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CHANGES IN THE QUALITY OF THE LOAN PORTFOLIO IN THE POLISH BANKING SYSTEM

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Abstract

The aim of this study is to examine the impact of changes in market conditions, the financial standing of enterprises and banks` capital requirements on the quality of the corporate loan portfolio in the Polish banking sector before and during COVID-19. The methodology of changes in the quality of the loans portfolio (QLP) corresponds to the methodologies used by central banks, e.g. by National Bank of Poland (NBP) and International Monetary Fund (IMF). This research applied Vector Error Correction Model (VECM) and also impulse response functions and decompositions of variables. This research used quarterly time-series data during 2009–2020 and a simple moving average filter (SMA). The empirical results of the VECM confirmed the importance of indicators of revenues, economic development (GDP), investments and costs of obtaining revenues on the part of corporations and total own funds on the part of banks. Evaluation of the EC1 indicates that the strongest correction of the deviation from long-term equilibrium occurs in the case of the revenues from the overall activity of corporations (ROAC), GDP equations and gross fixed capital formation (GFCF) and costs of obtaining revenues from the overall activity of corporations (CROAC) equations. Results of the analysis of the impulse function and variance decomposition confirmed the importance of market indicators and the financial situation of companies in explaining changes in the QLP. Analysis of the QLP response to impulses from the explanatory variables confirmed that the strength of the influence of these impulses increased over time. In the 4th quarter, the strongest QLP responses to impulses came from: CPI, ROAC and GDP. Nevertheless, in the 19–20th quarter (5th year) of the forecast, the QLP response was the strongest, including apparently against ROAC and CPI. Results of QLP decomposition indicate that in the 1st quarter these changes are fully accounted for with their own forecast errors. In the 4th – 20th quarter, their own changes lose significance and mainly by CPI, ROAC and GDP grow in significance, with less importance of other variables. The added value of the analysis is that QLP research confirmed the pro-cyclical nature of lending activity in Poland in the verified years. The empirical results may be of practical use by banks in modeling the dynamics and quality of the corporate loan portfolio. These findings provide insights for future asset quality reviews (AQR) required by European supervision.

Keywords: *Corporate loan portfolio, Loan impaired, non-financial corporation, Polish banking system, VECM.*

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1. INTRODUCTION

In case non-performing loans (NPLs), i.e. when customers do not meet their agreed repayment arrangements (for 90 days or more), the bank must set aside more capital on the assumption that the loan will not be paid back. This reduces its capacity to provide new loans. Limiting lending on the part of banks means limiting the sources of financing investments among enterprises and, further, increases unemployment in the economy. If bank has too many bad loans on its balance sheet, its profitability will suffer because it will no longer earn enough money from its credit business. In addition, it will need to put money aside as a safety net in case it needs to write off the full amount of the loan at some point in time. To be successful in the long run, banks need to keep the level of bad loans at a minimum so they can still earn a profit from extending new loans to customers. The important negative effects of the increase in the NPLs rate in the banking sectors of e.g. the Member States include: cross-border risks and side effects for the economy and the EU financial system, risks of financial fragmentation and hindering the restructuring processes of banking sectors.

Supervision of the quality of loan portfolio (including NPLs), is one of the key areas of risk reduction in the European banking sector. European Council notes that the financial crisis and ensuing recessions, together with structural factors, accompanied by inadequate loan origination practices, have left the banks in some Member States with high ratios of NPLs (European Council, 2017). The statistical data of the European Central Bank (ECB) show significant differences in the amount of NPLs in the banking sectors of EU countries (e.g. 41.6% Greece, 20.9% Cyprus, 11.2% Portugal, 7.8% Ireland, 6.3% Poland and 1.6% Germany, 1.2% United Kingdom and 0.9% Luxembourg in Q1.2019) (ECB, 2020a; European Commission, 2019b). Therefore, as part of the work of the ECB and new programs are being developed to support the reduction of NPL rates.

Monitoring the quality of the corporate loan portfolio in the banking sector results from *prudential regulations*. As part of its package of proposals on NPLs put forward in March 2018, the Commission proposed a Regulation amending the Capital Requirements Regulation (‘CRR’) (Regulation EU 575/2013, European Parliament, 2013), introducing a ‘statutory prudential backstop’ in order to prevent the risk of under-provisioning of future NPLs (Regulation EU, 2019/630, European Parliament, 2019). The regulation was adopted in April 2019 and it requires banks to have sufficient loan loss coverage (i.e. common minimum coverage levels) for newly originated loans if these become non-performing exposures (NPEs). In case a bank does not meet the applicable minimum coverage level, it has to deduct the

shortfall from its own funds. The above-mentioned reasons determine that monitoring the quality of the loan portfolio in the Polish banking sector is the area of the monetary policy of the NBP and the supervision of The Polish Financial Supervision Authority (PFSA), and adequately in the structures of the European Union (EU).

Because the quality of the loan portfolio depends on the borrower's creditworthiness and this ability depends on the financial condition of enterprises, external conditions (macroeconomic indicators) and on the banks' side, capital neutralizes credit risk - these variables were taken into account in the modeling.

Therefore, the aim of this study is to examine the impact of changes in market conditions, the financial standing of enterprises and banks` capital requirements on the quality of the corporate loan portfolio in the Polish banking sector before and during COVID-19.

2. LITERATURE REVIEW AND EMPIRICAL STUDIES

According to European Central Bank (ECB, 2020a, 2020b) a bank loan is considered non-performing when more than 90 days pass without the borrower paying the agreed installments or interest. Non-performing loans (NPLs) are also called “bad debt”. In detail, the ECB has performed a comprehensive assessment and developed criteria to define loans as nonperforming if they are: 1) 90 days past due, even if they are not defaulted or impaired, 2) impaired with respect to the accounting specifics for U.S. GAAP and International Financial Reporting Standards (IFRS) banks, 3) in default according to the Capital Requirements Regulation (CRR).

The quality of the loan portfolio depends on the exposure to banking risks, especially credit risk. Among the credit risk factors, there are internal factors – endogenous inside business entities and external factors – endogenous in the environment of enterprises and independent of them[1].

In terms of credit risk parameters, the following should be mentioned:

- default risk, the measure of this risk is the PD parameter (*probability of default*),
- risk of loss, the measure of this risk is LGD (*loss given default*),
- exposure at default, the measure here is the EAD parameter (*exposure at default*).

[1] In the estimated econometric model, these internal factors are related to the variables of the financial situation of corporations, and to external factors – market (macroeconomic) variables.

An inseparable element here is the rating of borrowers – the rating of entities or in the case of retail loans – scoring. A similar situation is related to the risk in banking activities. The bank's credit policy and credit portfolio management are adjusted to the internal and external factors (independent from them) (Matuszyk, 2017).

As part of maintaining financial stability, banks conduct: 1) surveillance of current financial market conditions to assess the risk of shocks, 2) macro-prudential surveillance framework, 3) analysis of macro-financial linkages and 4) surveillance of macroeconomic conditions. These activities are aimed at improving the quality of the loan portfolio. These variables are taken into account by the authors of the research when modeling credit risk, non-performing loans, quality of the loan portfolio or performing the so-called stress tests to assess future losses at banks (Pastor and Serrano, 2005; Yiping, 2008; Bhansali, Gingrich, Longstaff, 2008; Głogowski, 2008; Pastor, 2020). In their research, these authors and also International Monetary Fund (2003) take into account various macroeconomic indicators, including the corporate and banking sector as well as the capital market, etc.

Moreover, due to the interactions between risks at the bank, the risk of the balance sheet structure is important for the quality of the loan portfolio and the capital maintained in the context of security. As part of the concept of required capital, attention should be paid to the theory of economically required capital, according to which the value of economic capital for most institutions (in this case banks) should be higher than the regulatory capital required by the BASEL concept (Generst and Brie, 2013; Basel Committee on Banking Supervision, 2014). The above-mentioned capitals, international supervisory standards of risk management pay special attention to maintaining adequate levels of: the solvency ratio, leverage and liquidity ratios, and capital buffers.

The quality of the loan portfolio is calculated as the ratio of the non-performing loans (impaired loans) and advances to the gross value of total loans and advances (NBP, 2020). Non-performing rates (NPLs) are loans where the borrower has difficulties to make the scheduled payments to cover interest and/or capital reimbursements. When the payments are more than 90 days past due, or the loan is assessed as unlikely to be repaid by the borrower, it is classified as an NPL.

Asset quality monitoring is a key area of supervision in banks, alongside liquidity and profitability. The asset quality analysis mainly involves calculation: 1) NPLs to total loans, 2) NPLs less provisions to capital and 3) sectoral distribution of loans to total loans (IMF, 2003).

Elevated levels of NPLs may affect financial stability as they weigh on the viability and profitability of the affected institutions and have an impact, via reduced bank lending, on economic growth. More specifically, high stocks of NPLs can weigh on bank performance through two main channels:

1. NPLs generate less income for a bank than performing loans and thus reduce its profitability, and may cause losses that reduce the bank's capital. In the most severe cases, these effects can put in question the viability of a bank, with potential implications for financial stability.
2. NPLs tie up significant amounts of a bank's resources, both human and financial. This reduces the bank's capacity to lend, including too small and medium-sized enterprises, which rely on bank lending to a much greater extent than larger companies. In turn, this negative effect in terms of credit supply also reduces the capacity of businesses to invest, affecting economic growth and job creation, hence creating a tangible effect on the real economy (European Commission Services, 2020; European Commission, 2019a; 2019b).

For these reasons, the Commission and other EU authorities have long highlighted the urgency of taking the necessary measures to address the risks related to NPLs (European Commission Services, 2018; 2019). In order to reduce the high NPL stocks, the EU agreed on a comprehensive set of measures outlined in the "*Action Plan to Tackle NPLs in Europe*" (European Commission Services, 2020), which is currently being implemented.

In practice used, the assessment of the quality of the loan portfolio is one of the three stages of the assessment of financial institutions enforced by the Board of Supervisions European Banking Authority (BoS EBA) i.e .: 1) asset quality review (AQR), 2) stress testing (Virolainen, 2004; Jakubik and Schmeider, 2008), and 3) risk review and assessment (ECB, 2018).

As the increase in the NPL rate depends significantly on credit risk, it is worth paying attention to its components. Credit risk consists of general (systemic) risk, resulting from the impact of the macroeconomic situation and economic cycles on borrowers, and specific risk, related to factors specific to a given bank, such as credit policy or quality of credit risk management. Losses in the loan portfolio are therefore a function of both general risk and specific risk (Bhansali, Gingrich and Longstaff, 2008).

The pro-cyclicality of lending activity (*boom and bust cycle*) (Agelini *et at.*, 2010) is observed in the banking sector. Losses on banks' credit portfolios tend to follow the business cycle, falling during a recovery and increasing during a recession. Banks determine the level of these losses by means of loan loss provisions. As reserves reduce the value of revenues, their pro-cyclicality may contribute to the volatility and pro-cyclicality of bank profits and, consequently, of bank earnings and retained earnings. There is evidence that the amount of debt recovered during a recession is lower than during an expansion. The results of Frye's (2000) research, based on Moody`s data, show that the recovery during reviews is about 1/3 lower than during the expansion period. Recently, it was the outbreak of the crisis related to COVID-19 that had an impact on changes in the economic situation of corporations (borrowers), and thus on the quality of the loan portfolio (NPLs), as well as the banks' credit policy.

For example, according to NBP (2020) data the total value of loans in the banking sector in Poland showed a general upward trend in the years Q1.2010-Q1.2020 (from PLN 217.9 million to PLN 401.6 million). Only the period Q2.2020-Q3.2020 brought a decrease in the total value of loans (PLN 383.6 million and PLN 375.5 million). The NPL ratio showed a downward trend from 12.3% to 8.3% in the period Q4.2010-Q1.2020.[2] On the other hand, the last two analyzed quarters, brought an increase in the NPL ratio, respectively: 8.7% in Q2.2020 and 8.9% in Q3.2020. The indicated increase in the NPL ratio in the period Q2-Q3.2020 results from an acceleration in the dynamics of the value of impaired loans (PLN 33.3 million from Q1.2020 to PLN 33.5 million in Q2.2020) with a weakening of the dynamics of the value of loans without impairment from PLN 368.2 million in Q1.2020 to PLN 342.3 million in Q3.2020.

Furthermore, in the entire period Q1.2009–Q3.2020, the structure of the loan portfolio in the Polish banking sector showed stable shares, i.e. around 91–92% in terms of without impairment loans and around 9–8% of the value of impaired loans. Due to the fact that the Polish economy has not experienced the effects of the cyclical recession so far (Q3.2020), the scale of a marked deterioration in the corporate loan portfolio has also not occurred. The indicated changes in the loan portfolio (Q2.– Q3.2020) and increases in NPL rates were mainly caused by the reduction of economic activity and, consequently, lower income. According to Central Statistics Office (CSO, 2020) in Poland, while in Q4.2019 the value of net revenues

[2] The decline in total loans was also due to a decline in demand for loans from borrowers due to the uncertain macroeconomic situation related to the COVID-19 pandemic.

from the total activity of corporations amounted to PLN 147 311 million, it decreased to PLN 23 901 million in Q3.2020.

Nevertheless, in the longer term, the NPL ratio depends on many market conditions determining the rate of economic growth and influencing changes in borrowers' creditworthiness.

3. RESEARCH METHOD

The study used quarterly data gathered from the National Bank of Poland (NBP), Central Statistics Office (CSO) and Organisation for Economic Co-operation and Development (OECD.stat, 2020). The data were analysed using Gretl-2020a-git. The analysis method of data using Vector Error Correction Model (VECM), which is derived vector autoregression (VAR). These matters addressed to determine short term and long term between variables. Several stages of testing the test data using the unit root test to know the data is stationary or not stationary. Then, test models use 1) the determination of the optimal long lag systematic models, 2) cointegration relationship test exists determines the distance and close range of variables, 3) test to determine the VECM large independent effect variable against dependent on both long term and short term.

As already mentioned, the QLP is calculated as the ratio of the non-performing loans (impaired loans) and advances to the gross value of total loans and advances (NBP, 2020) and adequately for non-financial enterprises.

Changes in the QLP of non-financial corporation's (dependent variable) is calculated by: the market factors, the financial standing of enterprises and banks` capital requirements (independent variables) in the Polish banking system. A final formula for the QLP function was developed:

$$\text{QLP}_t = \propto_0 + \propto_1 GDP_t + \propto_2 CPI_t + \propto_3 WIBOR_t + \propto_4 ROAC_t + \propto_5 CROAC_t + \propto_6 + GFCF_t + \propto_7 CAR_t + \xi_i \qquad (1)$$

Where:

QLP_t – Quality of the loan portfolio of non-financial corporations

GDP_t – Gross domestic product

CPI_t – Consumer price index

$WIBOR_t$ – Warsaw Interbank Offered Rate

$ROAC_t$ – Revenues from the overall activity of corporations

$CROAC_t$ – Costs of obtaining revenues from the overall activity of corporations

$GFCF_t$ – Gross fixed capital formation

CAR_t – Capital adequacy ratio

ξ_i – random component

t – period

In the study attempts to assess the quality of the loan portfolio granted to non-financial corporations, therefore, respectively, impaired loans and total loans granted to these corporations (included in the so-called phase III, portfolio B) were taken into account (NBP, 2020).

In the methodology of explaining the sources of changes quality of the loans portfolio used the methodology: NBP (2020) and IMF (2003) and e.g. Matthewes, Guo and Zhang (2007), Maggi and Guida (2010). The study period includes 47 quarters data for the period Q1.2009–Q3.2020. All variables were smoothed by simple moving averages.

To verify the stationarity of the analysed time series, the Augmented Dickey-Fuller (ADF) test was used, estimated with the use of the regression equation in the following form:

$$\Delta_{yt} = \mu + \delta_{t-1} + \sum_{i=1}^{k} \delta_i y_{t-1} + \epsilon_t \qquad (2)$$

The value of the test statistic was calculated with the use of the formula:

$$ADF = \frac{\tilde{\delta}}{s_{\tilde{\delta}}} \qquad (3)$$

where δ means the parameter evaluation, and s_δ is the parameter estimate error.

For all analysed variables it was found that they lacked stationarity of time series, but a unit root a = 1 occurred at process I (1). A comparison between test τ statistics and critical values of these statistics shows that in the case of basic variables, the series are non-cointegrated and variables are non-stationary because the test probabilities are above 0.05. On the other hand, in the case of first differences, variables are mostly stationary and series are co-integrated to the order of 1 (Table 1).

Table 1. Augmented Dickey–Fuller (ADF) test

Variable	Null hypothesis: unit root appears	with absolute term (const)	
		test statistic: τ_*ct* (1)	asymptotic *p*-value
QLP	*a* = 1; process I (1)	-0,5848	0,8717
GDP		-2,8553	0,0508
CPI		-2,9281	0,0422
WIBOR		-0,9373	0,7769
ROAC		-2,0557	0,2631
CROAC		-1,0594	0,7338
GFCF		1,6944	0,9997
CAR		-4,0593	0,0071

Source: The author's own calculations.

To verify the conclusions drawn on the basis of the ADF test, the KPSS (Kwiatkowski-Philips-Schmidt-Shin) stationarity test was carried out, where the null hypothesis assumes a sequence stationarity, whereas the alternative hypothesis assumes the occurrence of the unit root. The initial test model can take the following form:

$$\gamma t = \beta t + rt + \xi t \qquad (4)$$

where: $r_t = r_t–1 + u_t$, where ξ_t and u_t are a stationary and a white-noise random component, respectively. On the other hand, the KPSS test statistic is calculated with the use of the formula:

$$KPSS = T^{-2} \sum_{t=1}^{T} (\sum_{t=1}^{t} e_i) / \hat{\delta}^2 \qquad (5)$$

where ei denotes residuals, and $\hat{\delta}^2$ is a long-term variance estimator (Kufel, 2011).

An ultimate confirmation of stationarity requires an additional test, e.g. KPSS (Table 2).

Table 2. KPSS stationarity test results (lag truncation = 3)

Specification		QLP	GDP	CPI	WIBOR	ROAC	CROAC	GFCF	CAR
without a trend	Test	0.945821	1.15961	0.36233	1.02753	1.12756	1.12623	1.0187	1.2107
	Critical value of the test	0.352 (10%); 0.462 (5%); 0.722 (1%)							

Source: The author's own calculations.

The lag order for the VAR/VECM model was determined on the basis of estimation of the following information criteria: the Aikake information criterion (AIC), Schwartz-Bayesian

information criterion (BIC), and Hannan-Quinn information criterion (HQC). According to these criteria, the best, that is, minimal values of the respective information criteria are: AIC = 2, BIC = 2 and HQC = 2, with the maximum lag order 3. Ultimately, the lag order 2 was accepted.

In order to analyze stability of the VAR model, a unit root test was applied. The test indicates that in the analyzed model equation roots in respect of the module are lower than one, which means that the model is stable and may be used for further analyses.

Co-integration was verified using two tests: the Engle-Granger and Johansen tests (Johansen 1991, 1992, 1995). Their results comprehensively confirmed co-integration for lag 1. This is proved by the values of the test statistic τ_e which are lower than critical values $\tau_{critical}$, levels of asymptotic p-values and integrated processes a = 1 and I (1), at the significance level α = 0.05 (Table 3).

Table 3. Results of the Engle–Granger co-integration test

Specification	QLP	GDP	CPI	WIBOR	ROAC	CROAC	GFCF	CAR
Unit root appears	a = 1, process I (1)							
test statistic τ_c τ_e (asymptotic p-value)	-0,204236 (0,9356)	-0,668505 (0,8527)	-1,15919 (0,6942)	-0,872538 (0,7975)	-1,9247 (0,3211)	-1,67249 (0,4454)	-0,615025 (0,865)	0,513939 (0,9873)

Source: The author's own calculations.

Testing cointegration aimed to find a long-term relationship between variables. Using the strong testing methods Johansen Cointegration, cointegration relationship variables if it can be concluded there is a long term relationship between variables. Results of the Johansen test (including trace and eigenvalue) show that at the significance level of 0.05, co-integration to the order of one occurs.

Due to the occurrence of unit element in all the time series and the existence of cointegration between the model variables, it was possible to extend and transform the model into vector error correction models (VECM).

4. ANALYSIS

4.1. VECM Model

Co-integration was verified by means of the Engle-Granger and Johansen tests which confirmed the occurrence of co-integration and thus justified the use of the VECM model for the lag order 2 and co-integration of order 1.

In accordance with the Granger representation theorem, if variables y_t and x_t are integrated to the order of I (1) and are co-integrated, the relationship between them can be represented as a vector error correction model (VECM) (Piłatowska, 2003).

The general form of the VECM can be written as:

$$\Delta Y_t = \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \ldots + \Gamma_{k-1} \Delta Y_{t-k+1} + \pi Y_{t-k} + \varepsilon_t =$$
$$= \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + \pi Y_{t-k} + \varepsilon_t, \qquad (6)$$

where:

$$\Gamma_i = \sum_{j=1}^{i} A_j - \mathrm{I}, \qquad i = 1, 2, \ldots, k-1, \quad \Gamma_k = \pi = -\pi(1) = -\left(\mathrm{I} - \sum_{i=1}^{k} A_i\right)$$

and I is a unit matrix.

Vector Error correction model estimates a long-term and short-term advance of the dependent with the independent variables. In the test of VECM, the QLP became dependent variable while: GDP, CPI, WIBOR, ROAC, CROAC, GFCF and CAR became independent variables.

The results of the VECM model confirmed the importance of revenues, economic development (GDP), indicators of investments, costs of obtaining revenues on the part of corporations and total own funds on the part of banks in short and long term relationship. The estimation results indicated that mainly short-term variables as: CPI, WIBOR, capital adequacy ratio (CAR) and gross fixed capital formation (GFCF) on the lag one significant negative effect i.e. there was decreased impaired loans and an improvement in QLP. Evaluation of the EC1 indicates that the strongest correction of the deviation from long-term equilibrium occurs in the case of the revenues from the overall activity of corporations (ROAC), GDP, GFCF and costs of obtaining revenues from the overall activity of corporations (CROAC) equations (Table 4).

Table 4. The Results of VECM in the short term and in the long term

Variables	Coefficient	T-statistics		
Short term relationship				
d_ma_QLP_1	0,644931	4,6620		
d_ma_GDP_1	0,000021	0,9608		
d_ma_CPI_1	−0,095861	−0,5307		
d_ma_WIBOR_1	−0,236702	−0,7249		
d_ma_ROAC_1	0,000025	1,6450		
d_ma_CROAC_1	−2,44049e-05	−1,5690		
d_ma_GFCF_1	−2,81359e-05	−0,7511		
d_ma_CAR_1	−0,435419	−1,2680		
Long term relationship				
Variables	Coefficient	T-statistics	R2	DW
d_ma_QLP_1	0,0015	0,9314	0,7185	2,0668
d_ma_GDP_1	−51,0287	−2,454	0,8374	2,0067
d_ma_CPI_1	−0,0002	−0,04651	0,7258	2,1243
d_ma_WIBOR_1	0,0015	1,995	0,8959	1,8384
d_ma_ROAC_1	−140,5800	−2,833	0,7809	1,6292
d_ma_CROAC_1	−25,2582	−0,1722	0,5946	1,9766
d_ma_GFCF_1	25,6813	2,248	0,6147	2,2184
d_ma_CAR_1	0,0003	0,3802	0,6458	2,2345

Note: VECM system, lag order 2, observations 2010:2-2020:3 (T = 42), cointegration rank = 1, case 3: Unrestricted constant.

Source: author's own calculations.

In order to verify the correctness of the VECM model results, two tests were carried out verifying occurrence of autocorrelation, i.e.: Autocorrelation Ljung-Box Q' test, lag order for test = 2, and ARCH test = lag order for test = 2

Ljung–Box tests (LMF, LM, Q) were conducted to verify autocorrelation for the lag order 4. The verifying statistic using the autocorrelation coefficient function (ACF) in the_form Q' and empirical *p*-value levels higher than the nominal $\propto$ = 0.05 let us conclude that there is no autocorrelation in the residual process (Kufel, 2011).

The ARCH test results indicate that in the examined model of the residual-based process (four variables), the ARCH effect was not observed because LM test statistics are lower than the levels of χ^2. This means that there is no autoregressive changeability of the conditional variance and there is no need to estimate model parameters by means of weighted least squares method. Thus, the results of both the tests confirm credibility of the VECM model and allow for conclusions drawn on their basis.

4.2. Impulse Response Functions and Variance Decompositions

Analysis of the QLP response to impulses from the independent variables confirmed that the strength of the influence of these impulses increased over time. In the 4th quarter, the strongest the QLP responses to impulses came from: CPI, ROAC and GDP. Nevertheless, in the 19th–20th quarter (5th year) of the forecast, the QLP responses were the strongest, including apparently against ROAC and CPI.

The QLP showed declining trends in response to impulses (decreased NPLs) from: the QLP`s own changes, GFCF, CROAC and CPI. It`s mean that these factors an improved quality of loans portfolio. The QLP showed increasing trends in response to changes: ROAC, GDP, WIBOR and CAR.

When interpreting the responses of the QLPs, it is worth emphasizing that the NPL rate showed a downward trend in the analyzed period 2009-2020. This downward trend resulted from the prudential norms which actually determined the tightening of the creditworthiness test and thus the reduction of below-standard claims in banks' portfolios. Thus, the expected impact of the following variables: QLP, CPI, GFCF and CAR on the responses of the QLP responses were confirmed.

The QLP responses come from the remaining variables were weakly and also related to the tightening of prudential standards. The GDP growth stimulated the growing demand for loans globally, while the variables: ROAC and CROAC are strongly dependent on changes in the economic growth (Table 5).

Table 5. Prediction of the response of the impulse function over time from Q1 to Q20

		Dependent variables							
	1Q-20Q	QLP	GDP	CPI	WIBOR	ROAC	CROAC	GFCF	CAR
Independent variables	QLP	↓	↓	↓	↓	↓	↓	↓	↓
	GDP	↑	↓	↑	↑	↓	↓	↑	↑
	CPI	↑	↑	↓	↑	↑	↑	↑	↑
	WIBOR	↑	↓	↓	↓	↓	↓	↓	↓
	ROAC	↑	↓	↑	↑	↓	↑	↑	↑
	CROAC	↓	↑	↑	↓	↓	↓	↑	↑
	GFCF	↓	↑	↑	↓	↑	↓	↓	↓
	CAR	↓	↓	↑	↓	↑	↓	↓	↓

Source: author's own calculations.

Next, the QLP and other explanatory variables were analyzed by means of variance decomposition in the forecast horizon of 20th quarters. Results of QLP decomposition indicate that in the 1st quarter these changes are fully accounted for with their own forecast errors (100.0%). In the 4th–20th quarter, their own changes lose significance (below 1.0%) and mainly by CPI (about 58.2%), ROAC (25.6%) and GDP (11.4%) grow in significance, with less importance of other variables. Thus, the share of GDP in explaining changes in the QLP (NPLs) confirms the pro-cyclical nature of lending to the corporate loan portfolio.

On the other hand (in turn), the analysis of the decomposition of explanatory variables shows, that the QLP (NPLs) was significant a factor in explaining the changes in the first period: WIBOR (about 22.3%), CPI (12.2%), GFCF (5.3%) and CAR (3.3%). In the subsequent periods of the forecast, the degree of explanation of the QLP in the investigated explanatory variables decreases to a level below 1.0% in the 20th quarter.

5. DISCUSSION

The results of the VECM model, the impulse response function and the variance decomposition confirmed the importance of the economic development and financial situation of companies for changes of the quality of loans portfolio in Polish banking sector. The results of the study are consistent with the results of other authors analyzing changes in the portfolio of non-performing loans or changes in credit risk.

Monitoring of the analyzed indicators in the study and others is the subject of analyzes, e.g. by the IMF (2003). The IMF collects these indicators under the so-called financial soundness indicators (FSIs) to evaluate: 1) banking sector financial strength, 2) banking sector vulnerability (asset quality, liquidity and sensitivity to market risk) 3) corporate sector (e.g. leverage ratio, return on equity, earnings to interest and principle payments).

Therefore, in further researches on the explanation of changes in the QLP, should be taken into account more explanatory variables. In addition to QLP analyzes, the research should focus on the leverage ratio and the cost of capital in the banking sector. Then changes in QLP could be more accurately diagnosed. The next step in the work on the QLP may be e.g. stress tests. These tests allow forecasting and estimating changes in the loan portfolio in advance. Moreover, these tests are also recommended under macroprudential regulations for EU banks.

6. CONCLUSIONS

The analysis of the quality of loans portfolio (QLP) of non-financial companies shows that there was a long-term downward trend confirming the improvement in this portfolio in Poland

in the period Q1.2009–Q1.2020. However, the last two analysis quarters, brought an increase in the NPL ratio, respectively: Q2.2020 (8.7%) and Q3.2020 (8.9%). In the entire period Q1.2009–Q3.2020, the structure of the loan portfolio in the Polish banking sector showed stable shares, i.e. around 91–92% in terms of without impairment loans and around 9–8% of the value of impaired loans. Due to the fact that the Polish economy has not experienced the effects of the cyclical recession so far (Q3.2020), the scale of a marked deterioration in the syndicated loan portfolio has also not occurred.

Analysis of the QLP response to impulses from the explanatory variables confirmed that the strength of the influence of these impulses increased over time. In the 4th quarter, the strongest QLP responses to impulses came from: CPI, ROAC and GDP. Nevertheless, in the 19th–20th quarter (5th year) of the forecast, the QLP response was the strongest, including apparently against ROAC and CPI. This confirms the important influence of market indicators on changes in the QLP (and NPLs).

Results of QLP decomposition indicate that in the 1st quarter these changes are fully accounted for with their own forecast errors. In the 4th–20th quarter, their own changes lose significance (below 1.0%) and mainly by CPI, ROAC and GDP grow in significance, with less importance of other variables. The share of GDP in explaining changes in the QLP confirms the pro-cyclical nature of lending to the corporate loan portfolio.

Thus, the results of the impulse response were confirmed by the results of the variance decomposition, indicating the importance of market and financial factors both in the volatility and the degree of explanation of QLP in the Polish banking sector. Also, the results of the NPLs research confirmed the pro-cyclical nature of lending activity in Poland in the verified years.

Resuming, in the period 2009–2020 there was a long-term trend of improving the quality of the loan portfolio of non-financial companies, which was mainly result of changes market (macroeconomic) factors and financial situation of corporation’s factors.

Further researches on the explanation of changes in the QLP, should be taken into account more explanatory variables. These researches should focus on the leverage ratio, the cost of capital in the banking sector and stress tests. These tests allow estimating changes in the loan portfolio in advance. Moreover, these tests are also recommended under macroprudential regulations for EU banks. The role of stress tests as an important instrument for enhancing the stability of financial institutions and the need further work on stress testing are also discussed in EU and the development of the banking union.

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