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## Quantifying the pull-to-par effect for German banks' bond portfolios

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# Technical Paper

Quantifying the pull-to-par effect  
for German banks' bond portfolios

06/2023

Lena Strobel

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## Non-technical summary

The rise in interest rates in 2022 has led to market price declines in German banks' bond portfolios. In some cases, banks reported bond losses in their profit and loss account; in bond portfolios which are measured at amortised cost, unrealised losses have built up instead. Unrealised losses can indicate future risks: if, for example, banks are forced to sell bonds that have already incurred unrealised losses in the future due to liquidity outflows, they would simultaneously have to realise the unrealised losses, i.e. report further losses.

In the coming years, however, there will be a recovery effect in bond portfolios, as the price of a bond corresponds to its par value, i.e. the redemption price, at maturity, regardless of temporary fluctuations in its value. The convergence of the price of a bond towards its par value is also known as the pull-to-par effect. This analysis quantifies the reversal of market price declines associated with the pull-to-par effect in the bond portfolios of German banks in the coming years. This is done by calculating the forward prices of each bond, where the forward price is the future price that the buyer and seller of a bond would agree upon today, as it results in the same return as an alternative investment at current interest rates.

The reversals of market price losses resulting from the pull-to-par effect in the bond portfolios of German banks amount to up to 0.69% of total assets. After two years, 39% of the reversals of market losses are expected to have taken place, and after five years 70%. Furthermore, an approximation shows that reversals of market price losses will lead to recognised valuation gains and a reduction in unrealised losses of roughly equal magnitude. As a result, the risk that hidden charges will lead to further realisation of losses in the event of a bond sale will also decrease over time.

The actual future performance of the bonds may diverge from the reversal of market price losses calculated here for various reasons. In particular, it should be noted that changes in the yield curve since 31 December 2022 have not been taken into account in the calculations. For example, a further rise in interest rates could lead to further losses on bonds, and reversals of write-downs resulting from the pull-to-par effect would be delayed.

The calculations and methodologies presented in this paper are also included in the Deutsche Bundesbank's 2023 Financial Stability Review (see Deutsche Bundesbank, 2023).

## Nichttechnische Zusammenfassung

Die Zinsanstiege im Jahr 2022 haben zu Marktpreiserückgängen in den Anleiheportfolios deutscher Banken geführt. Banken haben zum Teil Anleiheverluste im Bewertungsergebnis ausgewiesen; in Anleiheportfolios, welche zu fortgeführten Anschaffungskosten bilanziert werden, haben sich stattdessen stille Lasten aufgebaut. Stille Lasten können auf zukünftige Risiken hindeuten: Falls Banken beispielsweise aufgrund von Liquiditätsabflüssen zukünftig gezwungen sein sollten, Anleihen mit bestehenden stillen Lasten zu verkaufen, müssten sie gleichzeitig die stillen Lasten realisieren, also weitere Verluste ausweisen.

In den kommenden Jahren wird jedoch ein Erholungseffekt in den Anleiheportfolios eintreten, da der Preis einer Anleihe ungeachtet zwischenzeitlicher Wertschwankungen am Ende der Laufzeit dem Nennwert, also dem Rückzahlungspreis entspricht. Die Konvergenz des Preises einer Anleihe zu ihrem Nennwert wird auch als Pull-to-Par-Effekt bezeichnet. In der vorliegenden Analyse wird die in den kommenden Jahren eintretende Wertaufholung in den Anleiheportfolios deutscher Banken aus dem Pull-to-Par-Effekt ermittelt. Hierzu werden die zukünftigen Terminkurse jeder Anleihe berechnet, wobei der Terminkurs der zukünftige Preis ist, auf den sich Käufer und Verkäufer einer Anleihe aus heutiger Sicht einigen würden, da er zum gleichen Ertrag führt wie eine alternative Anlage zu den aktuellen Zinsen.

Die ermittelten Wertaufholungen aus dem Pull-to-Par-Effekt in den Anleiheportfolios der deutschen Banken belaufen sich auf bis zu 0,69 % der Bilanzsumme. Nach zwei Jahren haben sich voraussichtlich bereits 39 %, nach fünf Jahren 70 % der Wertaufholungen vollzogen. Weiterhin ergibt eine Annäherung, dass Wertaufholungen etwa zu gleichen Teilen zu Bewertungsgewinnen und zu einem Abbau stiller Lasten führen werden. Somit wird auch das Risiko, dass im Falle eines Verkaufs von Anleihen stille Lasten zu weiteren Verlusten führen, im Zeitverlauf abnehmen.

Die tatsächliche zukünftige Wertentwicklung der Anleihen kann aus verschiedenen Gründen von der hier errechneten Wertaufholung abweichen. Insbesondere ist zu beachten, dass Änderungen der Zinsstrukturkurve seit dem 31.12.2022 in den Berechnungen nicht berücksichtigt wurden. Beispielsweise könnten bei einem weiteren Anstieg der Zinsen weitere Verluste bei Anleihen auftreten und Wertaufholungen aus dem Pull-to-Par-Effekt würden sich verzögern.

Die in diesem Papier dargestellten Berechnungen und Methoden finden auch Eingang in den Finanzstabilitätsbericht 2023 der Deutschen Bundesbank (vgl. Deutsche Bundesbank, 2023).

# Quantifying the pull-to-par effect for German banks' bond portfolios

Lena Strobel<sup>1</sup>

## Abstract

The rise in interest rate levels in 2022 led to large losses in German banks' bond portfolios. The resulting unrealised losses also point to reduced profitability and, in the medium term, indicate the risk of further losses arising if unrealised losses end up having to be realised in the process of liquidating bonds. Based on the term structure as at end-2022 and taking into account implied forward interest rates, this analysis quantifies the pull-to-par effect, i.e. future reversals of market price losses which occur when the price of a bond converges towards its par value as it approaches maturity. In addition, the impact of the pull-to-par effect on the recognised net result and on unrealised losses is approximated. The results show how quickly the losses incurred by banks can likely be offset and how quickly risks arising from unrealised losses diminish.

*JEL Codes: G12, G21*

*Keywords: market risk, asset pricing, banks, financial stability*

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# 1 Introduction

The interest rate rises in 2022 led to sharp declines in bond prices and thus to significant losses in banks' bond portfolios. In cases where losses in market value were not recognised, unrealised losses have built up. Unrealised losses can be an indication of future risks, as they show that the bond portfolio is less profitable. If liquidity outflows force banks to liquidate bonds that have already incurred unrealised losses, they are also forced to realise the unrealised losses, meaning they have to report further losses. This can create a conflict between liquidity and profitability objectives.

A recovery effect in bond portfolios can be expected to materialise in the coming years seeing as the price of a bond corresponds to its par value at maturity, regardless of temporary fluctuations in its value, except where a deterioration in the bond issuer's credit quality leads to a partial default. The convergence of a bond's price towards its par value is also referred to as the pull-to-par effect. Based on the term structure as at the end of 2022 and taking into account implied forward interest rates, this analysis quantifies expected reversals of market price losses arising from the pull-to-par effect. Using appropriate assumptions, the analysis also approximates the valuation gains on the balance sheets of the institutions in question resulting from reversals of market price losses on bonds. This enables conclusions to be drawn about the period over which risks arising from unrealised losses can be expected to diminish again.

The calculations and methodologies presented in this paper are also introduced in the Deutsche Bundesbank's 2023 Financial Stability Review (see Deutsche Bundesbank, 2023).

## 2 Method

The pull-to-par effect is modelled based on calculations of the present value of bonds today and at the relevant future dates. The present value of a given bond<sup>2</sup> as of today (31 December 2022) is compared with the present value at future points in time, with the change in present value representing the pull-to-par effect (see Section 2.2). The next step is to approximate the extent to which the reversal of market price losses arising from the pull-to-par effect is expected to be reflected on institutions' balance sheets (see Section 2.3).

### 2.1 Data used

The calculations are performed using various data from national and international reporting systems. Some of these relate to individual securities and some to the level of individual institutions under analysis.

- **Securities Holdings Statistics (WP Invest):** granular information on banks' bond holdings and their ISINs (proprietary safe custody account).

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<sup>2</sup> Debt securities, except those with variable interest rates. Certificates and other interest-bearing instruments with unknown price functions are also excluded.



- **Centralised Securities Database (CSDB):** comprehensive information on bond characteristics at the ISIN level, containing data on coupon payments in annualised terms and residual maturities.
- **FINREP, COREP, SAKI, GVKI:** institution-level information on balance sheets, profit and loss accounts, other comprehensive income (OCI), as well as hidden reserves and unrealised losses.
- **EIOPA:** term structure as at 31 December 2022 for Germany and the United States.

The sample for analysis consists of 1,154 banks, with the analysis confined to the bonds in the banking book.<sup>3</sup>

## 2.2 Calculation of the pull-to-par effect

To calculate the pull-to-par effect  $PtP_s$ , the present value today,  $PV_{t,s=0}$ , is compared with the present value at future point in time  $s$ ,  $PV_{t,s}$ .

$$PtP_s = \frac{PV_{t,s}}{PV_{t,s=0}}$$

The present value today  $PV_{t,s=0}$  of a bond with a residual maturity of  $M$  years<sup>4</sup> is the sum of future cash flows  $CF_m$  discounted at the applicable spot rate<sup>5</sup>  $r_t(m)$  in each case.

$$PV_{t,s=0} = \sum_{m=1}^M \frac{CF_m}{(1 + r_t(m))^m}$$

The present value of a bond at future time  $s$ ,  $PV_{t,s}$ , is the sum of the cash flows still to be paid  $CF_{s+m}$  at time  $s$ , discounted at the applicable implied forward rate<sup>6</sup>  $r_t^{if}(s, m)$  in each case.

$$PV_{t,s} = \sum_{m=1}^{M-s} \frac{CF_{s+m}}{(1 + r_t^{if}(s, m))^m}$$

The implied forward rate  $r_t^{if}(s, m)$  is derived from the spot rate  $r_t(s)$  as follows:

$$(1 + r_t(s))^s \cdot (1 + r_t^{if}(s, m))^m = (1 + r_t(s+m))^{s+m}$$

$$r_t^{if}(s, m) = \sqrt[m]{\frac{(1 + r_t(s+m))^{s+m}}{(1 + r_t(s))^s}} - 1$$

<sup>3</sup> CRR institutions that are also deposit-taking institutions (MFIs), which report securities holdings to WP Invest and for which no reporting errors can be identified.

<sup>4</sup> To keep the required calculation work at a manageable level, the maximum value  $M$  can take is 150.

<sup>5</sup>  $r_t(m)$  is the spot rate of an investment in  $t$  to  $t + m$  for the period  $m$ , e.g.  $r_t(1)$  is the interest rate of an investment today for the period of one year.

<sup>6</sup>  $r_t^{if}(s, m)$  is the implied forward rate of an investment in  $t + s$  to  $t + s + m$  for the period  $m$ , e.g.  $r_t^{if}(2,1)$  is the interest rate of a bond in two years for the period of one year.

The underlying assumption is of no arbitrage. Thus, investments made in consecutive one-year periods at the respective forward rates have the same return as if the initial investment had been at the multi-year spot rate. To put it another way, the forward price  $PV_{t,s}$  on which the buyer and seller of a bond agree for future date  $s$  is, from today's perspective, an arbitrage-free price.

$$r_{t+s}(m) = r_t^{if}(s, m)$$

The analysis uses the portfolio level and term structure as at 31 December 2022; the pull-to-par effect is approximated over the horizon of the next 20 years. Cash flows within a maximum of up to 150 years are included in the calculations. Thus,  $t = 2022$ ,  $s = 1, \dots, 20$  years and  $m = 1, \dots, 150$  years.

### **2.3 Approximation of the balance sheet impact of the pull-to-par effect**

The valuation of bonds at market prices is not fully reflected on banks' balance sheets. Rather, accounting treatment in accordance with International Financial Reporting Standards (IFRSs) or the German Commercial Code (*Handelsgesetzbuch*) results in deviations from valuation at market price when it comes to the balance sheet reporting of bonds in the banking book. Where changes in market price are not reported on the balance sheet, hidden reserves or unrealised losses arise.

Under the IFRS framework, bonds are measured either at fair value<sup>7</sup> or at amortised cost. Bonds are assigned to different measurement categories based on criteria for their planned use (business model). For example, bonds which are held in order to collect contractual cash flows (solely payments of principal and interest) may be recognised at amortised cost. There is always the option of measuring bonds at fair value. Under the German Commercial Code, bonds are recognised at the lower of cost or market value, i.e. at whichever is lower of amortised cost or fair value. In addition, bonds in the banking book are assigned to current assets or other long-term assets. Only bonds classified as current assets are subject to the strict lower of cost or market principle; this means that when the market price decreases the bond has to be written down to the lower market price on the balance sheet. By contrast, bonds which are classified as other long-term assets and are therefore intended to serve business operations in the long term are subject to the less strict lower of cost or market principle. In this case, banks can choose whether or not to write down bonds to the lower market price in the event of market price drops which are probably temporary (due to interest rate hikes, for instance).

In summary, the balance sheet measurement categories which reflect market price changes are the fair value measurement categories under IFRSs, and the strict lower of cost or market principle for current assets under the German Commercial Code. For bonds held in these measurement categories, movements in market price are expected to also have an impact on

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<sup>7</sup> Specifically, under IFRS 9 the fair value measurement categories for bonds are designated at fair value through profit or loss (FVPL), mandatorily at FVPL and fair value through OCI (FVOCI).

balance sheet valuation.<sup>8</sup> As it is not known which accounting rules are followed when measuring individual securities, the balance sheet impact of the pull-to-par effect is approximated as follows using two scaling factors for bank *i*.

The first scaling factor  $scalar1_i$  takes into account the share of market price changes for bonds in 2022 that bank *i* also reported on the balance sheet in the same year, i.e. that led to gains or losses. Market price changes of the institutions under analysis are approximated by identifying the bonds in the banking book as at 31 December 2021 at the ISIN level and tracking market price developments up to 31 December 2022. The balance sheet impact in 2022 is approximated at bank level from reporting data.<sup>9</sup>

$$scalar1_i = \frac{balEffect2022_i}{marketEffect2022_i}$$

The second scaling factor  $scalar2_i$  approximates the share of the bond portfolio of bank *i* in the banking book as at 31 December 2022 which is held in measurement categories that are sensitive to market price movements. For IFRS institutions, these are the fair value measurement categories; for Commercial Code institutions, they are bonds classified as current assets and thus subject to the strict lower of cost or market principle. The information is taken from COREP reporting on a bank-by-bank basis.

$$scalar2_i = \frac{Holdings\_marketsensitive_i}{Holdings_i}$$

The balance sheet impact of the pull-to-par effect at time *s* of a bond held by bank *i* is attained by scaling using the scaling factors  $scalar1_i$  and  $scalar2_i$ . For Commercial Code institutions, it is included in the securities-related valuation result, which is part of the profit and loss account (P&L). For IFRS institutions, some effects are evident in P&L and some in OCI in the relevant valuation items for securities.

$$BalEffect\_PtP_{is} = PtP_s * \frac{scalar1_i + scalar2_i}{2}$$

To simplify matters, it can be assumed that reversals of market price losses from the pull-to-par effect, where these do not lead to recognised reversals, result in a reduction of unrealised losses.<sup>10</sup>

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<sup>8</sup> It must be borne in mind that, under the German Commercial Code, bonds are nevertheless not recognised at market price. Discrepancies arise, first, from the lower of cost or market principle in conjunction with the upper limit, according to which the value at amortised cost may be lower than the market price. Second, pursuant to Section 340f of the Commercial Code, institutions who prepare their financial statements according to the Commercial Code have the option of recognising securities 4% below the calculated lower of cost or market value and thus forming hidden reserves. Furthermore, under both the Commercial Code and IFRSs, changes in the value of securities are not reflected on the balance sheet if they qualify as hedging relationships together with derivatives whose prices move in opposite directions (hedging in the narrower sense).

<sup>9</sup> Note that, in some cases, it is only possible to determine overall securities losses from reporting data; in other words, they contain not only bond losses but also losses on shares and fund shares.

<sup>10</sup> This is a simplification, since there is no balance sheet impact in the case of hedging relationships (hedging in the narrower sense), but at the same time no unrealised losses are likely to have arisen in the past which could now be reduced as a result of the pull-to-par effect.

### 3 Results: Impact of the pull-to-par effect

#### 3.1 German banking sector

Figure 1 shows that over time, the pull-to-par effect leads to market value losses for bonds in the German banking sector being reduced by up to 0.69% of total assets. The calculated balance sheet impact in the form of valuation gains accounts for a maximum of 0.34% of total assets. Furthermore, after five years, a large proportion of the market value losses should have already been reversed by the pull-to-par effect. In the banking sector as a whole, 39% of the pull-to-par effect takes place after two years, and 70% after five years. The average residual maturity of the bonds in the banking book is 8.3 years.

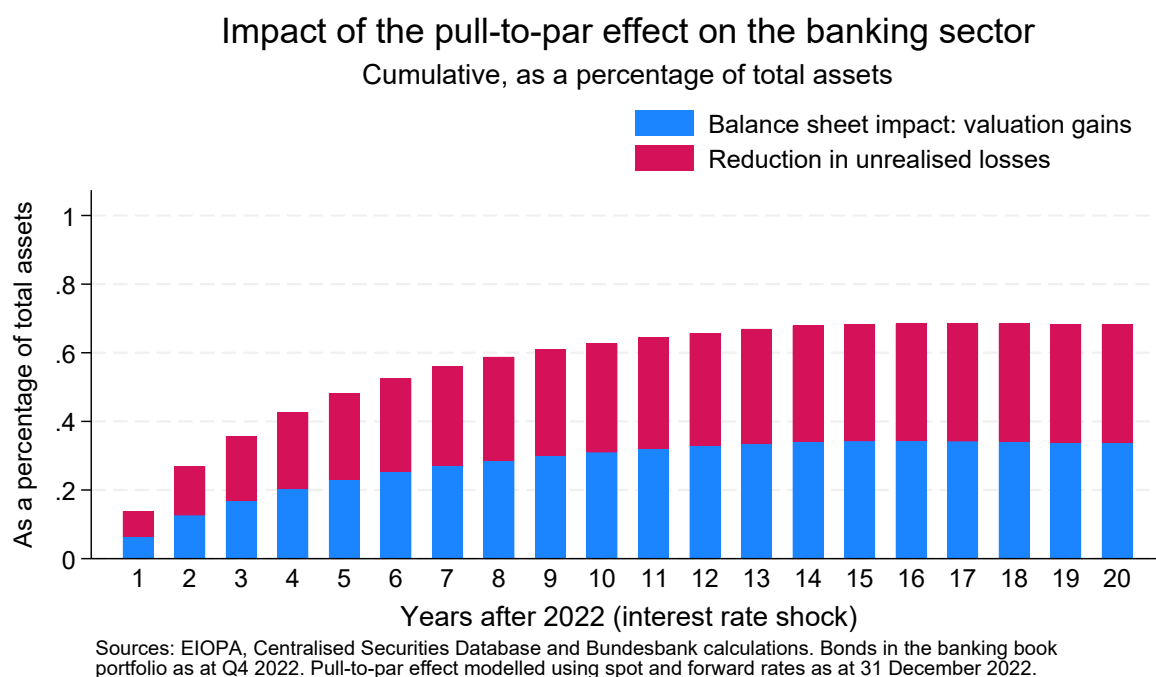


Figure 1: Impact of the pull-to-par effect on the banking sector

By comparison, recognised losses incurred on banking book securities in 2022 amounted to 0.34% of total assets, while the net volume of hidden reserves and unrealised losses<sup>11</sup> decreased by 0.52% of total assets. The maximum expected recognised gains resulting from the pull-to-par effect are therefore broadly comparable in scale with the recognised losses actually incurred in 2022, especially as the majority of these losses are likely attributable to losses sustained on bonds on account of the interest rate hikes in 2022.<sup>12</sup>

#### 3.2 Selected categories of bank

In the case of other systemically important institutions (O-SIIs), the pull-to-par effect could lead to reversals of market value losses for bonds of up to 0.4% of total assets over time (Figure

<sup>11</sup> In the case of IFRS institutions, the stock of unrealised losses is used rather than the change in net hidden reserves and unrealised losses, because reports on unrealised losses were available for the first time as at the end of 2022.

<sup>12</sup> The actual losses incurred are not fully comparable with the valuation gains calculated from the pull-to-par effect: for one thing, the recognised losses relate to losses that include hedging relationships with hedging instruments of all securities (i.e. shares and fund shares in addition to bonds). For another, losses may have been incurred in 2022 on securities that were already sold over the course of 2022. These would no longer have formed part of the institutions' portfolios as at 31 December 2022 and would therefore not serve as inputs in calculations of the pull-to-par effect, either.

2). The calculated balance sheet impact in the form of valuation gains comes to a maximum of 0.21% of total assets. For O-SIIs, 68% of the total pull-to-par effect is expected to have occurred after five years. The average residual maturity of the bonds in the banking book at O-SIIs is 10.7 years.

**Impact of the pull-to-par effect (O-SIIs)**  
 Cumulative, as a percentage of total assets

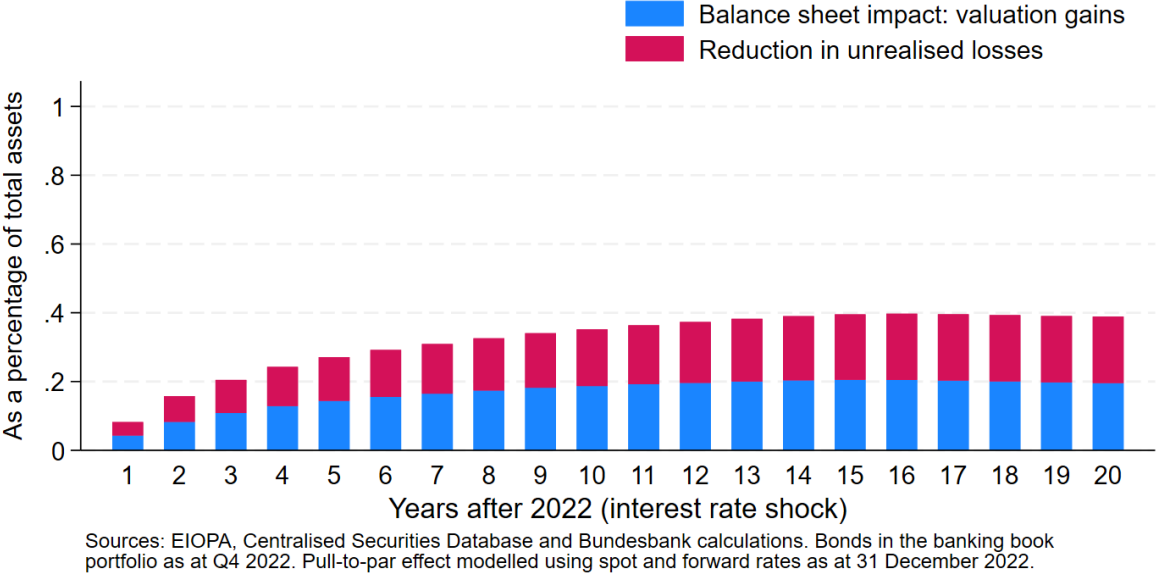
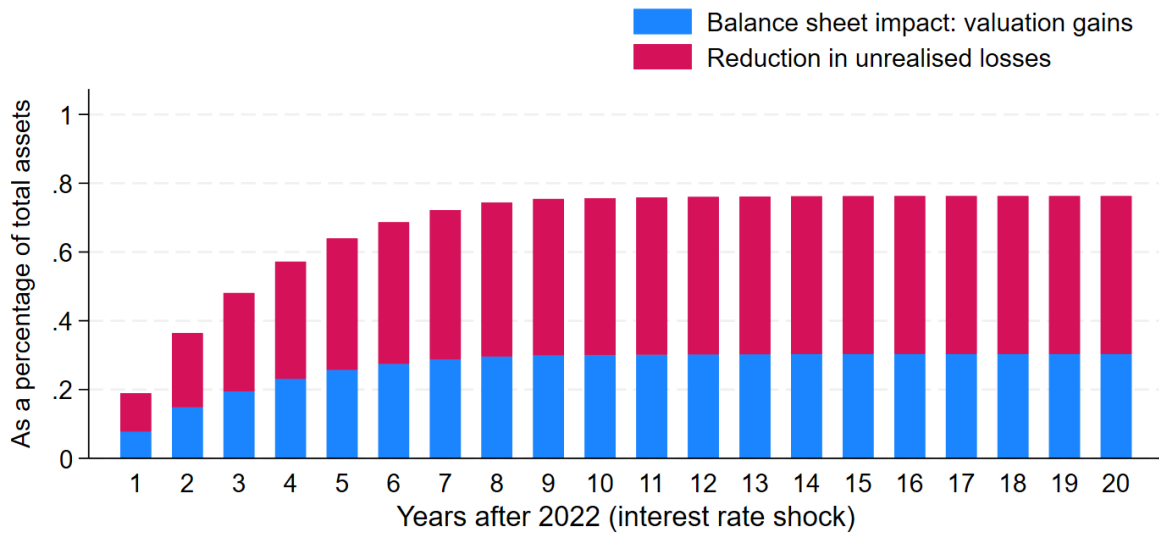


Figure 2: Impact of the pull-to-par effect (O-SIIs)

At primary institutions, future reversals of market value losses on bonds resulting from the pull-to-par effect are calculated at up to 0.76% of total assets at savings banks (Figure 3) and 0.93% of total assets at credit cooperatives (Figure 4). The percentage of the pull-to-par effect that will already have occurred after five years is 84% for savings banks and 81% for credit cooperatives. The relatively rapid reversal of market value losses is due to the short average residual maturity of the securities portfolios, which is 5.3 years at savings banks and 5.1 years at credit cooperatives for bonds in the banking book.

## Impact of the pull-to-par effect (savings banks)

Cumulative, as a percentage of total assets

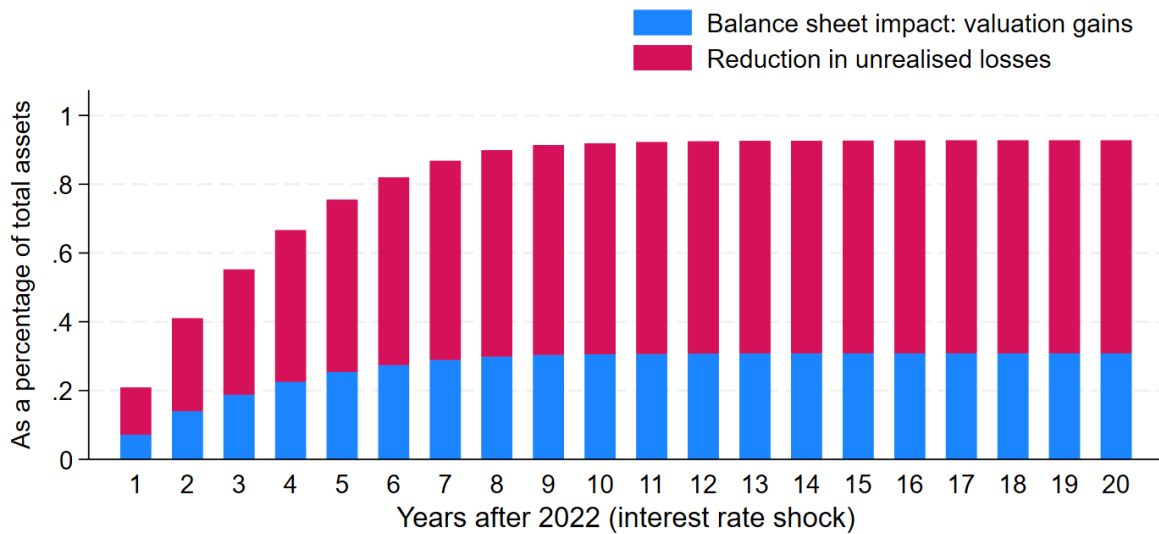


Sources: EIOPA, Centralised Securities Database and Bundesbank calculations. Bonds in the banking book portfolio as at Q4 2022. Pull-to-par effect modelled using spot and forward rates as at 31 December 2022.

Figure 3: Impact of the pull-to-par effect (savings banks)

## Impact of the pull-to-par effect (credit cooperatives)

Cumulative, as a percentage of total assets



Sources: EIOPA, Centralised Securities Database and Bundesbank calculations. Bonds in the banking book portfolio as at Q4 2022. Pull-to-par effect modelled using spot and forward rates as at 31 December 2022.

Figure 4: Impact of the pull-to-par effect (credit cooperatives)

## 4 Conclusion

The present analysis quantifies the reversals of market value losses that German institutions' bond portfolios are expected to see in the coming years owing to the pull-to-par effect at up to 0.69% of total assets. In addition, it provides a simple approximation of the extent to which the expected market price recoveries are also reflected in the balance sheet valuation of bonds and lead to valuation gains. The expected recognised valuation gains amount to up to 0.34%

of total assets, with 39% of this impact across the sector expected to have already materialised after two years and 70% likely to have taken place after five years. Unrealised losses in bond portfolios will likewise decrease accordingly over time, and so, therefore, will the risk of further losses having to be realised as a result of sales of securities and thus recognised on the balance sheet.

It should generally be noted that the results are subject to some restrictions. First, the calculated reversals of market value losses relate to securities held by the institutions as at 31 December 2022. Future dynamic balance sheet changes (purchases and sales of securities) cannot be taken into account. Second, the calculated reversals of market value losses relate to the term structure as at 31 December 2022. Changes to the term structure since this point in time have not been accounted for, and, as with further changes to the term structure going forward, may lead to further changes in the valuation of securities. For example, a further increase in the term structure could result in additional losses being sustained on bonds and the pull-to-par effect being delayed. Third, in addition to the term structure, changes in risk spreads also have an impact on the valuation of securities, which is not taken into account here. Fourth, as can be seen in Section 2.3, there is uncertainty around how institutions value individual securities in the banking book, i.e. whether these are assigned to current assets or other long-term assets (at Commercial Code institutions), or whether they are measured at fair value or amortised cost (at IFRS institutions). Banks can also influence the extent to which market value gains on securities are reflected in the profit and loss account by means of other accounting measures, such as the build-up of hidden reserves pursuant to Section 340f of the Commercial Code.

As a final point, the analysis does not cover all aspects relevant to the profitability of the bond portfolio. Although the pull-to-par effect analysis helps to show the extent to which valuation losses that occurred as a result of the interest rate hikes in 2022 are expected to be offset again, the relatively low interest income from the bond portfolios in turn has an adverse effect on institutions' net interest income, which is not considered here.

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