the exemption is made permanent, corporate mortgage lending secured by residential real estate collateral would receive lower risk weights, similar to household mortgages:

- A risk weight of 10% for the exposure with an LTV below 55%.
- A risk weight of 45% for the exposure with an LTV between 55-80%.

SMEs

Main scenario
SMEs receive different risk weights depending on whether they are secured by real estate collateral or not and the size of the exposure amount the institution has for a given SME.

For SME mortgage lending, loan amounts with an LTV above 55% will receive a counterparty risk weight equal to that of unsecured loans. Loan amounts with an LTV below 55% will be defined as being secured by real estate under the loan-splitting approach, receiving preferential risk weights. For mortgage loans secured by residential real estate, a risk weight of 20% is applied. For mortgage loans secured by commercial real estate, a risk weight of 60% is applied.

For SME loan amounts above EUR 2.5 million, an SME supporting factor of 85% is applied, also to exposures secured by real estate. For SME loan amounts below EUR 2.5 million, the special CRR2 SME supporting factor of 76.19% is applied, also to exposures secured by real estate.

Transitional arrangement for residential real estate
SME mortgage lending secured by residential real estate collateral would, assuming that the exemption is made permanent, receive lower risk weights, similar to household mortgages. Again, the different SME discounts would apply:

- A risk weight of 10% for the exposure with an LTV below 55%.
- A risk weight of 45% for the exposure with an LTV between 55-80%.

Other: Market risk, operational risk, institutions, etc.

Market risk, operational risk and CVA
For non-asset exposures, we follow EBA's impact assessment 2020, by imposing the change in REA found on the respective portfolios.[24] Note that the impacts are reported as averages per country, i.e., not results at the institutional level.

Financial institutions
Based on Standard & Poor's data, we assume that 100% of financial institutions are rated. For each country, we apply a country-specific distribution of ratings, also based on the Standard & Poor's global database. Banking Package 2021 contains six different credit quality steps, implying that exposures will receive different risk weights depending on the rating of the financial institutions to which a given credit institution has exposures:

- Credit quality step 1: Risk weight of 20%.
- Credit quality step 2: Risk weight of 30%.
- Credit quality step 3: Risk weight of 50%.
- Credit quality step 4: Risk weight of 100%.
- Credit quality step 5: Risk weight of 100%.
- Credit quality step 6: Risk weight of 150%.

Covered bonds
No changes to the standardised approach within this category have been made, implying that a risk weight of 10% is applied to all covered bond exposures.

SME retail
SME retail is defined under the general category "retail exposures." Under the standardised approach, the counterparty risk weight is 75%. In addition, SME retail will get an SME discount of 76.19%, as by definition the loan amount cannot exceed EUR 1 million within this category.

Public institutions
Central banks and central governments will receive a risk weight of 0% under the new standardised approach. As most IRB exposures today are for central banks and governments, we assume a risk weight of 0% for all exposures in this category.

Equity
We assume that all equity exposures get an average risk weight of 250% under the new standardised approach.

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24 EBA (2020b).

Household others

Household others are defined under the general category "retail exposures." Under the standardised approach, the counterparty risk weight is 75%.

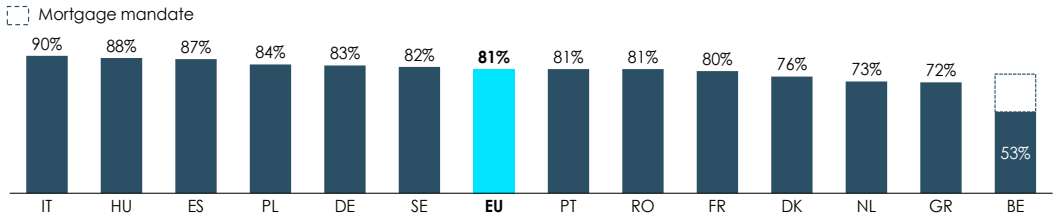
STEP 2: DATA AND ASSUMPTIONS – COUNTRY SPECIFIC

In the following section, we present the data points and assumptions for each country included in our analysis, focusing on the mortgage portfolio. However, we also pay attention to the assumed distribution of rated corporates and financial institutions.

As indicated in Step 1, one of the key parameters for the standardised approach in Banking Package 2021 (also for floored IRB risk weights, when the output floor is binding) is LTV ratios. Particularly, the share of the total exposure for mortgages with an LTV below 55%, as this share will get preferential risk weights.

For household mortgages, we find that around 81% of exposure amounts will have an LTV below 55% for the EU average; cf. Figure 12.

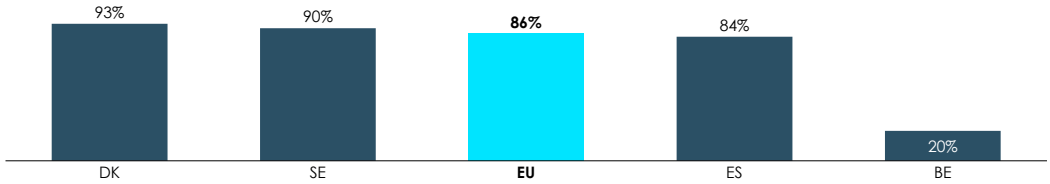
Figure 12
Share of exposure amount for household mortgages with LTV<55%
% of total household mortgage exposure amount



Note: If the mortgage mandate in Belgium does not count as collateral under the output floor and the standardised approach, we find that only 53% of exposures for household mortgages will be subject to the preferential risk weight applied to exposure amounts with an LTV below 55%.
Source: Copenhagen Economics, based on data sources per country as described below

For total corporate mortgage lending, we find that around 86% of exposure amounts will have an LTV below 55% for the EU average; cf. Figure 13.

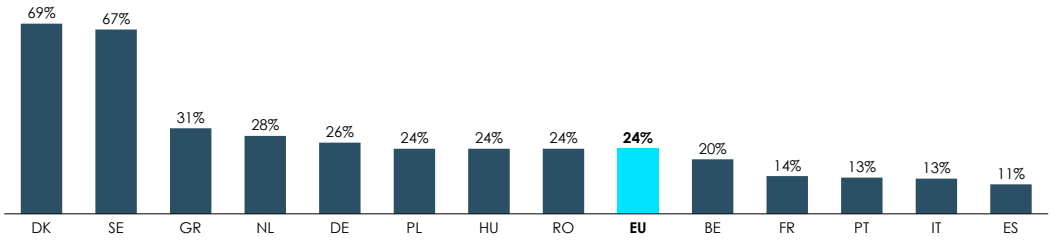
Figure 13
Share of exposure amount for total corporate mortgage lending with LTV<55%
% of total corporate mortgage exposure amount



Note: If the mortgage mandate in Belgium does not count as collateral under the output floor and the standardised approach, we find that only 20% of exposures for corporate mortgage lending will be subject to the preferential risk weight applied to exposure amounts with an LTV below 55%. Note that, in the EU average, we assume the mortgage mandate would still count as collateral, so we assume that 78% of exposure amounts would have an LTV below 55% instead of the 20% we find when the mortgage mandate does not count as collateral.
Source: Copenhagen Economics, based on data sources per country as described below.

Another important parameter is the share of total corporate exposures which consists of mortgage lending. When estimating the impact on the capital requirement for the EU mortgage portfolio, we only consider corporate exposures backed by mortgages, implying that we need to split up the corporate segment. The share of total corporate exposures that is mortgage lending varies significantly across countries; see Figure 14.

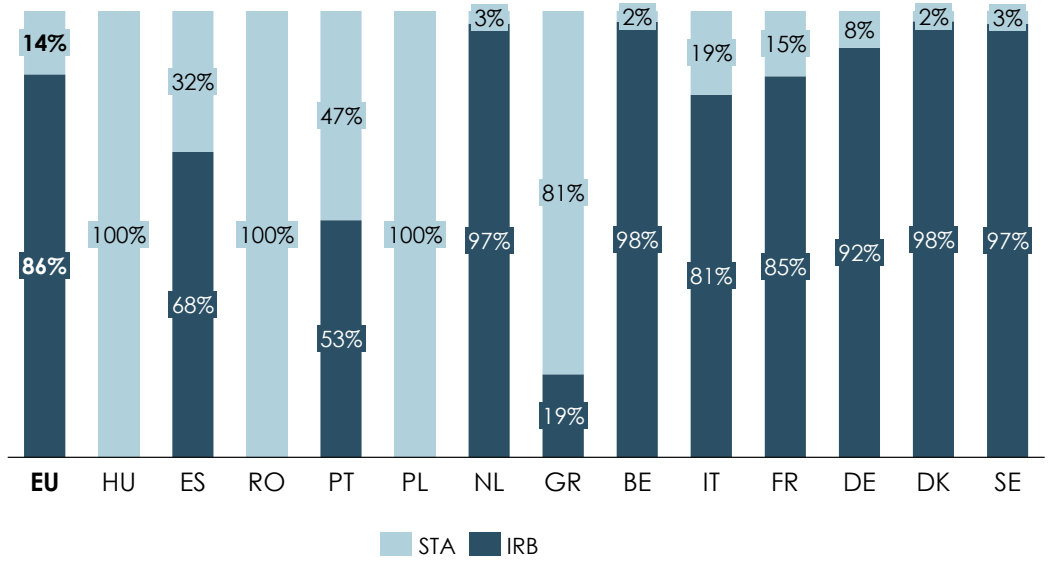
Figure 14
Share of total corporate exposures backed by mortgages
% of total corporate exposure amount



Source: Copenhagen Economics, based on data sources per country as described below.

Finally, the risk weight approach that is used today is important for the impact of Banking Package 2021. Whether the IRB approach or STA approach is more widespread varies significantly across countries. Figure 15 shows the share of mortgages based on the standardised approach and IRB approach by country. Countries like the Netherlands, Denmark, Belgium, and Sweden have close to 100% of their mortgage portfolios under the IRB approach, whereas countries like Hungary, Poland and Romania only use the standardised approach.

Figure 15
Share of STA/IRB institutions for the EU mortgage market
% of total mortgage market



Source: Copenhagen Economics (see Appendix A for a detailed explanation of data sources and methodology).

Country-specific assumptions behind risk weight estimations

In this section, we go through the different data points and assumptions behind our risk weight estimations for the mortgage portfolio for each country. For each country, we explain:

1) For **household mortgages**, how LTV ratios and the share of exposure amounts with an LTV below 55% are calculated. We also note any special cases.

2) For **total corporate mortgage lending**, how the mortgage lending share of total corporate exposures, LTV ratios, and the share of exposure amounts with an LTV below 55% are calculated and what we assume about the split of mortgage lending into residential versus commercial real estate.

3) For **corporates and financial institutions**, the assumed rating share and distribution of rated corporates and financial institutions. We base our assumptions on country specific data from S&P global database covering all external rated companies.

The Netherlands

1) For **household mortgages**, LTV distributions are based on the covered bond label database. Here, we have LTV distributions (reported according to the whole-loan approach) for

the cover pool for four out of six banks. We calibrate the distributions to the loan-splitting approach. Further, they are calibrated to a national average LTV ratio of 68% (based on European Systematic Risk Board (ESRB) data), because cover pool data do not capture the entire market. For the two remaining banks, we apply the weighted country average. The LTV distributions are reported using the current market value for the underlying collateral. We adjust the LTV ratios to be based on historical averages instead, in line with the European Commission's proposal, concretely for the last six years, assuming an increase in housing prices of 4% per year. The Netherlands has implemented a mortgage floor, artificially increasing initial IRB risk weights; we take this into account for household mortgages. A share of household mortgages is backed by NHG (a government fund), implying that they receive significantly lower risk weights. We assume the share to be 20% and the respective risk weight to be 0%.

2) For **total corporate mortgage lending**, LTV distributions are based on the weighted EU average, as no institution- or country-specific data are available for the Netherlands. For the share of mortgage lending out of total corporate exposures, we have institution-specific data for four out of six banks. The remaining two banks, where no institution-specific data are available, receive the weighted country average. We assume the split between corporate residential and corporate commercial real estate to be 50/50.

3) For the Netherlands, we find 100% of financial institutions to be rated while we assume 20% of corporate exposures to be rated. See the table below for the distribution of ratings.

CREDIT QUALITY STEP	CORPORATES	FINANCIAL INSTITUTIONS
1	4%	6%
2	32%	49%
3	23%	26%
4	38%	21%
5	3%	0%
6	0%	0%

Belgium

In Belgium, we find a large increase in capital requirements for most institutions, due to the EBA's interpretation that the Belgian-specific practise of mortgage mandates cannot be included as collateral in the LTV estimation behind the capital requirements.[25] Today mortgage portfolios are partially covered by a full mortgage registration and partially covered by a Belgian-specific practise of mortgage mandates. Today, the mortgage mandate is recognised as immovable property security under Belgian law. In addition, the EBA also confirms that to the extent that under Belgian law mortgage mandates – which are widely diffused in the Belgian market and are also largely standardised – are enforceable and need to be registered with a notary within 15 days, they are considered to meet the essential legal certainty criteria to be considered as eligible immovable property collateral. However, from a prudential perspective, a mortgage mandate is not recognised under the standardised approach (IRB risk weights are unaffected unless bounded by the output floor). The EBA concludes that since the mortgage mandate only ranks when the conversion to a mortgage is entered into the mortgage register, there could be prior liens established before the converted mortgage mandate takes rant.

Under the A-IRB approach, institutions can consider the potential inability to gain control of the collateral and liquidate it in their LGD estimates. The SA/F-IRB approach, however, neither foresees an appropriate haircut nor allows institutions to model this. It is therefore assumed that, under these approaches, the value of the property is fully reduced by a prior lien and, consequently, the value of the protection offered by a mortgage mandate is reduced to zero. Based on this, it is assumed that mortgage mandates cannot be included as collateral in the LTV estimation, even though the essential legal certainty criteria, to be considered as eligible immovable property collateral, are met. The lack of technical recognition of mortgage mandates in the prudential framework does not reflect the observed situation, where institutions in more than 99% of all cases can gain control of the collateral and liquidate it in practice.

1) For **household mortgages**, we assume 32% to be covered by the mortgage mandate. The share covered by the mortgage mandate will receive the higher counterparty risk weights instead of the preferential risk weights applied to exposures secured by immovable property. The LTV distributions for all institutions are based on an average distribution for the country as a whole. However, the first LTV bucket is from 0-80%, which is not granular enough, as we need the loan amount from 0-55%. Thus, we split it further by assuming a uniform distribution within each LTV bucket. Belgium has implemented a mortgage floor, artificially increasing initial IRB risk weights: We take this into account for household mortgages.

2) For **total corporate mortgage lending**, we assume the share covered by the mortgage mandate to be 74%. The LTV distributions are based on the same average distribution for the country as a whole as household mortgages, as it also includes corporate mortgage lending. For the share of mortgage lending out of total corporate exposures, we have institution-specific data for one out of five banks. The remaining four banks, where no institution-specific data are available, receive the same share as the one institution where data

[25] See EBA (2019) Q&A on Eligibility of mortgage mandates under Belgian law. The EBA's interpretation of the mortgage mandate not counting as collateral would impact corporate and SME mortgage lending to a higher extent compared to household mortgages. The reason is that, for corporate and SME mortgage lending, around 74% is covered by a mortgage mandate whereas this portion is around 32% of household mortgage lending. For full details of the estimation approach, please see Appendix A.

are available. We assume the split between corporate residential and corporate commercial real estate to be 50/50.

3) For Belgium, we find 100% of financial institutions to be rated while we assume 20% of corporate exposures to be rated. See the table below for the distribution of ratings.

CREDIT QUALITY STEP	CORPORATES	FINANCIAL INSTITUTIONS
1	0%	0%
2	58%	77%
3	27%	18%
4	15%	5%
5	0%	0%
6	0%	0%

Italy

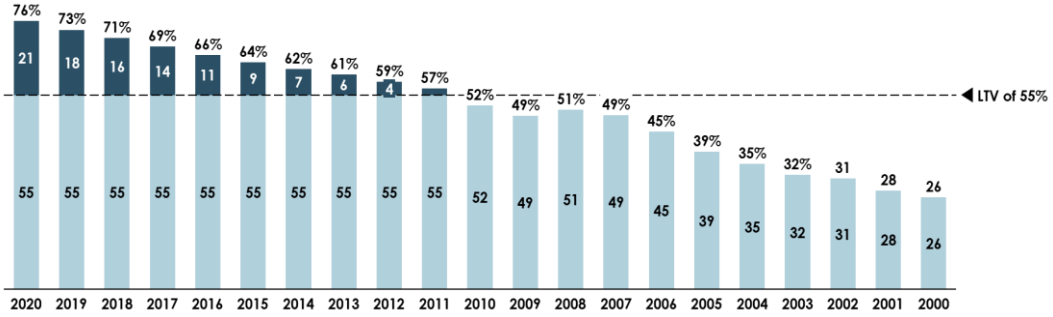
1) For **household mortgages**, LTV distributions are based on a country average of 76% for newly granted loans. We calibrate this to stock data via assumptions on the typical repayment profile. We assume the repayment time of the mortgages to be 20 years. Data for the interest rate are retrieved from Hypostat for all relevant years and assumed to be fixed throughout the years of repayment. Based on this, we calculate the initial amortisation rate, around 3.5% in recent years. No distribution around the average is available so, instead, we assume that all mortgages will have the average LTV in the given year. Thereby, we implicitly assume a uniform distribution. We adjust for lending growth, meaning that most recent loans receive a higher weight as they take up a larger share of the portfolio. See Figure 16.

2) For **total corporate mortgage lending**, the LTV distributions are based on the weighted EU average, as no institution- or country-specific data are available for Italy. For the share of mortgage lending out of total corporate exposures, we have institution-specific data for six out of nine institutions. The remaining three institutions, where no institution-specific data are available, receive the weighted average of the six institutions. We assume the split between residential and commercial real estate to be 50/50.

3) For Italy, we find 100% of financial institutions to be rated while we assume 20% of corporate exposures to be rated. See the table below for the distribution of ratings.

CREDIT QUALITY STEP	CORPORATES	FINANCIAL INSTITUTIONS
1	0%	0%
2	9%	27%
3	41%	46%
4	48%	27%
5	2%	0%
6	0%	0%

Figure 16
Household mortgages, loan amount with LTV<55% based on typical Italian repayment profile
LTV ratio, stock data



Source: Copenhagen Economics, based on data sources.

Greece

1) For **household mortgages**, the LTV distributions are based on institution-specific data for all institutions from annual reports or Pillar 3 reports. The LTV ratios include all mortgages for most institutions and are thus not limited to covering household mortgages. We calibrate the distributions to the loan-splitting approach.

2) For **total corporate mortgage lending**, the LTV distributions are based on the weighted EU average distribution, as no institution- or country-specific data are available for Greece. For the share of mortgage lending out of total corporate exposures, we have institution-specific data for all institutions. We assume the split between residential and commercial real estate to be 50/50.

3) For Greece, we find 100% of financial institutions to be rated while we assume 20% of corporate exposures to be rated. See the table below for the distribution of ratings.

CREDIT QUALITY STEP	CORPORATES	FINANCIAL INSTITUTIONS
1	0%	0%
2	0%	0%
3	7%	0%
4	80%	100%
5	13%	0%
6	0%	0%

Spain

1) For **household mortgages**, the LTV distributions are based on institution-specific data for all institutions from annual reports or Pillar 3 reports. The LTV distributions are reported for different customer segments. We assume "households," a definition applied in the Spanish annual reports and Pillar 3 reports, to be equal to what we define as household mortgages. The LTV distributions are reported according to the whole-loan approach. We therefore calibrate the distributions to the loan-splitting approach.

2) For **corporate mortgage lending**, the LTV distributions are based on institution-specific data for all institutions from annual reports or Pillar 3 reports. The LTV distributions are reported for different customer segments. We assume "corporates," a definition applied in the Spanish annual reports and Pillar 3 reports, to be equal to what we define as total corporate mortgages. The LTV distributions are reported according to the whole-loan approach. We calibrate the distributions to the loan-splitting approach. For the share of mortgage lending out of total corporate exposures, we have institution-specific data for all institutions. We assume the split between residential and commercial real estate to be 50/50.

3) For Spain, we find 100% of financial institutions to be rated while we assume 20% of corporate exposures to be rated. See the table below for the distribution of ratings.

CREDIT QUALITY STEP	CORPORATES	FINANCIAL INSTITUTIONS
1	0%	0%
2	27%	41%
3	34%	26%
4	31%	27%
5	8%	6%
6	0%	0%

Poland

1) For **household mortgages**, the LTV distributions for all institutions are based on an average distribution for the country as a whole published by the Polish Financial Services Authority (FSA). The LTV distribution is based on mortgage loans in both Polish zloty (PLN) and foreign currency. We calibrate the distributions to the loan-splitting approach.

2) For **total corporate mortgage lending**, the LTV distributions are based on the weighted EU average, as no institution- or country-specific data are available for Poland. For the share of mortgage lending out of total corporate exposures, we have no institution-specific data on the share of mortgages out of total corporate exposures, implying that Polish institutions receive the weighted EU average. We assume the split between residential and commercial real estate to be 50/50.

3) For Poland, we find 100% of financial institutions to be rated while we assume 20% of corporate exposures to be rated. See the table below for the distribution of ratings.

CREDIT QUALITY STEP	CORPORATES	FINANCIAL INSTITUTIONS
1	0%	0%
2	43%	57%
3	21%	29%
4	36%	14%
5	0%	0%
6	0%	0%

Sweden

In Sweden, a so-called **mortgage floor** is currently imposed by the FSA. Here, risk weights for residential mortgages, both retail and corporate residential, are artificially increased to 25%. For commercial mortgages, risk weights are increased to 35%. This implies that risk weights today for IRB banks are significantly higher than the outcome of the institutions' internal models. Implementing the European Commission's proposal in Sweden, we assume that the mortgage floor would still serve as a backstop, implying risk weights cannot fall below the current imposed levels, entailing a *de facto* decline in capital requirements for household mortgages.

1) For **household mortgages**, the LTV distributions are based on institution-specific data for four out of five institutions. The remaining institution receives the weighted average of the four institutions. The LTV distributions are reported using the current market value for the underlying collateral. We adjust the LTV ratios to be based on historical averages instead, in line with the European Commission's proposal, concretely for the last six years.

2) For **total corporate mortgage lending**, the LTV distributions are based on institution-specific data for two out of five institutions. In addition, we have a country-specific LTV distribution, which is used for the remaining three institutions. We do not adjust the LTV

distribution for commercial mortgages to be based on historical averages (the last three years) instead of current market values, as prices have been declining. For the share of mortgage lending out of total corporate exposures, we have institution-specific data for four out of five institutions. The remaining institution receives the weighted average of these. Based on inputs from the institutions, we assume 56% of corporate mortgages to be commercial and 44% to be residential. For corporate SMEs, we assume 36% to be commercial and 64% to be residential.

3) For Sweden, we find 100% of financial institutions to be rated while we assume around 9% of corporate exposures to be rated. See the table below for the distribution of ratings.

CREDIT QUALITY STEP	CORPORATES	FINANCIAL INSTITUTIONS
1	0%	0%
2	42%	90%
3	20%	0%
4	37%	10%
5	1%	0%
6	0%	0%

Denmark

1) For **household mortgages**, the LTV distributions are based on institution-specific data for three out of four banks. The remaining institution receives the weighted average of the three banks. The LTV distributions are reported using the current market value for the underlying collateral. We adjust the LTV ratios to be based on historical averages instead, in line with the European Commission's proposal, concretely for the last six years. For the Danish Bank, Danske Bank A/S, we adjust the initial risk weights for household mortgages by adding some extra REA that the institution is required to hold due to its operations in Sweden, where mortgage floors are in place. Initial household mortgage risk weights are thereby artificially increased, however, fairly limited for this institution.

2) For **total corporate mortgage lending**, the LTV distributions are based on institution-specific data for three out of four institutions. The remaining institution receives the weighted average of the three institutions. For the share of mortgage lending out of total corporate exposures, we have institution-specific data for three out of four banks. In addition, we have a country-specific share, which the remaining institution receives. A share of corporate mortgage lending for social housing is state-guaranteed and receives a risk weight of 0%. We assume this to be around 10% of the corporate mortgage portfolio, which does not apply to corporate SMEs. Of the remaining corporate mortgages, we assume 51% of total corporate mortgages to be commercial and 49% to be residential. For SME corporates, we assume the same split into commercial and residential real estate.

3) For Denmark, we find 100% of financial institutions to be rated while we assume 0% of corporate exposures to be rated. See the table below for the distribution of ratings.

CREDIT QUALITY STEP	CORPORATES	FINANCIAL INSTITUTIONS
1	0%	6%
2	0%	76%
3	0%	18%
4	0%	0%
5	0%	0%
6	0%	0%

Germany

Note, that in the EBA transparency exercise, on which our estimates are based, only 8% of the German mortgage exposures are on the standardised approach. The actual share of standardised approach lenders is likely significantly higher. Results should be interpreted with this in mind.

1) For **household mortgages**, the LTV distributions are based on a country average of 80% for newly granted loans. We calibrate this to stock data via assumptions about the repayment profile. We assume the mortgage repayment time to be 17 years. Data for the interest rate are retrieved from Hypostat for all relevant years and assumed to be fixed throughout the years of repayment. Based on this, we calculate the initial amortisation rate, around 3% in recent years. For now, no distribution around the average is available. Instead, we assume that all mortgages will have the average LTV in the given year. Thereby, we implicitly assume a uniform distribution. We adjust for lending growth, meaning that most recent loans receive a higher weight, as they take up a larger share of the portfolio. See Figure 17.

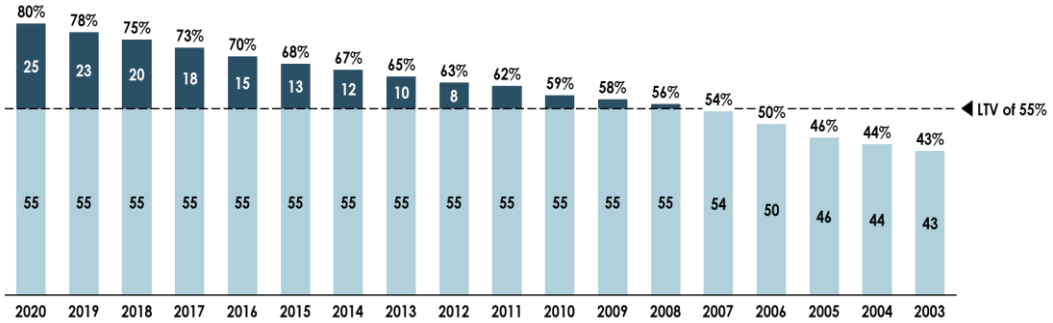
2) For **total corporate mortgage lending**, the LTV distributions are based on the EU average, as we assess that available information on LTVs for corporate mortgage lending is not representative of the stock of outstanding loans in Germany. We assume the split between residential and commercial real estate to be 35/65 based on an average of newly granted mortgage loans to corporates for the last 10 years. [26]

3) For Germany, we find 100% of financial institutions to be rated while we assume 20% of corporate exposures to be rated. See the table below for the distribution of ratings.

[26] Based on research from the IREBS (International Real Estate Business School – Universität Regensburg) and the German Debt Project 2021 – Corona edition 2: Back to business.

CREDIT QUALITY STEP	CORPORATES	FINANCIAL INSTITUTIONS
1	1%	1%
2	89%	97%
3	4%	1%
4	6%	1%
5	0%	0%
6	0%	0%

Figure 17
Loan amount with LTV below 55% based on typical German repayment profile (stock data)
LTV ratio



Source: Copenhagen Economics, based on data sources.

France

1) For household mortgages, the LTV distributions for all institutions are based on an average distribution for the country as a whole, published by Banque de France. This distribution includes both primary residence and other property assets. We calibrate the distribution to the loan-splitting approach.

2) For corporate mortgage lending, the LTV distributions are based on the weighted EU average, as no institution- or country-specific data are available for France. For the share of mortgage lending out of total corporate exposures, we have institution-specific data for five out of 11 institutions on the share of mortgages out of total corporate exposures. The remaining six institutions, for which no institution-specific data are available, receive the weighted average of the five banks. We assume the split between residential and commercial real estate to be 50/50.

3) For France, we find 100% of financial institutions to be rated while we assume 20% of corporate exposures to be rated. See the table below for the distribution of ratings.

CREDIT QUALITY STEP	CORPORATES	FINANCIAL INSTITUTIONS
1	0%	0%
2	50%	76%
3	19%	10%
4	29%	13%
5	2%	1%
6	0%	0%

Portugal

1) For **household mortgages**, the LTV distributions are based on the EU average distribution, implying the loan amount with an LTV below 55% is the weighted average of all institutions in the study for which we have data.

2) For **total corporate mortgage lending**, the LTV distributions are based on the weighted EU average, as no institution- or country-specific data are available for Portugal. For the share of mortgage lending out of total corporate exposures, we have no institution- or country-specific data on the share of mortgages out of total corporate exposures, implying that Portugal receives the weighted EU average. We assume the split between residential and commercial real estate to be 50/50.

3) For Portugal, we find 100% of financial institutions to be rated while we assume 20% of corporate exposures to be rated. See the table below for the distribution of ratings.

CREDIT QUALITY STEP	CORPORATES	FINANCIAL INSTITUTIONS
1	0%	0%
2	0%	0%
3	67%	50%
4	33%	50%
5	0%	0%
6	0%	0%

Romania

1) For **household mortgages**, the LTV distributions are based on the EU average distribution, implying that the loan amount with an LTV below 55% is the weighted average of all institutions in the study for which we have data.

2) For **total corporate mortgage lending**, the LTV distributions are based on the weighted EU average, as no institution- or country-specific data are available for Romania. For the share of mortgage lending out of total corporate exposures, we have no institution-

or country-specific data, implying that Romania receives the weighted EU average. We assume the split between residential and commercial real estate to be 50/50.

3) For Romania, we find 100% of financial institutions to be rated while we assume 20% of corporate exposures to be rated. See the table below for the distribution of ratings.

CREDIT QUALITY STEP	CORPORATES	FINANCIAL INSTITUTIONS
1	0%	1%
2	0%	49%
3	33%	25%
4	67%	24%
5	0%	1%
6	0%	0%

Hungary

1) For **household mortgages**, the LTV distributions are based on information provided by the institution included in the EBA transparency exercise, i.e., we have institution-specific information.

2) For **total corporate mortgage lending**, the LTV distributions are based on information provided by the institution in an interview. For the share of mortgage lending out of total corporate exposures, we have no institution- or country-specific data, implying that Hungary receives the weighted EU average. We assume the split between residential and commercial real estate to be 50/50.

3) For Hungary, we find 100% of financial institutions to be rated while we assume 20% of corporate exposures to be rated. See the table below for the distribution of ratings.

CREDIT QUALITY STEP	CORPORATES	FINANCIAL INSTITUTIONS
1	0%	0%
2	0%	0%
3	71%	75%
4	29%	25%
5	0%	0%
6	0%	0%

STEP 3: ESTIMATION OF RISK WEIGHTS FOR THE MORTGAGE PORTFOLIO

To estimate the impact on capital requirements, we need both the starting point, i.e., the initial risk weights, and the endpoint. From the EBA transparency exercise, initial risk weights for the household mortgage portfolio can easily be deducted. For corporate and SME mortgage lending, we must estimate the initial risk weights ourselves, as these portfolios are part of the bigger portfolios for total corporate and SME lending, including unsecured lending.

In the following sections, we go through our methodology and assumptions behind the initial risk weights for corporate and SME mortgage lending on the standardised and internal rating-based approaches, respectively. Then, we explain the estimated risk weights after the implementation of Banking Package 2021 for all mortgage portfolios.

Starting risk weights for corporate and SME mortgage portfolios under the standardised approach

We follow the **current regulation** for the standardised approach.[27] Here, the loan mass for residential real estate with an LTV below 80% is assigned a risk weight of 35%, whereas the loan mass for commercial real estate with an LTV below 50% is assigned a risk weight of 50%. The loan mass above the LTV thresholds is assigned a counterparty risk weight. The SME discount applies to all exposures.

By **national discretion**, some countries require institutions to apply higher standardised risk weights for mortgages than stated in the regulation. Sweden and Romania apply a risk weight of 100% to commercial mortgages. For each institution we **calibrate** the calculated risk weights by mortgages in real estate and other exposures, based on the current regulation, so that the overall risk weight for each of the corporate portfolios (corporates, excluding SME corporates and SME corporates) matches that inferred from the EBA transparency exercise.

Starting risk weights for corporate mortgage portfolios on the IRB approach

Key parameters are the generic **LGD** and the institution-specific **PD**.[28] The LGD is assumed to be smaller for mortgages in real estate (10%) than other exposures (25%) based on input floors following the current CRR2[29], whereas the institution-specific PD is equivalent across exposure classes.

27 Cf. Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 and Regulation (EU) 2019/876 of the European Parliament and of the Council of 20 May 2019.

28 Cf. Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013.

29 Regulation (EU) 2019/876 of the European Parliament and of the Council of 20 May 2019.

For each institution we **calibrate** the calculated risk weights by mortgages in real estate and other exposures so that the overall risk weight for each of the corporate portfolios (corporates excluding SME corporates and SME corporates) matches that inferred from the EBA transparency exercise.

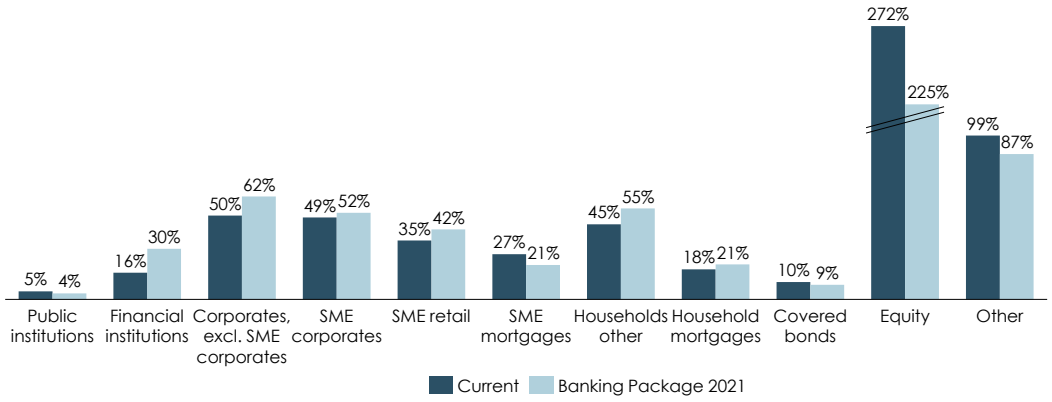
STEP 4: OUTPUT FLOOR ASSESSMENT

For each of the 80 institutions in the EBA transparency exercise, we assess whether the output floor is binding. In doing so, we follow three steps:

1) We implement measures in Banking Package 2021 not related to output floor and assess change to REA.
2) We estimate capital requirements under the output floor (including P2R buffer constant) for the entire portfolio incl. unsecured lending, market risk, operational risk, etc.
3) If larger than unfloored capital requirements – the institution is bound and "output floor RWs" are applied to the mortgage portfolio.

Figure 18 shows current average risk weights for the EU, including exposures under both the standard and the IRB approaches, and what risk weights will be under Banking Package 2021, including exposures under the IRB approach, both bound and not bound, by the output floor and exposures under the standardised approach.

Figure 18
Current average RWs and RWs under the Final Basel III for the total EU banking market



Source: Copenhagen Economics based on the EBA transparency exercise.

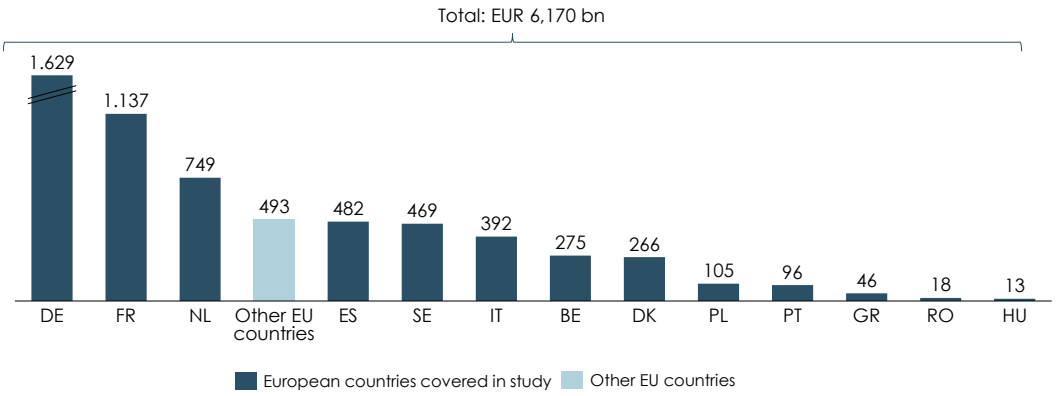
Finally, having assessed whether the output floor is binding or not, we can estimate what the actual risk weights for the different mortgage portfolios will be under Banking Package 2021. We translate these increases or decreases into changes in capital requirements, according to the main report.

APPENDIX B

BANKS COVERED BY EBA TRANSPARENCY EXERCISE 2020

The data sample included in our analysis covers 93% of the EU residential mortgage market based on country samples, according to Hypostat 2021, see Figure 19:

Figure 19
Total outstanding residential mortgage loans
EUR billion



Note: Based on total outstanding residential loans.
Source: EMF (2021), Hypostat, p. 149.

Concretely, in our analysis, we include the following institutions for which data are available in the EBA transparency exercise:

Table 1
Banks included in study

GERMANY	FRANCE	ITALY	SPAIN	THE NETH-ERLANDS	BELGIUM
Aareal Bank AG	BNP Paribas	Banca Popo-lare di Sondrio	Abanca	ABN AMRO	AXA
apoBank	Bpifrance	Banco BPM	BBVA	BNG Bank	Argenta
Bayern LB	Crédit Agricole	Cassa Centrale Banca	Banco Sabadell	De Volksbank	Belfius
Commerzbank	Crédit Mutuel	Credito Emili-ano	Bankinter	ING	BNY Mellon
DekaBank	CRH	Iccrea Banca	BCC	NWB Bank	KBC
Deutsche Bank	Groupe BPCE	Intesa Sanpao-lo	CaixaBank	Rabobank	
DZ Bank	HSBC France	Mediobanca	Grupo Santan-der		
Hamburg Com-mercial Bank	La Banque Postale	MPS	Ibercaja		
HASPA Finan-zholding	RCI	UniCredit	Kutxabank		
Helaba	SFIL		Unicaja Banco		
J.P. Morgan AG	Societe Generale				
LBBW					
MünchenerHyp					
NordLB					
PBB					
S-Finanzgruppe					
State Street					
UBS Europe SE					
Volkswagen Bank GmbH					

Source: Copenhagen Economics, based on the EBA transparency exercise.

Table 2
Banks included in study (cont.)

DENMARK	SWEDEN	POLAND	PORTU-GAL	ROMANIA	GREECE	HUNGARY
Danske Bank A/S	Handels-banken	Bank Pekao	CGD	Banca Transilvania	Alpha Bank	OTP-csoport
Jyske Bank A/S	Länsförsäkrin-gar	Bank Polski	LSF		Eurobank	
Nykredit Realkredit A/S	SBAB		Millennium BCP		NBG	
Sydbank A/S	SEB				Piraeus Bank	
	Swedbank					

Source: Copenhagen Economics, based on the EBA transparency exercise.