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# THE IMPACT OF THE OUTPUT FLOOR IN THE FINAL BASEL III PACKAGE

## How it can be implemented and what it entails for the Danish economy

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# PREFACE

The Final Basel III Standard from December 2017 sets out revised international standards for banking regulation. The package is now about to be implemented in the EU, and the European Commission is expected to publish a proposal this summer.

In preparation for the implementation, different options for implementing the package have recently been put forward. In light of this and our previous research, Finance Denmark has asked Copenhagen Economics to analyse the impact of the different options on the Danish banking sector and the real-economy.

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# EXECUTIVE SUMMARY

The Final Basel III Standard introduces the concept of an output floor, which has an impact on the minimum level of capital that banks are required to hold for each type of asset. The motivation behind the output floor is to create a backstop for excessively too low modelled capital requirements compared to a realistic assessment of risks, and to enhance comparability between banks.

The impact of the Final Basel III Standard and the output floor will very much depend on how it is implemented. Two main options for implementing the output floor are currently being discussed:

1) The *single stack approach*, where the output floor is applied to all capital requirements – including the EU specific – as suggested by the European Banking Authority (EBA).
2) The *parallel stack approach*, where the output floor is only applied to international agreed capital requirements.

## The single stack approach will push capital requirements above underlying risks with a negative impact on the real-economy

Implemented as a single stack approach, the output floor will de facto entail a significant increase in capital requirements for low-risk assets. On average in EU, capital requirements would increase between 13%-19%. Denmark would be one of the most affected countries, with an increase in capital requirements of between 29%-36%.

The increase in capital requirements is particularly pronounced for unrated corporates. Unrated corporates will all be subject to the same capital requirements, no matter the underlying risk. This means, for example, that a large international unrated corporate, with decades without default, will have higher capital requirements than a newly opened webshop.

As banks' internal models in Europe have on average been shown in a number of international studies to reflect well the level of risk – and to not be biased towards too low capital requirements compared to actual defaults and losses – we assess that the package will push capital requirements away from underlying risks.

## Higher capital requirements will increase borrowing costs for banking customers

In time, we expect that, the increase in capital requirements for low-risk assets will translate into higher borrowing costs for end-customers as capital is a more expensive source of funding (compared to debt). In total, we estimate that annual borrowing costs for Danish banking customers will increase by some DKK 13 bn (EUR 1.7 bn) in EBA's main implementation scenario.

Exactly how this will translate into higher costs for different customers depends on the pricing strategy within different banks as well as the local competitive situation.

In our price model estimation, we find that corporates (including lending secured by real estate) would be the customer group with the largest increase in borrowing costs, with an increase of around 0.3-0.4 percentage points on average. Some large corporates are likely to respond to the above-described hike in financing costs and look for funding elsewhere, e.g. on corporate bond markets. Smaller companies will have fewer options for alternative ways of financing and will have to accept the higher borrowing costs.

For retail mortgage customers, we find an average increase in borrowing costs of around 0.1 percentage points in our main scenario. For a typical new Danish homeowner, this corresponds to increased cost of DKK 1,600-2,200 (EUR 215 - 290) per year, depending on the loan-to-value ratio. For banks using the so-called loan-splitting approach, there is a risk that borrowing costs could increase up to twice as much, i.e. up to DKK 3,800 (EUR 510), depending on the concrete implementation.

## Increased borrowing costs will reduce investments and GDP

As a consequence of increased costs of borrowing for business customers, we expect investments in the Danish economy to be reduced. This will eventually impact productivity and GDP. Using a model framework similar to what was used as analytical foundation behind the original Basel III package, we estimate that the Danish GDP will permanently be reduced by between 0.6%-1%, depending on the extent to which buffers are fully replenished. This corresponds to around DKK 15-23 bn (EUR 2-3 bn). Put in other words, every year, Danish GDP will be DKK 15-23 bn lower than it would have otherwise been.

At the same time, we find little benefit of the higher capital requirements in EBA's suggested approach for the Danish economy as a whole. The already implemented post-crisis banking reform has increased capitalisation of the Danish banking sector to a point where additional increases do have a very limited ability to reduce the risk of a new financial crisis. In total, this means that we find net social costs of the single stack approach of corresponding to around 0.6%-0.9% of GDP, i.e. the proposal will reduce Danish welfare overall as the costs of lower investments and productivity exceeds marginal gains to economic stability.

## The parallel stacks approach keeps risk sensitivity of capital requirements

There is another interpretation of the Final Basel III agreement, where the output floor applies as a separate requirement which only includes capital requirements from the original Basel III package. This approach is dubbed the *parallel stacks* approach.

Our assessment is that the approach is more consistent with economic considerations as well as the original spirit behind the Final Basel III Standard, as it would:

- Largely keep the link between capital requirements and underlying risks for assets, letting the output floor work as a backstop only for excessively low modelled risks.
- Lead to a smaller but still significant impact on capital requirements (around 15% increase in Denmark), with resulting smaller impact on borrowing costs.
- Be closer to the impact on a global level, e.g. as in the Americas where capital requirements are expected to increase around 1%-2%.

- Bring the impact more in line with the original G20 mandate, which stated that the Basel III framework should be completed "*without further significantly increasing overall capital requirements across the banking sector*". Thus, aligned with the fact that international studies, including by EBA, show that the internal models used by the banks in scope are not too optimistic.

This underlines that imposing fixed global international standards on banks with highly different structures can reduce economic welfare. Hence, Denmark as well as the EU, would be best served with an implementation that reflects this variation hereby adhering to the original aim of the Basel proposals.

CHAPTER 1

# IMPACT ON THE BANKING SECTOR, INCLUDING LOSS OF RISK SENSITIVITY

In December 2017, the Basel Committee agreed on a new regulatory framework to address identified shortcomings of the original Basel III agreement denoted the 'Final Basel III Standard'. In a European context, the European Commission has asked the European Banking Authority (EBA) for an impact assessment of its implementation in the EU. How the Final Basel III Standard is implemented in the EU will determine its effect on the European banking sector and the European economy.

This chapter provides an overview of how the Final Basel III Standard will impact the Danish and European banking sector, if the single stack approach, suggested by EBA, is followed (in chapter 3 we present the parallel stack approach). Sections 1.1 and 1.2 give a short introduction to the original Basel III framework that was agreed upon in 2010 and the finalisation of the Basel III standard that was agreed upon in 2017, respectively. Section 1.3 provides an overview of the impact of the Final Basel III Standard and describes in more detail one of the central aspects of the reform, the output floor. Section 1.4 concludes this chapter with a brief comparison of the European and the US banking markets.

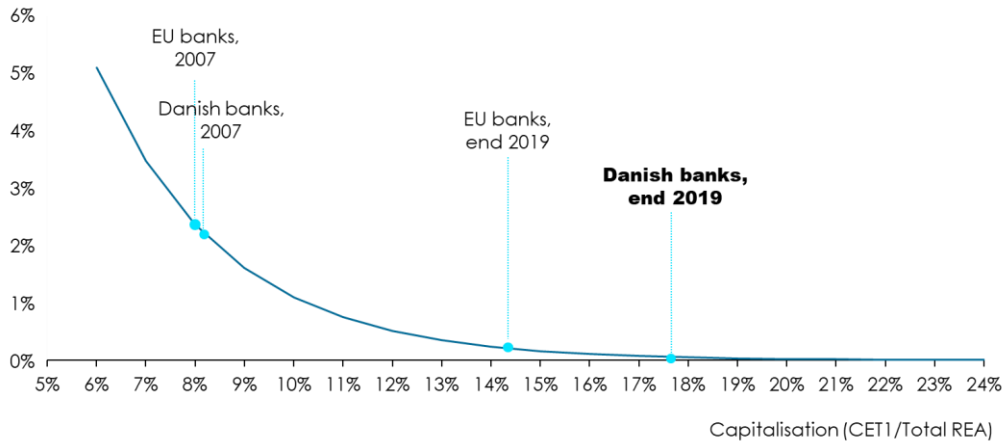
## 1.1 THE ORIGINAL BASEL III PACKAGE SIGNIFICANTLY INCREASED CAPITAL REQUIREMENTS

The third instalment of the Basel agreements, Basel III, was developed in response to the 2008 financial crisis with the objective of increasing resilience of the financial sector by increasing bank capital requirements[1] (i.e. the amount of equity banks have to hold).

The Basel III measures significantly reduced the risk of a financial crisis arising from insufficient capitalisation of the banking sector; average capitalisation in EU increased from around 8% in 2007 to close to 15%, see Figure 1. By 2019, the average capitalisation has reached around 18% for Danish banks.

[1] A capital requirement is the amount of equity that a bank is required to hold, based on the riskiness of its assets. This requirement is put in place to reduce/avoid systemic risk in the event of a crisis.

**Figure 1**
**Risk of a crisis in the EU given pre and post financial crisis capitalisation**
Risk of a crisis in a given year




Note: The figure shows the relationship between the level of capitalisation of banks (horizontal axis) and the probability of a financial crisis, in any given year. The higher the level of capital held by banks, the lower the probability of a financial crisis. The level of capitalisation is expressed as CET1 in % of un-floored Risk Exposure Amount (REA).
Source: BIS (2010), page 15 and own calculations; ECB(2007) and Danmarks Nationalbank (2008) for pre-crisis capital ratios .

## 1.2 THE FINAL BASEL III STANDARD SETS OUT NEW STANDARDS FOR BANK REGULATION

In December 2017, the Basel Committee agreed on a revised regulatory framework to finalise the post-crisis reforms denoted the 'Final Basel III Standard'.

The main objective of the framework is to ensure better alignment between banks' capital requirements based on their internal models and the banks' underlying risks. Most larger banks estimate a part of their capital requirements using internal models[2] that calculate the level of risk of the different assets the bank holds.[3]

Policy makers' key concern has been that the variation in the risk estimated by the internal models (and by that, variation in capital requirements) is not linked to corresponding variations in the underlying risks. In particularly, policy makers are concerned that modelled risks are underestimating actual risks. This would mean that banks might underestimate potential losses and therefore would not have enough capital to keep the financial system stable in a crisis.

To address this, the Basel Committee has suggested (among other measures)[4] the implementation of a so-called *output floor*, providing a minimum level of capital that a bank must hold (based on the banks' exposures), thus working as a back-stop for excessive low estimated risk.

2 Usually banks with an advanced risk model framework do so.
3 See Box 1 in Copenhagen Economics (2020) *Impact of The Final Basel III Framework in Sweden, Effects on the banking market and the real economy*, from now on abbreviated as "CE 2020".
4 See CE 2020 and Appendix A at the end of this study for more details.

Now, the package is in the hands of the European Commission, who will design its implementation. See Figure 2 for an overview of the timeline.

**Figure 2**
**Timeline of Final Basel III Standard: agreement and implementation**


Note: The start of the implementation depends on the duration of the negotiations with the European Parliament and the European Council.
Source: Illustration by Copenhagen Economics, based on publicly available information.

## 1.3 IMPACT ON THE BANKING SECTOR

As stated in the original G20 mandate, the purpose of the Final Basel III Standard is *not* to increase the overall level of capitalisation of the banking sector.

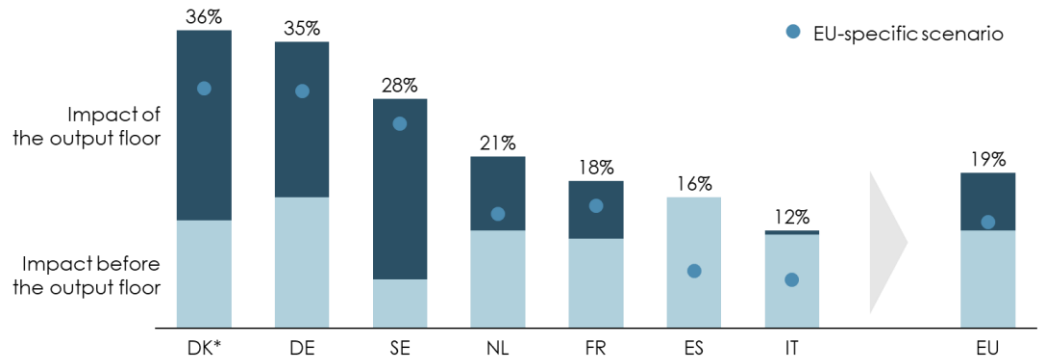
> *We confirm our support for the Basel Committee on Banking Supervision's (BCBS) work to finalise the Basel III framework without further significantly increasing overall capital requirements across the banking sector, while promoting a level playing field.*

Source: G20 Communique, March 18th, 2017

However, if the implementation follows the single stack approach, given the structure of the European financial as well as corporate sector, the package could lead to a significant increase in the level of capitalisation, of around 13%-19%, see Figure 3.[5]

[5] The impact is expected to be lower if the Final Basel III Framework will be implemented in a way that is somewhat more tailored to the European banking sector. This is called the EU-specific scenario in EBA's impact assessment and would imply an average increase in capital requirements of around 13% in the EU. Such an implementation of the framework would keep the SME supporting factor that implies a discount on risk-weighted assets for certain exposures to SMEs, would allow a supervisory discretion that would reduce the impact of the framework on operational risk and would keep the exemptions for the credit valuation adjustment risk that are currently in place in the EU.

**Figure 3**
**Increase in capital requirements following the Final Basel III Standard**
% of original capital requirements




Note: * The impact for Denmark has been underestimated in the most recent EBA study due to an error in the reported data. We therefore calibrate our model to the Danish FSA's corrected calculation which estimates an increase in risk exposure of Danish banks of around 36% and 29% for the Basel III scenario and the EU-specific scenario, respectively.
Source: EBA (2020) and own calculations.

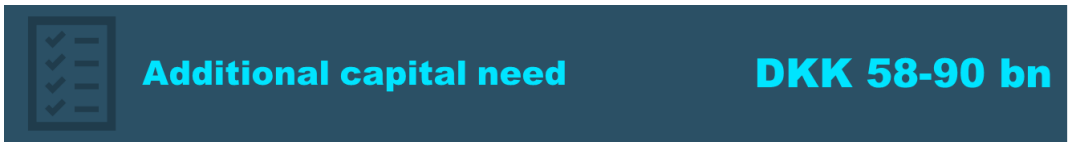
In some EU countries, the impact would be larger. In Denmark, the package can lead to a potential increase in banks' capital requirements of around 29%-36%, which corresponds to Danish banks having to raise additional CET1 capital of up to DKK 90 bn (EUR 12 bn).[6] This is our main scenario.

However, banks might not need to fully replenish their current CET1 ratios, which would result in a lower additional capital need. This could be due to banks' anticipation of the reform or supervisory action:

- Banks might already have started to increase capitalisation in preparation for the reform. In that case, banks could still satisfy market expectations by keeping their current market buffers (the buffer banks hold on top of minimum capital requirements) in absolute values, i.e. not increasing them according to the increase in risk exposure after the reform. The additional capital need would then amount to around DKK 70 bn (EUR 9.5 bn).
- If supervisory authorities adjusted, for instance, the so-called Pillar 2 requirement (P2R) to prevent an increase in absolute values, the additional capital need would decrease to around DKK 77 bn (EUR 10.3 bn).

Taken together, keeping both the market buffer and the P2R at their current absolute levels would decrease the additional capital need to close to DKK 58 bn (EUR 7.7 bn). This is our alternative scenario and provides a lower bound for our estimates.

[6] We assume that Danish banks will sustain their current CET1 ratios and we therefore take the buffers that banks usually hold on top of the required capital into account. Thus, the number gives an estimate of the capital banks will actually have to raise after the reform. If we were not taking these buffers into account, the amount would correspond to around DKK 30 bn. In EBA's EU-specific scenario with full replenishment we estimate an additional capital need of around DKK 72 bn.




Thus, for Europe in general – and Denmark in particular – the single stack approach leads to a significant increase in overall capital requirements, i.e. arguably more than merely a backstop for excessively low modelled risk.

### 1.3.1 The output floor

One of the most impactful aspects of the Final Basel III Standard in several countries (including Denmark) is the output floor. With the objective of reducing variability in banks' risk-weighted assets, it effectively puts a lower bound of required capital for each type of asset.

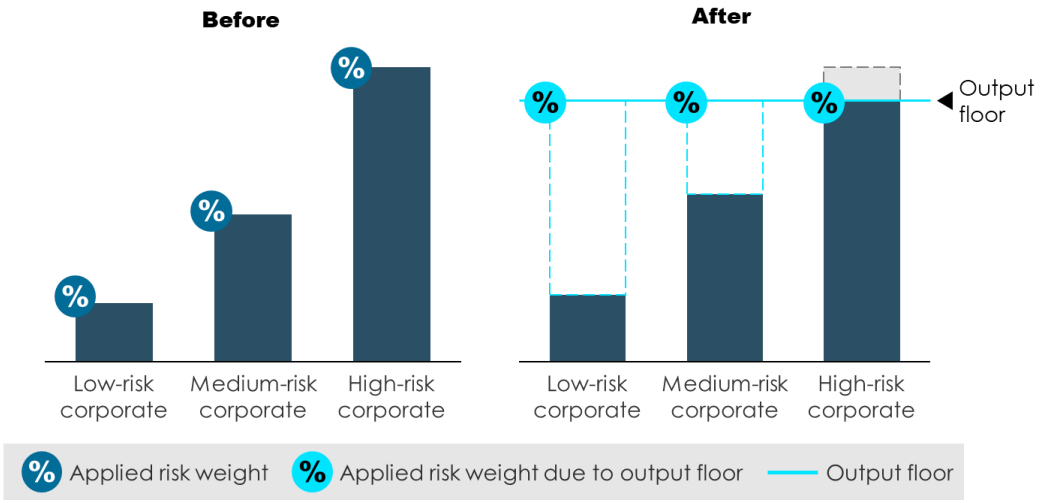
The required capitalisation of banks is not only determined by the total amount of exposures but also by the level of risk of these exposures, so-called *risk weights*. For example, holding a EUR 10,000 unsecured corporate loan entails a larger risk than holding a EUR 10,000 government bond. The larger risk is reflected in higher level of capital banks have to hold against such a loan.

The level of risk of each exposure is identified by its risk weight. Risk weights are estimated using internal models by most large banks.[7] The estimation process and outcome is then reviewed and approved by the competent regulatory authority. The resulting risk weights are used to determine the banks risk-weighted assets, which determine the overall amount of capital banks must hold.

The output floor proposed in the Final Basel III Standard effectively incorporates a lower bound for the banks' risk-weighted assets in order to provide a back-stop for banks' internally modelled risk weights. In practice, this is equivalent to banks having to apply a minimum risk weight to each category of assets (e.g. rated corporate, SME retail or retail mortgage), instead of applying a risk weight to each asset based on the estimated risk of that asset using internal models, see Figure 4.

[7] For banks not using internal models, standardised risk weights are prescribed by the Final Basel III Framework.

**Figure 4**
**Illustration of application of output floor**
Estimated level of risk




Note: The figure above illustrates how the output floor would increase risk weights for certain assets. As an example, we show how risk-weights for low- and medium-risk corporates will increase, because the risk estimated by banks' models is lower than when the output floor is applied (and binding). The risk weights for the high-risk corporate will actually be lower with a binding output floor, because the internal models set a risk weight above the output floor. It should be noted that the output floor is one floor applied on the totality of risk-weighted assets that a bank holds. However, the effect in practice has a different impact on different categories of assets, as illustrated in the figure below. Please note, that there are different risk weights applied to different categories of borrowers (e.g. unrated corporates, rated corporates, SMEs, etc), so the purpose of the figure is merely to illustrate the effect of the output floor.
Source: Illustration by Copenhagen Economics.

### 1.3.2 Loss of risk-sensitivity

For low-risk portfolios bounded by the output floor, risk sensitivity of capital requirements will be significantly reduced, i.e. below the output floor, the same risk level is applied to exposures, independent of their actual risk.

Banks' internal models in Europe have been found to reflect the level of risk well on average and are generally not biased towards lower capital requirements. In appendix C, we go through several studies by BIS, EBA, IMF, all confirming this. For example, one study by EBA analysing high-default portfolios finds that:

> *Estimated values for PDs and LGDs are, in general, higher than the observed default rates and loss rates, which suggests that banks are, on average, conservative*

Source: EBA (2017): *Results from the 2016 High Default Portfolios (HDP) Exercise*

Thus, the Final Basel III Standard will create a gap between capital requirements and the underlying risks of portfolios of European banks. This is particular pronounced for Danish banks, with large low-risk portfolios, e.g. mortgage loans, where there often is a large gap between the risk weight estimated by internal models and the minimum risk weights in the output floor.

This loss of risk sensitivity could distort incentives for financial institutions. Using internally modelled risk weights, there is a clear incentive for banks to reduce the risk within each asset class; if the risk of an asset increases, the capital requirement for that particular asset will also increase, and the bank will be required to hold more (costly) capital. However, with the output floor, increased risk-taking will not lead to higher capital requirements (when below the output floor). Consequently, risk-taking becomes "cheaper".

## 1.4 COMPARISON TO THE US MARKET

The impact in other regions of the world comes much closer to the objective of the Final Basel III Standard - to not significantly increase capital requirements. For example, in the United States (US) capital requirements are expected to increase by around 1%-2%, around one-tenth of the impact in the EU.[8] The large difference reflects different structures of the banking sector, as well as the corporate sector, which makes capital requirements of US banks less susceptible to the output floors.

In particular the mortgage portfolio is much more affected in Europe:

- **Mortgage loans are removed to a larger extent from US banks' balance sheets**: The majority of mortgages that US banks issue are sold to Government Sponsored Entities and securitisation is more common in general. Conversely, mortgage loans remain on the balance sheet of European banks until maturity. Because mortgage loans in general have a very low-risk profile – and because the mortgage portfolio is one of the largest bank asset classes in the EU – this significantly reduces the average risk-weights in EU banks, causing output floors to have a higher impact.
- **Dual recourse is not common in the US:** In Europe, the dual recourse to both the borrower and the property is a central element of mortgage lending. This significantly reduces the losses on mortgages compared to the US where non-recourse lending is more common. Again, this leads to lower risk-weights and therefore a larger impact of output floors.

[8] See in BIS (2019) "*Basel III monitoring report*". The country group "Americas" also contains Canadian, Brazilian and Mexican banks but is dominated by US banks in the sample. The impact in the Americas is therefore indicative of the impact in the US. The results stated here are the numbers for highly capitalised, internationally active banks (Group 1 banks). No US banks are represented in the sample of Group 2 banks.

**Also, the role of capital markets plays a role:** In the US corporate credit is granted to a much larger extent through capital markets. This is especially relevant for low-risk business which can benefit from favourable funding conditions on capital markets. Therefore, more companies are also rated in US. In Europe, on the other hand, the vast majority of lending to businesses is granted by banks. This implies that the final Basel III reform will have a much larger impact on the corporate portfolio in the EU than in the US.

**Finally, US banks have fewer capital buffers** in their capital requirements. This suggests that the impact on capital requirements in absolute terms is lower than in the EU even if the output floor is binding.

CHAPTER 2

# IMPACT ON BANK CUSTOMERS AND THE REAL-ECONOMY

In this chapter we analyse how customers of the Danish banking sector are likely to be affected by the Final Basel III reform, if the single stack approach is followed, and how this will impact the real economy in Denmark. Section 2.1 focuses on the impact on bank customers which will have to pay more for bank services. Section 2.2 illustrates the impact on customers in two concrete cases. Finally, Section 2.3 describes what the package will entail for the real economy in Denmark.

## 2.1 IMPACT ON BANK CUSTOMERS

The higher capital requirements, from the single stack approach, will translate into higher costs for banks, which we expect eventually will be passed on to bank customers in terms of higher borrowing costs, i.e. interest rates on bank loans and fees.[9] This is widely accepted in the economic literature, e.g., from Bank of England, IMF and ECB.[10]

The dynamics can be explained as follows: higher capital requirements mean that banks have to hold more equity for each loan they grant. Equity is a significantly more expensive source of funding than debt: it typically has a required return from investors in the range 10%-15% whereas debt funding costs are usually around 1%-2%.[11] The main reason is that equity is subordinated to debt in case of default, i.e. holding equity entails higher risk, giving rise to a higher required return.[12] Higher capital requirements therefore mean higher costs for banks.

In total, we estimate that the annual increase in cost of borrowing for Danish banking customers corresponds to some DKK 13 bn (EUR 1.7 bn) (given they do not change to market-based lending, as discussed below), see Figure 5. By comparison, this increase amounts to around 18% of the annual corporate tax revenue in Denmark (which is around DKK 70 bn[13]).

How the higher capital requirements are passed on to the different customer segments is uncertain. The pass on of costs is the result of banks' internal capital allocation model, price strategy as well as the local competitive situation. In our estimation, we assume that the price increase for different customers is proportional to the increase in capital requirements.

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9 We refer to these costs of borrowing from banks collectively as 'borrowing cost' below.

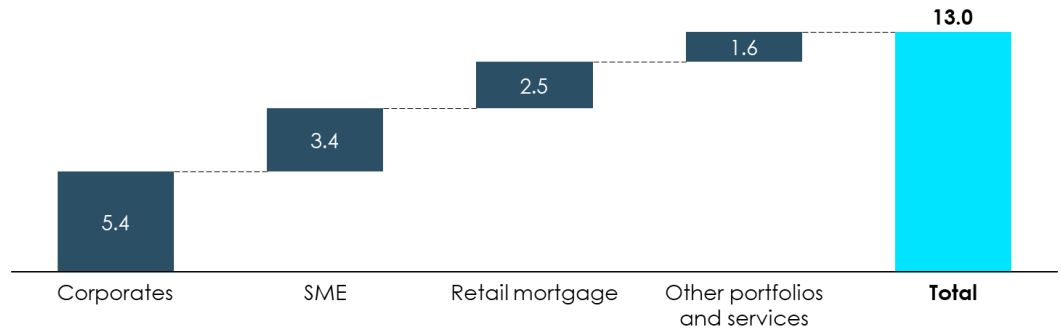
10 See, for instance, BIS (2010), Miles et al. (2011), The Riksbank (2011), IMF (2016), ECB (2016) and Bank of England (2016). Note, that this is a long-run consideration – in the short to medium run pass-on can be influenced by competitive dynamics in the banking market, see discussion in Copenhagen Economics (2020) "*Impact of the Final Basel III Framework in Sweden*"

11 In this study, we assume an average cost of equity funding after taxes of 10%, corresponding to a before-tax cost of equity of around 13%. This number is based on the European banking study by ZEB (2018), covering the 50 largest European banks. The debt funding rate for the Danish banks in our sample is around 1% and is calculated on a bank level using data on bank interest expenditure and total financial liabilities from EBA's transparency exercise.

12 A mitigating effect is that higher share of equity funding leads to lower required return, both for debt and equity because a higher capitalisation makes a bank less risky. This is known as the Modigliani-Miller effect and is included in our results. See Copenhagen Economics (2020) "*Impact of the Final Basel III Framework in Sweden*" for further discussion.

13 Based on the OECD Global Revenue Statistics Database.

**Figure 5**
**Total increase in costs for customers of Danish banks**
DKK bn




Note: The numbers are based on EBA's main scenario (Basel III scenario) and assume full replenishment of current CET1 ratios (our main scenario). The estimates are the outcome of our banking balance sheet model that covers around 80% of the Danish credit market. We assume that the rest of the banking sector follows the price increase of the banks in our model. The corporate and SME portfolios include lending secured on real estate property. The retail mortgage portfolio includes both the so-called "realkreditlån" (of up to 80% of the property value) and the "boliglån" (loan above 80% of the property value). The impact on capital costs for banks related to other exposure classes such as lending to banks, sovereigns, equity exposures as well as costs related to the revised rules for operational risk, market risk and credit valuation adjustment (CVA) risk are pooled within the group of 'Other portfolios and services'.
Source: Copenhagen Economics based on data from EBA transparency exercise as of end 2019.


In our estimation, we find that banks' business customers (including lending secured by real estate) are among the most affected. We estimate that on average the package will increase companies' borrowing cost by around 0.38 percentage points, see Figure 6.

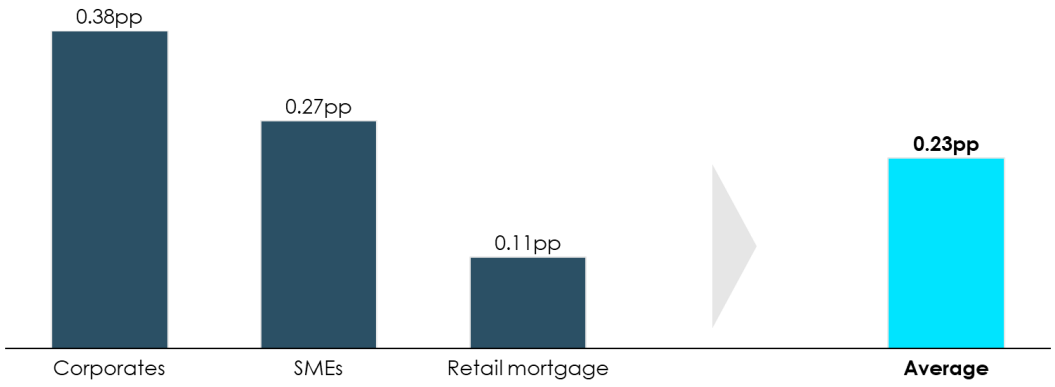
Among business customers, the impact of the package varies significantly. Newly established SMEs with high leverage (and risk) could experience little impact from the output floor. In contrast, large corporates that have not been rated by credit rating agencies (typically because the corporate has no need to access debt capital markets) and with a long track record of no default will be highly affected.

Retail mortgage customers will also be affected by the package. We estimate that on average the package will increase borrowing costs for retail mortgage customers by around 0.11 percentage points for banks using the whole loan approach. For banks applying the loan-splitting approach[14], the increase could be almost twice as high for the average loan-to-value ratio in Denmark, i.e. around 0.2 percentage points. Borrowing costs for SME customers could increase by around 0.27 percentage points.

[14] In the whole loan approach, standardised risk weights prescribed by the regulator apply to the entire mortgage loan, depending on the loan-to-value ratio. In the loan-splitting approach the part of the loan above 55% of the property value will receive a considerably higher flat risk weight (75% for retail customers) in the revised framework.

Note that the estimated increase in borrowing costs is permanent and will sustain across business cycles. Thus, the impact is not comparable to ordinary interest rate hikes but should rather be interpreted as a permanent cost wedge in capital allocation between lender and borrower.[15]

**Figure 6**
**Increase in companies' borrowing cost due to the Final Basel III**
Increase in cost of borrowing, percentage points (pp)




Note: These estimations are based on the following assumptions: a before-tax cost of equity of 13% and an average debt-funding rate for Danish banks of around 1%. The estimates include Modigliani-Miller effects, see Appendix A and B for further details on the estimation. The estimations are based on EBA's Basel III scenario and assume full replenishment of CET1 ratios (our main scenario).
Source: Own calculations, based on data from EBA's transparency exercise as of end 2019.

In time, we expect the increase in businesses borrowing costs to have real-economy consequences as described in Section 2.3 below. In addition, the single stack approach could distort companies' funding incentives, through two main channels:

- *First*, increased borrowing costs from banks provide a strong incentive to bypass the traditional banking system and seek financing elsewhere. This is especially the case for large unrated corporates that often are considered quite low-risk exposures, which could for instance issue more corporate bonds to bypass the banking system.
- *Second*, there is also a risk that credit will flow to less-regulated institutions, often referred to as shadow banking. This could include credit hedge funds and limited-purpose finance companies.

There appears to be no economic or financial stability rationale for such reallocation of businesses' financing channels, pushing corporate customers to the bond market and less-regulated finance providers. And we find it unlikely that such reallocation will improve financial stability or economic efficiency.[16]

[15] We primarily consider long-term effects as The Final Basel III Framework is a permanent regulation, intended to be in effect for many years. In the short-to-medium term, the competitive dynamics on the banking market could affect how banks adjust to the changing costs, and typically imply a lower pass-through of costs.

[16] See Plantin (2014): *Shadow Banking and Bank Capital Regulation*, ESRB (2018) *EU Shadow Banking Monitor* and Hansson et al. (2014) *Shadow Banking from a Swedish Perspective*.

### 2.1.1 Interaction with additional tier 1, tier 2 and MREL capital requirements

The above estimations of increase in borrowing costs, is solely a result of increase in core equity (CET1). In addition, the Final Basel III package will increase requirements for additional tier 1 and tier 2 capital as well as other loss-absorbing debt instruments compliant with the *Minimum Requirement for own funds and Eligible Liabilities* (MREL).[17] MREL was introduced as a bank-specific requirement to ensure an orderly resolution of banks in case of bank failure, and a bank can use different types of liabilities to comply with the requirement.[18]

The higher requirements for MREL compliant debt instruments and additional tier 1 and tier 2 capital could further increase borrowing costs as both are subordinated to other liabilities in case of default, and therefore is a more expensive source of finance (depending on the extent of Modigliani-Miller effects for these instruments – see CE (2020) "*Impact of the Final Basel III Framework in Sweden*" for further discussion).

## 2.2 CASES OF IMPACT ON CUSTOMERS

To illustrate the impact of the single stack approach, we in this section provide two cases of how the borrowing costs will increase for customers.

The first case illustrates how the package will impact different customers differently, depending on their risk profile, by comparing an increase in borrowing costs for an unrated corporate with a retail SME, see Box 1.

[17] The increase in risk-weighted assets as a consequence of the Final Basel III Standard will lead to an increase in MREL for many banks since the MREL requirement set relative to the banks' total risk-weighted assets can be expected to be binding. Banks can use part of the increase in the capital need due to the Final Basel III Standard simultaneously to cover MREL. However, if MREL increases by more than the additional capital need, banks will have to raise additional capital (as opposed to normal debt) to comply with MREL. The associated higher costs for banks will add to the increase in borrowing costs for bank customers and compound the impact on banks and their customers.

[18] Eligible liabilities are own funds (CET1 capital, additional tier 1 capital as well as tier 2 capital) and other senior debt instruments.

**Box 1 Illustration of impact of output floor on unrated corporates vs retail SMEs**

To illustrate the impact of output floors for different types of business borrowing costs, we consider two businesses:

- A large, established unrated corporate with a long track record of solid financial performance and positive business outlook; and
- A small, newly established corporate SME, with a relatively high debt burden and uncertain business outlook.

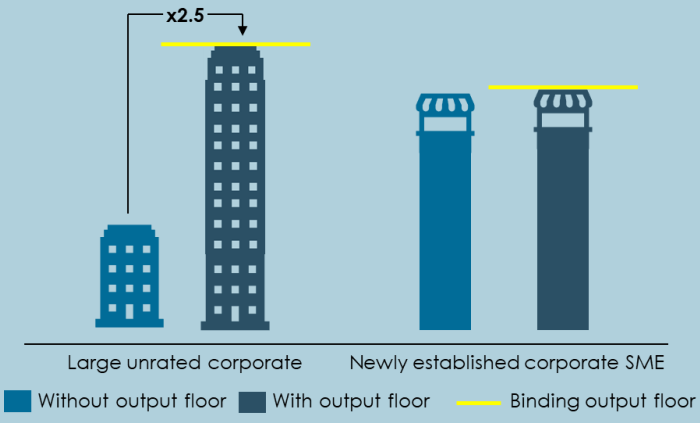
These two businesses have very different risk characteristics, and the small, newly established business is reasonably expected to be much less likely to repay their borrowing.

This difference in the credit risk would be reflected in the risk weights resulting from banks' credit risk models. Consequently, banks would hold more capital for lending to the riskier business. In our illustration we assume that the established large corporate would receive a risk weight of 30% and the small new business would receive a risk weight of 60%.

The output floor (implemented as proposed by EBA) would increase the risk weight of the large corporate to 72.5%, while it would leave the risk weight for the small business almost unaffected. This, in turn, would lead to an increase in capital requirements by a factor of close to 2.5 for the bank lending to this corporate, with the potential to increase the corporate's borrowing cost by around 0.8 percentage points.

In contrast, neither the capital requirements nor the borrowing cost for the newly established corporate SME would be significantly affected by the output floor, see Figure 7.

**Figure 7**
**Illustration of impact on bank capital requirements for unrated corporates vs SMEs**




Source: Illustration by Copenhagen Economics, based on data from EBA's transparency exercise and own calculations.

Our second case focuses on a typical new homeowner, financed with a mortgage. Here, interest expenditures will increase by DKK 1,600-2,200, depending on the loan-to-value ratio, see Box 2.

**Box 2 Case: impact on a new homeowner with loan-to-value of 80%**

To illustrate the impact of the reform on the mortgage market, we consider a family buying a new home.

We assume that the family purchases a house in Denmark and takes out a mortgage of 80% of the house price. With the average sales price for a house in Denmark currently at around DKK 2.4 million (EUR 320,000), this corresponds to a mortgage loan of around DKK 1.9 million (EUR 260,000).

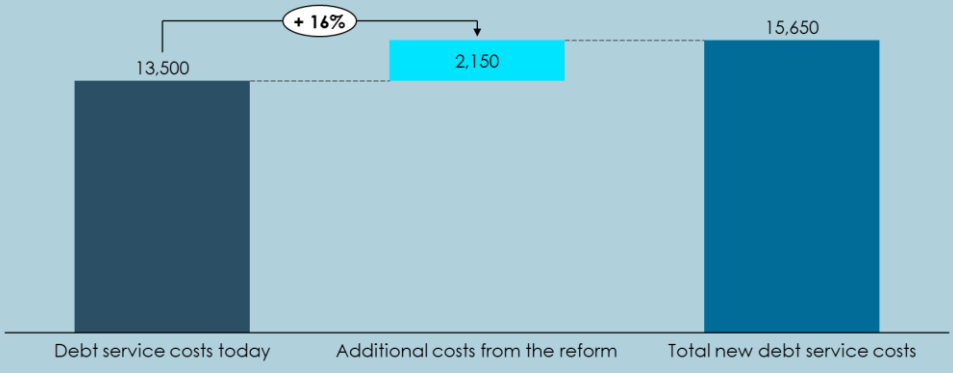
The output floor would increase the risk weight for the loan to around 22%, up from an average current risk weight of around 16%. We estimate that this could increase borrowing costs for a mortgage by around 0.11 percentage points which implies an increase in the annual cost to service the 80% mortgage loan of 2,150 DKK (EUR 290), see Figure 8.

This example is calculated under the so-called whole loan approach. For banks applying the loan-splitting approach, the impact on risk weights and borrowing costs would be higher. With an LTV ratio of 80%, the risk weight under the loan-splitting approach increases to around 27%[1] which could increase borrowing costs for the mortgage by around 0.2 percentage points. This results in an increase in the cost for the mortgage of around DKK 3,800 (EUR 510).

If the family gradually repays the mortgage, the increase in borrowing costs will be lower. For example, with a loan-to-value of 60%, the borrowing costs would increase by around DKK 1,600 (EUR 220) under the whole loan approach.

1) Under the loan-splitting approach, a risk weight of 20% is applied to the mortgage up until 55% of the property value. For the remaining 25% a flat risk weight of 75% is applied for retail customers. This results in an average risk weight of around 27% for a bank bound by the output floor.

**Figure 8**
**Increase in annual borrowing costs with a loan-to-value of 80%**
DKK




Note: The current mortgage rate in Denmark is around 0.7%, see Hypostat (2020).
Source: Illustration by Copenhagen Economics, based on data from EBA's transparency exercise, Hypostat (2020); Statistics Denmark (sales of real property database) and own calculations.

## 2.3 IMPACT ON THE REAL-ECONOMY

In time, we expect that the increase in capital requirements and businesses' borrowing costs will impact the real economy. The higher capital costs passed on to banks' customers reduce credit demand. This curbs investment activity, causing a decline in overall productivity that eventually contracts GDP, see Figure 9.

**Figure 9**
**Higher capital requirements decrease GDP, productivity and average wages**


Source: Illustration by Copenhagen Economics

To estimate the impact on the Danish economy, we use a modelling framework that was initially developed by the Canadian Central Bank and is similar to the analytical framework used during the development of the original Basel III package.[19]

*Macroeconomic costs*

We estimate that if the Final Basel III Standard is implemented via the single stack approach, there would be a permanent decline in the Danish GDP level of between 0.6%-1% per year[20], depending on the extent to which buffers are fully replenished.[21] This corresponds to around DKK 15-23 bn (EUR 2-3 bn) per year. In other words, the GDP level will, every year, be 0.6%-1% lower than it otherwise would have been.[22]


The decline in GDP is driven by a decline in investments in Denmark in a ten-year period.[23] We estimate that, every year in this period, investments will be some DKK 13-19 bn (EUR 1.7-2.5 bn) lower, corresponding to a decline of around 2.5%-3.8% in overall annual investments.[24]


19 See Copenhagen Economics (2019) and Copenhagen Economics (2020), Chapter 3 as well as Appendix B at the end of this study for details.

20 In percent of GDP end 2019. In the EU-specific scenario the impact on GDP would be in the middle of the interval, with GDP declining by close to 0.8% per year.

21 The lower bound of the estimate refers to our alternative scenario where banks keep both the market buffer and the P2R unchanged in absolute values. This lowers the additional capital need to around DKK 58 bn, see Section 1.3

22 See Copenhagen Economics (2020), Chapter 3 as well as Appendix B at the end of this study for details on the methodology.

23 Until a new steady state in the economy is reached, see Appendix B for a description of the methodology.

24 The data on total annual investments are from Statistics Denmark and are measured as gross fixed capital formation in 2019.

Moreover, we note that the higher capital requirements could also be an obstacle for Danish banks in terms of the finance investments needed for the transition to a low-carbon economy, see Box 3.

**Box 3 Additional capital for loans supporting green transition**

The transformation to a net-zero emission economy requires a massive amount of investments by Danish businesses and households. To achieve compliance with the Paris agreement, we estimated in a previous study that Danish banks, towards 2030, could need to finance up to DKK 300-400 bn (EUR 40-50 bn) of investments supporting green transition.

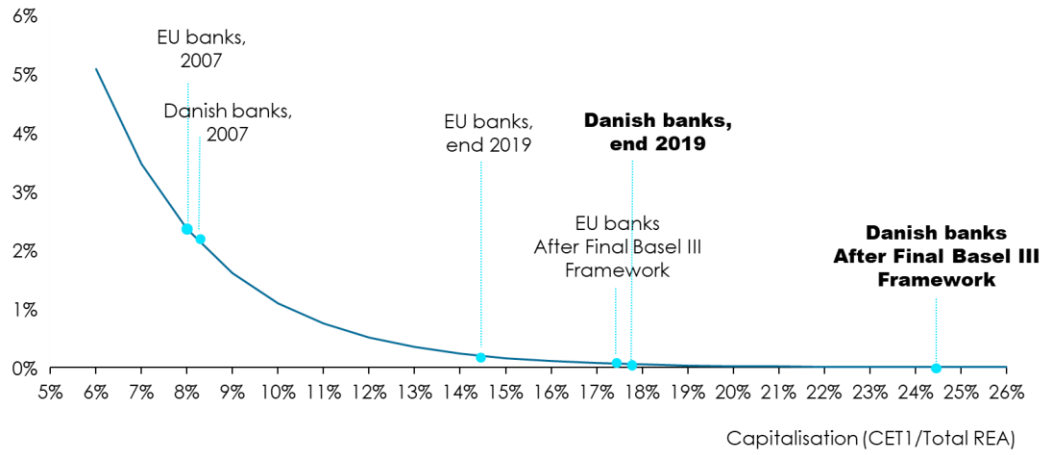
With current risk weights and capitalisation, this corresponds to that Danish banks would need to raise additional capital of the magnitude DKK 15-20 bn.[1] With the Final Basel III Standard, that number increases by around DKK 4-7 bn in our main scenario of full capital replenishment.

Note: 1) Based on an average leverage ratio (CET1/total exposures) of around 5% for danish banks.


*Macroeconomic benefits*

In general, economic research shows that higher capital requirements provide societal benefits in terms of lower risk of a crisis. However, since the financial crisis in 2008, the European banking sector, and the Danish one in particular, have increased solvency to a point where further general increases in capitalisation bring little benefits in terms of reducing the risk of a crisis, see Figure 10.

**Figure 10**
**Risk of a crisis in the EU given pre and post Final Basel III capital requirements**
Risk of a crisis in a given year




Note: This is the same figure as Figure 1, now showing the level of capitalisation resulting from the Final Basel III package (implemented according to EBA's main approach) and the corresponding probability of a financial crisis. The figure shows that for Denmark the gain in terms of reduced probability of a financial crisis is very small compared to the increase in capitalisation. The level of capitalisation is expressed as CET1 in % of non-floored risk-weighted assets.
Source: BIS (2010), page 15 and Copenhagen Economics' own calculations.

Concretely, we estimate that the benefits from the Final Basel III Standard correspond to a permanent increase in Danish GDP of around 0.05%.[25] This result is again based on estimates from the original analytical framework behind the Basel III package.[26]

Note that such estimations entail significant uncertainty and the optimal level of capitalisation is a heavily discussed topic within economic research. Nevertheless, a recent literature review by the Basel Committee shows that the majority of research assesses the current level of capitalisation of the Danish banking sector to be above or within the optimal level.[27]

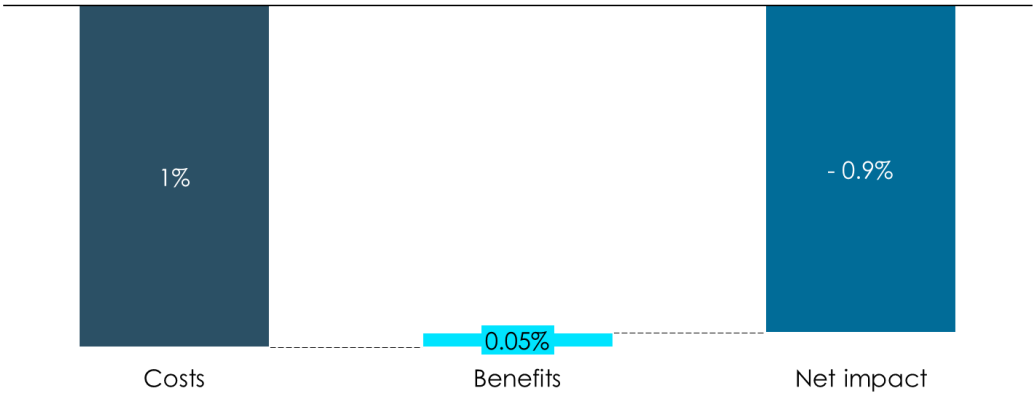
[25] Note that this does not rule out that financial or economic crises could happen in Denmark. Capital requirements for banks are not the only parameter determining the risk of a crisis. For example, ill-advised fiscal or monetary policies could still build up financial bubbles, with a following burst. We merely point out that the benefits from higher capital requirements have been exhausted. In the EU-specific and the alternative scenario with less than full capital replenishment, the benefits are slightly lower than the 0.05% in our main scenario.

[26] The main analytical work behind the original Basel III package (known as the LEI report): Basel Committee on Banking Supervision (2010): An assessment of the long-term economic impact of stronger capital and liquidity requirements.

[27] See for example a recent literature review by the Basel Committee on Banking Supervision (2019): The costs and benefits of bank capital – a review of the literature: Danish banks' capital ratios are currently within or above all of the recent estimates on the optimal level of capital, except for one estimate for the US banking sector. One noteworthy exception is the recent macroeconomic impact assessment conducted by EBA (2019b): Macroeconomic assessment, credit valuation adjustment and market risk. We discuss the implications of the report in CE (2020), p. 39.

Putting costs and benefits together, we find the Final Basel III Standard will deliver a net economic loss to the society corresponding to around 0.9% of GDP, see Figure 11. In the alternative scenario where banks don't fully replenish CET1 ratios, the net economic cost could amount to around 0.6% of GDP. We estimate that in EBA's EU-specific scenario the impact would be in between these two at around 0.7% of GDP, see Table 1 for an overview.

**Figure 11**
**Net GDP impact of Final Basel III measures in Denmark**
% of long-run GDP




Note: The estimations are based on EBA's Basel III scenario and assume full replenishment of CET1 ratios (our main scenario).
Source: Copenhagen Economics' estimations. See Appendix B at the end of this study for details on the estimations.

**Table 1**
**Impact of the Final Basel III Standard for different scenarios**

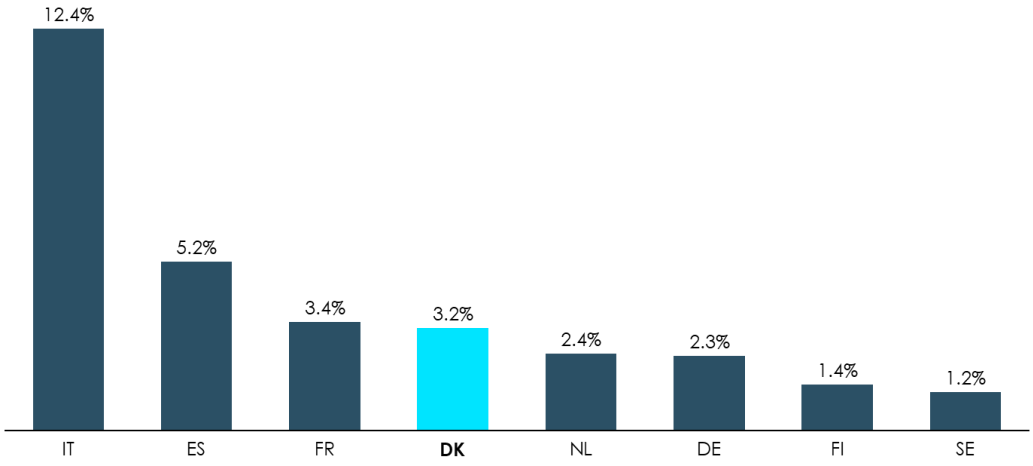
| SCENARIO | ADDITIONAL CAPITAL NEED | NET IMPACT ON GDP |
|---|---|---|
| Basel III scenario, full replenishment (main scenario) | DKK 90 bn | -0.9% |
| EU-specific scenario, full replenishment | DKK 72 bn | -0.7% |
| Basel III scenario, no increase in market buffer and P2R (alternative scenario) | DKK 58 bn | -0.6% |

Source: Copenhagen Economics based on data from EBA transparency exercise as of end 2019.

The few benefits of increasing capital requirements are backed-up by key risk indicators, indicating a very robust Danish banking sector. Below, we provide two examples:

*First*, the Danish banking sector has historically had low credit losses, see Figure 12.

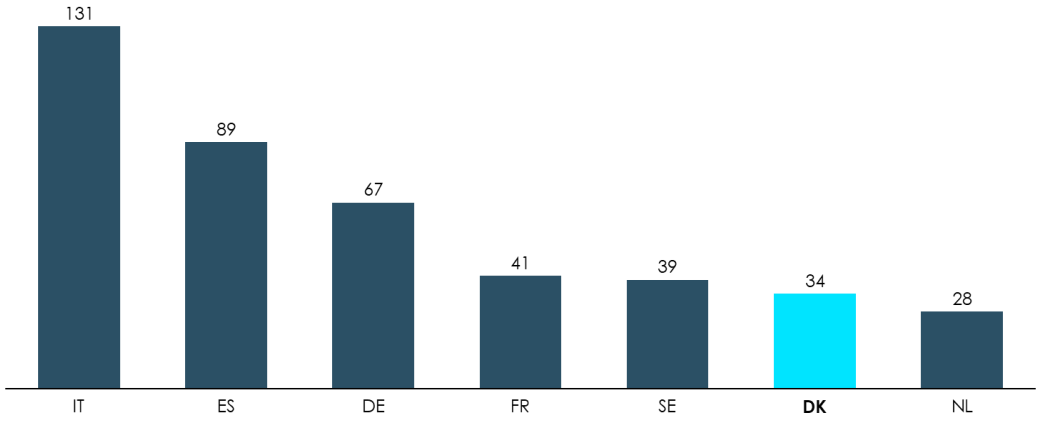
**Figure 12**
**Gross non-performing loans, 2014-2019**
Percent of total loans




Note: Gross non-performing loans are expressed as average share of gross loans for the period 2014-2019 (i.e. non-performing loans as a share of total loans), domestic and foreign entities.
Source: Eurostat (2020) Gross non-performing loans, domestic and foreign entities - % of gross loans, 2014-2019 [TIPSBD10]. EBA (2020). Own calculations.

*Second*, Danish banks have one of the lowest credit default swap (CDS) spreads. A CDS spread identifies the cost of buying an insurance against the default of a specific bank. Danish banks have among the lowest CDS spreads in the EU, meaning that the market has assessed a low risk of default, see Figure 13.

**Figure 13**
**Average CDS spreads in 2020, selected banks**
Basis points




Note: The average CDS spread in each country is calculated as the simple average of CDS spreads of selected large banks in the respective country.
Source: Eikon Refinitiv database.

CHAPTER 3

# ALTERNATIVE OPTIONS OF IMPLEMENTING THE OUTPUT FLOOR

The large impact of the Final Basel III package in Denmark outlined in the previous two chapters is to a large degree the result of the application of the output floor following the *single stack* approach.

However, there is another way of interpretating the implementation of the output floor, the *parallel stack* approach. This way of implementing the output floor would not be binding for most banking assets, thus keeping the risk sensitivity of capital requirements.[28] This will in turn avoid a large increase in capital requirements in some European countries, thus leading to a much more uniform impact across Europe.

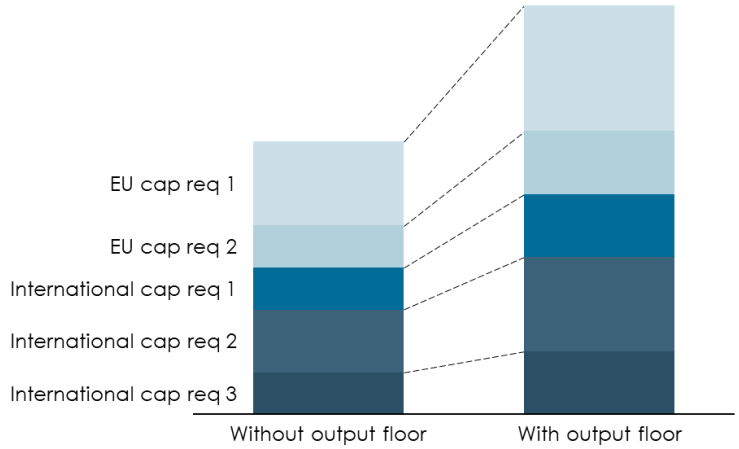
In this chapter, we evaluate different options of implementing the output floor in a European context. In Section 3.1, we describe the differences between the single and parallel stack approach. In Section 3.2, we analyse the impact in Denmark of the different options for the implementation of the output floor. We conclude in Section 3.3 by presenting a possible way forward for the implementation of the Final Basel III Standard in EU.

## 3.1 ALTERNATIVE IMPLEMENTATION: THE PARALLEL STACKS APPROACH

EU banks are subject to locally set capital requirements (for example O-SII and P2R buffer) to guard against different local systemic and institutional specific risks.The interaction between these EU specific capital requirements and the output floor is one of the reasons why the impact is larger in the EU than globally, see Figure 14.

[28] Note that the parallel stack approach also provides a backstop against excessively low risk weights, just at a less strict level.

**Figure 14**
**Illustration of single stack approach, without output floor vs with output floor**
Absolute level of capital requirement, as sum of different buffers




Source: Illustration by Copenhagen Economics.

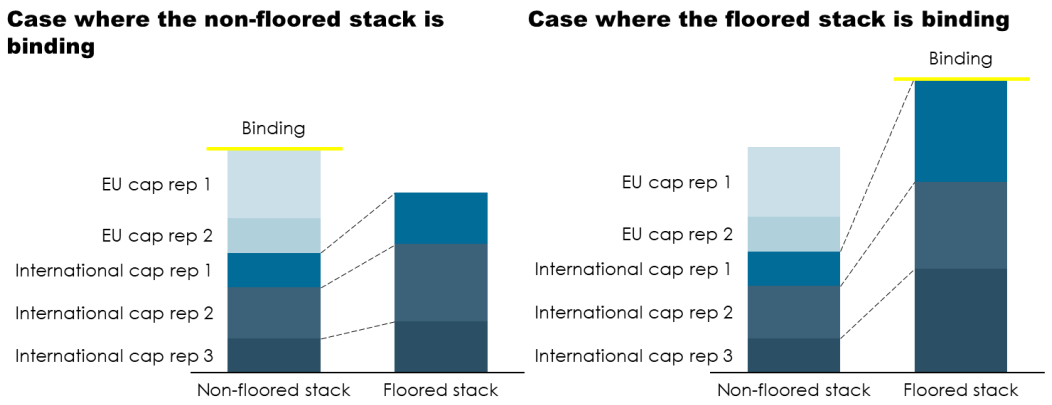
To avoid this interaction, the *parallel stack* approach has been suggested.[29] Fundamentally, the approach means that banks are subject to two parallel calculations of capital requirements:

- The *floored stack* calculation, where the output floor is only applied to capital requirements that are internationally agreed (and not the EU specific ones).
- The *non-floored stack* calculation, where EU banks are subject to all capital buffers – including the EU specific ones – in a calculation without the output floor.

The binding capital requirement for banks is then the highest of the two stacks, see Figure 15.

[29] For more details on the technical workings see CE 2020.

**Figure 15**
**Illustration of parallel stack approach**
Absolute level of capital requirement, as sum of different buffers




Source: Illustration by Copenhagen Economics.

## 3.2 EVALUATION OF FIVE DIFFERENT OPTIONS FOR THE IMPLEMENTATION OF THE OUTPUT FLOOR

Even within the single and parallel stack approach, there are different variations of how the output floor could be implemented, which are currently being discussed. In the following, we analyse the impact of five different approaches to implement the output floor – two following the single stack approach and three following the parallel stack approach:

1. **Standard single stack:** This is the main option as proposed by EBA described in chapter 1 and 2.
2. **Adjusted single stack:** The implementation of the output floor is the same as in Option 1, but the entire so-called *Pillar 2 Requirement (P2R)* is assumed to not mechanically increase due to higher risk-weighted assets from a binding output floor.
3. **Standard parallel stacks:** This is the option for the parallel stacks approach described conceptually in the section above. Only internationally agreed capital requirements are included in the floored stack.[30]
4. **Parallel stacks including O-SII buffer:** This departs from the standard parallel stacks approach in option 3 described above, but with the buffer for other systemically important institutions (O-SII) included in the floored stack.[31] Thus, compared to the *Standard parallel stacks*, the impact can be expected to be larger.
5. **Parallel stacks including P2R:** This option departs from the parallel stacks approach including the O-SII buffer but assumes that 50% of P2R are included in the floored stack. Compared to the "*Parallel stacks including O-SII buffer"* approach, the impact can be

[30] Including the minimum requirement of 4.5%, the countercyclical capital buffer, the capital conservation buffer and the so-called *buffer for global systemically important institutions (G-SIIs).*

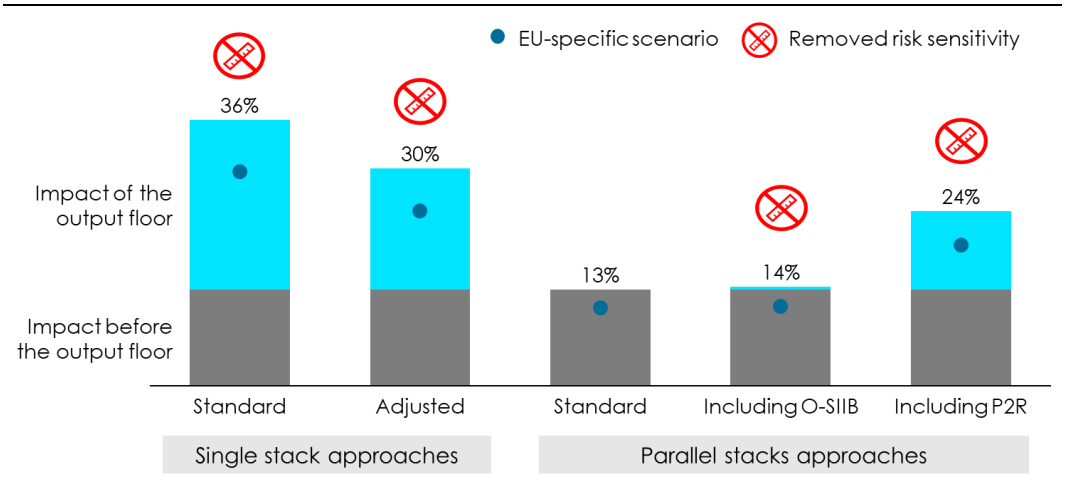
[31] The O-SII buffer is an additional capital requirement at national discretion to address the potentially negative impact an institution might have on the financial system. With the updated framework introduced by the CRD V the O-SII buffer will replace the systemic risk buffer for Danish banks (the systemic risk buffer is currently at around 2.5% on average for the Danish banks in our sample).

expected to be larger since more capital requirements are added to the floored stack. This means that the output floor will be binding for more banks.[32]

Looking at increases in capital requirements, the two options of the single stack approach will lead to the largest increases, see Figure 16. The "*Parallel stacks including P2R*"-option will also lead to a significant impact from the output floor because all of the Danish banks in our sample are bound by the output floor. In contrast to that, we estimate that the two other parallel stacks options will not lead to a significant increase in capital requirements.

It is not only the impact on capital requirements that determines the economic impact. It is equally important whether risk sensitivity of the capital requirements is maintained. For "*Standard Parallel stacks"*, the output floor is not binding for any of the Danish banks, meaning that risk sensitivity is fully kept. Risk sensitivity is however considerably reduced in the *" Parallel stacks including O-SII buffer*" option, since we find that the output floor will be binding for a significant share of Danish banking assets. In *"Parallel stacks including P2R"* the output floor will be binding for all of the Danish banks in our sample and risk sensitivity will be removed to an even larger degree.[33]

**Figure 16**
**Increase in capital requirements for the different output floor options**
Increase in capital requirements, average among Danish banks




Note: The removed risk sensitivity indicates that at least one Danish bank is bound by the respective option of the output floor. The calculations take into account that the O-SII buffer will replace the systemic risk buffer for Danish banks due to CRD V (see description of the options above).
Source: Own calculations based on data from EBA's transparency exercise

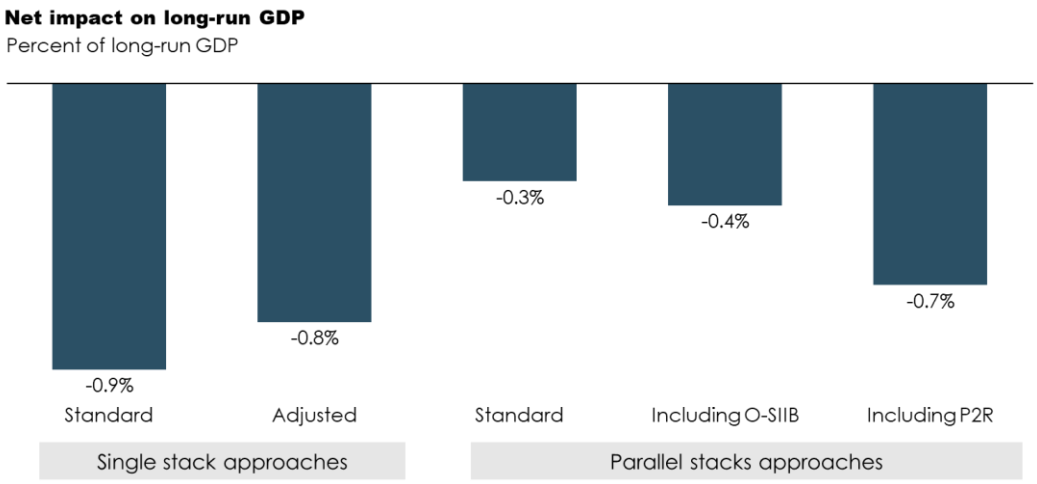
As described in chapter 2, the loss of risk sensitivity in combination with higher capital requirements for banks translates into higher borrowing costs. The impact on borrowing costs can be expected to be particularly high in the single stack approaches to the output floor and in the option

[32] The parallel stack approach is binding if the capital requirement calculated with the floored stack (using risk-weighted assets implied by the output floor) is larger than the capital requirement calculated with the non-floored stack.
[33] The smaller increase in capital requirements compared to the standard single stack approach is due to the fact that the floored stack in the last option contains only half of the P2R and is therefore smaller than in the standard single stack approach.

*"Parallel stacks including P2R"*, where the floored stack contains more capital requirements compared to the other two parallel stacks approaches.

The net GDP impact for the different options for the output floor mirrors closely the impact on capital requirements; in particular, the standard parallel stack option and the parallel stack option including the O-SII buffer reduce the negative impact of the Final Basel III Standard on the Danish economy, see Figure 17.

**Figure 17**
**Net GDP impact in Denmark for the different output floor options**
% of long-run GDP




Note: The estimations are based on EBA's Basel III scenario and assume full replenishment of CET1 ratios (our main scenario).
Source: Copenhagen Economics' estimations. See Appendix B at the end of this study for details on the estimations.

## 3.3 A WAY FORWARD

This paper has highlighted the different paths that the implementation of the Final Basel III can take. Both from an economic as a well as a financial stability perspective, we find the standard parallel stacks approach to be the best suited option for the Danish economy, due to two main reasons:

- It will lead to a much smaller impact on capital requirements, with resulting smaller impact on borrowing costs and therefore fewer real-economy costs;
- It will largely keep the link between capital requirements and underlying risk for assets, letting the output floor work as a backstop for excessively low modelled risks.

In addition, applying the parallel stacks approach in Denmark will also bring the impact on the Danish banking sector closer to the impact at a global level, thus more in line with the original spirit of the Final Basel III Standard to not significantly increase capital requirements.

We also suggest to consider refinements to the standardised risk-weight framework, to mitigate the reduction in risk-sensitivity of capital requirements in situations where the output floor is binding. This would in general limit the extent to which capital requirements are being pushed above underlying risks. Here, we provide two options:

- **Corporate portfolio:** One options is to allow *investment grade corporates*[34] in all jurisdictions in the EU. Consequently, risk weights would be reduced to 65% for unrated corporates with a sound financial standing. Currently, the investment grade classification is generally not allowed in Denmark and the EU, while it is more widely applicable in the US.
- **Real estate lending:** Another option is a more risk sensitive and granular standardised risk weight for mortgage loans. Such refinements could be considered for both the whole loan and the loan-splitting approach.[35] For the loan-splitting approach, in particular, we suggest considering a more granular risk weight for the part of the loan above 55%, which with the current regulation will be subject to a flat risk-weight, based on the risk of the counterparty, e.g. 75% for households.

Finally, we suggest continuing the ongoing work to increase transparency, comparability, and precision of internal models of financial institutions. This is, for example, the focus of the ECB's targeted review of internal models (TRIM) as well as the ongoing monitoring by the national competition authorities (NCAs) and the European Banking Authority within its mandate to provide guidelines for and assessments of internal models. Ultimately, financial institutions that have (1) solid, verifiable models identifying their risks and (2) can document their solidity, even in very adverse economic conditions, through stress tests, should be able to use these models in determining their capital adequacy.

34 An investment-grade corporate is an entity with "adequate capacity to meet its financial commitments in a timely manner and its ability to do so is assessed to be robust against adverse changes in the economic cycle and business conditions" (EBA (2019a), p. 74).

35 In the whole loan approach, standardised risk weights prescribed by the regulator apply on the entire mortgage loan, depending on the loan-to-value ratio. In the loan-splitting approach the part of the loan above 55% of the property value will receive a considerably higher flat risk weight of 75% in the revised framework. In a Danish context, the impact under the loan-splitting approach from the Final Basel III Standard can therefore be expected to be higher.

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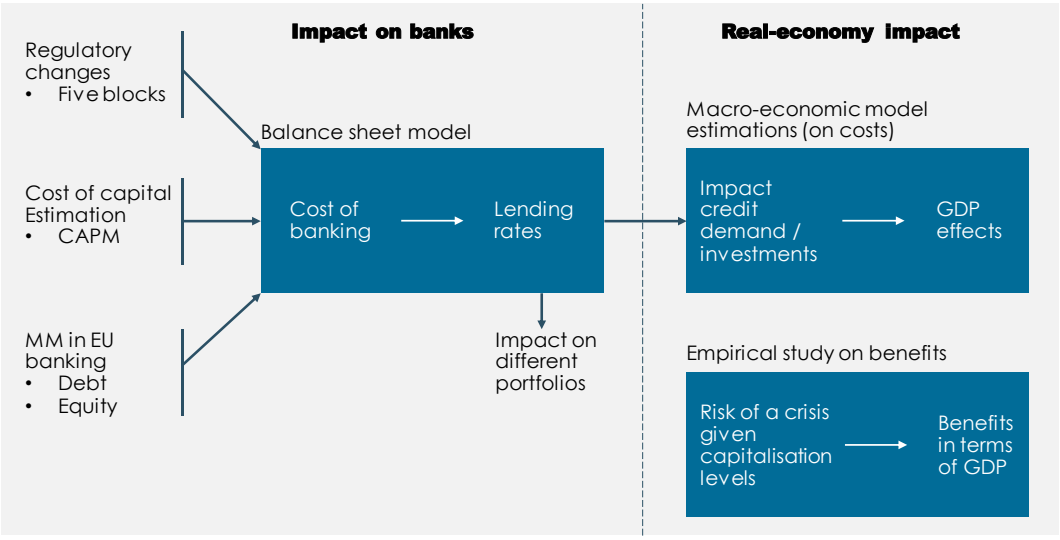
APPENDIX A

# THE BANKING BALANCE SHEET MODEL

The appendix describes both the balance sheet model we use to estimate the impact of The Final Basel III Standard on different customers as well as the impact on demand, investment and GDP estimated with our macroeconomic model (see Figure A.1 for an overview).

In Appendix A, we explain our estimations within the balance sheet model. The estimation of the macroeconomic effects is described in Appendix B.

**Figure A.1**
**Overview of the model framework**




## DATA AND SAMPLE

For our estimations, we use three primary sources of data:

- **The results from the EBA transparency exercise:** the EBA transparency exercise contains detailed information on the regulatory capital for 111 banks across 24 European countries. The data includes information on original exposures, exposure values (exposure at default in BIS terminology) and risk-exposure amounts (REA) for credit risk split across different asset classes. It also contains data on own funds, total assets and liabilities as well as data from the banks' income statements. This data forms the basis for the calculations within the balance sheet model. The data are from end December 2019.

- **EBA impact assessments:** the EBA impact assessments provide a detailed analysis of the expected impact of the Final Basel III Standard. We closely follow the results obtained in the EBA impact assessments in that we calibrate the country-average impact obtained in our model to the numbers estimated by EBA for all countries but Denmark.[36] We mainly use data from EBA's updated impact assessment[37] published in 2020 that uses data from December 2019 as well. When specific data needed for the analysis was only available in the first update of the impact assessment[38] or in the original impact assessment from 2019[39], we resorted to either of these impact assessments.
- **Annual reports**: To estimate the share of exposure to corporate customers that is secured on real estate we complemented the data from EBA's transparency exercise with data from the annual reports of the Danish banks in our sample and the associated mortgage credit institutions.

Additionally, we use data from the European Systemic Risk Board to obtain information on additional European capital buffers currently in place (e.g., the countercyclical capital buffer or the systemic risk buffer).[40] We assume that with the updated framework introduced by CRD V the O-SII buffer will replace the systemic risk buffer for Danish banks (which is currently at around 2.5% on average for the Danish banks in our sample).

The Danish banks covered in our sample are: Danske Bank A/S, Jyske Bank A/S, Nykredit A/S, and Sydbank A/S. These four banks account for around 80% of the Danish banking market. We have obtained additional input from two of these banks and have fine-tuned our model results for these banks according to the input we have received.

## ESTIMATION OF THE IMPACT ON CAPITAL REQUIREMENTS OF THE FINALISATION OF BASEL III

The finalisation of Basel III can impact banks' capital requirements through different channels such as the revision of the standardised approach to credit risk (CR-SA) as well as the internal ratings-based approach, adjustments in the calculation of CVA, market risk and operational risk capital requirements and the output floor.

Our estimation is carried out in five steps:

- Step 1: Original exposure values and risk exposure amounts
- Step 2: Implementing the measures of the package, except output floor
- Step 3: Implementing output floor
- Step 4: Calibration to EBA country-specific MRC impact

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36 The impact for Denmark has been underestimated in the most recent EBA study due to an error in the reported data. We therefore calibrate our model to the Danish FSA's corrected calculation which estimates an increase in risk exposure of Danish banks of around 36% in the Basel III scenario.

37 EBA (2020) – Basel III Reforms: Updated Impact Study (Results based on data as of 31 December 2019)

38 EBA (2019b) – Basel III Reforms: Impact Study and Key Recommendations (macroeconomic assessment, credit valuation adjustment and market risk)

39 EBA (2019a) – Basel III Reforms: Impact Study and Key Recommendations

40 In our estimations we apply a countercyclical capital buffer of 2%, which is the buffer banks faced at the end of 2019. That buffer was subsequently reduced to 0% to mitigate the impact of the COVID-19 pandemic. However, we expect this to be a temporary measure and that the countercyclical capital buffer will be increased back up to 2% once the pandemic is overcome.

- Step 5: Simulating impact on interest rates.

## Step 1: Original Portfolios

First, we calculate the exposure values, risk exposure amounts (REA) and average risk weights for our portfolios (both for exposure classes under the CR-SA and the IRB approach):

- **SME**: including SME retail exposure, SME mortgage exposure as well as exposure to SME corporates.
- **Mortgage** is only composed of mortgage exposure to households.
- **Corporate**: exposure to corporates excluding corporate SMEs.
- **Public sector:** exposures to central banks, central government and other public sector entities.
- **Bank:** exposures to financial institutions.

The remaining credit portfolios (equity, securitisation and non-credit-obligation assets) are left unchanged and correspond to the exposure classes in the EBA transparency exercise.

Apart from the credit-risk portfolios we also include REA for market risk, operational risk, CVA as well as other remaining non-credit-risk portfolio REAs.

## Step 2: Impact of the measures other than the output floor

In this part of the calculation, we estimate the impact on the individual banks' REA of the revision of the standardised as well as the IRB approach, adjustments in the calculation of CVA, market risk and operational risk capital requirements.

In a first step, we estimate the revised standardised risk weights due to the finalisation of Basel III. Specifically, the current SA risk weights are calculated as the ratio of portfolio REA over portfolio exposure for each bank (giving the current portfolio risk weight) and are then adjusted according to the increase in exposure class standardised REA estimated in EBA's impact study.

The impact of the revision of the IRB approach is based on the portfolio impact of EBA's impact study and is calibrated to match the total change in REA due to the IRB revision on an EU level. We conduct these calculations for each of the different portfolios in our model.

The increase in REA due to CVA, market risk and operational risk is approximated by using the EU-average impact provided in the EBA. This implies that CVA REA increases by 572% for each bank in the implementation of the framework, as recommended in the EBA impact study. Market risk and operational risk are assumed to increase by 200% and 139%, respectively. We adjust the impact in Denmark to country-specific results estimated in the EBA impact assessment if country specific estimations are published, see Annex 2 in EBA (2019b).

We calibrate the overall country impact of all the measures except the output floor to the results in EBA's updated impact assessment.

## Step 3: Implementing the output floor

The output floor is implemented as the last requirement and it provides a lower bound for risk weights estimated using internal models for the determination of banks' risk exposure amount by

restricting risk exposure amounts to be at least 72.5% of the risk exposure amounts calculated under the standardised approaches. The output floor is applied on an aggregate level.

For assumptions regarding risk weights under the output floor, see appendix in CE (2020): "*EU implementation of the Final Basel III Framework*". These assumptions are adjusted to fit the Danish banking sector, based on input from the sector.

To determine the impact of the output floor, we calculate the 'hypothetical' REAs by applying the above risk weights to the banks' IRB exposures and then floor total REA by multiplying by 72.5%. The binding REA will be the largest of either the output floor REA or the pre-floor REA from step 2.

### Step 4: Calibration to EBA country-specific MRC impact

In a fourth step, we calibrate the new REA obtained from our model to the country-average results in the EBA report usind data from December 2020. In particular, we calibrate the increase in REA to the increase in MRC in the respective country (except for Denmark where we calibrate to the Danish FSA's corrected impact).

### Step 5: Impact of a change in capital requirements on interest rates

The impact on the portfolio borrowing costs is a consequence of the change in the bank-funding structure after the implementation of the Final Basel III Standard. Due to the increase in the capital need following the banking package, banks will need to finance a larger share of their credit portfolio with equity, which is more expensive than debt. We assume that banks keep the same CET1 ratio as before the implementation of the Final Basel III Standard. This means that banks are not able to use any buffer they might hold on top of the capital requirements to compensate for the increased capital requirements due to the Basel III revisions.

In general, the impact on funding costs for a portfolio is calculated as:

$$\text{Increase in risk weight} \bullet \text{capital ratio} \bullet (\text{equity cost rate} - \text{debt cost rate})$$

We make the simplifying assumption that the percentage point increase in funding costs will lead to an equivalent percentage point increase in borrowing costs, i.e. that banks fully pass on higher costs to their customers. In the calculations, we assume a required return on equity of 13% (10% after taxes) which is in line with an estimate in a recent study conducted by the EBF, covering the 50 largest banks in Europe.[41] In comparison, the assumed cost of equity in BIS (2010) is higher than what we assume, namely at 14.8%.

The debt-funding cost rate is estimated for each bank using data on bank interest expenses and financial liabilities from EBA's transparency exercise.

In our estimation, we also account for so-called 'Modigliani-Miller' effects (MM-effects). We assume that when the capital ratio increases by 1 percentage point, the cost of equity decreases by around 0.15 percentage points. The impact on borrowing costs from an increase in capital is thus mitigated by MM-effects. For a discussion on MM-effects, see Appendix B and Copenhagen Economics (2016a): "*Cumulative impact on financial regulation in Sweden*".

[41] See ZEB (2018).

Finally, we distribute the impact on operational risk REA across credit portfolios according to the share of the respective credit portfolio REA in total banks' credit risk REA.

APPENDIX B

# ESTIMATION OF THE MACROECONOMIC EFFECTS OF THE FINAL BASEL III FRAMEWORK

## MACROECONOMIC COSTS

To estimate the macroeconomic costs, i.e., the impact on GDP and investments, we use a model developed by Meh and Moran (2010). It is a so-called Dynamic Stochastic General Equilibrium (DSGE) model, which is a structural macroeconomic model. The model has a well-specified financial sector, which enables us to analyse the effects of higher banking costs.

There are several reasons why Meh and Moran (2010) is our preferred macro model:

1. The micro-foundation enables a modelling of banks' response to changing financial regulation. This includes adjustments, both on the asset and liability side, as well as the effects on lending rates.
2. The general equilibrium effects of the model allow for continuous feedback between the real economy and the financial sector. When higher capital requirements are introduced, this increases lending costs, which reduce investments and hereby compress GDP. This, in turn, decreases asset values, making lending even more costly, which reduces investments and thereby GDP further. This cycle continues until the economy has reached a new equilibrium. This is the so-called financial accelerator mechanism.
3. Finally, the paper by Meh and Moran (2010) is respected in academic literature, with numerous citations. The framework constitutes the theoretical foundation of applied models in many economic institutions. For instance, the Swedish Riksbank has used the framework to estimate the effects of Basel III in a paper from 2011. The method is thus a proven way to analyse the relationship between the real economy and changes in the capitalisation of banks.

The model can be calibrated to fit national economies, as described in the appendix of Copenhagen Economics (2016a) - *Cumulative impact of financial regulation in Sweden*.

### How our macroeconomic model works

In the model, there is a moral hazard issue between the households that hold deposits in the banks and the owners of the banks, called 'bankers'. The households cannot monitor whether the bank is monitoring their loans. If the bank does not monitor their loan, there is a risk that borrowers will choose a bad investment project which has a higher risk of default. Monitoring implies a cost to the bankers. Therefore, the households demand that the bankers hold equity to ensure that they have an incentive to monitor their loans – that they have 'skin in the game'.

If the monitoring costs increase, the incentive for the bankers not to monitor their loan increases (since it is costly) – therefore, the capital requirements from the households increase to ensure that the bankers have enough 'skin in the game' to monitor the loans. As a result, the capital requirement in the model can be increased through increasing the monitoring costs.

## Capital requirements and cost of capital

Fundamentally, a bank has two sources of finance, namely equity and debt. Of these, equity has the highest required return. If capital requirements increase, banks are forced to hold more of the expensive equity and their funding costs increase. The increase in funding costs is mitigated by – viewed in isolation – a decline in the required return on both equity and debt, since more equity implies a lower risk of bank failure.

In fact, taking a very simplistic view on finance – disregarding taxes, asymmetric information and regulation – if the capital requirements increase, the required return on debt and equity is reduced exactly so much that the overall funding costs of banks are unchanged. This is the so-called Modigliani-Miller irrelevance theorem. However, when tested empirically, this simplistic perception does not hold true, *cf. Box B.1 below*.

**Box B.1 Why the Modigliani-Miller theorem does not hold true**

1. **Tax shield**
   In contrast to equity, debt payments are tax exempt, and shifting to more equity will increase funding costs. Put simply, a bank needs to provide a larger return on investment simply to pay more in corporate taxes.

2. **Explicit guarantees**
   Through the deposit guarantee, the risk to private depositors is guaranteed, i.e., the required return on this part of the debt will not react to the funding structure.

3. **Implicit guarantees**
   When banks are too big to fail, the government implicitly takes on a part of the default risk, especially for 'unsecured' debt and equity holders. However, we think this plays a minor role now because banks are fairly well-capitalised.

4. **Creditors value bank debt highly**
   Liquidity production is a major element of banks' business models. Creditors tend to value bank debt highly due to its high liquidity, which implies that debt is a relatively cheap source of funding for banks. When banks are forced to replace debt with equity, this is undermined.

Thus, when capital requirements increase, the required return on debt and equity might decline, but overall funding costs will increase. The extent to which funding costs increase depends on factors such as the initial capitalisation level of the bank and the economic activity:

- *With low levels of equity*, an increase in equity will represent a significant reduction in the risk of bank failure. This will imply a significant reduction in the required return on equity and debt, which will curb the increase in the overall funding cost.
- *With high levels of equity*, the reduction in the risk of failure is already quite small and the required return will not decline very much. Equity finance will nevertheless still be more expensive than debt finance due to aforementioned reasons and the overall funding cost will increase.

The required return also depends on the level of activity in the economy:

- *In normal times*, the required return is hardly affected by higher capitalisation as investor sensitivity to default risk is low. Acquiring new equity or readjusting the portfolio is more costly than taking on debt leading to an increase in overall funding cost.
- *In crisis times*, a reduction in default risk can have a large impact on funding costs. Investors will, to a larger extent, discipline banks, as they are less prone to take on risks. Consequently, higher capital requirements will be somewhat offset by the decline in overall funding costs.

In general, the results in the literature are very fragmented and dependent on the data sample used. A study including banks in a 'normal situation' provides results different to one including thinly capitalised banks during the financial crisis. When including the latter, the stressed banks might have a strong influence on the overall results.

A main conclusion from the literature is that higher capitalisation has a distinct, non-linear impact on overall funding costs; above a certain threshold, investors will not consider a bank less risky if it increases the level of equity so overall funding costs will rise.[42]

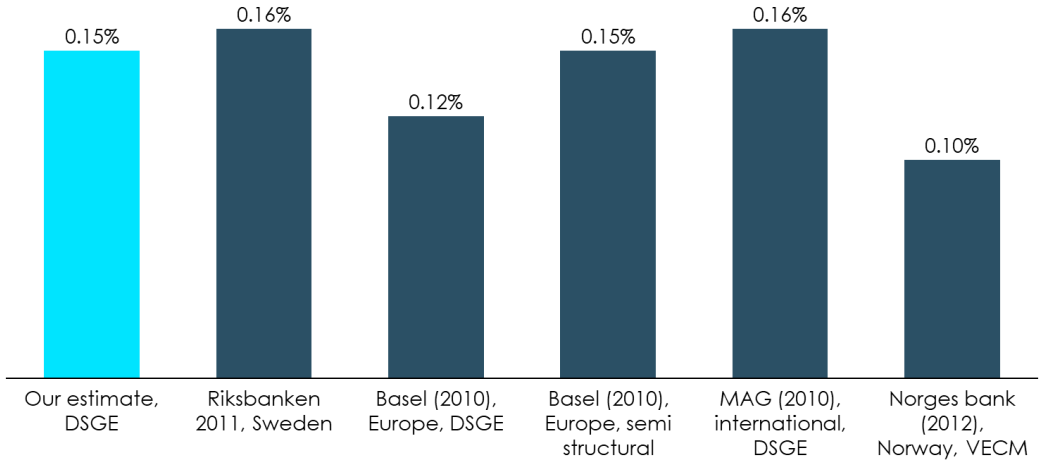
### Adjustment of macro-model impact

Our model impact on GDP from higher capital requirements might be in the high end. First, it does not include any Modigliani-Miller effects and second, and perhaps more importantly, there are no alternative funding sources that companies can switch to when banking financing becomes more costly. As discussed, this is particularly important for large corporates that can more easily switch to bond financing.

To incorporate this, we adjusted our macro-model estimate of 20% downward, giving rise to an estimate of a 0.15% decline in GDP for an increase in CET1 ratio requirement of 1 percentage point.

[42] See the appendix of Copenhagen Economics (2016): Cumulative impact of financial regulation in Sweden, for a more thorough discussion of the topic.

**Figure B.1**
**Our estimate compared to those of other institutions**
Decline in long-run GDP due to 1 percentage point increase in CET1 ratio requirements




Source: Copenhagen Economics.

## MACROECONOMIC BENEFITS

The macroeconomic benefit arises from reducing the risk of a crisis due to too low capital ratios.

To estimate the benefits, we need an estimate of 1) the impact of higher capital requirements on the risk of a crisis and 2) the macroeconomic costs of a crisis if it were to occur. The macroeconomic benefits can then be estimated as:

GDP benefit = 'Reduction in risk of crisis' • 'GDP cost of a crisis'

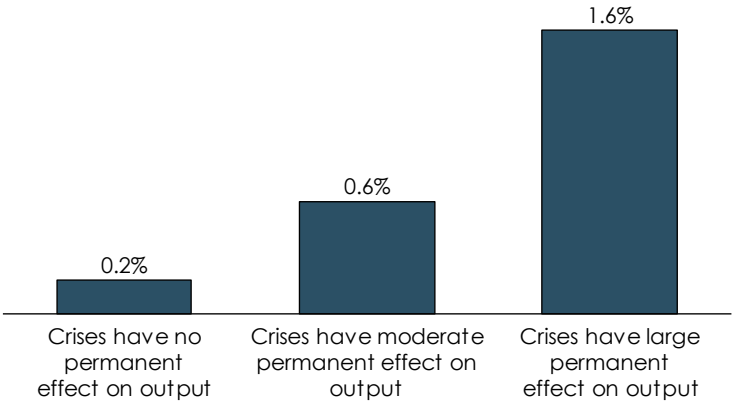
### 1) Cost of a crisis

The estimated benefits of reducing the risk of a crisis naturally depend on the assumed social and economic costs of a financial crisis. Although it is clear that the costs are immense, they are difficult to estimate and depend on several assumptions.

The estimated benefits of reducing the risk of a financial crisis depend largely on the assumptions made about the long-run effects on productivity. Standard macroeconomic theory suggests that shocks to the economy only have temporary effects and that the economy will eventually recover to its structural long-run level (i.e., that there is a 'steady-state' path unaffected by financial crises).

Basel (2010) summarises the results from several papers. They find that the benefit of reducing the risk of a crisis by one percentage point corresponds to a permanent increase in GDP of around 0.19% to 1.58%, depending on the assumptions, cf. Figure B.2 below:

**Figure B.2**
**Benefit of reducing the risk of a financial crisis by one percentage point**
% of GDP




Source: Basel (2010).

In our estimations documented in chapter 3, we have assumed that financial crises have moderate permanent effects on the output (estimate of 0.6%). This entails that after a crisis, GDP will at some point pick up the pre-crisis growth rate *but at a lower level*. The permanent loss in output stems partly from a lower level of business innovation during the crisis, due to an elevated number of bankruptcies and a deteriorated credit transmission impairing investment infrastructure.[43]

## 2) Risk of a crisis

Our results, described in section 3.2, is based on work from BIS (2010). BIS estimates the relationship between the probability of a banking crisis and the sector-wide average capital ratio. They find a clear non-linear relationship, with benefits converging towards zero. Given the capitalisation of the current EU banking sector, they find that an additional percentage point increase in the capital ratio decreases the risk of a crisis by 0.08 percentage points.

The estimations are based on six different statistical models, which, overall, reduce the risk of outlier results. Nevertheless, it should be mentioned that all six models are (at least to some extent) based on historical correlations under Basel I and II rules. This increases the uncertainty when the estimated relationships are used to assess capital adequacy under Basel III (which is higher and thus out of sample).

[43] See OECD (2012): Innovation in the crisis and beyond.

APPENDIX C

# EMPERICAL STUDIES ON VARIABILITY OF INTERNAL MODELS

Generally, empirical research on internal models – by BIS, EBA and IMF – finds some variability in prediction of internal models – however this variability is not biased towards lower capital requirements.

For example, a paper by BIS from 2013[44] finds that:

- For wholesale exposures, unwarranted variation can explain around 15-20% of variations in capital ratios. This means that the remaining 80-85% are explained by fundamentals.
- The variation due to model variability goes in both directions, i.e., is not biased towards lower capital requirements.

A more recent study by the EBA[45], analysing mortgage, SME and corporate portfolios – the so-called high-default portfolios – largely confirms this:

- 82% of the variability can be explained by observable factors, such as default status, country of the counterparty and portfolio mix, etc. The remaining 18% is either due to variability in credit risk within each portfolio or because of variability of the internal models.
- Model variability is not biased towards lower capital requirements. In fact: "*estimated values for PDs and LGDs are, in general, higher than the observed default rates and loss rates, which suggests that banks are, on average, conservative*"
- Expressing capital ratios based on observed default rates (rather than PD estimates) would only have a minor impact, i.e., the internal model-based capital adequacy ratios seem in line with observed default rates.

A paper by BIS[46] from 2016 also finds that model variation does not lead to capital ratios being biased:

- Estimates of PDs for retail and SME exposures are closely aligned with actual outcomes and tend to be higher than the actual long-run default rates for about two thirds of banks in the sample.
- Average LGD and EAD estimates are generally higher than the average actual loss rate and defaulted exposure outcomes.

Finally, a paper from IMF from 2017[47] finds "*that it is possible to harmonise risk weights without significant impact on bank capital*", "*is also in line with the ECB's most recent TRIM program*".

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44 BCBS (2013): *Analysis of risk-weighted assets for credit risk in the banking book.*
45 EBA (2017): *Results from the 2016 High Default Portfolios (HDP) Exercise*
46 *BCBS (2016): Analysis of risk-weighted assets for credit risk in the banking book*
47 IMF (2017): *Heterogeneity of Bank Risk Weights in the EU*