*Journal of Applied Finance & Banking, Vol. 12, No. 2, 2024, 119-134*
*ISSN: 1792-6580 (print version), 1792-6599(online)*
*https://doi.org/10.47260/jafb/1427*
*Scientific Press International Limited*

# Determinants of Asset Value Adjustments: The Case of Germany's Cooperative Banks

**Richard Reichel**[1]

## Abstract

This paper studies the driving forces behind asset value adjustments in the German cooperative banking sector. Firm-specific as well as macroeconomic factors are considered. We estimate a Vector Error Correction Model for the post-unification period from 1992 to 2022. The main factor behind the improvement in value adjustments is the declining long-term interest rate. Besides these macroeconomic factors, the average bank size and the loans-to-deposits ratio are important. The trend towards larger banks has counteracted the improvement as well as the more loan-oriented business strategy of recent years.

**JEL classification numbers:** C580, C58, G21, P13, P34.
**Keywords:** Cooperative Banks, Asset Value Adjustments, Mergers, Vector Error Correction Model.

---

[1] FOM University, Essen, and Nuremberg Research Institute for Cooperative Studies.

Article Info: *Received:* February 24, 2024. *Revised:* March 10, 2024.
*Published online*: March 28, 2024.

## 1. Introduction

Cooperative banks have a relatively high market share in Germany. More than 700 independent banks account for about 20 percent of loans or deposits (Kowallik 2021, Stappel 2023). Credit cooperatives are very stable banks, bankruptcies are virtually non-existing. In case of economic difficulties, weak banks typically are merged with more profitable neighbors under the auspices of the mutual security institution, the “Sicherungseinrichtung”. During and after the financial crisis 2008/2009, the German cooperative banking sector was the only sector that did never receive government support, contrary to the sectors of savings banks and private credit institutions. This was due to relatively high equity ratios and a profitable, regionally oriented, low-risk business model. This business model still follows the ideas of the German cooperative founding father Friedrich Wilhelm Raiffeisen. However, eight years before the outbreak of the financial crisis, the notion, that the regionally restricted business model of credit cooperatives can be characterized by low risks, was challenged by Beckmann (2000). He hypothesizes that it is precisely the personal relationships that often exist between bank employees and loan customers that encourage people to grant risky loans. Following Beckmann, this is indicated by the “extremely high need for value adjustments compared to other banking groups”. Beckmann empirically supports his hypothesis of low risk awareness by above-average impairments and write-downs.

## 2. Literature Findings

Though an important aspect, the literature is largely silent regarding the cooperative-specific determinants of impairments and write-downs. The German Bundesbank (Central Bank) reported determinants of value adjustments in the Financial Stability Review 2009 (Deutsche Bundesbank, 2009). Here, the (absolute) loan losses of all German banks are estimated based on the balance sheet data of individual institutions. Explanatory variables are the balance sheet total, the credit ratio, the proportion of non-performing loans, the rate of change in real gross domestic product, as well as the short-term interest rate (one-year interest rate) and the long-term interest rate (ten-year rate). Institute-specific determinants are recorded within the framework of the selected panel model, but are not specified or discussed. There is also no measure for the goodness of fit of the estimation equation. Write-downs in securities were not estimated.
The simple OLS panel estimates uncover the following relationships:

- Higher economic growth reduces depreciation expenses.
- The higher the proportion of non-performing loans, the higher the need for value adjustment.
- Higher long-term interest rates increase the risk of insolvency for companies and thus the credit default risk.

- In addition to GDP growth, short-term interest rates reflect the business cycle. Higher short-term interest rates tend to correspond to upswing phases in which the credit risk of default is lower.
- Regarding the average balance sheet total (bank size), the relationship is positive. The larger the bank, the higher impairments.
- A higher loan-to-deposit ratio leads to increased value adjustments.

However, the Bundesbank's approach does not allow any statement to be made about the need for value adjustments and its determinants in credit cooperatives. In the aftermath of the financial crisis/great recession a number of studies was published, analyzing the determinants of non-performing loans (NPL), as a part of the broader defined value adjustments. Contrary to the Bundesbanks' approach, multi-country samples were used mostly.

Klein (2013) uses a panel VAR model for 16 Central, Eastern, and South-Eastern Europe country in the period of 1998-2011. Both macroeconomic as well as firm-specific determinants were found to play a role. However, macroeconomic variables like GDP growth, unemployment, and inflation were more important than bank-level factors. In the latter group profitability and equity ratios were inversely related to NPLs, whereas loan-growth and the loans-to-assets ratio positively affected the volume of NPLs. Interest rates were not included as determinants. Specific conclusions regarding cooperative banks cannot be drawn.

Messai and Jouini (2013) analyze determinants of NPLs in a sample of 85 larger banks in Spain, Italy, and Greece in the period of 2004-2008. The authors estimate a fixed effects model relating NPL to macro and bank-specific variables. Low GDP growth, high unemployment rates, and high real interest rates are all conducive to high NPL level. Higher profitability reduces NPLs. All in all, the macro variables seem to play a more important role, if t-statistics are used as proxies for standardized coefficients. However, the results of the study are hardly transferable to cooperative banks.

Makri, Tsagkanos, and Bellas (2016) investigate the determinants of NPLs in 14 Eurozone countries in the pre-crisis period 2000-2008. They estimate an unbalanced panel with 120 observations and include the standard firm-level and macroeconomic determinants. Lower GDP growth, higher unemployment rates increase NPLs. Regarding bank-specific variables, lower profitability precedes increasing NPLs due to decreasing risk aversion. However, the study did not include interest rates which may cause an omitted variable bias. Seemingly, cooperative banks were not included.

A later paper by Anastasiou, Louri, and Tsionas (2016) also refers to the Euro area countries. The authors use an unbalanced panel in the period of 1990-2015 with quarterly data and apply the GMM estimator. Firm-specific as well as macroeconomic variables as determinants of NPL are included. Basically, the researchers confirm previous findings, e. g. the role of the unemployment rate. A novelty is the inclusion of income tax rates and the output-gap which both prove significant.

The study by Ciukaj and Kil (2020) concentrates on seven southern and south-eastern European countries with a high NPL exposure. The authors use a panel-based approach and present estimates for the period from 2011 to 2017. Contrary to previous studies, a large number of firm-level and macroeconomic factors are included. The main results are: A high level of NPLs is associated with lower GDP growth rates, higher unemployment rates, higher interest rates, higher house prices, and higher market concentration, as far as macroeconomic determinants are concerned. Regarding firm-specific factors, a higher level of NPLs is associated with smaller banks, a lower loans-to-assets ratio, and lower returns on assets. As in all other cases, the paper does not differentiate between different types of banks.
A different approach explicitly directed towards cooperative banks was taken by Coen et al. (2018), researchers of the Bank of England. The authors do not directly evaluate the determinants of value adjustments, but analyze the determinants of a credit union failure in the United Kingdom using a logistic regression model. Although the left-hand side variable (failure) is different from value adjustments, it can be argued that significant write-offs or impairments put bank profitability under pressure and thus may finally lead to a failure. As in the Bundesbank-study, the authors explicitly distinguish bank-specific and macroeconomic determinants. Because of the use of bank-specific data, the study is also microeconomic in nature. The main results are as follows. The probability of failure is higher,

- the smaller the bank,
- the lower the equity ratio,
- the higher the percentage of unsecured loans,
- the higher the loans-to-deposit ratio,
- the lower the return on assets, and
- the higher the unemployment rate.

These results are mostly in accordance with the Bundesbank results but not fully comparable because of differences in the dependent variable, the banks targeted, and the bundle of exogeneous variables. Regarding the role of bank size, the results are conflicting. The Bundesbank reveals that size is bad for value adjustments! The long-term interest rate is not considered a determinant in the Bank of England paper.

# 3. Data and Econometric Analysis

Following the literature, this paper distinguishes two aspects that may affect value adjustments (VALADJ) or write-offs of a bank. The dataset was compiled from a series of the Monatsberichte der Deutschen Bundesbank (monthly reports), annual September issues.[2]

On the one hand, determinants may be firm-specific, one the other hand they may be related to macroeconomic factors. We deviate from previous approaches in estimating a time series model explicitly for cooperative banks in Germany. Secondly, we apply cointegration techniques, which were so far not used.

In our study, we include the following variables:

*Firm-specific factors*
Total assets as a measure of bank size (AVTOTASS)
Source: Bundesverband der Deutschen Volksbanken und Raiffeisenbanken (2023). Entwicklung der Volksbanken und Raiffeisenbanken von 1970 bis 2022.[3]

Loans-to-deposit ratio (LDR)
Source: same as variable AVTOTASS

*Macroeconomic factors*
Growth rate of real gross domestic product (GRO)
Source: Statista (2023a). Veränderung des realen Bruttoinlandsprodukts (BIP) in Deutschland gegenüber dem Vorjahr von 1992 bis 2023.[4]

Long-term interest rate (LR)
Source: Statista (2023b). Entwicklung des Kapitalmarktzinses in Deutschland in den Jahren von 1975 bis 2023.[5]

Term structure of interest rates (TSTR)
Source for short-term rates: Deutsche Bundesbank Zeitreihendatenbank, Geldmarktsätze nach Monaten.[6]

Unemployment Rate (U)
Scource: WSI Gender Datenportal (2023). Arbeitslosenquoten der Männer und Frauen in Deutschland 1991-2022.[7]

---

[2]Deutsche Bundesbank (various issues). Die Ertragslage der deutschen Kreditinstitute, Monatsberichte der Deutschen Bundesbank, various issues, for current issue see https://www.bundesbank.de/resource/blob/915924/d77f5fd7c20e003e02d69138605ff156/mL/2023-09-ertragslage-data.pdf

[3]https://www.bvr.de/p.nsf/0/F0F8A6D1636D3A1CC1257D0A00540564/$file/BVREntwicklungseit19702022.pdf

[4]https://de.statista.com/statistik/daten/studie/2112/umfrage/veraenderung-des-bruttoinlandprodukts-im-vergleich-zum-vorjahr/

[5]https://de.statista.com/statistik/daten/studie/201419/umfrage/entwicklung-des-kapitalmarktzinssatzes-in-deutschland/

[6]https://www.bundesbank.de/dynamic/action/de/statistiken/zeitreihen-datenbanken/zeitreihen-datenbank/759778/759778?listId=www_szista_mb03_neu

[7]https://www.wsi.de/de/erwerbsarbeit-14617-arbeitslosenquoten-26623.htm

Based on the literature findings, the following hypotheses can be made.

**H1:** The larger a bank, the higher the willingness to take risks. Traditional small cooperative banks in Germany are largely focused on small-scale, low-risk lending. Their regional business model implies good knowledge of the borrowers' financial standing. As bank sizes increase (due to mergers) this comparative advantage may fade and lending strategies may become more aggressive and willing to accept greater risks. Consequently, value adjustments may increase. We thus expect a positive relationship between value adjustments and bank size, although empirical evidence until now is mixed. (+)
**H2:** The higher the loans-to-deposit ratio, the more value adjustments can be expected. The business model of traditional German cooperative banks has always been driven largely by consumer deposits. This results in a loans-to-deposit ratio (LDR) below unity. Assuming that loans specifically entail more risks than deposits, a higher LDR will result in increasing value adjustments. This is in accordance with the literature. (+)
**H3:** The lower GDP growth rates, the higher value adjustments will be because of higher loan losses. (-)
**H4:** As the long-term interest rate (LR) may be interpreted as an overall economic risk indicator, it may thus be related to value adjustments directly. Higher interest rates may imply higher value adjustments. Even if long-term rates are primarily driven by the Central Banks' monetary policy, lower rates imply less tight monetary conditions and thus lower risks of loan defaults. The relationship between long-term rates and value adjustments should thus be positive. (+)
**H5:** The term structure of interest rates (long-term rate minus short-term rate, TSTR) is an indicator for short-term monetary policy conditions. If the term structure gets inverse (short rates > long rates), this indicates a restrictive monetary policy and thus the risk for the economy to slide into recession increases. In this case, higher value adjustments can be expected. (-)
**H6:** The higher the unemployment rate (U), the more impairments and write-downs can be expected. (+)

In our study, the dependent variable is the overall value adjustment (loans, securities) of German cooperative banks which is reported on an annual basis by the German Bundesbank. The official term is "result from the valuation of assets". Figure 1 displays a time series for the German cooperative banking sector from 1993 to 2022 (n = 30). Positive values indicate write-downs, i.e. losses from revaluation.

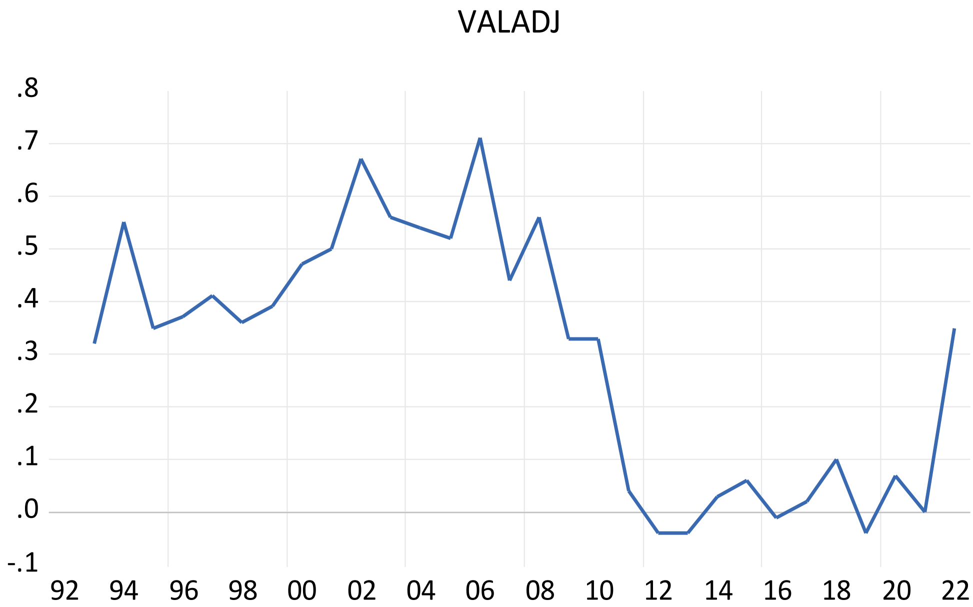


**Figure 1: Asset Valuation Adjustments - Cooperative Banking Sector Germany**

Between 1993 and 2006 German cooperative banks faced rather high value corrections. Since the mid-2000s, the situation improved. Surprisingly, the financial crisis and the great recession (2007 – 2010) did not affect German credit cooperatives negatively. Since the 2010s only very little write-offs were recorded, with the exception of 2022, when the pandemic-related losses manifested.

### 3.1 Bivariate Correlations

Next simple bivariate correlations are computed in order to check whether the hypotheses are rejected on the basis of a simple test, without taking into account the time series properties of the six series. Table 1 shows the correlation coefficients and the corresponding t-statistics.

**Table 1: Bivariate Correlation Coefficients**

| Correlation t-Statistic | VALADJ | AVTOTASS | LDR | GRO | LR | TSTR | U |
|---|---|---|---|---|---|---|---|
| **VALADJ** | 1.000000 | | | | | | |
| | ----- | | | | | | |
| **AVTOTASS** | -0.646472 | 1.000000 | | | | | |
| | -4.483734 | ----- | | | | | |
| **LDR** | 0.017121 | 0.481695 | 1.000000 | | | | |
| | 0.090608 | 2.908564 | | | | | |
| **GRO** | 0.018479 | -0.027584 | 0.136308 | 1.000000 | | | |
| | 0.097799 | -0.146017 | 0.728070 | ----- | | | |
| **LR** | 0.749193 | -0.922539 | -0.442696 | 0.032075 | 1.000000 | | |
| | 5.985277 | -12.64979 | -2.612472 | 0.169814 | ----- | | |
| **TSTR** | 0.301625 | -0.437962 | -0.113115 | -0.025319 | 0.465599 | 1.000000 | |
| | 1.674013 | -2.577860 | -0.602416 | -0.134020 | 2.783872 | ----- | |
| **U** | 0.792901 | -0.856276 | -0.164948 | 0.035270 | 0.824425 | 0.496552 | 1.000000 |
| | 6.885424 | -8.772172 | -0.884943 | 0.186747 | 7.707885 | 3.027053 | ----- |

The bank size variable (AVTOTASS) is significant but seemingly has the wrong sign. The bigger the average bank, the better the results from valuation adjustments. Long-term interest rates, however, show the predicted sign. The higher interest rates, the higher the valuation result. The same applies to the unemployment rate. All other variables are insignificant. Intercorrelations between independent do not reveal serious multicollinearity, except in two cases. The correlation between bank size and the unemployment rate on the one hand and the long-term interest rate on the other are high. We shall evaluate this potential problem later.

## 3.2 Order of Integration and Cointegration Test

The time series are next tested for the order of integration. We compute ADF- and PP-tests as these tests are appropriate when time series are very short (Arltová and Fedorová, 2016). Table 2 reports test results for the variables in levels, first and second differences.

**Table 2: Unit Root Tests**

| Variable | Test | Level | p-Value | First Diff. | p-Value | Sec. Diff. | p-Value | Conclusio |
|---|---|---|---|---|---|---|---|---|
| **VALADJ** | ADF | -1.473 | 0.532 | -2.551 | 0.115 | -13.879 | 0.000 | I(2) |
| | PP | -1.444 | 0.547 | -7.334 | 0.000 | -20.182 | 0.000 | I(1) |
| **AVTOTA** | ADF | 1.934 | 0.999 | -2.043 | 0.268 | -4.744 | 0.001 | I(2) |
| | PP | 3.127 | 1.000 | -2.123 | 0.238 | -3.881 | 0.007 | I(2) |
| **LDR** | ADF | -3.491 | 0.016 | -4.446 | 0.001 | -8.506 | 0.000 | I(1) or I(0) |
| | PP | -3.370 | 0.021 | -4.427 | 0.002 | -10.537 | 0.000 | I(1) or I(0) |
| **GRO** | ADF | -4.779 | 0.001 | -4.164 | 0.004 | -4.070 | 0.005 | I(0) |
| | PP | -10.445 | 0.000 | -17.582 | 0.000 | -24.116 | 0.000 | I(0) |
| **LR** | ADF | -1.849 | 0.351 | -4.751 | 0.000 | -4.385 | 0.002 | I(1) |
| | PP | -1.909 | 0.324 | -4.615 | 0.001 | -11.299 | 0.000 | I(1) |
| **TSTR** | ADF | -4.316 | 0.002 | -3.956 | 0.006 | -3.859 | 0.009 | I(0) |
| | PP | -3.561 | 0.013 | -4.907 | 0.001 | -10.299 | 0.000 | I(0) |
| **U** | ADF | 0.372 | 0.901 | -3.895 | 0.006 | -5.998 | 0.000 | I(1) |
| | PP | 0.372 | 0.902 | -3.839 | 0.007 | -12.935 | 0.000 | I(1) |

The tests reveal that the variables GRO and TSTR are I(0), i. e. stationary variables. Results for the dependent variable VALADJ depend on the test. In order to resolve the puzzle, an additional Ng-Perron Unit Root tests was conducted. The test shows, that the first differenced series is I(0), confirming the PP test. We therefore treat VALADJ as first difference-stationary, i. e. I(1). The LDR variable can be considered already I(0) at the 5 percent error level. At the 1 percent error level LDR is I(1). Given the rather low power of these tests and our relatively short time series, we prefer the more conservative error level and thus treat LDR as I(1). Contrary, the variable AVTOTASS is clearly I(2). The unemployment rate is I(1). The following list of variables related to their order of integration emerges.

I(0): GRO, TSTR
I(1): VALADJ, LR, LDR, U
I(2): AVTOTASS

It can now be discussed whether VALADJ should be considered a dependent variable in the classical sense or an endogenous variable in the sense of a Vector Autoregressive Model or a Vector Error Correction Model. From a theoretical perspective it cannot be ruled out that bank size (AVTOTASS) for example depends on macroeconomic factors. In order to account for potential feedbacks, we now treat the variable VALADJ, LR, LDR, U, and the first difference of AVTOTASS (D(AVTOTASS) as endogenous I(1) variables.
The results from the cointegration tests are mixed. We first conduct single-equation based Engle-Granger as well as Phillips-Ouliaris tests. Both tests do not indicate any cointegration among the variables. The result of the Johansen-Test is reported in Table 3.

**Table 3: Johansen Cointegration Test**

| Unrestricted Cointegration Rank Test (Trace) | | | | |
|---|---|---|---|---|
| **Hypothesized No. of CE(s)** | **Eigenvalue** | **Trace Statistic** | **0.05 Critical Value** | **Prob.** Critical Value** |
| None * | 0.736800 | 97.48856 | 69.81889 | 0.0001 |
| At most 1 * | 0.618648 | 61.44790 | 47.85613 | 0.0016 |
| At most 2 * | 0.533077 | 35.41904 | 29.79707 | 0.0101 |
| At most 3 | 0.392810 | 14.85608 | 15.49471 | 0.0622 |
| At most 4 | 0.050017 | 1.385411 | 3.841465 | 0.2392 |
| Trace test indicates 4 cointegrating equation(s) at the 0.05 level<br>* denotes rejection of the hypothesis at the 0.05 level<br>**MacKinnon-Haug-Michelis (1999) p-values | | | | |
| **Unrestricted Cointegration Rank Test (Max-eigenvalue)** | | | | |
| **Hypothesized No. of CE(s)** | **Eigenvalue** | **Max-Eigen Statistic** | **0.05 Critical Value** | **Prob.** Critical Value** |
| None * | 0.736800 | 36.04066 | 33.87687 | 0.0272 |
| At most 1 | 0.618648 | 26.02886 | 27.58434 | 0.0780 |
| At most 2 | 0.533077 | 20.56296 | 21.13162 | 0.0599 |
| At most 3 | 0.392810 | 13.47067 | 14.26460 | 0.0664 |
| At most 4 | 0.050017 | 1.385411 | 3.841465 | 0.2392 |
| Max-eigenvalue test indicates 1 cointegrating equation(s) at the 0.05 level<br>* denotes rejection of the hypothesis at the 0.05 level<br>**MacKinnon-Haug-Michelis (1999) p-values | | | | |

The Trace Test shows four cointegrating relations whereas the Max-Eigenvalue indicates a single cointegration equation.

### 3.3 Vector Error Correction Model

We therefore estimate a Vector Error Correction Model and test whether the loading coefficient of the Error Correction Term (ECT, lagged once) is negative and significant in the endogenous variables' equations. The variables GRO and TSTR are included as short-run exogenous regressors. Given the very short time series, we use only a time lag of one. The results are as follows.

**Table 4: Vector Error Correction Estimates – Model 1**

| **Cointegrating Eq:** | **CointEq1** | | | | |
|---|---|---|---|---|---|
| **VALADJ(-1)** | 1.000000 | | | | |
| **DAVTOTASS(-1)** | -0.007321 | | | | |
| | (0.00107) | | | | |
| | [-6.84988] | | | | |
| **LDR(-1)** | -0.047095 | | | | |
| | (0.00894) | | | | |
| | [-5.26992] | | | | |
| **LR(-1)** | 0.016796 | | | | |
| | (0.02256) | | | | |
| | [0.74437] | | | | |
| **U(-1)** | -0.118777 | | | | |
| | (0.01766) | | | | |
| | [-6.72443] | | | | |
| **C** | 4.884024 | | | | |
| **Error Correction:** | **D(VALADJ)** | **D(DAVTOT...** | **D(LDR)** | **D(LR)** | **D(U)** |
| **COINTEQ1** | -0.693244 | 75.10726 | -5.966405 | -3.104148 | 0.216175 |
| | (0.15177) | (14.6762) | (1.90841) | (0.62482) | (0.79949) |
| | [-4.56762] | [5.11762] | [-3.12638] | [-4.96808] | [0.27039] |
| **D(VALADJ(-1))** | -0.376678 | -31.62447 | 1.299473 | 1.162514 | -0.838320 |
| | (0.16748) | (16.1950) | (2.10591) | (0.68948) | (0.88222) |
| | [-2.24909] | [-1.95273] | [0.61706] | [1.68608] | [-0.95023] |
| **D(DAVTOTASS(-1))** | -0.004261 | 0.160173 | -0.012151 | -0.024276 | 0.011590 |
| | (0.00217) | (0.20987) | (0.02729) | (0.00894) | (0.01143) |
| | [-1.96345] | [0.76319] | [-0.44526] | [-2.71695] | [1.01374] |
| **D(LDR(-1))** | -0.030788 | 6.069508 | -0.139750 | -0.257462 | 0.091251 |
| | (0.01904) | (1.84135) | (0.23944) | (0.07839) | (0.10031) |
| | [-1.61681] | [3.29623] | [-0.58366] | [-3.28426] | [0.90971] |
| **D(LR(-1))** | 0.083831 | -6.007273 | -0.462389 | 0.124500 | 0.182738 |
| | (0.05554) | (5.37088) | (0.69840) | (0.22866) | (0.29258) |
| | [1.50931] | [-1.11849] | [-0.66207] | [0.54448] | [0.62458] |
| **D(U(-1))** | -0.005234 | 10.70999 | -0.827361 | -0.455121 | 0.520568 |
| | (0.03677) | (3.55528) | (0.46231) | (0.15136) | (0.19367) |
| | [-0.14234] | [3.01242] | [-1.78963] | [-3.00686] | [2.68785] |
| **C** | -0.013414 | 20.26987 | -1.320961 | -0.515632 | -0.149117 |
| | (0.04947) | (4.78349) | (0.62202) | (0.20365) | (0.26058) |
| | [-0.27117] | [4.23746] | [-2.12367] | [-2.53195] | [-0.57225] |
| **GRO** | -0.008434 | -2.208095 | 0.250082 | 0.092787 | -0.236664 |
| | (0.01042) | (1.00729) | (0.13098) | (0.04288) | (0.05487) |
| | [-0.80960] | [-2.19210] | [1.90928] | [2.16367] | [-4.31298] |
| **TSTR** | 0.050750 | -18.73085 | 1.083660 | 0.267610 | 0.329475 |
| | (0.03392) | (3.27986) | (0.42649) | (0.13964) | (0.17867) |
| | [1.49623] | [-5.71087] | [2.54086] | [1.91649] | [1.84404] |

| | | | | | |
|---|---|---|---|---|---|
| **R-squared** | 0.655473 | 0.704181 | 0.487757 | 0.660945 | 0.699888 |
| **Adj. R-squared** | 0.510409 | 0.579626 | 0.272076 | 0.518185 | 0.573525 |
| **Sum sq. resids** | 0.171712 | 1605.599 | 27.14887 | 2.910156 | 4.764667 |
| **S.E. equation** | 0.095066 | 9.192671 | 1.195361 | 0.391364 | 0.500771 |
| **F-statistic** | 4.518505 | 5.653570 | 2.261473 | 4.629765 | 5.538713 |
| **Log likelihood** | 31.58767 | -96.41694 | -39.29811 | -8.034309 | -14.93660 |
| **Akaike AIC** | -1.613405 | 7.529782 | 3.449865 | 1.216736 | 1.709757 |
| **Schwarz SC** | -1.185196 | 7.957990 | 3.878074 | 1.644945 | 2.137966 |
| **Mean dependent** | 0.000000 | 0.046429 | 0.321429 | -0.203929 | -0.164286 |
| **S.D. dependent** | 0.135865 | 14.17830 | 1.402473 | 0.565236 | 0.767494 |

The Error Correction Term is negative and significant in the short-run equation for the variable VALADJ. R-square for this equation is 0.655 which is quite high. Likewise, LDR and LR may also be endogenous, but we do not analyze this further as we are interested in identifying the determinants of value adjustments. There is, however a problem in the cointegrating equation in the upper section. The long-term interest rate is insignificant. It can be assumed that this is due to the collinearity between LR and U. A separate cointegration test for LR and U was conducted, with the result of co cointegration. Therefore, U was removed from the long-run equation.

**Table 5: Vector Error Correction Model Estimates – Model 2**

| Cointegrating Eq: | CointEq1 | | | |
|---|---|---|---|---|
| **VALADJ(-1)** | 1.000000 | | | |
| **LDR(-1)** | -0.092719 | | | |
| | (0.01863) | | | |
| | [-4.97679] | | | |
| **D(AVTOTASS(-1))** | -0.006168 | | | |
| | (0.00235) | | | |
| | [-2.61969] | | | |
| **LR(-1)** | -0.125391 | | | |
| | (0.02384) | | | |
| | [-5.25879] | | | |
| **C** | 7.967119 | | | |
| **Error Correction:** | **D(VALADJ)** | **D(LDR)** | **D(DAVTOTA...** | **D(LR)** |
| **COINTEQ1** | -0.622057 | -1.850652 | 32.77404 | -1.319324 |
| | (0.13102) | (1.90938) | (17.5017) | (0.73866) |
| | [-4.74788] | [-0.96924] | [1.87262] | [-1.78610] |
| **D(VALADJ(-1))** | -0.346768 | 0.152389 | -17.63034 | 0.563602 |
| | (0.16273) | (2.37148) | (21.7373) | (0.91743) |
| | [-2.13100] | [0.06426] | [-0.81106] | [0.61433] |
| **D(LDR(-1))** | -0.037659 | 0.048006 | 4.491525 | -0.189988 |
| | (0.02020) | (0.29442) | (2.69868) | (0.11390) |
| | [-1.86408] | [0.16306] | [1.66434] | [-1.66805] |
| **D(AVTOTASS(-1),2)** | -0.003862 | 0.003775 | 0.008714 | -0.017920 |
| | (0.00220) | (0.03203) | (0.29363) | (0.01239) |
| | [-1.75712] | [0.11785] | [0.02968] | [-1.44599] |
| **D(LR(-1))** | -0.035942 | -0.784704 | -1.837404 | -0.037261 |
| | (0.05006) | (0.72951) | (6.68677) | (0.28222) |
| | [-0.71802] | [-1.07566] | [-0.27478] | [-0.13203] |
| **C** | -0.013644 | -0.589984 | 11.14778 | -0.127608 |
| | (0.03982) | (0.58031) | (5.31924) | (0.22450) |
| | [-0.34263] | [-1.01666] | [2.09575] | [-0.56841] |
| **GRO** | 0.012869 | 0.258661 | -2.457636 | 0.100710 |
| | (0.00992) | (0.14450) | (1.32455) | (0.05590) |
| | [1.29784] | [1.78999] | [-1.85545] | [1.80151] |
| **TSTR** | -0.001757 | 0.334803 | -9.535781 | -0.116498 |
| | (0.02757) | (0.40174) | (3.68244) | (0.15542) |
| | [-0.06372] | [0.83338] | [-2.58953] | [-0.74958] |
| **R-squared** | 0.620293 | 0.241639 | 0.377822 | 0.299171 |
| **Adj. R-squared** | 0.480401 | -0.037757 | 0.148598 | 0.040970 |
| **Sum sq. resids** | 0.189246 | 40.19313 | 3376.964 | 6.015316 |
| **S.E. equation** | 0.099801 | 1.454451 | 13.33173 | 0.562668 |
| **F-statistic** | 4.434082 | 0.864862 | 1.648267 | 1.158677 |
| **Log likelihood** | 28.65601 | -43.68244 | -103.5014 | -18.04071 |
| **Akaike AIC** | -1.530075 | 3.828329 | 8.259365 | 1.928942 |
| **Schwarz SC** | -1.146123 | 4.212281 | 8.643317 | 2.312893 |
| **Mean dependent** | 0.000000 | 0.333333 | 0.048148 | -0.211481 |
| **S.D. dependent** | 0.138453 | 1.427747 | 14.44838 | 0.574561 |

In model 2, the insignificant loading coefficients reveal that LDR, LR, and DAVTOTASS can hardly be considered endogenous. In the cointegrating equation, LDR, and the first difference of AVTOTASS are significant. Contrary to model 1, LR is now highly significant after the removal of U. As in model 1, the short-run regressors are not significant.

Since the long-run relationship is normalized to VALADJ, the signs have to be reversed in order to check whether the result complies with the hypotheses.

Starting with LR, the coefficient reveals that value adjustments and interest rates are positively related. Higher interest rates lead to higher value adjustments. This result confirms the simple correlation relationship as well as the results of the Bundesbank study. The bank-specific factors LDR and AVTOTASS also show the predicted signs. As the relative importance of loans rises, value adjustment will also increase, which is in accordance with most literature findings. The same effect has an increase in the average bank size. This result contradicts other empirical results, but agrees with the original business model of cooperative banks. It also shows, how misleading simple correlation or OLS regression analysis can be. Note, that the simple correlation is negative, i.e. larger banks will have less write-downs.

In order to directly compare the effects of AVTOTASS, LDR, and LR in the cointegrating equation, standardized coefficients should be computed. As the EVIEWS software output does not report standardized coefficients, t-statistics can serve as a substitute. Comparing the t-stats shows that LR is the most important variable. The long-term downward trend of the capital market interest rate is thus the main driving factor behind the improved result from revaluations. Increasing bank size and the strategic shifts towards more lending have counteracted this. As the downward interest rate trend has come to an end in 2022, increasing average bank size due to mergers is likely to produce additional value corrections. It must be pointed out, that the creation of ever larger banks contradicts the traditional cooperative banking business model. Based on the t-statistics the two bank-specific variables account for approximately 59 percent of the total effect. These results do not, however, imply that banks get less profitable because of increasing value adjustments. Theoretically, this effect could be counteracted by economies of scale. For German cooperative banks, however, this theory has not yet been supported empirically (Abeska-Fritsch, 2014).

### 3.4 Short-run Effects

Apart from the long-run effects captured by the cointegrating equation, a few short-run effects will be discussed. First, the variables GRO and TSTR are insignificant, which is somewhat surprising. The annual changes of VA are significant and negatively related to last years' VA. This indicates rather quick corrections in case of too high or too low adjustments. Changes of the loans-to-deposit-ratio and changes of bank size are borderline significant, as the following table shows. However, given the rather short time series, this result should not be overinterpreted.

**Table 6: Block Exogeneity Wald Tests**

| **Dependent variable: D(VA)** | | | |
|---|---|---|---|
| **Excluded** | **Chi-sq** | **df** | **Prob.** |
| **D(LDR)** | 3.474800 | 1 | 0.0623 |
| **D(AVTOTASS,2)** | 3.087475 | 1 | 0.0789 |
| **D(LR)** | 0.515557 | 1 | 0.4727 |
| **All** | 4.976564 | 3 | 0.1735 |

The long-run interest rate does not have any short-run effect.

## 4. Conclusion

The purpose of this study is the identification of main determinants of value adjustments in the German cooperative banking sector. A cointegration analysis of aggregate time series for these banks revealed some interesting and, so far unknown results.

a) The only relevant macroeconomic variable in the long-run is the long-term interest rate. Value adjustments decrease with falling interest rates. This factor seems to be the main driving factor behind the significant reduction of cooperative banks' depreciation volume. Surprisingly, this variable has been rarely used in empirical research.
b) Short-term economic fluctuations (GDP growth, term structure of interest rates) did not play a significant role.
c) The growth in size of the average German cooperative bank has contributed to higher value adjustments. This result questions the growth and merger strategies of several banks. It supports, however, the traditional business model of rather small regionally oriented credit cooperatives.
d) The shift from the traditional deposit business to more loan-orientation seems to have increased the risk exposure of cooperative banks. As a result, value adjustments increased with a higher loan-to-deposit ratio.

## References

[1] Abeska-Fritsch, A. (2014). Fusionserfolg bayerischer Kreditgenossenschaften, Nürnberg, 2014.

[2] Anastasiou, D., Louri, H., and Tsionas, M. (2016). Determinants of non-performing loans: Evidence from Euro area countries, Finance Research Letters, 18, pp. 116-119.

[3] Arltová, M. and Federová, D. (2016). Selection of Unit Root Tests on the Basis of Time Series Length and Value of the AR (1) Parameter, Statistika, 96, 3, pp. 47-63.

[4] Beckmann, K. (2000). Die Dezentralität im genossenschaftlichen Bankensektor, in: Zeitschrift für das gesamte Kreditwesen, 2000, 3, pp. 120-122.

[5] Ciukaj, R. and Kil, K. (2020). Determinants of the non-performing loan ratio in the European Union banking sectors with a high level of impaired loans, Economics and Business Review, 2020, 6(1), pp. 22-45

[6] Coen, J., Francis, W. B., and Rostom, M. (2018). The determinants of credit union failure in the United Kingdom: how important are macroeconomic factors? Staff Working Paper No. 658, Bank of England. https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2018/the-determinants-of-credit-union-failure-in-the-uk-update.pdf

[7] Deutsche Bundesbank (2009). Financial Stability Review 2009, Frankfurt. https://www.bundesbank.de/resource/blob/626158/a393b7e5fa94e5f9370487504091b291/mL/2009-finanzstabilitaetsbericht-data.pdf

[8] Klein, N. (2013). Non-performing loans in CESEE: Determinants and impact on macroeconomic performance, IMF Working Paper 13/72.

[9] Kowallik, M. (2021). Die Coronapandemie hinterlässt Spuren-die Kernherausforderungen sind jedoch erheblicher, Vierteljahrshefte zur Wirtschaftsforschung, Duncker & Humblot, Berlin, Vol. 90, Iss. 2, pp. 81-96, https://doi.org/10.3790/vjh.90.2.81

[10] Makri, V., Tsagkanos, A. and Bellas, A. (2014). Determinants of non-performing loans: The case of Eurozone, Panoeconomicus, 2014, 61(2), pp. 193-206.

[11] Messai, A. S., and Jouini, F. (2013). Micro and macro determinants of non-performing loans, International Journal of Economics and Financial Issues, 2013, 3(4), pp. 852-860.

[12] Stappel, M. (2023). Die deutschen Genossenschaften 2023. DG Nexolution eG, Wiesbaden.