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Impact of COVID-19 on European Banks' Credit Ratings[1]

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Abstract

The aim of this paper is to analysis the impact of the COVID-19 pandemic on European banks' default risks, as measured by foreign long-term issuer credit ratings published by the main credit rating agencies. Two hypotheses are put forward: (1) The macroeconomic situation has a stronger negative impact on banks' financial conditions during COVID-19; (2) changes in the capital adequacy, assets, management, earnings, and liquidity indicators have a significant impact on changes in banks' credit ratings. The analysis has been prepared for the 2000–2021 period for listed and unlisted banks on the European stock exchanges, that received long-term issuer credit ratings from the main credit rating agencies. To the analysis have been used the ordered logit panel data models and the research has been made on the first differences to analyse the impact of the changes of the financial and macroeconomic conditions on the credit ratings changes. The obtained results suggest a direct and significant impact of the COVID-19 pandemic on the credit rating changes, but a delayed reaction. Credit ratings are especially significant during a crisis in relation to the basic interest rates published by central banks, bond interest rates, price purchasing parity, and the government debt ratio. Another significant impact occurs with regard to capital adequacy and the quality of assets. A raising effect has also been noted in relation to earnings and liquidity indicators. This

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relationship occurs based on a few reasons. The first is the decreased value of the central banks' interest rates, which has a direct impact on the banks' interest revenues, especially in developing countries and those outside the Eurozone. The decreasing value of the interest accrued on deposits has a direct impact on the withdrawal of money by depositors and their investment of these deposits, such as on the real estate or capital markets. As a result, the stability of the deposit base is important during the first stage of a crisis. Furthermore, another, less significant impact on the quality of assets and capital adequacy indicators in relation to banks' credit rating changes relates to the relaxing of the Basel III requirements by the national regulators. The direct financial support provided by governments reduces companies' default risks in the first stage of a crisis. The impact of the quality of assets and, in particular, increased loan loss provisions and non-performing loans has a delayed impact.

Keywords: credit ratings; crisis; COVID-19; CAMEL

Subject classification codes: G23, G15, G21.

1. Introduction

Over the last two years, the global economy has suffered as a result of the COVID-19 pandemic. Unfortunately, COVID-19 appeared as a time when the global economy was already displaying signs of a slowdown. The shock associated with COVID-19 has created problems for institutions and individuals. For example, high liquidity stress, limited access to credit, and increasing probability of default were observed. Moreover, recorded private debt, including corporate and household debt, were also apparent. As a result, nearly half of the investment-grade market currently holds a triple B-rating.

Central banks around the world intervened to settle markets by using a range of possible

measures. In most cases, measures involved decreasing interest rates. Central banks also reacted by responding to the repo market to add future liquidity, increasing asset purchases (such as the Bank of Japan), adding cash directly into the financial system (such as the People Bank of China) or preparing various plans to counter COVID-19 (e.g., Bank of England, European Central Bank).

Banks and capital market firms around the world must organize their activities by implementing virtual equipment. Institutions have also increased measures to ensure the health and safety of their employees via various appropriate means. Banks have also requested that regulators ease capital requirements. In some cases, regulators have proactively granted relief for regulatory financed reporting to companies affected by COVID-19 (such as SEC). Furthermore, banks also created policies associated with extending loans to hard-hit borrowers, renegotiating credit terms, providing an opportunity for "credit holidays" or reducing bank provisions.

Moreover, in practice, there is also a demand to actively organize short-term financing and risk analysis. Research from the financial market suggests that banks play a significant role in absorbing liquidity shocks by supplying capital (Acharya, Steffen, 2020; Borio, 2020) created directly or indirectly.

This article explores banks' conditions and seeks to verify the impact of changes in the macro- and microeconomic financial situation on banks' default risk which is measured by credit ratings—comparing before and during the COVID-19 pandemic. **The aim of this paper is to analysis the impact of the COVID-19 pandemic on European banks' default risks, as measured by foreign long-term issuer credit ratings published by the main credit rating agencies.** They are few reasons, why the presented paper has been prepared. At first in most studies, about impact of the COVID-19 crisis on the banking sector, was

analysed the default risk. Credit ratings should predict the increasing default risk. The prepared analysis of the literature suggests that the mentioned impact has not been tested. The lack of studies about the reaction and the factors that can impact on the credit ratings changes was the first reason to prepare this study. The next reason, as it was mentioned before, has been to check the procycality of the banks' credit ratings during COVID-19. Their credit ratings should react on the changes in macroeconomic environment. Not without significance is also the list of variables that are taken by the credit rating agencies to testing. The literature review and the practical analysis of the methodologies presented by credit rating agencies suggest that the mentioned institutions use different catalogues of variables to estimate default risk. Previous studies have already drawn attention to financial factors. These can be classified according to the CAMEL structure, that is: (1) capital adequacy, (2) asset quality, (3) management quality, (4) earnings potential, and (5) liquidity. The previous analysis relied on an estimation of the factors which can influence credit ratings presented by one of the two biggest agencies, i.e., Fitch and Moody's. The differences between macroeconomic determinants have yet to be analyzed or presented. Opinions on the mentioned group of factors also vary, as has been shown in the literature review. As a result, the following hypothesis has been put forward: *Changes in the capital adequacy, assets, management, earnings, liquidity indicators have significant impacts on banks' credit ratings changes*.

In the previous studies, as has been mentioned earlier, no clear opinion on the impact of the macroeconomic situation on banks' credit ratings has been presented. In the particular agencies' methodologies, a relationship between the mentioned variables can be found. The analysis of the methodologies presented by the Investor Services of Moody's and Fitch suggests that they took into account country risk. The mentioned agencies also focused on the inflation rate. Previous research and methodologies presented by the main agencies suggested that higher inflation has a negative impact on credit ratings. In the COVID-19 pandemic

period, inflation trends and associated risks surrounding interest rates and exchange rates may have had direct sovereign credit implications. Higher levels of global government debt due to COVID-19 have rendered sovereign creditworthiness increasingly sensitive to interest rate adjustments. Most central banks take the view that the rise in inflation is not indefinite and that now is not the time to tighten financial conditions. Higher inflation leads to higher nominal GDP, resulting in an immediate improvement in debt/GDP ratios ("inflating debt away"). This is particularly the case if there is a muted response from benchmark yields to higher inflation, thus lowering governments' real marginal borrowing costs. Even if benchmark yields rise in tandem with inflation and nominal GDP growth, it will take time for the effective (or average) cost of borrowing to reach a higher marginal cost, particularly for sovereigns with long average debt maturities. All else being equal, these inflation conditions are positive for sovereign credit. However, should inflation prove more persistent than transitory, markets may demand higher yields to compensate for greater uncertainty surrounding inflation outcomes. Increases in benchmark yields and corresponding effective rates may exceed the rise in inflation, meaning higher real interest rates for governments. In this case, interest payments on government debt will increase more rapidly than nominal GDP and the numerator of the debt/GDP ratio will increase relative to the denominator, diminishing sovereign creditworthiness. Both policy-rate decisions and adjustments to quantitative easing (QE) strategies may affect bond yields. The QE policies of the US Federal Reserve and ECB have received the most attention, however, higher inflation will also spur discussion around quieting programs in emerging markets. Sovereign bond yields generally fell in emerging markets on QE announcements, implying that there is a risk of symmetric market reaction to exit strategy announcements.

As a result, the following hypothesis is put forward: *The macroeconomic situation has a strong negative impact on banks' financial condition during the COVID-19 pandemic.*

The knowledge about factors influencing on the credit ratings is especially significant for the financial market. They have got the direct influence on the credit risk and are taken into consideration during the investment decisions, as factors taken to the investment portfolio building.

The analysis has been prepared for the 2000–2021 period for listed and unlisted banks on the European stock exchanges. To the analysis have been used the ordered logit panel data models and the research has been made on the first differences to analyse the impact of the changes of the financial and macroeconomic conditions on the credit ratings changes. The remainder of the paper proceeds as follows. In Section 2, previous studies that investigate the determinants of credit ratings. Section 3 reports the methodology by describing the features of this data sample and the model specification on which the empirical analysis is based. Section 4 provides a discussion of the findings, and Section 5 concludes by declaring limitations on the current study and consequently suggesting future developments.

2. Literature review

2.1. The business cycle impact on the credit ratings changes

Cantor and Parker (1996) were the first to study the business cycle and its impact on credit rating. In their analyzes, they used the GDP growth rate as a measure of the financial condition of the country's credit ratings. In turn, Ferri et al. (1999), while measuring the determinants of countries credit ratings, applied a non-linear credit rating decomposition—the purpose of which was to consider the business cycle phase. In their analysis, they used changes in the CDS premiums as a measure of the economy and downturn. Amato and Furfine (2003) carried out one of the first studies assessing the impact of the business cycle on the stability of rating notes. Based on S&P's ratings for a sample of American companies, they showed that not only was there an impact of the downturn on credit ratings, but also on forecasts or short- and long-term attitudes. At the same time, however, Kräussl (2003) found

different results. In his opinion, the downgrade of ratings during the crisis did not result from a change in the business cycle. Importantly, he concluded that there is also no causality between credit ratings and the business cycle. Following the financial crisis of 2008, De Saints (2012) observed a spiral phenomenon between ratings. This is particularly strong in times of economic downturn. At this point, risks associated with a country's credit rating are shifting to notes given to banks or institutions outside the financial sector. Research on the pro-cyclical nature of rating notes was also conducted by Auh (2013). In this analysis, the occurrence of the above-mentioned spiral phenomenon was observed. The rated entities received more pessimistic ratings in the downturn compared to the economic boom. Companies that roll their obligations towards creditors on the capital market are exposed to a stronger influence of the business cycle on the credit ratings they receive. The impact of the business cycle on notes received by issuers of debt securities from outside the financial sector was also verified by Kiff et al. (2013). They compared the effectiveness and method of assigning ratings by rating agencies and banks as part of an internal risk assessment method. It was found that rating agencies evaluate entities by considering the business cycle phase. However, the situation is different in the case of banks. These financial institutions analyzed the point at which they conduct the assessment. The data they provide are therefore not pro-cyclical. The ratings of the agencies are more stable in periods of prosperity, but in times of downturn fluctuate more. Loffer (2013), in turn, drew attention to the speed of adjusting ratings. It was found that ratings react slowly to changes in economic conditions and in the evaluation process, agencies consider the business cycle stage. Bar-Isaac and Shapiro (2013) found that ratings are not subject to cyclicality, but rather to the anti-cyclicality. The behavior of credit rating agencies is also influenced by other factors, namely giving less accurate ratings when the rating fee income is high, when cooperation is difficult, and a low likelihood of bankruptcy. This contributes to a decrease in the quality of the presented ratings. This

situation deepens in stable periods in the financial markets. In this period, agencies are exposed to a lower risk of losing their reputation on the market. Moreover, they state that this phenomenon is influenced by the presence of naive investors, which further exacerbates the issue of quality ratings, however, they are still counter cyclical. Analyzing the level of competition shows similar results. Similar conclusions were obtained by Freitag (2015). He suggests that the business cycle phase is not considered by agencies when conducting an issuer bankruptcy risk analysis. In his opinion, research on this subject is carried out on an ongoing basis and the ratings are adjusted to market disturbances. At the same time, it is noted that agencies are unwilling to frequently adjust their ratings, and that current ratings are closely related to existing ratings. There are also significant disproportions in terms of the number of announced improvements and downgrades. Trouillet (2015) noted high ratings during the boom and their low value during the financial crisis. It results in an increase in debt servicing costs. Moreover, it identifies the phenomenon of causality between ratings and the condition of the rated entity. In his opinion, this causes further deepening of the crisis. Isakin and David (2015) carried out an analysis of debt servicing costs in connection with the issued notes. In their opinion, during economic downturn, there was a change in the rating methodology. When analyzing the bankruptcy risk of the assessed institution, the agencies consider macroeconomic risk. As a result, if the economy's condition worsens during an economic downturn, it has an impact on the assessment of issuers. Moreover, during a crisis, the older tranches are assessed as lower risk. On the other hand, deHaan (2016) pointed out that the business cycle does not affect the rating, but companies' ratings improve when they recover from the crisis. During this period, investors' confidence in the presented notes declines. Research on the impact of the business cycle has so far been presented for country ratings (Giacomino, 2013; Freitag, 2015) and companies (Cesaroni, 2015; Isakin, David, 2015; Iannotta, Nocera, Resti, 2013). Only a few studies have dealt with this topic for the

banking sector sample (Bangia, Diebold, and Schuermann, 1999; Fei, Fuertes, and Kalotychou, 2012). An analysis of the factors considered in the process of assessing bank ratings leads to the conclusion that ratings are significantly dependent on quantitative indicators. It is true that the use of qualitative indicators significantly improves the obtained results, however, they can be treated as a supplement to the evaluation process. The indicators used in the research presented so far can be divided according to the CAMEL classification into the following indicators: (1) capital adequacy (Shen, Huang, Hasan, 2012; Bissoondoyal-Bheenick, Treepongkaruna, 2011; Chodnicka-Jaworska, 2016), (2) asset quality (Poon, Firth, Fung, 1999; Chodnicka‐Jaworska, 2016; Estrella et al., 2000), (3) management quality (Chodnicka‐Jaworska, 2016), (4) profitability (Pagratis, Stringa, 2007; Shen, Huang, Hasan, 2012; Bissoondoyal‐Bheenick, Treepongkaruna, 2011; Poon, Firth, Fung, 1999; Hassan, Barrell, 2013; Öğüt et al., 2012) and (5) liquidity (Pagratis, Stringa, 2007; Shen, Huang, Hasan, 2012; Bissoondoyal‐Bheenick, Treepongkaruna, 2011; Chodnicka‐Jaworska, 2016). The impact of short-term interest rates (Pagratis, Stringa, 2007; Poon, Firth, and Fung, 1999) and the risk of bankruptcy (Belotti et al., 2011a; 2011b; Poon, Firth, and Fung, 1999) were also examined. In addition, the macroeconomic conditions were also analyzed (Bissoondoyal-Bheenick, Treepongkaruna, 2011).

2.2. COVID-19 Pandemic Impact on the Banking Sector

The COVID-19 pandemic created a high default risk for banks. Financial institutions must manage various problems, such as liquidity crunch, credit squeeze, increasing value of nonperforming loans and default risk, lower returns on credits and investments, lower interest rates and triggering contagious bank-run (Larbi-Odam et al. 2020; Cecchetti, Schoenholtz 2020; Goodell 2020; World Bank 2020c; Stiller and Zink 2020). As a result, banks will have increased risk in nearly all working areas. Wilson (2020) and Tyson (2020) suggest that the

impact of the COVID-19 pandemic will be more noticeable in developing countries, where banking clients are those with lower creditworthiness. It can also be associated with a weaker economy, political situation, or aggressive market competition. Furthermore, in developing countries, this can result from issues with significantly high loan default, difficulty recovering borrowed funds, withholding customer savings for daily living requirements, problems with receiving loans, or decreased investments due to future fear (Lagoarde-Segot, Leoni, 2013). Damak et al. (2020) suggest that the mentioned factors can strengthen the negative impact of the COVID-19 pandemic on banks' financial condition. The mentioned relationship has been especially analyzed for developed countries (World Economic Forum, 2020; BIS, 2020; Cecchetti, Schoenholtz, 2020; Stiller, Zink, 2020; Strietzel et al., 2020).

Macroeconomic COVID-19 shocks have had a direct or indirect impact on high default risk individuals and firms (Vidovic, Tamminaina, 2020); as a result, the credit risk increases. The mentioned risk is basic and occurs during the estimation of credit ratings. Usually, it is measured by the non-performing loans ratio or the credit size of the portfolio, and the value of reserves. Moreover, the mentioned risk is strictly connected with lower households and companies reserves as an effect of losing jobs—lower production is associated with lockdowns. As a result, it will be harder for companies to rely on international connections and exports (Dua, et al., 2020). Smaller companies will also experience problems with liquidity due to the low value of reserves and cash. The mentioned scenario can create problems with solvency and the risk of default as a result of increased credit risk from banks. Baret et al. (2020) suggest that the market value of collaterals provided against secured loans will decline. The mentioned situation will be more severe if the pandemic is observed for longer.

Another serious risk for banks is strictly connected to liquidity. In most banks, especially in developing countries, 60 to 80% of working assets are household savings. If depositors make decisions regarding withdrawing their savings, it can create serious problems with liquidity. This is related to a few reasons. The first is the need for financial sources for maintaining household health and living expenses (Baret et al., 2020). The second is the rate of return value from alternative investments. The rational investor will opt for investments with higher rates of return with similar risk. During the COVID-19 pandemic, the transfer cash from banks on the capital market was observed. High abnormal rates of return on the stock exchanges were observed— particularly in the technology, video, and medical sectors (Chodnicka-Jaworska, Jaworski, 2020). Lastly, liquidity shortages will occur if households continue to withdrawal deposits indefinitely (Cheney et al., 2020).

The next issue relates to the low value of earnings and banks' business models. The mentioned situation is an effect of lower interest rates. Lower interest rates cause lower interest revenues from borrowing activity. The mentioned profits are most significant for banks' activity. Next, lower production creates problems with companies' revenues and lower creditworthiness as a result. Lower creditworthiness reduces the possibility of receiving credit. Moreover, lower production reduces companies' investment decisions. As a result, the need for long- or short-term financing decreases until the economy recovers (Ryan et al., 2020). The reaction of the banking sector to the described problem is delayed. This is the main problem of banks in developing countries, where their business models are based on savings–borrowing activity. Banks' incomes can decrease due to reduced international trade and foreign exchange dealings. Moreover, interest incomes can also decrease because in most countries, banks make decisions based on waiting fees and charges, issuing "credit holidays", increasing credit limits, extending repayment dates, which assist people and companies during a pandemic. If banks do not propose renegotiating or changing credit conditions, the default

risk of borrowers will increase. As a result, this will transfer to the banks' default risk. The mentioned problem has been noticed by Ryan et al. (2020) and Yousufani et al. (2020).

The highest risk and the biggest problem involve low-quality assets and higher value of non-performing loans. The described situation will reduce the value of assets and banks' capitalization. The lower value of risk-weighted assets reduces the banks' capital adequacy, which directly influences the banks' solvency and their financial stability. Some banks will use CET1, Tier1, or Tier2 capital to support financial stability. The mentioned situation is an effect of using capital buffers to reduce shocks and aid banks to improve their financial stability (this is assumed by Basel III regulation (BIS, 2017)). The use of capital buffers is limited in developing countries since these countries compete aggressively and typically do not have a high value of capital buffers. Görg et al. (2020) and Dominguez (2009) suggest that in developing countries financial markets are less effective, regulators' activities are limited to the basic level, and moral and adverse selection problems are present. As a result, the banking sector of developing countries demonstrates increased problems associated with the COVID-19 crisis.

Analyzing the financial market and reviewing previous studies suggests that banks' credit ratings can be determined by the macroeconomic situation and countries' credit ratings. Research on the relationship between sovereign banks shows that government debt is maintained in banks' balance sheets (Dell'Ariccia et al. 2018) by: liquidity risk reduction, credit risk assessment, and investment decisions. The growing government debt can also lead to financial repressions (Reinhart, Sbrancia 2015). As a result, both positive and negative effects should be distinguished. Expansionary fiscal policy, especially associated with issuing treasury bonds, can help reduce shocks on the financial market but can also create the "doom loops" effect (Farhi, Tirole 2018). It can also build the specific "loans crowding-out" effect on

the banking asset side (IMF, 2010). The sovereign debt crisis may be transformed from banking risk into sovereign risk, creating a spiral effect (IMF, 2010;). The mentioned situation was observed during the 2008 global crisis. Financial problems of the banking sector associated with higher risk created government interventions in the financial sector, which led to high pressure on public finance. European countries also noticed a higher probability of default, which was correlated with a higher default risk of national banks (Bell, et al., 2019). The mentioned domino effect was also strengthened by political and economic relationships between European countries, especially based on the common European bond and indebtedness (Favero, Missale 2012; Leandro, Zettelmeyer 2018).

The COVID-19 pandemic has wider consequences for economies and banks, both in developing and developed countries. At the beginning of the crisis, the worst situation was observed in poorer countries (Bulow et al., 2020), which was correlated to the central banks' operations, along with high liquidity or borrowing from the global capital market. Wyplosz (2020) suggests that after the crisis rapid sustainable recovery will not be observed. The impact of COVID-19 on economies creates increased sovereign debt distress that has reached unprecedented levels and increased bank exposure to their sovereign debt through holding domestic public debt by the Eurozone banking systems. Schularick et al. (2020) showed that a European strategy for the precautionary recapitalization of banks will contribute to re-launching lending to the economy and to the weakening of the sovereign–bank relationship. Cevik and Öztürkkal (2020) revealed that the COVID-19 pandemic has had a significant impact on market-implied sovereign default risk, especially in developed economies.

3. Research Design

3.1. Definition of Dependent and Explanatory Variables

In the presented analysis, the dependent variable is a long-term issuer credit rating proposed by credit rating agencies for European banks. The mentioned data was downloaded from the Thomson Reuters Database for the period between 1990 and 2021. These data are credit ratings taken from the end of a quarter. Moreover, CAMEL factors, including capital adequacy, assets quality, management quality, earrings, and liquidity indicators, are used as independent variables. The first of the mentioned groups of indicators taken for the analysis comprises Tier 1 and leverage ratios. *Tier 1* is the ratio of capital to risk-weighted assets. It is strictly associated with Basel II and Basel III regulations. Because it is one of the newest factors, it can only be considered for a short-term period. The mentioned measure represents capital buffers, and thus it should be negatively correlated with credit risk. In the COVID-19 pandemic, the Tier 1 ratio can have a stronger negative impact. Most regulators place attention on the higher capital buffers during the crisis. The *leverage ratio* is the measure of average total assets to average total common equity. The higher value of the mentioned factors would correlate positively with the default risk.

The next group of determinants are asset quality indicators, including loan loss provisions as a percentage of average total loans and non-performing loans to total loans. *Loan loss provisions as a percentage of average total loans* measure the bank's credit risk and are strictly associated with the quality portfolio of credits. If the mentioned factors are higher, it should positively influence credit risk, and as an effect decrease the bank's credit rating. *Non-performing loans to total loans* is calculated as non-performing loans at the end of the year divided by total gross loans for the same period. It should be positively correlated with credit risk and increase default risk.

The management quality groups of determinants contain the following factors: efficiency ratio and securities as a percentage of earning assets. The *Efficiency ratio* is the ratio of non-

interest expense for a fiscal year to the total revenue less interest expense over the same period and is expressed as a percentage. It measures the cost to the bank of each revenue unit. If the mentioned value is higher, it can increase credit risk. *Securities as a percentage of earning assets* is the ratio of average earning assets represented by securities at the end of a fiscal year. This ratio measures the extent to which the bank's income is dependent on investment income rather than interest on loans. If the mentioned value is higher, it can generate an additional default risk.

The next group of banks' risk determinants are profitability factors, including the following determinants: net interest income ratio, return on equity (ROE), return on assets (ROA), operating leverage, loan growth, and deposit growth. The *Net interest income ratio* is calculated as a percentage interest yield of interest-bearing assets. It measures the lending margin charged by a particular bank. A higher lending margin may signal higher risk taking, and as a result, exerts a negative impact on the mentioned factor of banks' credit rating. *Return on assets* and *return on capital* measures the bank's profit generated by total assets and shareholders' capital. If the mentioned value is higher, the default risk should be lower. The *operating leverage* is the percent change in net revenue less the percent change in operating expenses for a fiscal year. It should be positively correlated with the mentioned factors and credit ratings. *Loan growth* is the percent change in annual period net loans as compared to the same period one year previously. It is calculated as net loans for a fiscal year minus net loans for the same period one year previously divided by the annual net loans one year previously, multiplied by 100. A high value of this variable suggests the possibility of receiving additional earnings by banks, but conversely, it can generate credit risk. It should be compared with *deposit growth*, that is, the percentage change in annual deposits as compared to the same period one year previously. Total deposits represent the sum of non-interest-bearing deposits, interest-bearing deposits, and other deposits at the end of the fiscal year.

The last group of determinants associated with banks' financial statements are liquidity factors including the loan to deposit ratio. *Loan to deposit ratio* analyses the dependence of funding on the non-deposit capital. Because deposits are a more stable, cheaper, and safer source of funding, the high value of the mentioned variable suggests a higher risk for banks.

Macroeconomic factors include GDP growth and a country's risk. According to research proposed by Ötker-Robe and Podpiera (2010), *GDP growth* is negatively correlated with the share of non-performing loans and positively with the recovery rate. Therefore, higher GDP growth is expected to negatively correlate with default risk, and as a result, it positively influences banks' credit ratings. The next group of determinants are the *country's credit ratings*. The methodologies presented by credit rating agencies suggest that during the estimation process, they are taken into consideration with the same group of factors analyzed during a country's risk estimation. On the other hand, we can observe the "sovereign ceiling" effect in practice. Therefore, the downgrade of a country's credit rating often triggers downgrades of credit ratings of other financial institutions located in its sovereignty. The next variable that has been taken into consideration is the *purchase power parity*. As has been mentioned earlier, the inflation rate can have various impacts on the banks' credit ratings. A stronger impact on banks' notes has the *debt to GDP ratio*. A higher value of the mentioned indicator creates problems with the countries' probability of default. On the other hand, governments around the world have pumped cash directly to economies and have financed these operations by issuing bonds (sometimes bought by central banks). The last factor is *interest rates*. Decreasing interest rates reduces the cost of debt. Households and companies pay lower credit rates. On the other hand, lower interest rates reduce the interest income, the most significant income in the financial statement that directly influences the gross profit and indirectly affects the value of banks' capital. The impact of the cost of debt is measured by the *bond interest rates*.

3.2. Data Sample and Methodology

To analyze the determinants of banks' credit ratings, all long-term foreign issuer credit ratings given to European banks are used. Until the end of July 2021, only 10 different credit ratings for banks were proposed by credit rating agencies. From 2020, S&P's credit ratings cannot be collected from the Refinitiv database, so they must be collected from the analyzed banks' websites. Banks' credit ratings from the period between 1990 and 2021 have been taken from Refinitiv database. A separate analysis for a particular credit rating agency and a crisis period will be prepared. Credit ratings of 874 banks from European countries have been analyzed. To analyze the impact of particular determinants on banks' credit ratings, a linear decomposition proposed by Ferri et al. (1999) has been used. The same methodology has been used in other studies.

Table 1. Decomposition of Moody's, Dominion Bond Rating Service, Fitch long-term issuer credit ratings.

Moody's Long-Term Issuer Rating		Dominion Long-Term Issuer		Fitch Long-Term Issuer Rating		S&P's Long-term Issuer Rating	
Rating	Code	Rating	Code	Rating	Code	Rating	Kod
Aaa	100	AAA	100	AAA	100	AAA	100
Aa1	95	AA (high)	96	AA+	94,74	AA+	95
Aa2	90	AA	92	AA	89,47	AA	90
Aa3	85	AA (low)	88	AA-	84,21	AA-	85
A1	80	A (high)	84	A+	78,95	A+	80
A2	75	A	80	A	73,68	A	75
A3	70	A (low)	76	A-	68,42	A-	70
Baa1	65	BBB (high)	72	BBB+	63,16	BBB+	65
Baa2	60	BBB	68	BBB	57,89	BBB	60
Baa3	55	BBB (low)	64	BBB-	52,63	BBB-	55
Ba1	50	BB (high)	60	BB+	47,37	BB+	50
Ba2	45	BB	56	BB	42,11	BB	45
Ba3	40	BB (low)	52	BB-	36,84	BB-	40
B1	35	B (high)	48	B+	31,58	B+	35
B2	30	B	44	B	26,32	B	30
B3	25	B (low)	40	B-	21,05	B-	25
Caa1	20	CCC (high)	36	CCC	15,79	CCC+	20

Caa2	15	CCC	32	CC	10,53	CCC	15
Caa3	10	CCC (low)	28	C	5,26	CCC-	10
Caa	5	CC (high)	24	RD	-5	CC	5
C	0	CC	20	D	-5	NR	0
WR	-5	CC (low)	16	WD	-5	SD	-5
		C (low)	4				
		SD/D	-5				

Source: own elaboration.

Ordered logit panel data models—in which European banks' long-term issuer credit ratings are the dependent variable—have been used for the analysis. The analysis has been prepared on the first difference. Logit models are defined as those that rely on the verification of the probability unit which is then transformed into its cumulative probability value from a normal distribution. The final version of the model is:

$$y_{it}^{*} = \beta x_{it}' + \gamma Z_{it} + \varepsilon_{it}$$

where Y_{it}^{*} is an unobservable latent variable that measures the creditworthiness of a bank *i* in period *t*; X'_{it} is a vector of time varying explanatory variables; β is a vector of unknown parameters; Z_{it} are time invariant regressors that are generally dummy variables; ε_{it} is a random disturbance term with a normal distribution. y_{it}^{*} is related to the observed variable y_i, which is a credit rating in this case, in the following manner:

$$y_i = -5 \; if \; y_i^{*} < \tau_0$$

$$0 \; if \; \varepsilon_0 < \; y_i^{*} < \tau_1$$

$$5 \; if \; \varepsilon_1 < \; y_i^{*} < \tau_2$$

$$10 \; if \; \varepsilon_2 < \; y_i^{*} < \tau_3$$

$$15 \; if \; \varepsilon_3 < \; y_i^{*} < \tau_4$$

…

$$100 \; if \; \varepsilon_{21} < \; y_i^{*} < 0$$

where the $\tau_s(\tau_0 < \tau_1 < \tau_2 < \cdots < \tau_{22})$ are the known threshold parameters to be estimated. The following model may be named as a factor ordered probit model:

$$y_{it}^{*} = \beta F_{it}' + \gamma Z_{it} + \delta(F * Z)_{it} + \varepsilon_{it}$$

where $y_{i,t}$ is the Dominion, Fitch, Moody's and S&P's long-term issuer rating for European banks. F_{it} is a vector of explanatory variables.

$$F_{it} = [tier_{it}, ass_{it}, llp_{it}, npl_{it}, eef_{it}, sek_{it}, nint_{it}, roe_{it}, fee_{it}, opp_{it}, nloan_{it}, dep_{it},$$

$$eop_{it}, tax_{it}, rinv_{it}, size_{it}, macro_{it}, stopy_{it}, dług_{it}, bond_{it}, ppp_{it}\ ]$$

where $tier_{it}$ is the Tier 1 ratio; ass_{it} is the leverage ratio; llp_{it} are loan loss provisions as a percentage of average total loans; npl_{it} are non-performing loans to total loans; eef_{it} is the efficiency ratio; sek_{it} is the value of securities as a percentage of earning assets; $nint_{it}$ is the net interest income ratio; roe_{it} is the return on equity; fee_{it} is the commissions and fee to net revenue ratio; opp_{it} is the operating leverage; $nloan_{it}$ is the loan growth; dep_{it} is the deposit growth; eop_{it} is the ratio of loans to deposit; tax_{it} is the tax complement ratio, $rinv_{it}$ is the reinvestment; $size_{it}$ is the logarithm of assets ratio; $macro_{it}$ is the country's credit rating given by a particular credit rating agency; $stopy_{it}$ is the central bank interest rates; ppp_{it} is the purchasing power parity; $dług_{it}$ is the government debt to GDP ratio; $bond_{it}$ is the bonds interest rates; Z_{it} contains time invariant regressors that are generally dummy variables; ε_{it} is a random disturbance term.

To verify the mentioned phenomenon, the analysis has been prepared on the first difference.

4. Findings

The analysis of factors that can influence the banks' credit rating changes has been prepared in a few subsamples. The impact of determinants on the entire sample for credit rating

agencies has been verified—results are in Appendixes 1–4. Next, the influence of macro and microeconomic determinants according to the crisis period, the level of country's development, and belonging to the European Union and Eurozone has been verified.

4.1. Determinants of Credit Rating Changes According to the Level of Country's Development

The analysis of a country's development by considering the moment of crisis is presented in Tables 2 and 3. Table 2 presents the results of the impact of financial indicators on the credit rating changes during the COVID-19 pandemic from 1st quarter 2020 to 2nd quarter 2021. The various determinants of banks' credit rating changes can be noticed in the case of Moody's, S&P's, and DRBS notes. In the case of Fitch credit ratings, there are too few credit rating changes to build a model and verify the analyzed phenomenon. The mentioned scenario confirms the opinion of Loffer (2013) and credit ratings react slowly to the changes in the business cycle. It may be particularly associated with the slower reaction of the banking sector to the mentioned scenario, according to research by Kiff et al. (2013).

The presented results highlight differences in the studied factors in particular business cycles. The mentioned situation is different than in studies by Bar-Isaac and Shapiro (2013). Moreover, it can relate to a pandemic crisis. It is also observed that agencies are unwilling to frequently adjust their ratings, and the current ratings are closely related to the existing ratings. There are also significant disproportions in terms of the number of announced improvements and downgrades. The described situation confirms the opinion of Freitag (2015).

At first, in the case of DRBS ratings, the increase in banks measured by the logarithm of assets causes the rise of credit notes. In the case of Moody's and S&P's notes, there is an opposite relationship. If we compare the mentioned relationship to the pre-crisis period, the analyzed relationship is different. In the case of DRBS, the bigger banks that have a higher value of assets have a lower possibility of default. This relates to the "too big to fail"

phenomenon. Bigger banks have more opportunities to earn money. At first, they offer more financial products. They also use improved ways to reduce the default risk by utilizing derivatives and financial products. Bigger banks usually have access to financial support from the government in the case of default. Smaller institutions have a lower probability to receive the same support. On the other hand, if big banks default, it can create large systemic risk. Moreover, in some cases, the financial support can be excessive, and countries simply do not have enough wealth to assist banks with their financial problems. The second opinion is presented by Moody's and S&P's credit rating agencies, especially during the COVID-19 pandemic. The positive impact of the size of banks is confirmed by research from Chodnicka-Jaworska (2018). The mentioned relationship can also be associated with the type of institutions that wish to receive credit ratings. The biggest agencies are usually the most expensive; as a result, in a subsample, they usually have two types of clients: large banks and those that would like to receive reputation profits from earning credit ratings from a large recognizable credit rating agency.

Table 2. Financial determinants of Moody's and DRBS long-term issuer credit ratings during the COVID-19 pandemic given for banks from developed European countries.

drating	**>2019 developed**					
	Moody		DRBS		S&P	
	Coef.	P>z	Coef.	P>z	Coef.	P>z
deef	-0.2189	0.003	-0.186124	0	-.0944992	0.003
dfee			0.21176	0.001	.0853333	0.031
dnint	2.62286	0			-.0608317	0.162
dnloan	0.323481	0.011	-0.33435	0.023		
ddep			0.146135	0.024		
dllp					9.647141	0.000
dtier					.729808	0.029
deop			38.46888	0.002	3.72457	0.158
dsek					.1845214	0.123
dass					.9364023	0.009
droe					.8663666	0.001
drinv			0.765432	0	.4179312	0.000
dsize	-59.9076	0	47.23915	0.002	-29.62148	0.001
/cut1	-12.8474		-8.29265		-6.636968	
/cut2	9.024129		7.187801		-4.816147	
/cut3					4.712574	
no obs	1037		673		541	
Wald	0		0		0	

Rsq	0.7672	0.3069	0.2168

d-prefix means first differences; eef_{it} is the efficiency ratio; $nint_{it}$ is the net interest income ratio; fee_{it} is the commissions and fee to net revenue ratio; $nloan_{it}$ is the loan growth; dep_{it} is the deposit growth; eop_{it} is the ratio of loans to deposit; $rinv_{it}$ is the reinvestment; $size_{it}$ is the logarithm of assets ratio; $tier_{it}$ is the Tier 1 ratio; ass_{it} is the leverage ratio; llp_{it} are loan loss provisions as a percentage of average total loans; sek_{it} is the value of securities as a percentage of earning assets; roe_{it} is the return on equity; no obs is the number of observations; Wald is the probability from the Wald test; Rsq is the R^2 ratio.

Source: own elaboration.

The next step of the analysis relies on studying the impact of capital adequacy indicators on the banks' credit rating changes before and during the COVID-19 pandemic. The significance of the mentioned group of variables has been underlined by Shen et al. (2012), Bissoondoyal-Bheenick and Treepongharuna (2011) and Chodnicka-Jaworska (2016). The mentioned group of variables were labeled as one of the most significant. The idea of capital buffers and capital adequacy indicators relies on the use of capital to reduce default risk during a crisis by building capital surplus during the economic recovery. Most regulators postulated that the COVID-19 pandemic will weaken capital adequacy restrictions. As a result, if we compare the significance of the capital adequacy indicators before and during the COVID-19 pandemic we observe that changes in the mentioned factors are unimportant for credit rating changes for notes issued by DRBS and Moody's, however, these changes are important in order to receive higher notes in the case of ratings issued by S&P. Both of the analyzed factors, i.e., Tier 1 indicator and the leverage ratio have a significant impact on credit rating changes, especially in the case of DRBS notes. As has been mentioned earlier, this can be an effect of the type of financial institution that would like to receive credit ratings.

With capital adequacy indicators, there is a direct association with the asset quality factors. This group of indicators belongs to loan loss provisions as a percentage of average total loans and non-performing loans to total loans. The significance of the mentioned group of factors has been observed by Poon et al. (1999), Estrella et al. (2000). The changes of both determinants are insignificant for DRBS and Moody's rating changes during the COVID-19 pandemic. Problems with loan repayments and the quality of assets have impacted banks from all around the world; as a result, the mentioned group of indicators are not the most significant

during the stated period. The situation is different if we consider the notes given by S&P. The loan loss provisions as a percentage of the average of total loans is an important variable. Increasing the value of the mentioned variable reduces the default risk. Moreover, it is associated with maintaining financial sources for potential problems with loan repayment during the COVID-19 pandemic. The described relationship is weaker in the case of S&P's notes before the COVID-19 pandemic. The mentioned agency also places attention on the non-performing loans to total loans. In their opinion, the higher value of non-performing loans generates additional credit risk and as a result, indirectly impacts the default risk. Various opinions are presented by Moody's and DRBS. Both institutions place attention only on the loan loss provisions indicator. Changes to this indicator generate the default risk, especially for DRBS credit rating changes.

The management quality groups of determinants contain the following factors: efficiency ratio and securities as a percentage of earning assets. The change of the efficiency ratio should have a negative impact on the credit rating changes. It measures the cost to the bank of each revenue unit. If the mentioned value is higher, it can increase credit risk. The higher negative impact of the mentioned variable is observed during the COVID-19 pandemic in the case of all note types. The increase in the banks' costs creates high risk during the pandemic. The mentioned relationship is weaker for Moody's ratings, stronger for DRBS notes, and positive (but very low) for S&P's ratings. At first, it can relate to investment decisions made by banks at the first stage such as using Fintech products. A significant impact is also observed for the type of sample. Problems associated with rising revenue costs are especially important during the COVID-19 pandemic due to the unstable macroeconomic and health environment. The securities as a percentage of earning assets measure the extent to which the bank's income is dependent on investment income rather than interest on loans. If the mentioned value is higher, it can generate an additional default risk. If we compare the impact of the mentioned

variable before and during the COVID-19 pandemic we notice that this factor is insignificant during the COVID-19 pandemic for Moody's and DRBS notes. S&P places attention on the mentioned variable changes, based on a few reasons. During the COVID-19 pandemic, when the interest rates are lower, banks must find additional sources of profits. The security market brings higher profits during the pandemic. S&P also assesses a lot of investment banks. Before the COVID-19 pandemic, increases in the mentioned variable were assessed as being problematic for Moody's and especially DRBS notes.

The next group of banks' risk determinants are profitability factors, including the following determinants: net interest income ratio, return on equity (ROE), operating leverage, loan growth, and deposit growth. The significance of the mentioned variables has been verified by Pagratis and Stringa (2007), Shen et al. (2012), Bissoondoyal‐Bheenick and Treepongkaruna (2011), Poon et al. (1999), Hassan and Barrell (2013), and Öğüt et al. (2012). The mentioned group of factors, in their analysis, was one of the most significant. The presented research confirms this opinion.

Net interest income measures the lending margin charged by a particular bank. A higher lending margin may signal higher risk-taking, and as a result, exerts a negative impact on the mentioned factor of banks' credit rating. The presented relationship has been observed in the case of the banks' credit rating changes before the COVID-19 pandemic, especially in the case of the DRBS notes. In the case of S&P's notes, the mentioned positive relationship relates to the type of sample—banks that are larger with stable credit policies. The opposite relationship has been noticed during the pandemic. Changes in the S&P's notes are negatively correlated with changes in the net interest income indicator. This is an effect of the quality of the credit portfolios. The increase in the mentioned variable positively influences Moody's notes changes. It can relate to the decrease in central bank interest rates. The decrease in these notes reduces the borrowing interest income. As a result, banks earn less money on lending

activity. Return on equity measures the profit a bank can generate given total assets and shareholders' capital. If the mentioned value is higher, the default risk should be lower. The presented relationship is significant only for S&P's notes during the COVID-19 pandemic. The decreasing value of interest rates reduces the interest revenue—the main source of profits in banks' income statements. As a result, the impact of the mentioned variable is lower in the case of the COVID-19 period than before the pandemic. The pandemic time reduces banks' profits, as a result, credit rating agencies do not place such strong attention on the mentioned changes. Before the pandemic, the strongest reaction was observed for DRBS ratings. The operating leverage should have a positive correlation with the mentioned factors and credit ratings. Changes in the mentioned factor cause a weak significant negative impact before the COVID-19 pandemic period for all credit ratings. This can be related to the sample that has been considered for analysis. A high value of the loan growth suggests the possibility of receiving additional earnings by banks, but conversely, it can generate credit risk. It should be compared with deposit growth. Total deposits represent the sum of non-interest-bearing deposits, interest-bearing deposits and other deposits at the end of the fiscal year. Changes in the loan growth on the banks' credit rating adjustments have a positive impact on the case of Moody's ratings, especially during the COVID-19 pandemic. It can relate to more restrictive credit policies and difficulties in obtaining loans. In contrast, the mentioned variable creates additional profit. Changes in the mentioned variable negatively impact the credit rating changes in the case of the DRBS notes, but lower than before the pandemic. Too strong of a lending activity creates additional risk based on the opinion of the mentioned agency. A significant impact of the deposit growth is observed in the case of the DRBS sample. Problems with collecting money from households were observed during the pandemic. It relates to the lower interest rates and more profitable investment in the capital market. As a result, an increase in the deposits is positively assessed by the mentioned agency. Prior to the

COVID-19 pandemic, in the case of DRBS and S&P's notes, negative relationship between this variable were observed. High-value deposit growth can generate investment risk of additional financial sources in a riskier investment. Because of the COVID-19 pandemic, decisions have been made to verify the impact of adjusting commissions and fees as a percentage of the net revenue on the credit rating changes. The mentioned relationship is especially significant in the case of the DRBS and S&P's notes. The relationship during the COVID-19 pandemic is strictly associated with seeking additional profits by banks, other than interest revenue; it is stronger than before the pandemic, especially for notes presented by S&P. This confirms the strong impact of the commission and fees received by banks on their profits. The tax complement ratio is positively significant in the case of the credit rating changes before the pandemic, especially for DRBS notes. The reinvestment rate has a lower impact during the pandemic period—it is only significant for DRBS notes. In the case of S&P's notes, a negative relationship between the mentioned changes during the pandemic is observed. The reinvestment ratio increases the percentage of the annual cash flows that banks invest back into businesses as a new investment. Banks must make swift decisions during COVID-19—associated with the reduced opportunity to contact clients along with borrowing and depositing activity. As a result, many banks invest in new technologies (Fintech investments) in a short time.

The described relationship confirms the significance of the earnings factors during the COVID-19 pandemic. Credit rating agencies focus attention on the possibility to earn money, i.e., reducing problems associated with default risk. This can relate to a reduction in interest revenue as an effect of the decrease in interest rates by central banks. As a result, the main revenue can be achieved from non-interest activities undertaken by banks.

The analyzed liquidity indicator is the loan to deposit ratio. It has a positive impact on the DRBS and S&P's ratings, especially during the pandemic period. The mentioned group of

factors and their significance has been analyzed by Pagratis and Stringa (2007), Shen et al. (2012), Bissoondoyal‐Bheenick and Treepongkaruna (2011) and Chodnicka‐Jaworska (2016). The mentioned group of factors is particularly important because of problems associated with loan repayments by companies and households. Depositors also withdraw money and formulate alternative investment decisions. It has been observed that a strong outflow of cash from the banking sector is associated with a decrease in central banks' interest rates. The mentioned scenario is especially problematic for the stability of the banking sector as it increases the liquidity risk. If deposit withdrawal by households continues, it will cause a liquidity shortage (Cheney et al., 2020).

Table 3. Financial determinants of Moody's and DRBS long-term issuer credit ratings before COVID-19 pandemic given for banks from developed European countries.

drating	**2011-2019 developed**					
	Moody		DRBS		S&P	
	Coef.	P>z	Coef.	P>z	Coef.	P>z
deef	-0.039185	0	-3.10915	0.005	-.0795646	0.003
dopp	-0.0133	0	-3.31502	0.001	-.0058461	0.016
dnint	-0.42244	0.006	-1.19627	0.88	.7395821	0.099
dfee	0.03775	0	4.620931	0.001	.0245794	0.275
dnloan	0.010063	0	-1.02038	0	-.0051013	0.815
ddep	0.02069	0	-3.80765	0.004	-.0434397	0.003
dllp	-8.38298	0	-183.6933	0.013	4.593553	0.032
dnpl					-.5300517	0.000
dtier	-0.04622	0.065	-19.7031	0	-.120658	0.083
deop	0.108745	0.822	7.86032	0	4.66044	0.015
dsek	-0.02216	0.031	-7.72652	0.001	.0106844	0.157
dass	0.134065	0	36.15705	0.001	.2946641	0.004
droe	0.325022	0	7.787185	0.038	.5431506	0.000
dtax	0.025861	0.16	4.458598	0.056	.1010573	0.106
drinv	0.01307	0.365	1.1158	0	.1492888	0.000
dsize	10.19822	0	-108.581	0.035	24.88158	0.000
/cut1	-8.88865	0	-153.999	0	-7.808609	0.000
/cut2	-3.20637	0	151.4842	0	-5.690823	0.000
/cut3	-2.20223	0			-4.790515	0.000
/cut4	2.746722	0			-3.646136	0.000
/cut5	3.287702	0			4.168119	0.000
/cut6	3.430378	0			8.715755	0.000
no obs	5218		1765		2035	
no group	406		191		236	
Wald	0		0		0	

d-prefix means first differences; $tier_{it}$ is the Tier 1 ratio; ass_{it} is the leverage ratio; llp_{it} are loan loss provisions as a percentage of average total loans; npl_{it} are non-performing loans to total loans; eef_{it} is the efficiency ratio; sek_{it} is the value of securities as a percentage of earning assets; $nint_{it}$ is the net interest income ratio; roe_{it} is the return on equity; fee_{it} is the commissions and fee to net revenue ratio; opp_{it} is the operating leverage; $nloan_{it}$ is the loan growth; dep_{it} is the deposit growth; eop_{it} is the ratio of loans to deposit; tax_{it} is the tax complement ratio, $rinv_{it}$ is the reinvestment; $size_{it}$ is the logarithm of assets ratio; no obs is the number of observations; no group is the number of groups; Wald is the probability from the Wald test.

Source: own elaboration.

4.2. Determinants of Credit Ratings Changes According to Belonging to the European Union

Analyzing changes in financial indicators can influence credit rating changes—in those countries belonging to the EU—has been also prepared for the COVID-19 pandemic and prior to the pandemic. The generated results suggest that credit rating agencies have not made many credit rating adjustments. Furthermore, most of them are stable regarding EU banks. As a result, it was impossible to prepare an analysis for these banks.

Tables 4–6 highlight the analysis before and during the COVID-19 pandemic period. The prepared analysis suggests that credit rating changes are sensitive to changes in the banks' size. The significance of the mentioned variable, in the case of Moody's, S&P's, and DRBS notes changes, is similar for European Union banks. If banks are larger, there is an increase in credit rating changes. An opposite observation is presented for banks from countries that do not belong to the EU. A similar reaction has been observed for banks that do or do not belong to the Eurozone (Table 7). If we compare this reaction, we find a stronger relationship between these two changes in the Eurozone division. This can be related to the higher stability of banks from the mentioned area and the possibility of receiving financial support from the European Central Bank (EBC). Stronger competition in the mentioned area—i.e., more developed financial market, utilizing new ways to reduce the probability of default—is also important. Banks in the Eurozone are also larger. The described relationship can be also associated, in the mentioned counties, with the "too big to fail" attitude that some banks take on. Moreover, capital requirements that are also mentioned are more restrictive. The financial condition of the mentioned is also the same due to uniform monetary policy. In Moody's and S&P's opinion, using the sample of banks, the default risk rises during the COVID-19 pandemic. The mentioned relationship can relate to the less stable economies of the

mentioned countries. The banking sector is also dependent on the financial market. A stronger relationship has been noticed for banks from the Eurozone.

The next group of indicators are those associated with the capital adequacy indicators. Changes in the Tier 1 ratio are statistically significant only for banks from the European Union. A stronger relationship is noticed between the DRBS notes and the Eurozone countries. The overmentioned relationship can relate to the restrictiveness of European rules. The Tier 1 ratio is especially significant for the Eurozone—also European Union banks during the COVID-19 pandemic. This confirms previous results. The leverage ratio has a significant impact prior to the COVID-19 pandemic on Moody's credit rating changes of banks from European countries. The mentioned relationship is stronger for the Eurozone subsample, especially for S&P's notes and banks' credit rating changes from countries that are not within the Eurozone. The significance of the leverage ratio increases during the COVID-19 pandemic. This can be related to the asset's quality and issues with loan repayments.

Table 4. Financial determinants of Moody's and DRBS long-term issuer credit ratings before the COVID-19 pandemic given for banks from European Union and non-European Union countries.

drating	**2011-2019**									
	EU				non EU		EU		EU	
	Moody						DRBS		S&P	
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z
deef	-0.03001	0.314	-0.0289	0.004	0.005495	0.929	-1.03349	0	.0898331	0.002
dopp	-0.00108	0.738	-0.01558	0	-0.00282	0.773	-0.45984	0	-.0185467	0.000
dnint	1.797189	0	0.32291	0.024	-8.26497	0.15	10.89381	0	.9223459	0.053
dfee	-0.02807	0.15	0.042026	0	-0.38809	0.007	0.539375	0	.0548165	0.020
dnloan	0.210993	0	0.011205	0	-0.07027	0.49	0.203772	0.017	-.0351156	0.127
ddep	-0.00674	0.504	-0.02301	0	0.032148	0.696	-0.44775	0	-.0535081	0.001
dllp	-9.66848	0.002	-7.241752	0	-11.7762	0.187	-49.34854	0.004	1.568628	0.483
dnpl	-0.846234	0.001							-.6041941	0.000
dtier	-0.08012	0.182	-0.04601	0.076	0.188757	0.653	-1.66731	0.007	-.0161852	0.841
deop	-6.23376	0	0.221625	0.652	-27.8477	0.006	70.07642	0	5.600284	0.004
dsek	0.0351	0.088	-0.01721	0.096	-0.56918	0.154	-1.19117	0	-.0727247	0.001
dass	-0.39018	0	0.126764	0.001	0.223164	0.745	0.847427	0.197	.4191169	0.000
droe	0.114034	0.51	0.257091	0	-0.703	0.136	-0.64236	0.527	.7332984	0.000
dtax	0.460149	0.018	0.031877	0.087	10.48144	0.05	-1.59069	0.011	.7494162	0.000
drinv	0.108228	0.001	-0.00556	0.706	-0.03365	0.83	1.766538	0	-.1367228	0.000
dsize	-18.4338	0	10.83413	0	-18.5529	0.064	10.60377	0	29.99013	0.000
/cut1	-7.82516	0	-8.93658	0	-6.66756	0	-22.3599	0	-7.892032	0.000
/cut2	-3.50908	0	-3.25712	0	4.359254	0	-21.6669	0	-5.752866	0.000
/cut3	3.131878	0	-2.24885	0			20.2462	0	-4.792886	0.000
/cut4	4.794022	0	2.89782	0					-3.661445	0.000
/cut5			3.397753	0					4.173733	0.000

/cut6		3.540869	0		9.274447	0.000
no obs	1573	5504	532	1819	1724	
no group	126	374	32	130	195	
Wald	0	0	0.0304	0	0	

d-prefix means first differences; $tier_{it}$ is the Tier 1 ratio; ass_{it} is the leverage ratio; llp_{it} are loan loss provisions as a percentage of average total loans; npl_{it} are non-performing loans to total loans; eef_{it} is the efficiency ratio; sek_{it} is the value of securities as a percentage of earning assets; $nint_{it}$ is the net interest income ratio; roe_{it} is the return on equity; fee_{it} is the commissions and fee to net revenue ratio; opp_{it} is the operating leverage; $nloan_{it}$ is the loan growth; dep_{it} is the deposit growth; eop_{it} is the ratio of loans to deposit; tax_{it} is the tax complement ratio, $rinv_{it}$ is the reinvestment; $size_{it}$ is the logarithm of assets ratio; no obs is the number of observations; no group is the number of groups; Wald is the probability from the Wald test.

Source: own elaboration.

The loan loss provisions as a percentage of total loans and the non-performing loans as a percentage of total loans have a strong significant impact on banks' credit rating changes from non-European Union countries. A stronger relationship is observed for banks rated by DRBS. This relates to the asset's quality and issues with cash repayment in the mentioned banks. Banks from developing countries are more sensitive to the economic environment, especially during a crisis. Issues with cash repayment are an effect of job loss, companies' default risk, the developing financial market, and firms' international connections. In the case of S&P's notes, a positive reaction on the loan loss provisions indicators during COVID-19 is observed, which confirms previous results for developed countries.

Changes in the efficiency ratio have a negative impact on the credit rating changes. The higher negative impact of the mentioned variable can be observed during the COVID-19 pandemic in the case of Moody's and S&P's notes given for non-Eurozone banks. The increase in the banks' costs creates high risk during the crisis. The mentioned variable before the COVID-19 pandemic has a stronger impact on the DRBS notes changes and in the case of Moody's in the sample of banks from the Eurozone. A positive relationship can be observed for notes issued by S&Ps for banks during the COVID-19 pandemic—particularly those from the Eurozone. The securities as a percentage of earning assets, for Moody's notes, are insignificant during the COVID-19 pandemic. In the case of S&P's ratings, the mentioned variable has a significant impact, especially for the group with Eurozone banks. This is associated with the alternative decisions made by banks to invest in the capital market, as a

result of reduced interest rates by central banks. This is also significantly important prior to the stated period. This created an increase in high default risk according to the DRBS and S&P's opinion, and for banks from non-Eurozone countries.

Table 5. Financial determinants of DRBS long-term issuer credit ratings during the COVID-19 pandemic given for banks from non-European Union countries.

drating	**>2019**	
	non EU	
	Moody	
	Coef.	P>z
deef	-0.21257	0.014
dnint	2.864806	0.008
deop	65.46926	0.044
dass	4.910013	0.021
dsize	-28.682	0.015
/cut1	-18.7412	0.049
/cut2	5.788947	0
no obs	225	
no group	75	
Wald	0.0091	

d-prefix means first differences; ass_{it} *is the leverage ratio;* eef_{it} *is the efficiency ratio;* $nint_{it}$ *is the net interest income ratio;* eop_{it} *is the ratio of loans to deposit;* $size_{it}$ *is the logarithm of assets ratio; no obs is the number of observations; no group is the number of groups; Wald is the probability from the Wald test.*
Source: own elaboration.

Net interest income has been observed in the case of the banks' credit rating changes prior to the COVID-19 pandemic, especially for the DRBS notes. Moody's notes are more sensitive during the COVID-19 pandemic, especially in the case of non-European banks. This can be related to a decrease in the central bank interest rates. The decrease in these notes reduces the borrowing interest income. As a result, banks earn less money on lending activity. As a result, the higher value of the mentioned variable symbolizes higher profits. In the case of non-European Union or non-Eurozone banks, a negative relationship is associated with the risk of insecure decisions made by these banks to generate additional profits is observed. S&P confirms this opinion during the COVID-19 pandemic.

Return on equity measures the profit a bank can generate given total assets and shareholders' capital. If the mentioned value is higher, the default risk should be lower. The presented relationship is seen to be significant before the COVID-19 pandemic, especially in the case of the DRBS, S&P credit rating changes for the Eurozone banks, confirming previous results

gained for developed countries. The negative relationship is observed for the non-Eurozone banks in the case of the S&P's notes, and positive for Moody's ratings. This is an effect from a similar result for the net interest income ratio, associated with risky decision making. During the COVID-19 pandemic, most banks had issues with generating high profits, as a result, the impact of the return on equity changes is stronger than before the pandemic.

Table 6. Financial determinants of S&P long-term issuer credit ratings during the COVID-19 pandemic given for banks from Eurozone and European Union countries.

drating	**>2019**			
	S&P			
	UE		Euro	
	Coef.	P>z	Coef.	P>z
deef	.1568224	0.001	.9522337	0.000
dopp	-.0008706	0.948	-.1282644	0.002
dnint	-.1722365	0.010	-1.231815	0.417
dfee	.1262071	0.011	.4016347	0.112
dnloan	-.2041361	0.036	.1128429	0.789
ddep	-.0172332	0.663	-.1460662	0.382
dllp	10.92026	0.001	75.19237	0.000
dtier	1.692938	0.000	4.582327	0.000
deop	3.726499	0.375	-33.15334	0.189
dsek	.1182262	0.432	1.324742	0.099
dass	3.478055	0.000	6.468862	0.091
droe	1.177587	0.003	1.062994	0.000
drinv	-.7390371	0.000	-.6253709	0.422
dsize	-63.91165	0.000	-87.53908	0.226
/cut1	-8.027335		-15.71457	
/cut2	-6.159753		-11.89641	
/cut3	5.604763		17.60082	
no obs	489		327	
no group	0		0	
Wald	0.2879		0.6669	

d-prefix means first differences; $tier_{it}$ is the Tier 1 ratio; ass_{it} is the leverage ratio; llp_{it} are loan loss provisions as a percentage of average total loans; npl_{it} are non-performing loans to total loans; eef_{it} is the efficiency ratio; sek_{it} is the value of securities as a percentage of earning assets; $nint_{it}$ is the net interest income ratio; roe_{it} is the return on equity; fee_{it} is the commissions and fee to net revenue ratio; opp_{it} is the operating leverage; $nloan_{it}$ is the loan growth; dep_{it} is the deposit growth; eop_{it} is the ratio of loans to deposit; tax_{it} is the tax complement ratio, $rinv_{it}$ is the reinvestment; $size_{it}$ is the logarithm of assets ratio; no obs is the number of observations; no group is the number of groups; Wald is the probability from the Wald test.
Source: own elaboration.

The operating leverage has a significant negative impact prior to the COVID-19 period. It is particularly significant in the group of banks from non-European countries. In the case of the COVID-19 pandemic, the mentioned relationship is stronger for banks from the Eurozone assessed by S&P. Risky investment decisions creates additional default risk for banks from the Eurozone, where there are negative interest rates.

Changes in the loan growth on the banks' credit rating changes have a positive impact in the case of Moody's ratings, especially for banks from Eurozone countries. This can be related to the more restrictive credit policies and difficulties in obtaining loans. On the other hand, the mentioned variable creates additional profit. During the COVID-19 pandemic, S&P suggests that increasing loan policy creates additional risk, especially for European Union banks. This relates to problems with repayment credits, leading to bankruptcy. A significant impact is observed in the case of the deposit growth for all ratings. The mentioned relationship has not been observed for S&P's and Moody's notes during the COVID-19 pandemic. Cheap cash with zero-cost capital is available on the market. The impact of changes in commissions and fees as a percentage of the net revenue on the credit rating changes is especially significant in the case of all notes before the COVID-19 pandemic, however, the mentioned relationship is negative for the non-European countries, which can be an effect from the type of business activity—it is higher for banks from non-Eurozone countries. The mentioned relationship suggests that banks from this area seek additional profits from non-lending activities. The tax complement ratio is positively significant in the case of the credit rating changes before the pandemic, especially for DRBS notes, and negative for S&P's ratings. In the last opinion, increases in tax reduce net profits for banks outside the Eurozone. The reinvestment rate has a significant impact prior to the COVID-19 pandemic. This is especially significant for DRBS notes and banks from non-Eurozone countries. Credit rating agencies in the reinvestment of profits see the possibility of developing banks' activity and reducing the possibility of default. On the other hand, S&P suggests that changes in the reinvestment ratio have a negative impact on credit ratings, especially during the pandemic. Making investment decisions during a crisis reduces financial sources in the case of an increased probability of default.

The analyzed liquidity indicator is the loan to deposit ratio. It has a positive impact on all ratings. In the case of Moody's notes, it is especially significant during the pandemic period.

The mentioned agencies visualize the possibility of investing cheap capital received from households as a way to develop banking activities. The situation associated with COVID-19 requires more restrictive credit policies.

Table 7. Financial determinants of Moody's and DRBS long-term issuer credit ratings before the COVID-19 pandemic given for banks from Eurozone and non-Eurozone countries.

drating	**2011-2019**									
	Moody				DRBS		S&P			
	Euro		non Euro		Euro		Euro		non Euro	
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z
deef	-0.01134	0.029	-0.04916	0.029	0.040381	0.489	.6878487	0.000	-.1280983	0.003
dopp	-0.01018	0	0.000253	0.953	-0.11012	0	.0174448	0.083	-.0277069	0.000
dnint	0.006901	0.071	2.260655	0	-0.24051	0	-1.025528	0.189	-2.385223	0.049
dfee	0.068829	0	0.088014	0	0.098044	0.015	.3460119	0.000	-.2323723	0.000
dnloan	0.034103	0	0.127635	0	-0.0023	0.963	-.4459606	0.000	.0653236	0.187
ddep	-0.06877	0	-0.06206	0	-0.02069	0.707	-.0268972	0.462	.0185866	0.499
dllp	-1.44003	0.039	-6.483655	0.039	-58.59824	0	32.14216	0.000	-.6377131	0.834
dnpl							-2.288932	0.000	-.0482915	0.848
dtier	-0.22769	0	-0.02537	0.543	1.444734	0	.162371	0.391	-.1475642	0.142
deop	-4.82323	0	-4.86798	0	55.33795	0	69.23231	0.000	-.9133249	0.793
dsek	0.015832	0.15	0.053361	0.014	-0.31141	0	-.5779055	0.000	.009463	0.437
dass	0.04091	0.29	0.300864	0.014	0.84151	0.001	.7240772	0.000	-.5387094	0.056
droe	0.021835	0.687	0.777075	0	1.361416	0.002	4.117357	0.000	-.3792877	0.147
dtax							.9145353	0.000	-.1505798	0.168
drinv	0.023216	0.454	0.067285	0.025	0.553755	0	-.6181587	0.000	-.1113454	0.042
dsize	14.66222	0	-15.8443	0	21.52957	0.034	72.4491	0.000	12.98703	0.034
/cut1	-6.06551	0	-6.51509	0	-22.7011	0	-9.333659	0.000	-6.447148	0.000
/cut2	-6.01412	0	-4.20556	0	-20.1927	0	-7.705218	0.000	-6.158119	0.000
/cut3	-3.34256	0	3.275587	0	7.261007	0	-6.273874	0.000	-4.081138	0.000
/cut4	-2.09642	0			9.573009	0	5.642746	0.000	6.266723	0.000
/cut5	3.220818	0					11.64353	0.000		
/cut6	3.502537	0								
/cut7	3.644468	0								
no obs	5976		1917		1864		1079		978	
no group	331		75		88		137		101	
Wald	0		0		0		0		0	

d-prefix means first differences; $tier_{it}$ is the Tier 1 ratio; ass_{it} is the leverage ratio; llp_{it} are loan loss provisions as a percentage of average total loans; npl_{it} are non-performing loans to total loans; eef_{it} is the efficiency ratio; sek_{it} is the value of securities as a percentage of earning assets; $nint_{it}$ is the net interest income ratio; roe_{it} is the return on equity; fee_{it} is the commissions and fee to net revenue ratio; opp_{it} is the operating leverage; $nloan_{it}$ is the loan growth; dep_{it} is the deposit growth; eop_{it} is the ratio of loans to deposit; tax_{it} is the tax complement ratio, $rinv_{it}$ is the reinvestment; $size_{it}$ is the logarithm of assets ratio; no obs is the number of observations; no group is the number of groups; Wald is the probability from the Wald test.

Source: own elaboration.

4.3. Macroeconomic Determinants of Credit Ratings Changes

Analyzing the macroeconomic risk for estimating credit rating changes relies on analyzing changes in the macroeconomic variables and the country's credit rating on the banks' notes. Analysis of the macroeconomic variables is presented in Table 8. Factors such as: central bank interest rates, the price purchasing parity, the government debt to GDP ratio, and bond interest rates have been utilized in the analysis. Moreover, the analysis has been prepared for developed countries before and during the COVID-19 pandemic period. Changes in the central banks' interest rates on the credit rating changes can be observed for DRBS notes during the COVID-19 pandemic. The mentioned relationship is especially significant for the COVID-19 pandemic. It is strictly associated with a decrease in the stated rates by central banks. As a result, banks' interest incomes are decreased. The banks' revenues are also lower. The mentioned situation creates high default risk. Lower interest rates cause lower interest revenues from borrowing activity. The mentioned profits are most significant for banks' activity. Next, lower production creates issues associated with companies' revenues and as a result lowers their creditworthiness. Lower creditworthiness reduces the possibility of receiving credit. Moreover, lower production reduces the likelihood of companies making investment decisions. As a result, the need for long- or short-term financing decreases until the economy recovers (Ryan et al., 2020). Therefore, the reaction of the banking sector to the described problem is delayed. The analyzed relationship is weaker for Moody's and S&P's notes before the pandemic.

The price purchasing parity has a significant impact on the credit rating changes. The increasing wealth of householders has a positive impact on the stability of an economy. A stable economy creates improved conditions for banks' financial stability and reduces the default risk. The mentioned variable is especially significant during the COVID-19 pandemic, for S&P's credit rating changes. This confirms the opinion presented by Wilson (2020) and Tyson (2020), who suggest that a stronger impact from the COVID-19 pandemic will be

noticed in developing countries, where banks' clients are those with lower creditworthiness. As a result, in practice, the impact of the COVID-19 pandemic can be stronger in the mentioned area. In these countries, it can result from issues based on substantial loan defaults, difficulty recovering borrowed funds, withholding customer savings for daily living, problems with receiving loans, or decreased investments due to future fear (Lagoarde-Segot, Leoni, 2013). The mentioned relationship has been specifically analyzed for developed countries (World Economic Forum, 2020; FSG, 2020; BIS, 2020; Cecchetti, Schoenholtz, 2020; Stiller, Zink, 2020; Stietzel et al., 2020). The macroeconomic COVID-19 shocks have had direct/indirect impacts on high default risk individuals and firms (Vidociv, Tamminaina, 2020).

Another variable that has been used in this analysis is the central debt to GDP ratio. This indicator is significant for Moody's and S&P's credit rating changes, however, the relationship is opposite. For Moody's ratings, the increase in the mentioned variable—especially during the COVID-19 pandemic—stimulates the economy and increases the credit ratings. In the case of S&P's notes, the increase in the central debt to GDP ratio causes an increased probability of the debt crisis, as a result, creating a negative economic environment. This is higher for the COVID-19 pandemic period. The increasing value of this variable is strictly associated with the expansionary fiscal policy and direct cash distributed to reduce companies' default risk. Reinhart (2012) and Reinhart and Sbrancia (2015) present an opposing opinion, that the growing government debt can also lead to financial repressions. The mentioned direct assistance for companies reduces their default risk during the COVID-19 pandemic and reduces the banks' credit risk. In the future, it can also build the specific "loans crowding-out" effect on the banking asset side (IMF, 2001). The sovereign debt crisis may be transformed, on the banking risk, into sovereign risk, creating a spiral effect (IMF, 2010, Dotz and Fischer, 2010), similar to that during the 2008 global crisis. Schularick et al.

(2020) highlighted that a European strategy for the precautionary recapitalization of banks will contribute to the re-launch of lending to the economy and to the weakening of the sovereign–bank relationship. The increasing value of capital financing measure costs by the bonds' interest rates creates higher default risk. This is particularly significant for Moody's long-term issuer credit rating changes. The impact of the mentioned variable is strengthened during the COVID-19 pandemic.

Table 8. Macroeconomic determinants of Moody's and DRBS long-term issuer credit ratings given for banks from developed European countries.

drating	**developed >2019**						**developed 2011-2019**					
	Moody		DRBS		S&P		Moody		DRBS		S&P	
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z
stopy	30.974	0.22	352.714	0	1.889747	0.372	-1.02982	0	0.021086	0.934	2.258806	0.000
ppp	-0.16602	0.015	-0.300752	0.001	-2.163364	0.000	-0.0748	0	-0.10083	0	-.067759	0.090
dług	0.321931	0	-0.00648	0.935	-4.187986	0.000	0.058802	0	0.001766	0.863	-.8303627	0.000
bond	-4.13209	0.091	-2.249635	0.083	-.730755	0.360	-0.38465	0	-0.93393	0	-.0286213	0.232
/cut1	-4.6458	0.423	20.70986	0.016	-5.92627		-17.8076	0	-21.339	0	-8.636415	0.000
/cut2	-3.51568	0.548	22.77736	0.008	-4.516891		-14.0132	0	-20.6458	0	-7.431758	0.000
/cut3			37.7874	0	6.878346		-13.1893	0	-19.0355	0	-5.924888	0.000
/cut4							-13.179	0	-16.4598	0	-5.902837	0.000
/cut5							-13.0538	0	-8.32726	0	-5.670211	0.000
/cut6							-11.6682	0	-7.36648	0	-4.898543	0.000
/cut7							-10.5433	0	-7.28397	0	-4.791544	0.000
/cut8							-4.34225	0	-7.19411	0	-3.439386	0.000
/cut9							-3.36771	0	-6.74565	0	-2.467704	0.000
/cut10							-3.22307	0			2.931804	0.000
/cut11											5.741279	0.000
/cut12											5.84167	0.000
/cut13											8.788857	0.000
/cut14											9.48208	0.000
no obs	1355		532		1329		14363		5012		13351	
no group	455		32				457		294		454	
Wald	0		0.0304				0		0		0	

$macro_{it}$ is the country's credit rating given by a particular credit rating agency (Dominion Bond Rating Service (DBRS) Long-Term Issuer, Fitch Long-Term Issuer Rating, Moody's Long-Term Issuer Rating); $stopy_{it}$ is the central bank interest rates; ppp_{it} is the purchasing power parity; $dług_{it}$ is the government debt to GDP ratio; $bond_{it}$ is the bonds interest rates; no obs is the number of observations; no group is the number of groups; Wald is the probability from the Wald test.
Source: own elaboration.

The small number of observations associated with the credit rating changes during the COVID-19 pandemic period creates issues with analyzing the country's effect. As a result, only the analysis of the impact of a country's credit rating changes prior to the COVID-19 pandemic has been prepared. The mentioned analysis has been presented in Table 9. A strong

significant relationship is observed for both credit rating agencies, however, the mentioned correlation is higher for DRBS notes. The described relationship has been previously observed. This confirms that banks' notes are strictly related to a country's conditions and economic stability.

Table 9. Impact of Moody's and DRBS countries long-term issuer ratings on banks' long-term issuer credit ratings given for developed European countries subsample.

drating	**developed 2011-2019**			
	DRBS		Moody	
	Coef.	P>z	Coef.	P>z
macro	0.976315	0	0.438723	0
/cut1	-8.34043	0	-11.6677	0
/cut2	-8.24509	0	-7.61297	0
/cut3	-7.69836	0	-6.30418	0
/cut4	-4.29707	0	-6.2828	0
/cut5	3.815116	0	-5.19888	0
/cut6	4.988585	0	-4.84541	0
/cut7	5.069966	0	-3.58624	0
/cut8	5.158464	0	2.924428	0
/cut9	5.601067	0	6.29943	0
/cut10			6.399778	0
no obs	8064		8917	
no group	513		317	
Wald	0		0	

$macro_{it}$ is the country's credit rating given by a particular credit rating agency (Dominion Bond Rating Service (DBRS) Long-Term Issuer, Fitch Long-Term Issuer Rating, Moody's Long-Term Issuer Rating); no obs is the number of observations; no group is the number of groups; Wald is the probability from the Wald test.
Source: own elaboration.

5. Conclusions

The presented research confirms the opinion regarding the stability of banks' credit ratings during the first stage of the COVID-19 pandemic. Moreover, it suggests that credit rating agencies impact the stability of the banking sector. The mentioned situation confirms the opinions of Freitag (2015) and Baar-Issac and Shapiro (2013). This can raise questions regarding the significance and importance of credit ratings during the estimation of the default risk, especially during the pandemic. The described situation, especially in the case of Fitch notes, brings another question regarding the procyclicality nature of credit ratings.

Increased bank size can bring additional risks during the pandemic. On the other hand, this can also be related to the "too big to fail" phenomenon. Bigger financial institutions make riskier decisions. The mentioned situation is observed in the sample of Moody's credit rating changes. As a result, it suggests that bigger banks can have issues regarding financial stability, based on Moody's opinion. As a result, future work should focus on analyzing the mentioned

area. Lastly, this is especially disturbing since it was not observed prior to the COVID-19 pandemic.

One significant aspect that has been particularly noticed in this research, and in practice, is the change of the list of variables that significantly influence the credit rating changes. This situation reduces the significance of the capital adequacy indicators associated with the Basel III regulations. The mentioned measures are more important during the estimation of the default risk by credit ratings prior to the COVID-19 pandemic. This can be related to relaxing the Basel III requirements by the national supervisors. Furthermore, the mentioned situation is strictly associated with the significance of the asset's quality indicators. Changes in the significance of the stated group of variables should be analyzed in the near future. The reaction of the credit rating changes—upon changes in the quality of assets—can also be delayed. In many countries, results associated with preferential loans and financial support received from governments have been observed.

A strong significant impact of the earnings indicator was observed during the COVID-19 pandemic. The same situation is observed for liquidity factors. At first, it is related to lower-income profits received by banks, lower interest rates, cash withdrawal by depositors, and investing elsewhere such as the capital market. The rising liquidity risk can also be a source of problems in assessing the default risk of banks.

Analysis of the macroeconomic risk for the credit ratings changes estimation confirms the strong significant impact of changes in basic interest rates by banks thereby creating additional default risk. Lower interest revenue will be a significant problem in the near future. It should be verified over a longer period, but it can have a stronger impact on the sample of banks from developing countries and financial entities from countries outside the Eurozone. The reaction of the banking sector to the described problem is delayed. In addition, the price

purchasing parity impact is similar. The impact of the COVID-19 pandemic is more pronounced in the mentioned area. In these countries, it can result from problems associated with large loan defaults, difficulty in recovering borrowed funds, withholding customer savings for daily living, problems with receiving loans, and/or decreased investments due to future fear.

The central debt to GDP ratio is also higher for the COVID-19 pandemic period. Credit rating agencies positively assess the support of government policy. The mentioned relationship is strictly associated with this phenomenon and in the near future, it should be inversely evaluated. Questions regarding the "loans crowding-out" effect or spiral effect and the negative impacts of government debt on the default risk of the banking sector should be put forward. The described situation is strictly associated with the cost of the capital measured by the bonds' interest rates.

The prepared analysis confirms the strong impact of the macroeconomic environment—of the COVID-19 pandemic—on the banking sector's default risk and has a direct influence on the methodology used by credit rating agencies. Future analysis should distinguish the direct and indirect effects of the mentioned situation on the credit rating changes. This study also confirms the opinion regarding the lagged reaction of credit rating agencies on the changes in the situation during the COVID-19 pandemic.

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Appendix 1. Determinants of Moody's European banks' long term issuer credit ratings.

drating	**Coef.**	**P>z**	**Coef.**	**P>z**	**Coef.**	**P>z**
deef	0.102725	0	0.028699	0	-0.03909	0.004
dopp	-0.00846	0	-0.00178	0	-0.01345	0
dnint	-0.02445	0.93	-0.31587	0.009	1.000989	0
dfee	0.046015	0.001	0.017645	0	0.060245	0
dnloan	0.022233	0	0.011603	0	0.030684	0
ddep	-0.04905	0	-0.02277	0	-0.05848	0
dllp	-2.13263	0.177	3.967694	0	-8.60368	0
dtier	-0.00456	0.914	-0.13678	0	-0.15501	0.065
deop	-2.4906	0.017	-1.0673	0.016	-3.25593	0
dsek	-0.01592	0.469	0.019396	0	-0.04022	0.02
dass	0.155961	0.012	-0.05862	0.002	-0.34799	0
droe	0.676122	0	-0.03038	0.435	0.328652	0
dtax	0.282298	0	0.015779	0.379	0.20583	0
drinv	0.073669	0	0.038185	0.001	0.097685	0.006
dsize	-5.8852	0.017	7.603076	0	12.0631	0
macro	0.447068	0				
dstopy					9.903165	0
dbezr					-0.23026	0.287
dppp					0.028324	0.855
ddlug					-0.85598	0
dbond					1.204705	0.001
/cut1	-10.7601	0	-9.45769	0	-10.3741	0
/cut2	-6.25812	0	-3.71706	0	-6.07873	0
/cut3	-3.92819	0	-2.80401	0	-3.26326	0
/cut4	3.252132	0	3.000586	0	2.788393	0
/cut5	5.420488	0	3.319704	0	3.114762	0
/cut6	5.882428	0	4.130597	0	3.259507	0
/cut7			8.460759	0		
no obs	2964		11586		4183	
no group	125		408		337	
Wald	0		0		0	

d-pretax means first differences; $tier_{it}$ is the Tier 1 ratio; ass_{it} is the leverage ratio; llp_{it} are loan loss provisions as a percentage of average total loans; npl_{it} are non-performing loans to total loans; eef_{it} is the efficiency ratio; sek_{it} is the value of securities as a percentage of earning assets; $nint_{it}$ is the net interest income ratio; roe_{it} is the return on equity; fee_{it} is the commissions and fee to net revenue ratio; opp_{it} is the operating leverage; $nloan_{it}$ is the loan growth; dep_{it} is the deposit growth; eop_{it} is the ratio of loans to deposit; tax_{it} is the tax complement ratio, $rinv_{it}$ is the reinvestment; $size_{it}$ is the logarithm of assets ratio; $macro_{it}$ is the country's credit rating given by a particular credit rating agency (Dominion Bond Rating Service (DBRS) Long-Term Issuer, Fitch Long-Term Issuer Rating, Moody's Long-Term Issuer Rating); $stopy_{it}$ is the central bank interest rates; ppp_{it} is the purchasing power parity; $dług_{it}$ is the government debt to GDP ratio; $bond_{it}$ is the bonds interest rates; no obs is the number of observations; no group is the number of groups; Wald is the probability from the Wald test.

Source: own elaboration.

Appendix 2. Determinants of Fitch's European banks' long term issuer credit ratings.

drating	**Coef.**	**P>z**	**Coef.**	**P>z**
deef	-0.01222	0.033	-0.01521	0.009
dopp	-0.00819	0	-0.00844	0
dnint	0.238559	0.164	0.144532	0.398
dfee	-0.0255	0	-0.03085	0
dnloan	0.00407	0.27	0.005873	0.102
ddep	0.015422	0.001	0.014642	0.001
dllp	0.252922	0.659	0.392612	0.51
dtier	0.2511	0	0.240689	0
deop	3.451172	0	3.270605	0
dsek	0.011325	0.087	0.012427	0.062
dass	0.223226	0	0.269988	0
droe	0.390854	0	0.369581	0
dtax	-0.11054	0	-0.11579	0
drinv	-0.00039	0.976	0.008888	0.314
dsize	7.269305	0	5.933662	0
macro			-0.02788	0
/cut1	-10.4955	0	-10.4793	0
/cut2	-6.62268	0	-6.60644	0
/cut3	-5.66332	0	-5.64699	0
/cut4	-4.57659	0	-4.55828	0
/cut5	-4.46606	0	-4.44733	0
/cut6	-4.44081	0	-4.42199	0
/cut7	-4.43804	0	-4.41922	0
/cut8	6.87031	0	6.999025	0
no obs	17738		17577	
no group	582		568	
Wald	0		0	

d-pretax means first differences; $tier_{it}$ is the Tier 1 ratio; ass_{it} is the leverage ratio; llp_{it} are loan loss provisions as a percentage of average total loans; npl_{it} are non-performing loans to total loans; eef_{it} is the efficiency ratio; sek_{it} is the value of securities as a percentage of earning assets; $nint_{it}$ is the net interest income ratio; roe_{it} is the return on equity; fee_{it} is the commissions and fee to net revenue ratio; opp_{it} is the operating leverage; $nloan_{it}$ is the loan growth; dep_{it} is the deposit growth; eop_{it} is the ratio of loans to deposit; tax_{it} is the tax complement ratio, $rinv_{it}$ is the reinvestment; $size_{it}$ is the logarithm of assets ratio; $macro_{it}$ is the country's credit rating given by a particular credit rating agency (Dominion Bond Rating Service (DBRS) Long-Term Issuer, Fitch Long-Term Issuer Rating, Moody's Long-Term Issuer Rating); no obs is the number of observations; no group is the number of groups; Wald is the probability from the Wald test.
Source: own elaboration.

Appendix 3. Determinants of DRBS European banks' long term issuer credit ratings.

drating	Coef.	P>z	Coef.	P>z
deef	0.058988	0.116	-0.10055	0.529
dopp	-0.00027	0.87	-0.05407	0.041
dnint	3.494488	0	8.03396	0.001
dfee	0.068112	0.004	0.207902	0
dnloan	0.174705	0	0.257631	0
ddep	-0.12602	0	-0.15527	0.002
dllp	1.633813	0.713	-13.9315	0.24
dtier	-0.92467	0	-2.05467	0
deop	12.33836	0	24.1082	0
dsek	0.180156	0	-0.28038	0
dass	-0.20568	0.099	-1.43119	0
droe	-0.45326	0.01	-1.58412	0.125
dtax	-0.14541	0.022	-0.24958	0.627
drinv	0.464178	0	0.908089	0
dsize	7.761399	0.086	78.82222	0
macro			1.667856	0
/cut1	-10.662	0	-14.9112	0
/cut2	-10.3266	0	-12.965	0
/cut3	-9.32933	0	11.81251	0
/cut4	5.709919	0		
no obs	3017		2381	
no group	192		192	
Wald	0		0	

d-pretax means first differences; $tier_{it}$ is the Tier 1 ratio; ass_{it} is the leverage ratio; llp_{it} are loan loss provisions as a percentage of average total loans; npl_{it} are non-performing loans to total loans; eef_{it} is the efficiency ratio; sek_{it} is the value of securities as a percentage of earning assets; $nint_{it}$ is the net interest income ratio; roe_{it} is the return on equity; fee_{it} is the commissions and fee to net revenue ratio; opp_{it} is the operating leverage; $nloan_{it}$ is the loan growth; dep_{it} is the deposit growth; eop_{it} is the ratio of loans to deposit; tax_{it} is the tax complement ratio, $rinv_{it}$ is the reinvestment; $size_{it}$ is the logarithm of assets ratio; $macro_{it}$ is the country's credit rating given by a particular credit rating agency (Dominion Bond Rating Service (DBRS) Long-Term Issuer, Fitch Long-Term Issuer Rating, Moody's Long-Term Issuer Rating); no obs is the number of observations; no group is the number of groups; Wald is the probability from the Wald test.

Source: own elaboration.

Appendix 4. Determinants of S&P European banks' long term issuer credit ratings.

drating	**Coef.**	**P>z**	**Coef.**	**P>z**
deef	.0107187	0.000	.0258422	0.000
dopp	-.001784	0.000	-.0056422	0.000
dnint	-.0338259	0.000	-.041488	0.000
dfee	.0036767	0.187	-.0055363	0.435
dnloan	-.0056561	0.002	-.0073628	0.023
ddep	.0104305	0.003	.0139256	0.032
dllp	-.3382879	0.126	-.4923757	0.098
dtier	.0307732	0.254	.0251422	0.514
deop	1.846409	0.000	3.346598	0.000
dsek	.0045395	0.115	.0944657	0.000
dass	-.0757539	0.000	-.2208143	0.000
droe	-.0068447	0.714	-.0163432	0.601
drinv	.0202387	0.023	.044382	0.002
dsize	3.018213	0.000	4.872688	0.000
dstopy			2.075674	0.000
dbezr			-1.416547	0.000
dppp			-.1665455	0.022
ddlug			-.2891371	0.006
dbond			.3466539	0.000
/cut1	-8.274808	0.000	-8.344098	0.000
/cut2	-7.987045	0.000	-8.056387	0.000
/cut3	-7.1757	0.000	-7.245126	0.000
/cut4	-6.327321	0.000	-6.395451	0.000
/cut5	-4.947228	0.000	-6.03525	0.000
/cut6	-3.97669	0.000	-4.478224	0.000
/cut7	-2.787785	0.000	-3.040962	0.000
/cut8	3.241015	0.000	1.034801	0.000
/cut9	5.930627	0.000	5.910312	0.000
/cut10	5.989624	0.000	8.720281	0.000
/cut11	8.795399	0.000	9.413641	0.000
/cut12	9.488626	0.000		
no obs	11654		5572	
no group	395		320	
Wald	0		0	

d-pretax means first differences; $tier_{it}$ is the Tier 1 ratio; ass_{it} is the leverage ratio; llp_{it} are loan loss provisions as a percentage of average total loans; npl_{it} are non-performing loans to total loans; eef_{it} is the efficiency ratio; sek_{it} is the value of securities as a percentage of earning assets; $nint_{it}$ is the net interest income ratio; roe_{it} is the return on equity; fee_{it} is the commissions and fee to net revenue ratio; opp_{it} is the operating leverage; $nloan_{it}$ is the loan growth; dep_{it} is the deposit growth; eop_{it} is the ratio of loans to deposit; tax_{it} is the tax complement ratio, $rinv_{it}$ is the reinvestment; $size_{it}$ is the logarithm of assets ratio; $macro_{it}$ is the country's credit rating given by a particular credit rating agency (Dominion Bond Rating Service (DBRS) Long-Term Issuer, Fitch Long-Term Issuer Rating, Moody's Long-Term Issuer Rating); no obs is the number of observations; no group is the number of groups; Wald is the probability from the Wald test.

Source: own elaboration.