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**THE SPILLOVER EFFECT BETWEEN CREDIT RATINGS—
COVID-19 CRISIS PERSPECTIVE**

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The spillover effect between credit ratings—COVID-19 crisis perspective

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Abstract

The aim of this study is to analyze the impact of the COVID-19 crisis on the spillover effect between European and American banks and the long-term issuer credit ratings of non-financial companies. A literature review was prepared and, as a result, three hypotheses are proposed: During the COVID-19 crisis, the long-term issuer credit ratings of non-financial companies presented high volatility, which increased during the later period of the crisis; higher volatility of the credit ratings of non-financial companies was noticed in Europe than in the U.S.; and a stronger spillover effect was noticed in Europe than in the U.S. An analysis was prepared for the period of 2000–2022 for listed non-financial companies on the European and U.S. stock exchanges that had received long-term issuer credit ratings from the main credit rating agencies. For the analysis, panel data models were used.

Keywords: spillover effect, credit ratings, default risk, contagion effect

JEL Classification: G24, G21, G33

1. Introduction

In recent years, especially during the COVID-19 pandemic, an increasing uncertainty in financial markets has occurred. During the COVID-19 period, many companies declared bankruptcy, while others generated lower profits or even losses. The direct effect of the COVID-19 crisis was an increasing inflation rate as an effect of, for example, relaxed fiscal policy and the provision of financial support for companies in bad financial condition by governments. An increasing inflation rate causes rising interest rates as an effect of the higher cost of financing on the financial market (e.g., increasing costs of credits, higher interest costs). It also creates problems in the banking sector, especially in the case of banks with the short-term financing based on variable interest rates and providing long-term loans at a fixed interest rate during times of low interest rates, which creates the liquidity problems, especially in the case of banks which have low capital requirements. Not without significance is the bad quality of credit portfolios due to problems such as toxic credits that are not paid by individuals and companies, as well as the effect of increasing interest rates. This situation caused problems, for some banks, which had been not observed before. Recent defaults of a few big American banks, such as Silicon Valley Bank or Signature, have been observed, while others such as the First Republic Bank have suffered from financial problems. The Silicon Valley Bank's default is the largest collapse of an American bank since the financial crisis in 2008. According to the FDIC announcement, at the end of December 2022, the bank had \$209 billion assets, and deposits amounted to over \$175 billion. These numbers indicate the third largest U.S. bank failure in history after Washington Mutual in 2008 (which was worth \$307 billion in assets) and Lehman Brothers (which had \$639 billion in assets). New York Signature, which dealt

with cryptocurrencies, also declared bankruptcy. In Europe, the largest Swiss bank, UBS, had to take over the crisis-ridden Credit Suisse at the behest of politicians.

This situation on the financial market has led to the need to analyze the financial condition of banks and corporates, as well as the spillover effect between countries, banks, and corporate credit ratings; in particular, the spillover effect occurs when sovereign credit rating changes affect domestic corporate credit ratings. In other words, government creditworthiness affects corporate creditworthiness. If sovereign ratings spill over to firm-level ratings, corporate credit ratings result from not only performance and credit risk, but also sovereign risk. The mentioned situation is strictly connected with the role of the credit rating agencies, which should help to reduce the asymmetry of information between investors and issuers and help to predict the default risk by publishing credit ratings. As a result, changes in credit ratings should be the first signal of a changing situation in response to a financial crisis and predict corrections in the business cycle. According to the methodology presented by credit rating agencies, significant impacts lead to macro-economic risk on the credit ratings given for banks and non-financial companies. As a result, it can be assumed that changes in sovereign credit ratings can have an impact on changes in the ratings of banks and corporates. In the methodology presented by credit rating agencies to assess companies, the default risk is not presented as direct information about the impact of the banking sector's condition on the credit ratings of non-financial companies. On the other hand, the bad financial condition of the banking sector increases risk for corporates, due to problems related to finding financing. The rising risk of the banking sector also reduces the level of investment in the economy and creates a slowdown in economic growth.

The aim of the paper is to analyze the impact of the COVID-19 crisis on the spillover effect between European and American banks and the long-term issuer credit ratings of non-financial companies. A literature review was prepared and, as a result, three hypotheses are proposed: During the COVID-19 crisis, the long-term issuer credit ratings of non-financial companies presented high volatility, where the volatility increased during the later period of the crisis; higher volatility of the credit ratings of non-financial companies credit ratings was noticed in Europe than in the U.S.; and a stronger spillover effect was noticed in Europe than in the U.S. There is a lack of research on the impact of the changes in sovereign and bank credit ratings on those of corporates. In previous studies, the spillover effect between sovereign credit ratings and stock prices and indices or bank notes has been considered in analyses; however, the mentioned effect between a particular group of notes has not been tested. The presented study aims to assess the relationship between particular type of notes, in order to help answer questions regarding the impact of the sovereign credit rating changes on corporate notes and to assess the impact of the financial condition of banking sector on the default risk of corporates. The present study aims to assess the differences between American and European credit rating markets, which will be useful for analysis of the relationship between credit ratings during the business cycle, as the presented analysis takes into consideration the behavior of credit ratings during the last two crises; that is, the global financial crisis (GFC) in 2008–2009 and the COVID-19 crisis and the consequent recession. The presented analysis hopes to enable future studies on the relationships between credit ratings changes between group of entities. The analysis was prepared for the 2000–2022 period, considering listed non-financial companies on the European and U.S. stock exchanges that received long-term issuer credit ratings from the main credit rating agencies. For the analysis, panel data models were used.

The remainder of the paper proceeds as follows. In Section 2, previous studies that have investigated the spillover effect and the reaction of credit ratings changes during crises are detailed. 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 the paper by declaring the limitations of the current study and consequently suggesting future lines of research.

2. Literature review

2.1. The spillover effect as an effect of credit ratings changes

Increasing sovereign credit risk burdens financial institutions and corporates in different channels. In the case of financial institutions, according to BIS (2011), four main transmission channels have been

noticed: first, bank holdings of sovereign debt and derivative securities; second, collateral used for obtaining external wholesale funding and central bank re-financing; third, implicit and explicit government guarantees; and fourth, sovereign rating downgrades, which contribute to a deterioration in the creditworthiness of domestic or foreign banks (BIS, 2011). In the case of corporates, the increasing default risk of financial institutions and countries can have an impact in the following aspects: first, problems with finding capital; second, increasing costs of capital; third, changing of investors, as banks are buyers of financial instruments such as stocks and corporate bonds; and fourth, increasing risk for investors.

The spillover effect is generally tested in two types of study. The first relies on testing the mentioned effect as a transition of the impact of credit ratings changes on securities, with studies focusing on the spillover effect of sovereign credit ratings on bonds spreads, stock prices, and CDS premiums.

Bedendo and Colla (2015) have determined the spillover of credit risk from the sovereign to the non-financial corporate segment using credit default swap (CDS) data for Eurozone entities during the recent turmoil in European debt markets. The increase in sovereign risk was associated with an increase in the credit risk (and, hence, borrowing costs) of non-financial firms. The deterioration in a country's credit quality affects firms that are government controlled, those whose sales are more concentrated in the domestic market, and those that rely more heavily on bank financing more adversely. Government guarantees, domestic demand, and credit markets are important credit risk transmission mechanisms.

Arezki et al. (2011), by analyzing the impact of sovereign credit ratings on the CDS spreads, have found that sovereign rating downgrades have statistically and economically significant spillover effects both across countries and financial markets. The sign and magnitude of the spillover effects depend both on the type of announcements, the source country experiencing the downgrade, and the rating agency from which the announcements originate. The downgrades to near-speculative grade ratings for relatively large economies have a systematic spillover effect across Euro zone countries. Claeys and Borek (2012) found a two-sided relation between rating news and sovereign risk premia. The spillover of rating news is very heterogeneous, and is substantially stronger for downgrades at lower grades. The impact is often weaker domestically than on bond spreads of other sovereigns.

Abad et al. (2018) have found that the type of spillover effects within and between groups of countries are influenced by the sovereign rating level, split ratings, and the extent of rating convergence (i.e., specific types of rating action will induce different and/or stronger effects). The results revealed a clear pattern whereby downgrades of high-rated countries induce contagion to both high- and low-rated countries, while downgrades of low-rated countries have an opposite effect (i.e., they induce competitive effects). Split ratings were found to intensify stock market spillover effects. Rating convergence or divergence across similarly-rated sovereigns has a meaningful influence on spillover effects. For the downgrades of high-rated countries, rating convergence mitigates the contagion effect to other high-rated countries in the region, but has a very limited effect on the contagion to low-rated countries. For downgrades of low-rated countries, rating convergence strengthens the competitive effect on other low-rated countries, but has little effect on the competitive impact on high-rated countries. Böninghausen and Zabel (2015) found that while there is strong evidence of negative spillover effects in response to downgrades, while positive spillovers from upgrades are much more limited at best. Furthermore, negative spillover effects are more pronounced for countries within the same region. Strikingly, this could not be explained by fundamental linkages and similarities between countries.

Mutize and Gossel (2018) found that marginal regional sovereign rating spillover impacts are quickly absorbed into capital markets trading long-term securities. Their analysis further showed that marginal spillover effects persist over longer time periods in sovereign ratings of other countries in the same region from a sovereign rating change in one country. These results imply that the regional bilateral linkages between countries serve as channels of capital and sovereign credit rating information flow.

The second group of studies relies on testing the spillover effect between credit ratings. The presented paper belongs to this second group of research. Most popular studies rely on estimation of the sovereign-to-banking rating spillover effect through the sovereign ceiling channel (Williams et al., 2013; Alsakka et al., 2014; Poon et al., 2017; Klusak et al., 2017; Almeida et al. 2017; Chodnicka-Jaworska, 2019). The mentioned studies rely on the testing the spillover effect based on the methodology presented by credit rating agencies. When estimating the default risk, credit rating agencies take into consideration the macroeconomic risk (macro profile), after which they test the microeconomic financial situation of

banks. As a result, the macroeconomic profile—which relies on testing nearly the same factors as in the case of the sovereign credit ratings—suggests that sovereign credit ratings can have an impact on bank notes. In some studies, the sovereign ceiling effect was also tested, which relies on the idea that bank notes should not have higher ratings than countries, due to the impact of macroeconomic factors on the financial condition of banks. In other studies, the impact of the credit ratings of banks on sovereign credit ratings has also been tested (Hu, et al. 2020). The mentioned effect relates to some transition channels: first, high levels of systemic risk in the banking sector lead to aggregate lending activity, causing a reduction in economic growth (Allen et al., 2012); second, developments in the banking sector can affect macroeconomic and fiscal outcomes (Giglio et al., 2016); third, credit market shocks contribute significantly to economic fluctuations (Gilchrist et al., 2009; Gilchrist, Zakrajšek, 2012); fourth, changes in the cost of capital, such as sovereign CDS spreads, have a significant impact on bank default risks (and vice versa) during and after government interventions (Schüler, 2012; Merler, Pisani-Ferry, 2012); fifth, during crisis periods, the greater financial sector distress leads to a larger scale of bank bailouts which, in turn, results in higher sovereign credit risk (Acharya et al., 2014). Angelini et al. (2014) have introduced the self-reinforcing negative spiral among sovereign difficulties, bank fragility, and economic recession. Hu et al. (2020) have shown that both positive and negative bank-to-sovereign spillover effects exist, where the negative rating spillover is more pronounced than the positive one. Against the background of the European debt crisis, the results also showed that the severity of positive and negative rating transmission effects differs and depends upon the pre-crisis/crisis-and-post-crisis periods and the origin countries. Moreover, there is evidence of agency-related differences with respect to the existence of positive spillover effects and the degree of negative spillover effects.

The next group of studies tested the sovereign-to-corporate credit rating spillover effect. Borensztein et al. (2007) found that, although credit rating agencies have gradually moved away from a policy of never rating a private borrower above the sovereign (the "sovereign ceiling"), it appears that sovereign ratings remain a significant determinant of the credit rating assigned to corporations. Sovereign ratings have a significant and robust effect on private ratings, even after controlling for country-specific macroeconomic conditions and firm-level performance indicators.

Ho et al. (2023) found that changes in sovereign credit ratings positively impact corporate credit rating actions, particularly in the financial industry. The national culture of power distance and muscularity (individualism and long-term orientation) has a positive (negative) impact on corporate rating actions. Furthermore, their results showed that national culture significantly affects the spillover effects. Specifically, positive spillover effects reverse with higher power distance and are more pronounced with a greater long-term orientation. The main contribution of this research is that it shed light on the vital role that national culture plays in spillover effects.

Augustin et al. (2018) found evidence of risk spillovers from sovereign to corporate credit risk through financial and fiscal channels, as the effects were more pronounced for firms that are bank- or government-dependent. They found no support for indirect risk transmission through a deterioration of macroeconomic fundamentals.

Sovereign rating actions very frequently drive rating actions at the corporate and bank levels (see, e.g., Adelino, Ferreira, 2016; Almeida et al., 2017; Borensztein et al., 2013; Huang, Shen, 2015). In addition, banks are strongly affected by sovereign rating actions for their home country and internationally, due to their holdings of sovereign debt, collateral, and implicit government guarantees (see, e.g., BIS, 2011; Blundell- Wignall, Slovik, 2010; Caselli et al., 2016; De Bruckeyere et al., 2013). Given the increasing prevalence of such 'split ratings,' these are anticipated to be influential on the spillover evidence. Several closely related papers have only used the data from one credit rating agency and, hence, were unable to account for this effect in any way (see, e.g., Chen et al., 2016; Drago and Gallo, 2016; Wengner et al., 2015). Relating to the quantification of split ratings, most prior papers have ignored outlook and watch actions, which have been demonstrated to be a crucial component of the information content of credit rating agency actions (see, e.g., Kaminsky, Schmukler, 2002).

The spillover effect can be also noticed between bank-to-bank credit ratings or corporate-to-corporate credit ratings. Tsoumas (2017) has examined the spillover effect of a bank default on its neighboring banks, propagating through the disrupted local economic activity in areas the failed institution was operating in through its branches. The insolvency risk of the affected neighboring banks increased

considerably one year after the shock, especially during crisis periods. This effect is driven by capital deterioration, an increase in non-performing loans, and a surge in the volatility of profits. Moreover, this spillover effect is asymmetrically distributed, impinging more neighboring banks that bear higher risk whereas better-capitalized ones are not better shielded.

The presented literature review shows that there is a lack of studies on bank-to-corporate credit ratings spillover effects.

2.2. The impact of the business cycle on the credit ratings changes

Early studies used GDP growth as an indicator of the business cycle changes and their impact on the sovereign credit ratings (Cantor, Parker, 1996), while a more developed method was used by Ferri et al. (1999). They applied the non-linear credit rating decomposition based on the changes in the CDS premiums as a measure of the economy and downturn. The first study taking into account the business cycle to analyze the stability of credit ratings was prepared by Amato and Furfine (2003), who showed that not only was there an impact of the downturn on credit ratings, but also on forecasts or short- and long-term attitudes. On the other hand, Kräussl (2003) found that the causality between credit ratings and the business cycle did not exist, and the downgrade of ratings during the crisis did not result from a change in the business cycle.

The spillover effect between credit ratings was first noticed during a crisis by De Saints (2012) and Auh (2013), and is particularly strong in times of economic downturn. At this point, risks associated with a country's credit rating shift to notes given to banks or institutions outside the financial sector. The mentioned studies underlined the pro-cyclical nature of rating notes. The rated entities received more pessimistic ratings in the downturn, compared to the economic boom. The significance influence of the business cycle on the credit ratings changes has been noticed, especially in the case of companies that roll their obligations towards creditors on the capital market. The mentioned phenomenon has also been observed, by Kiff et al. (2013), for debt securities from outside the financial sector. By comparing the methods of default risk assessment used by credit rating agencies and by banks as part of internal risk assessment, they 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; however, in times of downturn, they fluctuate more.

The slow reaction of credit rating agencies to changes in economic conditions has been noticed by Loffer (2013), who tested the speed of adjusting ratings. Credit rating agencies, according to his studies, only consider the business cycle stage in the evaluation process. The presented findings were the first to suggest that credit ratings may be anti-cyclical. The first study confirming this presented opinion was prepared by Bar-Isaac and Shapiro (2013), who found that the effectiveness of credit ratings is also connected with other factors, such as giving less accurate ratings when the rating fee income is high, when cooperation is difficult, and under a low likelihood of bankruptcy. This causes the decrease in the quality of the presented ratings, which is especially observed 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 stated 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 showed similar results. Similar conclusions have been obtained by Freitag (2015), who suggested 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 was 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) has noted high ratings during the boom and their low value during the financial crisis, resulting in an increase in debt servicing costs. Moreover, he identified the phenomenon of causality between ratings and the condition of the rated entity. In his opinion, this leads to further deepening of the crisis. Isakin and David (2015) have carried out an analysis of debt servicing costs in connection with the issued notes. In their opinion, during an economic downturn, a change in the rating

methodology occurs. 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 the ratings of companies improve when they recover from the crisis. During this period, investor 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), while only a few studies have dealt with this topic for the banking sector (Bangia, Diebold, and Schuermann, 1999; Fei, Fuertes, and Kalotychou, 2012).

3. Methodology

The aim of the paper is to analyze the impact of the COVID-19 crisis on the spillover effect between European and American banks and the long-term issuer credit ratings of non-financial companies. A literature review was prepared and, as a result, three hypotheses are proposed: During the COVID-19 crisis, the long-term issuer credit ratings of non-financial companies presented high volatility, with the volatility increasing during the later period of crisis; higher volatility in the credit ratings of non-financial companies was noticed in Europe than in the U.S.; and stronger spillover effects were noticed in Europe than in the U.S. To analyze the determinants of corporate credit ratings, all long-term issuer credit ratings given by the main credit rating agencies (i.e., Fitch, Moody, and DRBS) to companies listed on the stock exchanges were obtained, taking into consideration that the mentioned credit rating agencies are connected with the nearly 70% of the market shares in Europe and more than 40% in the U.S. As a result, the mentioned agencies cover nearly the whole market and using the notes given by them can help to compare the situation between European and American companies and the spillover effect between sovereign and bank notes and corporate credit ratings. Up to the end of December 2022, only few different credit ratings were proposed by credit rating agencies for the mentioned companies. The mentioned credit ratings were collected from the Refinitiv database, although the 2021 S&P credit ratings could not be collected from Refinitiv database. For a better understating of the problem of the spillover effect, credit ratings from the period between 2000 and 2022 were obtained, and separate analyses of particular credit rating agencies and crisis periods will be prepared. In the analysis, more than 7000 companies from all European countries and the U.S. were analyzed. To analyze the impact of determinants on company credit ratings, the linear decomposition proposed by Ferri, Liu, and Stiglitz (1999) was used. The same methodology has been used in other research presented in the literature review. The linear method of decomposition is detailed in the table below.

Table 1. Decomposition of DRBS, Moody, and Fitch long-term issuer credit ratings.

Moody's Long-Term Issuer Rating		Dominion Long-Term Issuer		Fitch Long-Term Issuer Rating	
Rating	Code	Rating	Code	Rating	Code
Aaa	100	AAA	100	AAA	100
Aa1	95	AA (high)	96	AA+	94,74
Aa2	90	AA	92	AA	89,47
Aa3	85	AA (low)	88	AA-	84,21
A1	80	A (high)	84	A+	78,95
A2	75	A	80	A	73,68
A3	70	A (low)	76	A-	68,42
Baa1	65	BBB (high)	72	BBB+	63,16
Baa2	60	BBB	68	BBB	57,89
Baa3	55	BBB (low)	64	BBB-	52,63
Ba1	50	BB (high)	60	BB+	47,37
Ba2	45	BB	56	BB	42,11
Ba3	40	BB (low)	52	BB-	36,84

B1	35	B (high)	48	B+	31,58
B2	30	B	44	B	26,32
B3	25	B (low)	40	B-	21,05
Caa1	20	CCC (high)	36	CCC	15,79
Caa2	15	CCC	32	CC	10,53
Caa3	10	CCC (low)	28	C	5,26
Caa	5	CC (high)	24	RD	-5
C	0	CC	20	D	-5
WR	-5	CC (low)	16	WD	-5
		C (low)	4		
		SD/D	-5		

Source: own elaboration.

Ordered logit panel data models, in which the long-term issuer credit ratings of non-financial companies are the dependent variable, were used for the analysis. Logit models are defined as those which 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 corporate 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, which are generally dummy variables; and 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:

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

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

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

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

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

...

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

where the τ_s ($\tau_0 < \tau_1 < \tau_2 < \dots < \tau_{22}$) are the known threshold parameters to be estimated. The final version of the ordered logit model is:

$$\Delta y_{it} = \alpha_1 BR1_{cjt}^+ + \alpha_2 BR2_{cjt}^+ + \alpha_3 BR_{cjt} + \alpha_4 BR1_{cjt}^- + \alpha_5 BR2_{cjt}^- + \theta \Delta CR_{jt} + \beta \Delta F'_{it} + \delta (F * Z)_{it} + \varepsilon_{it}; \text{ where } \varepsilon_{it} \sim N(0,1)$$

y_{it} is an unobservable latent variable that measures the creditworthiness of a company i in period t ;
 $BR1_{cjt}^+$ denotes the number of bank credit ratings increases by one degree according to credit rating agency c (i.e., Moody, DRBS, Fitch, measured separately) in country j in period t ;
 $BR2_{cjt}^+$ denotes the number of bank credit ratings increases by at least two degrees according to credit rating agency c (i.e., Moody, DRBS, Fitch, measured separately) in country j in period t ;

BR_{cjt} denotes number of no bank credit ratings changes according to credit rating agency c (i.e. Moody, DRBS, Fitch, measured separately) in country j in period t ;
 $BR1_{cjt}^-$ denotes the number of bank credit ratings decreases by one degree according to credit rating agency c (i.e., Moody, DRBS, Fitch, measured separately) in country j in period t ;
 $BR2_{cjt}^-$ denotes the number of bank credit ratings decreases by at least two degrees according to credit rating agency c (i.e., Moody, DRBS, Fitch, measured separately) in country j in period t ;
 ΔCR_{jt} denotes a sovereign credit rating change according to credit rating agency c (i.e., Moody, DRBS, Fitch, measured separately) in country j in period t ; and
 F_{it} is a vector of explanatory variables; that is,

$$F_{it} = [EBIT_{it}, TAX_{it}, TUR_{it}, ROE_{it}, EQ_{it}, EAR_{it}, CUR_{it}, COV_{it}, CYC_{it}, DEBT_{it}, HIS_{it}, ART_{it}, VEN_{it}, FIX_{it}, RET_{it}, ASS_{it}]$$

where:

$EBIT_{it}$ is the EBITDA margin; TAX_{it} is the income tax rate; TUR_{it} is the assets turnover ratio; ROE_{it} is the return on equity ratio; EQ_{it} is the total assets to common equity ratio; EAR_{it} is the earnings retention rate; CUR_{it} is the current ratio; COV_{it} is the interest coverage ratio; CYC_{it} is the average payable days; $DEBT_{it}$ is the long-term debt to equity ratio; HIS_{it} is the history net debt to EBITDA ratio; ART_{it} is the net income to liabilities ratio; VEN_{it} is the inventory turnover ratio; FIX_{it} is the fixed assets turnover ratio; RET_{it} is the return on long-term capital ratio; and ASS_{it} is the logarithmized value of assets.

We investigated bank-to-corporate credit rating spillover effects separately for each credit rating agency. Companies were divided into European and American groups. To account for potential structural changes in the bank–corporate channel associated with the crisis, the models were separately estimated for the pre-crisis period versus the post-crisis period.

In the second part of our robustness test, we modified our original rating data sets by deleting the entries without rating actions and generating a new sample structure of company, sovereign, and bank ratings. Consistent with the test methodology employed by Williams et al. (2013), we then ran a pooled regression with new model specifications, as follows:

$$\Delta y_{it} = \mu_1 BR1_{cjt}^+ + \mu_2 BR2_{cjt}^+ + \mu_3 BR_{cjt} + \mu_4 BR1_{cjt}^- + \mu_5 BR2_{cjt}^- + \pi \Delta CR_{jt} + \beta \Delta F'_{it} \beta \Delta F'_{it} + \gamma Z_{it} + \delta (F * Z)_{it} + \rho crisis + \varepsilon_{it}; \text{ where } \varepsilon_{it} \sim N(0,1)$$

where $crisis$ is a dummy variable, where “1” denotes crisis in the banking sector, and “0” otherwise.

An analysis was also prepared regarding the impact of other credit ratings changes. As a result, we also tested the contagion effect between particular credit ratings changes, which are presented by different agencies.

$$\Delta y_{it} = \mu_1 SSBR1_{cjt}^+ + \mu_2 SSBR2_{cjt}^+ + \mu_3 SSBR1_{cjt}^- + \mu_4 SSBR2_{cjt}^- + \pi \Delta CR_{jt} + \beta \Delta F'_{it} \beta \Delta F'_{it} + \gamma Z_{it} + \delta (F * Z)_{it} + \rho crisis + \varepsilon_{it}; \text{ where } \varepsilon_{it} \sim N(0,1)$$

The presented analyses were also prepared separately for positive and negative changes in the corporate credit ratings.

$$\Delta y_{it}^+ = \alpha_1 BR1_{cjt}^+ + \alpha_2 BR2_{cjt}^+ + \alpha_3 BR1_{cjt}^- + \alpha_4 BR2_{cjt}^- + \varepsilon_{it}; \text{ where } \varepsilon_{it} \sim N(0,1)$$

$$\Delta y_{it}^- = \alpha_1 BR1_{cjt}^+ + \alpha_2 BR2_{cjt}^+ + \alpha_3 BR1_{cjt}^- + \alpha_4 BR2_{cjt}^- + \varepsilon_{it}; \text{ where } \varepsilon_{it} \sim N(0,1)$$

y_{it}^+ is an unobservable latent variable that measures the increase the credit-worthiness of a company i in period t ;

y_{it}^- is an unobservable latent variable that measures the decrease the credit-worthiness of a company i in period t .

In the analysis, we also tested the impact of lagged variables.

$$\begin{aligned} \Delta y_{it} &= \alpha_1 BR1_{cjt-1}^+ + \alpha_2 BR2_{cjt-1}^+ + \alpha_3 BR_{cjt-1} + \alpha_4 BR1_{cjt-1}^- + \alpha_5 BR2_{cjt-1}^- + \theta \Delta CR_{jt-1} + \beta \Delta F'_{it-1} + \delta (F * Z)_{it-1} + \varepsilon_{it}; \text{ where } \varepsilon_{it} \sim N(0,1) \\ \Delta y_{it} &= \alpha_1 BR1_{cjt}^+ + \alpha_2 BR2_{cjt}^+ + \alpha_3 BR_{cjt} + \alpha_4 BR1_{cjt}^- + \alpha_5 BR2_{cjt}^- + \theta \Delta CR_{jt} + \beta \Delta F'_{it} + \delta (F * Z)_{it} + \rho_1 BR1_{cjt-1}^+ + \rho_2 BR2_{cjt-1}^+ + \rho_3 BR_{cjt-1} + \rho_4 BR1_{cjt-1}^- + \rho_5 BR2_{cjt-1}^- + \pi \Delta CR_{jt-1} + \tau \Delta F'_{it-1} + \eta (F * Z)_{it-1} + \varepsilon_{it}; \text{ where } \varepsilon_{it} \sim N(0,1) \\ \Delta y_{it} &= \mu_1 BR1_{cjt}^+ + \mu_2 BR2_{cjt}^+ + \mu_3 BR_{cjt} + \mu_4 BR1_{cjt}^- + \mu_5 BR2_{cjt}^- + \pi \Delta CR_{jt} + \beta \Delta F'_{it} + \gamma Z_{it} + \delta (F * Z)_{it} + \rho \text{ crisis} + \varepsilon_{it}; \text{ where } \varepsilon_{it} \sim N(0,1) \\ \Delta y_{it} &= \alpha_1 BR1_{cjt}^+ + \alpha_2 BR2_{cjt}^+ + \alpha_3 BR_{cjt} + \alpha_4 BR1_{cjt}^- + \alpha_5 BR2_{cjt}^- + \theta \Delta CR_{jt} + \beta \Delta F'_{it} + \delta (F * Z)_{it} + \rho_1 BR1_{cjt-1}^+ + \rho_2 BR2_{cjt-1}^+ + \rho_3 BR_{cjt-1} + \rho_4 BR1_{cjt-1}^- + \rho_5 BR2_{cjt-1}^- + \pi \Delta CR_{jt-1} + \tau \Delta F'_{it-1} + \eta (F * Z)_{it-1} + \zeta \text{ crisis} + \varepsilon_{it}; \text{ where } \varepsilon_{it} \sim N(0,1) \end{aligned}$$

4. Findings

4.1. The relationship between corporates and sovereign credit ratings

The first step of the analysis relied on testing the country's ceiling effect between the corporates and sovereign credit ratings and the contagion effect between changes in corporate credit ratings according to the different agencies. The results of these estimations are presented in Tables 2 and 3.

The analysis of the correlation matrix between corporates and sovereign credit ratings changes shows that the strongest relationship was noted in the case of Fitch, followed by Moody, while the lowest was observed for the DRBS. The obtained results indicate that there exists a relationship between changes in the credit ratings of countries and corporates, which is connected with taking the macroeconomic variables to assess the default risk of non-financial companies by agencies.

Table 2. Correlation matrix between corporate and sovereign credit rating changes.

	Ydom	CRd	Yfit	CRf	Ymoo	CRmo	
Ydom	1.0000		Yfit	1.0000	Ymoo	1.0000	
CRd	0.0386	1.0000	CRf	0.3755	1.0000	CRmo	0.1869
							1.0000

Ydom – DRBS corporate credit ratings changes, Yfit – Fitch corporate credit ratings changes, Ymoo – Moody's corporate credit ratings changes, CRd - DRBS sovereign credit ratings changes, CRf - Fitch sovereign credit ratings changes; CRmo – Moody's sovereign credit ratings changes. Source: own calculations.

The prepared analysis indicated the differences in the methodologies utilized by the particular credit rating agencies, allowing for rating of the type of the estimated issuers. The received results revealed the similarities between changes in the corporate credit ratings. A similar reaction was observed between the Fitch and Moody credit ratings changes; in particular, the direction of the changes was the same. Next, it was noticed that the relationship between the DRBS and Fitch notes changed, while the mutual reaction between corporate credit ratings changes presented by DRBS and Moody was much weaker. As mentioned above, this can be connected with the sample of estimated entities and the methodology used.

Table 3. Correlation matrix between corporate credit ratings changes.

	Ydom	Yfit	Ymoo
Ydom	1.0000		
Yfit	0.2048	1.0000	
Ymoo	0.0776	0.1994	1.0000

Ydom – DRBS corporate credit ratings changes, Yfit – Fitch corporate credit ratings changes, Ymoo – Moody's corporate credit ratings changes. Source: own calculations.

4.2. Bank-to-corporate credit rating spillover effect estimation results

The next step of the analysis involved testing the bank-to-corporate credit rating spillover effect for the whole sample. The results of this analysis are presented in Table 4.

The received results indicate that there exists a spillover effect between the credit ratings of banks and corporates. It was also noted that the changes in a country's credit rating has an effect on company notes. The mentioned relationship was observed for all of the estimated agencies, and the strongest reaction was observed for DRBS notes. These results confirm the presence of the country ceiling effect.

The next step relied on testing the significance of the number of bank credit ratings changes and their scale with respect to the corporate credit ratings changes. The mentioned relationship was not observed for the DRBS credit ratings changes, which can be attributed to the size of the sample and the methodology used by the agency. The DRBS is the smallest of the mentioned agencies and, so, it did not assess enough entities to verify the mentioned phenomenon. In the case of Moody and Fitch, the reaction was varied. The decrease of bank credit ratings on one note did not have a statistically significant impact on the corporate notes, indicating that the agency paid attention only to two or more decreases in bank notes when making a decision about the credit ratings changes of non-financial companies. This can be connected to the fear of a worsening crisis and the contagion effect between credit ratings.

Table 4. Estimation of spillover effect between sovereign and bank credit ratings for Moody, Fitch, and DRBS notes.

Y	Moody						Fitch						DRBS									
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z
ACR_{it}	0,03	0,00	0,03	0,00					0,02	0,00	0,02	0,00			0,01	0,95	0,10	0,01				
BR2-	-0,01	0,00			-0,01	0,00			0,00	0,00			0,00	0,56	-0,04	0,53			-0,01	0,53		
BR1-	-0,01	0,02			0,00	0,21			0,08	0,00			0,14	0,00	-0,02	0,27			-0,01	0,24		
BR	0,01	0,00							0,00	0,00					-0,01	0,07						
BR1+	-0,01	0,00					-0,01	0,00	0,03	0,00					-0,01	0,74					0,01	0,34
BR2+	0,02	0,00					0,00	0,09	0,13	0,00												
/cut1	-7,11	0,00	-7,80	0,00	-7,19	0,00	-7,19	0,00	-6,44	0,00	-6,35	0,00	-5,93	0,00	-4,54	0,00	-4,98	0,00	-3,86	0,00	-3,85	0,00
/cut2	-4,90	0,00	-4,46	0,00	-6,31	0,00	-6,31	0,00	-5,85	0,00	-5,74	0,00	-5,46	0,00	-4,36	0,00	-4,32	0,00	-3,72	0,00	-3,71	0,00
/cut3	-4,54	0,00	-4,01	0,00	-5,57	0,00	-5,57	0,00	-4,94	0,00	-4,80	0,00	-4,70	0,00	-4,10	0,00	-4,16	0,00	-3,45	0,00	-3,44	0,00
/cut4	-4,19	0,00	-3,63	0,00	-4,94	0,00	-4,94	0,00	-4,33	0,00	-4,26	0,00	-4,11	0,00	-3,79	0,00	-3,83	0,00	-3,27	0,00	-3,26	0,00
/cut5	-4,00	0,00	-3,46	0,00	-4,31	0,00	-4,30	0,00	-3,63	0,00	-3,53	0,00	-3,39	0,00	-3,59	0,00	-3,56	0,00	-2,93	0,00	-2,92	0,00
/cut6	-3,52	0,00	-2,94	0,00	-4,10	0,00	-4,09	0,00	-3,63	0,00	-3,53	0,00	-3,39	0,00	-3,36	0,00	-3,38	0,00	-2,64	0,00	-2,63	0,00
/cut7	-3,16	0,00	-2,61	0,00	-3,87	0,00	-3,87	0,00	-3,30	0,00	-3,22	0,00	-3,10	0,00	-2,98	0,00	-3,09	0,00	-2,56	0,00	-2,55	0,00
/cut8	-3,13	0,00	-2,58	0,00	-3,58	0,00	-3,58	0,00	-2,89	0,00	-2,83	0,00	-2,68	0,00	-2,90	0,00	-3,03	0,00	-2,31	0,00	-2,30	0,00
/cut9	-3,06	0,00	-2,55	0,00	-3,10	0,00	-3,10	0,00	-2,57	0,00	-2,50	0,00	-2,37	0,00	-2,79	0,00	-2,83	0,00	-2,27	0,00	-2,25	0,00
/cut10	-3,04	0,00	-2,51	0,00	-2,92	0,00	-2,92	0,00	-2,56	0,00	-2,50	0,00	-2,36	0,00	-2,71	0,00	-2,75	0,00	-2,23	0,00	-2,22	0,00
/cut11	-3,01	0,00	-2,48	0,00	-2,85	0,00	-2,85	0,00	-2,30	0,00	-2,23	0,00	-2,11	0,00	-2,47	0,00	-2,45	0,00	-2,17	0,00	-2,16	0,00
/cut12	-2,98	0,00	-2,46	0,00	-2,68	0,00	-2,67	0,00	-2,29	0,00	-2,23	0,00	-2,11	0,00	-1,87	0,00	-1,52	0,00	-2,13	0,00	-2,12	0,00
/cut13	-2,88	0,00	-2,45	0,00	-2,58	0,00	-2,57	0,00	-2,17	0,00	-2,12	0,00	-1,98	0,00	2,03	0,00	1,83	0,00	-2,11	0,00	-2,10	0,00
/cut14	-2,62	0,00	-2,40	0,00	-2,49	0,00	-2,49	0,00	-2,17	0,00	-2,12	0,00	-1,98	0,00	2,56	0,00	2,38	0,00	-2,04	0,00	-2,03	0,00
/cut15	-2,35	0,00	-2,28	0,00	-2,43	0,00	-2,43	0,00	-2,12	0,00	-2,07	0,00	-1,93	0,00	2,72	0,00	2,59	0,00	-1,97	0,00	-1,96	0,00
/cut16	-1,88	0,00	-2,02	0,00	-2,37	0,00	-2,37	0,00	-2,12	0,00	-2,07	0,00	-1,93	0,00	2,78	0,00	2,63	0,00	-1,82	0,00	-1,81	0,00
/cut17	-1,09	0,00	-1,68	0,00	-2,25	0,00	-2,25	0,00	-2,08	0,00	-2,04	0,00	-1,90	0,00	2,83	0,00	2,67	0,00	-1,48	0,00	-1,47	0,00
/cut18	1,43	0,00	-1,04	0,00	-2,06	0,00	-2,06	0,00	-2,08	0,00	-2,04	0,00	-1,90	0,00	2,85	0,00	2,68	0,00	1,66	0,00	1,67	0,00
/cut19	2,43	0,00	1,45	0,00	-1,77	0,00	-1,76	0,00	-2,06	0,00	-2,01	0,00	-1,88	0,00	2,89	0,00	2,73	0,00	2,05	0,00	2,06	0,00
/cut20	3,09	0,00	2,11	0,00	-1,23	0,00	-1,23	0,00	-2,06	0,00	-2,01	0,00	-1,88	0,00	3,03	0,00	2,82	0,00	2,14	0,00	2,15	0,00
/cut21	3,25	0,00	2,50	0,00	1,12	0,00	1,12	0,00	-2,06	0,00	-2,01	0,00	-1,87	0,00	3,06	0,00	2,84	0,00	2,19	0,00	2,20	0,00
/cut22	3,29	0,00	2,64	0,00	1,61	0,00	1,61	0,00	-2,05	0,00	-2,00	0,00	-1,86	0,00	3,09	0,00	2,88	0,00	2,25	0,00	2,26	0,00
/cut23	3,32	0,00	2,66	0,00	1,87	0,00	1,88	0,00	-2,05	0,00	-2,00	0,00	-1,86	0,00	3,28	0,00	2,96	0,00	2,26	0,00	2,27	0,00
/cut24	3,41	0,00	2,66	0,00	2,04	0,00	2,04	0,00	-2,04	0,00	-1,99	0,00	-1,86	0,00	3,63	0,00	3,55	0,00	2,28	0,00	2,29	0,00
/cut25	4,25	0,00	2,67	0,00	2,14	0,00	2,14	0,00	-2,04	0,00	-1,99	0,00	-1,85	0,00	4,15	0,00	4,61	0,00	2,32	0,00	2,33	0,00
/cut26	4,84	0,00	2,68	0,00	2,21	0,00	2,21	0,00	-2,04	0,00	-1,99	0,00	-1,85	0,00	4,75	0,00	4,88	0,00	2,33	0,00	2,34	0,00
/cut27	4,99	0,00	2,70	0,00	2,28	0,00	2,28	0,00	-2,04	0,00	-1,99	0,00	-1,85	0,00	5,15	0,00	5,32	0,00	2,40	0,00	2,41	0,00
/cut28	5,01	0,00	2,71	0,00	2,39	0,00	2,39	0,00	-2,04	0,00	-1,99	0,00	-1,85	0,00					2,75	0,00	2,76	0,00
/cut29	5,25	0,00	2,73	0,00	2,51	0,00	2,51	0,00	-2,03	0,00	-1,98	0,00	-1,85	0,00					2,89	0,00	2,90	0,00
/cut30	8,67	0,00	2,79	0,00	2,69	0,00	2,69	0,00	-2,03	0,00	-1,98	0,00	-1,84	0,00					3,12	0,00	3,13	0,00
/cut31			3,30	0,00	2,78	0,00	2,78	0,00	-2,03	0,00	-1,98	0,00	-1,84	0,00					3,39	0,00	3,40	0,00
/cut32			4,02	0,00	2,96	0,00	2,96	0,00	-2,03	0,00	-1,98	0,00	-1,84	0,00					3,61	0,00	3,62	0,00
/cut33			4,26	0,00	3,39	0,00	3,39	0,00	-2,03	0,00	-1,98	0,00	-1,84	0,00					3,79	0,00	3,80	0,00
/cut34			4,52	0,00	3,66	0,00	3,66	0,00	-2,02	0,00	-1,98	0,00	-1,84	0,00					4,10	0,00	4,11	0,00

/cut35			4,94	0,00	3,89	0,00	3,89	0,00	-2,02	0,00	-1,97	0,00	-1,84	0,00						
/cut36			8,40	0,00	4,20	0,00	4,20	0,00	-2,02	0,00	-1,97	0,00	-1,83	0,00						
/cut37					4,78	0,00	4,78	0,00	-2,02	0,00	-1,97	0,00	-1,83	0,00						
/cut38					5,50	0,00	5,50	0,00	-2,01	0,00	-1,97	0,00	-1,83	0,00						
/cut39					6,54	0,00	6,54	0,00	-2,00	0,00	-1,97	0,00	-1,82	0,00						
/cut40					7,92	0,00	7,92	0,00	-2,00	0,00	-1,97	0,00	-1,81	0,00						
/cut41									-2,00	0,00	-1,97	0,00	-1,81	0,00						
no ons	4652	17939			77684		77684		44633		77799		80828		1283	4444	51233		51233	
no group	807	910			2316		2316		2328		2331		2446		381	422	432		432	
Wald	0	0			0		0		0		0		0		0	0	0		0	

$BR1_{cjt}^+$ is the number of banks with rating upgrade on one note according to credit rating agency c (in country j in period t ; 0 otherwise); $BR2_{cjt}^+$ is the number of banks with rating upgrade on more than one note according to credit rating agency c (in country j in period t ; 0 otherwise); $BR1_{cjt}^-$ is the number of banks with rating downgrade on one note according to credit rating agency c (in country j in period t ; 0 otherwise); $BR2_{cjt}^-$ is the number of banks with rating downgrade on more than one note according to credit rating agency c (in country j in period t ; 0 otherwise); ΔCR_{jt} denotes a sovereign credit rating change according to credit rating agency c (i.e., Moody, S&P, Fitch, measured separately) in country j in period t . Source: own calculations.

A different reaction was observed in the case of Fitch; the reaction was stronger than for Moody and was observed for decreasing ratings on only one note.

The significance of the increase in bank credit ratings on the changes in corporate notes were not observed for DRBS and Fitch ratings. In the case of the Moody notes, both the changes on one note and at least two notes presented a statistically significant impact on corporate changes. The mentioned reaction was varied. An increase in the number of bank credit ratings on one note caused a decrease in corporate ratings, which is connected with the lagged reaction of non-financial credit ratings changes. Meanwhile, an increase in bank notes by at least two degrees led to growth in the corporate ratings, which is related to waiting for stronger changes.

The obtained results demonstrate that the decreasing notes had a stronger impact than the increasing notes, which is consistent with perspective theory.

The next step of the analysis relied on testing the impact of the sum of the number of the bank credit ratings changes on the decision of the credit ratings agencies regarding non-financial institution notes changes. The results are presented in Table 5, which confirms that the bank credit ratings changes lead to a reaction in the corporate notes, not only in the case of the particular credit rating agency but also in terms of the decisions of the other agencies. The presented results indicate that the reaction of corporate notes to the sum of the number of the banks with credit ratings changes is stronger than for a particular agency. The strongest reaction was observed in the case of the Fitch ratings, followed by DRBS and Moody. In the case of the decrease in bank notes, negative reactions were observed for Fitch and Moody, while a positive reaction was observed for DRBS (i.e., when agencies make a decision considering notes falling by one degree). This varied reaction is an effect of making the decision regarding changes in the corporate ratings. A stronger relationship was observed when decreasing the bank ratings by at least two degrees. These results demonstrate that, if agencies decide to change corporate ratings, they do not take the default risk of banks into account when it is only a little higher; in particular, the spillover effect requires a stronger decrease in bank notes.

In the case of increasing bank notes presented by all credit ratings agencies, the reaction was also stronger than in the particular case. As in the analysis of the spillover effect for the particular agencies, corporates note reacted more weakly to bank ratings increases than decreases, and a stronger relationship was observed for the growth of bank notes by one degree than for two and more. The mentioned relationship varied, which may be an effect of the varied methodologies used.

In conclusion, there exists a bank-to-corporate credit ratings spillover effect. A stronger bank-to-corporate credit ratings spillover effect was noted with respect to the total number of bank credit ratings changes than when considering a particular agency, which indicates the presence of a contagion effect in the mentioned phenomenon. A stronger reaction was observed for downgrading than upgrading of bank notes. Furthermore, the reaction of the corporate credit ratings was varied, with a stronger reaction to a decrease of the bank credit ratings by at least two degrees, compared to one degree.

Table 5. Estimation of spillover effect between sum of bank credit ratings changes for all credit ratings agencies.

Y	Moody		Fitch		DRBS	
	Coef.	P>z	Coef.	P>z	Coef.	P>z
SSBR2-	.0041898	0.002	.0193292	0.000	.0084264	0.008
SSBR1-	-.0035233	0.000	-.0064763	0.000	.0058461	0.000
SSBR1+	.0287346	0.000	.0234488	0.000	.0199465	0.002
SSBR2+	.0007346	0.086	-.0014585	0.063	-.0002174	0.829
/cut1	-7.266364	0.000	-5.592307	0.000	-3.868514	0.000
/cut2	-5.973775	0.000	-5.445338	0.000	-3.704564	0.000
/cut3	-5.181541	0.000	-4.67524	0.000	-3.408764	0.000
/cut4	-4.680616	0.000	-4.018595	0.000	-3.243008	0.000
/cut5	-3.949091	0.000	-3.239571	0.000	-2.88919	0.000
/cut6	-3.747976	0.000	-3.235249	0.000	-2.576102	0.000
/cut7	-3.560722	0.000	-2.94036	0.000	-2.507133	0.000
/cut8	-3.355827	0.000	-2.49893	0.000	-2.252479	0.000
/cut9	-2.997071	0.000	-2.155517	0.000	-2.209363	0.000
/cut10	-2.811124	0.000	-2.154363	0.000	-2.174946	0.000
/cut11	-2.712417	0.000	-1.877648	0.000	-2.111141	0.000
/cut12	-2.499833	0.000	-1.874601	0.000	-2.081545	0.000
/cut13	-2.363791	0.000	-1.726103	0.000	-2.06589	0.000

/cut14	-2.251718	0.000	-1.725892	0.000	-2.002967	0.000
/cut15	-2.179369	0.000	-1.66825	0.000	-1.918835	0.000
/cut16	-2.111851	0.000	-1.66703	0.000	-1.764873	0.000
/cut17	-1.999857	0.000	-1.620995	0.000	-1.437603	0.000
/cut18	-1.852077	0.000	-1.600831	0.000	1.63257	0.000
/cut19	-1.600194	0.000	-1.600053	0.000	2.013426	0.000
/cut20	-1.096287	0.000	-1.599082	0.000	2.104565	0.000
/cut21	1.836835	0.000	-1.58285	0.000	2.151551	0.000
/cut22	2.551078	0.000	-1.569258	0.000	2.212136	0.000
/cut23	2.912105	0.000	-1.567354	0.000	2.221704	0.000
/cut24	3.160123	0.000	-1.567163	0.000	2.243507	0.000
/cut25	3.281563	0.000	-1.557111	0.000	2.280719	0.000
/cut26	3.360505	0.000	-1.556922	0.000	2.288298	0.000
/cut27	3.407745	0.000	-1.546937	0.000	2.356006	0.000
/cut28	3.455381	0.000	-1.545623	0.000	2.722707	0.000
/cut29	3.493245	0.000	-1.545435	0.000	2.862278	0.000
/cut30	3.58518	0.000	-1.542998	0.000	3.100597	0.000
/cut31	3.614589	0.000	-1.541313	0.000	3.384203	0.000
/cut32	3.827738	0.000	-1.540191	0.000	3.586938	0.000
/cut33	4.354189	0.000	-1.53963	0.000	3.76932	0.000
/cut34	4.760491	0.000	-1.537388	0.000	4.038264	0.000
/cut35	4.94024	0.000	-1.52715	0.000		
/cut36	5.589506	0.000	-1.526037	0.000		
/cut37	6.386198	0.000	-1.525666	0.000		
/cut38	6.993353	0.000	-1.525481	0.000		
/cut39	7.281414	0.000	-1.517715	0.000		
/cut40			-1.516424	0.000		
no ons	33708		37460		4578	
no group	1911		2180		422	
Wald	0		0		0	

$SSBR1_{cjt}^+$ is a number bank's rating upgrade on one note by all analyzed credit rating agencies in country j in period t ; $SSBR2_{cjt}^+$ is a number bank's rating upgrade on more than one note by all analyzed credit rating agencies in country j in period; $SSBR1_{cjt}^-$ is a number bank's rating downgrade on one note by all analyzed credit rating agencies in country j in period; $SSBR2_{cjt}^-$ is a number bank's rating downgrade on more than one note by all analyzed credit rating agencies in country j in period. Source: own calculations.

The next step of the analysis of the bank-to-corporate credit ratings spillover effect involved testing the impact of the direction of change for corporate credit ratings. The results are presented in Table 6, which indicate that the decision about unchanging bank credit ratings did not have a statistically significant impact on corporate credit ratings changes when taking into account the direction of ratings changes for the non-financial companies. In the case of the Moody subsample, a statistically significant impact was observed with the upgrading of bank notes; however, this reaction was not observed with the downgrading of notes. The stronger relationship was noticed for the impact of the increase in bank notes by one degree, compared to two or more degrees. The obtained results confirm our previous findings regarding the direction of changes. In the case of the Fitch notes, a statistically significant impact was noticed for the decrease of bank ratings by one degree on the decline of corporate ratings. A bank-to-corporate credit ratings spillover effect was not observed for the DRBS ratings, both for the decrease and increase in bank notes.

In conclusion, the bank-to-corporate credit ratings spillover effect varies, and the impact on the downgrading and upgrading of corporate credit ratings should be taken into account.

Table 6. Estimation of spillover effect between sovereign and banks credit ratings for Moody, Fitch and DRBS notes according to the direction of changes.

Y	Moody								Fitch				DRBS							
	positive		negative		positive		negative		negative		negative		positive		negative		positive		negative	
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z
ΔCR_{jt}	.0154641	0.019	.02535	0.000	.0178042	0.005	.0260119	0.000	.00964	0.000	.010147	0.000	0		-2.117476	0.078	0		.00003	1.000
BR2-	-.1000753	0.062	-.0007253	0.867			-.000447	0.914	-.0025252	0.063	-.0022388	0.105	30.90545	1.000	.6782612	0.252			-.0153478	0.977
BR1-	-.0320783	0.001	-.0039636	0.366			-.0040131	0.345	.5010962	0.000	.4997426	0.000	.2859215	0.702	.0294815	0.545			.0003471	0.994
BR	.002063	0.674	.0040831	0.561					-.0010393	0.178			.0122594	0.490	.0580376	0.027				
BR1+	-.0555357	0.001	-.0012421	0.706	-.0490639	0.003			.2116319	0.000			.1606184	0.508	-.0723146	0.717	.0864516	0.714		
BR2+	.0340906	0.002	.0370797	0.271	.0332923	0.002			.0262515	0.834			0		0		0			
/cut1	-.01774	0.947	-13.26237	0.000	.1366669	0.604	-13.26814	0.000	-16.67682	0.000	-16.62939	0.000	-.7982565	0.029	-7.578863	0.000	-1.035461	0.001	-8.35001	0.000
/cut2	2.161496	0.000	-8.814151	0.000	2.283477	0.000	-8.814023	0.000	-14.3473	0.000	-14.30811	0.000	-.2715994	0.456	-6.77108	0.000	-.5134082	0.098	-7.513115	0.000
/cut3	2.756085	0.000	-7.974907	0.000	2.87882	0.000	-7.973847	0.000	-10.50693	0.000	-10.47541	0.000	-.0815684	0.824	-5.568849	0.000	-.3260707	0.291	-6.272481	0.000
/cut4	2.900689	0.000	-7.013595	0.000	3.023507	0.000	-7.012503	0.000	-7.479086	0.000	-7.455194	0.000	.0734527	0.842	-4.223085	0.000	-.1735816	0.573	-4.887688	0.000
/cut5	3.026917	0.000	-6.433634	0.000	3.150222	0.000	-6.432803	0.000	-4.001746	0.000	-3.984825	0.000	.1526675	0.679	-3.44432	0.000	-.095755	0.755	-4.084488	0.000
/cut6	3.36168	0.000	-4.866935	0.000	3.486187	0.000	-4.867192	0.000	-3.983283	0.000	-3.966401	0.000	.2736563	0.461	-2.501621	0.001	.0227361	0.941	-3.111701	0.000
/cut7	5.926895	0.000	-3.38393	0.000	6.061876	0.000	-3.385739	0.000	-2.173528	0.000	-2.167346	0.000	.689938	0.073	-5.322356	0.431	.4277671	0.171	-1.09543	0.117
/cut8	7.26	0.000	-3.233671	0.000	7.656726	0.000	-3.235719	0.000	.3182289	0.034	.315108	0.034	.7767748	0.046	.0067951	0.992	.5117405	0.103	-5.481039	0.423
/cut9	7.908352	0.000	-2.897785	0.000	8.054813	0.000	-2.900501	0.000	2.627524	0.000	2.619345	0.000	.8652273	0.028	.6881909	0.305	.5970969	0.059	.1493025	0.825
/cut10	7.983363	0.000	-2.783474	0.000	8.130228	0.000	-2.786482	0.000	2.654022	0.000	2.645727	0.000	1.36522	0.001	1.261368	0.064	1.075373	0.001	.7400487	0.278
/cut11	8.586682	0.000	-2.574515	0.000	8.736764	0.000	-2.578038	0.000	4.973466	0.000	4.949995	0.000	2.220658	0.000	2.820126	0.000	1.887465	0.000	2.326095	0.001
/cut12	13.81749	0.000	-2.435229	0.000	13.98535	0.000	-2.439042	0.000	5.012705	0.000	4.988784	0.000	3.36653	0.000			2.950523	0.000		
/cut13			-1.892444	0.000			-1.897205	0.000	6.562281	0.000	6.515537	0.000	4.558281	0.000			3.990342	0.000		
/cut14			-.7694329	0.011			-.7745983	0.009	6.571221	0.000	6.524308	0.000	5.31616	0.000			4.58642	0.000		
/cut15			.2836157	0.343			.2779425	0.348	7.305904	0.000	7.245124	0.000								
/cut16			1.943032	0.000			1.932541	0.000	7.315082	0.000	7.254122	0.000								
no obs	946		1298		946		1298		6910		6910		177		222		177		222	
no grou	399		4444		399		4444		2043		2043		101		145		101		145	
Wald	0		0		0		0		0		0		0		0		0		0	

$BR1_{cjt}^+$ is a number bank's rating upgrade on one note by credit rating agency c (in country j in period t; $BR2_{cjt}^+$ is a number bank's rating upgrade on more than one note by credit rating agency c (in country j in period t; $BR1_{cjt}^-$ is a number bank's rating downgrade on one note by credit rating agency c (in country j in period t; $BR2_{cjt}^-$ is a number bank's rating downgrade on more than one note by credit rating agency c (in country j in period t; ΔCR_{jt} is a sovereign credit rating change given by credit rating agency in country j in period t; Source: own calculations.

4.3. Bank-to-corporate credit rating spillover effects according to the stage of the business cycle

The next step of the analysis relied on testing the bank-to-corporate credit ratings spillover effect while taking into consideration the stage of the business cycle. The results of the analysis are presented in Table 7, and the business cycle was divided into three periods: The Global Financial Crisis (GFC) period, the period between crises, and the COVID-19 pandemic crisis. The country's credit ratings changes did not show a statistically significant impact on the corporate credit ratings changes for DRBS, while the country's ceiling effect was observed during the GFC period for the Fitch and Moody notes. The abovementioned relationship was not observed for the COVID-19 pandemic crisis. During the stable period, the country credit ratings changes had an impact on the corporate notes for the Moody ratings and the country ceiling effect had an impact on the corporate credit ratings changes, but the mentioned relationship varied according to the methodology presented by the particular agency and the size of the sample.

A bank-to-corporate credit ratings spillover effect was not noticed in the case of DRBS and Fitch. The decrease in bank notes has a significant influence on corporate credit ratings changes only in the case of the notes downgrading by at least two degrees during the stable period in the case of the Moody subsample. During the GFC period, the bank-to-corporate credit ratings spillover effect was observed for the Moody ratings if the mentioned agency decides to decrease notes by one degree. During the COVID-19 pandemic, the mentioned phenomenon was stronger than for the GFC period. A statistically significant impact was observed if Moody decided to decrease notes by at least two degrees.

Taking into account the stage of the business cycle, the increase in banks notes did not have a statistically significant impact on the change in corporate notes presented by Fitch. In the case of Moody, the mentioned relationship was observed if the agency increased notes on one degree. The growth of bank credit ratings had an impact only in the case of stability of the financial market.

The stable bank credit ratings did not have an impact on the corporate notes.

The results obtained through this analysis lead to several conclusions. First, there only existed a bank-to-corporate credit ratings spillover effect when taking into consideration the stage of the business cycle when considering the Moody ratings changes. The effect of downgrading bank notes was noticed for all stages of the business cycle, but the strongest reactions were noticed during crises, especially the COVID-19 pandemic crisis. The upgrading of bank notes was only significant during the stable period of the financial market. Therefore, the reaction to positive information is weaker than that to negative information. The mentioned relationship may be an effect of perspective theory and the fear of transferring the default risk of banks to corporates and creating a bankruptcy spiral, transferred between the financial and non-financial sectors, which will deepen the financial crisis. The presented findings indicate that the strength of the bank-to-corporate credit ratings spillover effect is strictly connected with the methodology used by agencies and the frequency of the decisions taken by a particular agency.

Table 7. Estimation of spillover effect between sovereign and bank credit ratings for Moody, Fitch, and DRBS notes according to the stage of the business cycle.

Y	Moody						Fitch						DRBS			
	COVID-19		GFC		no crisis		COVID-19		GFC		no crisis		COVID-19		no crisis	
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z
CR	0,01	0,16	0,02	0,03	0,02	0,00	0,00	0,19	0,00	0,00	0,00	0,83	-0,06	0,95	0,01	0,95
BR2-	-0,07	0,05	0,01	0,87	-0,01	0,00			0,00	0,93	0,07	0,43			-0,04	0,53
BR1-	0,01	0,54	-0,01	0,05	0,00	0,89					-0,03	0,69			-0,03	0,23
BR	0,01	0,19	-0,38	0,28	0,00	0,72	0,00	0,38	0,00	0,57	0,00	0,33	0,03	0,12	-0,01	0,03
BR1+	-0,01	0,66			-0,01	0,00			-0,29	0,13					-0,01	0,71
BR2+	-0,05	0,33			-0,11	0,40	0,11	0,81	0,03	0,97	0,04	0,24				
/cut1	-7,38	0,00	-5,47	0,00	-7,09	0,00	-5,99	0,00	-6,23	0,00	-6,04	0,00	-7,92	0,00	-4,38	0,00
/cut2	-6,73	0,00	-3,66	0,00	-5,06	0,00	-5,16	0,00	-5,47	0,00	-5,42	0,00	-6,91	0,00	-4,18	0,00
/cut3	-6,30	0,00	-3,50	0,00	-4,65	0,00	-4,60	0,00	-4,48	0,00	-4,47	0,00	-6,23	0,00	-3,90	0,00
/cut4	-5,77	0,00	-3,12	0,00	-4,23	0,00	-3,87	0,00	-3,91	0,00	-3,91	0,00	-4,76	0,00	-3,63	0,00
/cut5	-5,21	0,00	-2,93	0,00	-4,07	0,00	-3,12	0,00	-3,23	0,00	-3,21	0,00	-4,64	0,00	-3,41	0,00
/cut6	-4,95	0,00	-2,62	0,00	-3,53	0,00	-3,11	0,00	-3,23	0,00	-3,21	0,00	-4,01	0,00	-3,20	0,00
/cut7	-4,89	0,00	-2,55	0,00	-3,13	0,00	-2,80	0,00	-2,92	0,00	-2,88	0,00	-3,29	0,00	-2,91	0,00
/cut8	-4,83	0,00	-2,21	0,00	-3,11	0,00	-2,35	0,00	-2,47	0,00	-2,48	0,00	-2,48	0,00	-2,82	0,00
/cut9	-4,46	0,00	-2,16	0,00	-3,03	0,00	-2,04	0,00	-2,14	0,00	-2,16	0,00	3,51	0,00	-2,70	0,00
/cut10	-3,85	0,00	-2,12	0,00	-3,02	0,00	-2,03	0,00	-2,13	0,00	-2,15	0,00	4,50	0,00	-2,68	0,00
/cut11	-3,47	0,00	-1,54	0,00	-3,00	0,00	-1,77	0,00	-1,87	0,00	-1,88	0,00	4,59	0,00	-2,49	0,00
/cut12	-2,97	0,00	-0,80	0,00	-2,98	0,00	-1,76	0,00	-1,87	0,00	-1,87	0,00	4,68	0,00	-1,88	0,00
/cut13	-2,01	0,00	0,83	0,00	-2,89	0,00	-1,67	0,00	-1,73	0,00	-1,73	0,00	4,97	0,00	1,99	0,00
/cut14	2,12	0,00	2,03	0,00	-2,62	0,00	-1,62	0,00	-1,68	0,00	-1,68	0,00	6,53	0,00	2,49	0,00
/cut15	4,50	0,00	2,20	0,00	-2,32	0,00	-1,58	0,00	-1,65	0,00	-1,68	0,00	8,72	0,00	2,66	0,00
/cut16	5,74	0,00	2,24	0,00	-1,83	0,00	-1,55	0,00	-1,63	0,00	-1,64	0,00			2,72	0,00
/cut17	6,56	0,00	2,39	0,00	-1,03	0,00	-1,54	0,00	-1,62	0,00	-1,62	0,00			2,78	0,00
/cut18	7,04	0,00	3,06	0,00	1,80	0,00	-1,53	0,00	-1,60	0,00	-1,61	0,00			2,81	0,00
/cut19			4,20	0,00	2,98	0,00	-1,53	0,00	-1,60	0,00	-1,60	0,00			2,86	0,00
/cut20					3,48	0,00	-1,52	0,00	-1,59	0,00	-1,59	0,00			2,98	0,00
/cut21					3,68	0,00	-1,52	0,00	-1,58	0,00	-1,58	0,00			3,02	0,00
/cut22					3,71	0,00	-1,51	0,00	-1,58	0,00	-1,58	0,00			3,06	0,00
/cut23					3,86	0,00			6,60	0,00	-1,57	0,00			3,30	0,00
/cut24					5,10	0,00			6,72	0,00	-1,57	0,00			3,80	0,00
/cut25									7,19	0,00	8,99	0,00			4,06	0,00
no obs	626		238		3365		2687		6572		21329		210		1073	
no group	348		121		768		1639		2218		2308		173		359	
Wald	0		0		0		0		0		0		0		0	

$BR1_{cjt}^+$ is a number bank's rating upgrade on one note by credit rating agency c (in country j in period t ; $BR2_{cjt}^+$ is a number bank's rating upgrade on more than one note by credit rating agency c (in country j in period t ; $BR1_{cjt}^-$ is a number bank's rating downgrade on one note by credit rating agency c (in country j in period t ; $BR2_{cjt}^-$ is a number bank's rating downgrade on more than one note by credit rating agency c (in country j in period t ; ΔCR_{jt} is a sovereign credit rating change given by credit rating agency c (i.e. Moody, S&P, Fitch, measured separately) in country j in period t . Source: own calculations.

The next part of the analysis relied on testing the bank-to-corporate credit ratings spillover effect by taking into account the regional location. As an effect, companies were divided into European and American groups. The results of this analysis are presented in Table 8. To test the mentioned phenomenon, we also lagged the decisions of agencies taken about bank notes, by one quarter. The obtained findings presented varied results. At first, we observed differences between the reactions of European and American companies. In most cases, statistically significant impacts were noticed not only in the case of the current changes of bank notes, but also for the previous decisions taken by agencies. The findings also suggest that the bank-to-corporate credit ratings spillover effect was not observed for the DRBS ratings. Taking into account the division of American and European non-financial institutions, the mentioned phenomenon was observed only in the case of European companies. In the case of the DRBS, the strongest impact was that of stabilization in the banking sector's default risk, both in the case of lagged and current decisions taken by the agency. An increase in bank notes had an impact on corporate credit ratings changes regarding previous decisions, which is connected with a lagged reaction to positive information on the financial market. The mentioned ratings reacted up to date when considering the decrease of bank notes by one degree.

The analysis prepared for Fitch credit ratings changes showed that a stronger reaction was observed for American than European non-financial companies regarding the bank-to-corporate credit ratings spillover effect, in both the cases of decreasing and increasing notes. In both cases, the previous

decisions taken by agencies had a statistically significant impact on the changes in corporate notes. The prepared analysis also showed that U.S. companies reacted strongly to an increase in bank notes, where the reaction to current changes was stronger than that to previous decisions. Next, the Fitch ratings tended to react especially if the agency decided to decrease the bank ratings by one degree, both for the European and U.S. companies. In the case of increasing notes, the presented relationship was stronger for the growth of bank ratings on at least two notes; however, the difference was not as strong as in the case of declining ratings. Decisions about non-changing bank note had very weak impact on the same decision about corporate ratings, suggesting that agencies mostly take into consideration the situation in the banking sector when something is happening.

The analysis of the bank-to-corporate credit ratings spillover effect in the case of the Moody corporates credit ratings changes indicated that European companies were mostly significant regarding the previous decisions about changing bank notes. In the case of the European companies, the corporate notes were more sensitive to a decrease in ratings by at least two degrees. The same situation was noticed in the case of increasing notes. The stabilization of bank ratings did not have a significant impact on the corporate notes. Similarly, in the case of the Moody ratings, a stronger reaction was noticed for the U.S. companies regarding the bank-to-corporate credit ratings spillover effect, compared to the European companies. The received findings demonstrate the existence of a stronger relationship for the decisions about decreasing bank notes by one degree than two or more, and in the case of the increasing notes by at least two degrees.

The obtained findings confirm the significance of the bank-to-corporate credit ratings spillover effect, and also show that there exist strong differences between American and European companies. There was also a strong significant impact of previous decisions about bank credit ratings changes.

Table 8. Estimation of bank-to-corporate credit ratings spillover effect for lagged variables according to location.

Y	Moody								Fitch								DRBS							
	Europe				US				Europe				US				Europe				US			
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z		
CR	0,02	0,00								0,01	0,00													
BR2-	0,00	0,74			0,05	0,00			0,00	0,43			-0,01	0,02					-0,02	0,70				
BR1-	0,00	0,68			-0,17	0,00			0,03	0,00			2,03	0,00										
BR	-0,02	0,35			-0,06	0,00			0,00	0,00			-0,04	0,00					-0,02	0,72		0,08	0,00	
BR1+	-0,01	0,15			0,31	0,00			0,02	0,00			1,57	0,00							0,26	0,01		
BR2+	0,03	0,00			-0,52	0,00			0,12	0,01			1,76	0,00										
L1.CR	0,01	0,09	0,03	0,00					0,01	0,00	0,02	0,00												
L1.BR2-	-0,01	0,00	-0,01	0,00	-0,07	0,00	-0,04	0,00	0,00	0,63	0,00	0,91	0,04	0,00	-0,01	0,00			0,01	0,34				
L1.BR1-	0,01	0,47	-0,01	0,03	-0,20	0,00	-0,19	0,00	0,02	0,00	0,04	0,00	1,44	0,00	2,63	0,00			0,00	0,65				
L1.BR	-0,02	0,38	0,00	0,33	-0,11	0,00	-0,04	0,00	0,00	0,00	0,00	0,00	-0,02	0,00	-0,03	0,00	0,03	0,48	0,00	0,12	0,04	0,04	0,10	
L1.BR1+	0,00	0,79	-0,01	0,00	0,36	0,00	0,13	0,00	0,01	0,00	0,01	0,00	1,17	0,00	1,66	0,00	0,09	0,10	0,02	0,16	-0,06	0,58	0,10	
L1.BR2+	0,04	0,49	0,02	0,00	-0,62	0,00	-0,30	0,00	0,23	0,00	0,08	0,00	1,82	0,00	1,53	0,00								
/cut1	-6,57	0,00	-7,28	0,00	-6,95	0,00	-6,90	0,00	-5,95	0,00	-7,57	0,00	-5,81	0,00	-5,77	0,00	-2,28	0,00	-4,97	0,00	-3,45	0,00	-3,47	
/cut2	-6,16	0,00	-5,16	0,00	-6,46	0,00	-6,14	0,00	-4,56	0,00	-5,54	0,00	-5,09	0,00	-5,05	0,00	-1,50	0,00	-2,54	0,00	-3,29	0,00	-3,32	
/cut3	-5,87	0,00	-4,82	0,00	-5,90	0,00	-5,49	0,00	-4,01	0,00	-4,44	0,00	-4,33	0,00	-4,27	0,00	-1,44	0,00	-1,85	0,00	-2,92	0,00	-3,04	
/cut4	-4,95	0,00	-4,17	0,00	-5,49	0,00	-4,93	0,00	-3,42	0,00	-3,93	0,00	-3,46	0,00	-3,42	0,00	-1,38	0,00	-1,80	0,00	-2,75	0,00	-2,86	
/cut5	-4,48	0,00	-3,93	0,00	-4,75	0,00	-4,16	0,00	-3,10	0,00	-3,34	0,00	-3,45	0,00	-3,42	0,00	-1,11	0,01	-1,74	0,00	-2,69	0,00	-2,76	
/cut6	-3,70	0,00	-3,36	0,00	-4,62	0,00	-4,00	0,00	-2,79	0,00	-3,02	0,00	-3,17	0,00	-3,12	0,00	-0,35	0,38	-1,60	0,00	-2,64	0,00	-2,69	
/cut7	-3,15	0,00	-3,02	0,00	-4,50	0,00	-3,87	0,00	-2,56	0,00	-2,70	0,00	-2,70	0,00	-2,65	0,00	1,94	0,00	-0,94	0,00	-2,58	0,00	-2,60	
/cut8	-3,13	0,00	-2,96	0,00	-4,38	0,00	-3,74	0,00	-2,55	0,00	-2,47	0,00	-2,36	0,00	-2,32	0,00	2,21	0,00	1,38	0,00	-2,21	0,00	-2,21	
/cut9	-3,11	0,00	-2,94	0,00	-4,15	0,00	-3,52	0,00	-2,33	0,00	-2,47	0,00	-2,09	0,00	-2,05	0,00	2,78	0,00	1,99	0,00	-2,13	0,00	-2,14	
/cut10	-3,09	0,00	-2,90	0,00	-3,93	0,00	-3,33	0,00	-2,33	0,00	-2,26	0,00	-2,08	0,00	-2,05	0,00			2,10	0,00	-2,07	0,00	-2,10	
/cut11	-2,96	0,00	-2,85	0,00	-3,80	0,00	-3,22	0,00	-2,26	0,00	-2,26	0,00	-1,92	0,00	-1,89	0,00			2,27	0,00	-1,97	0,00	-2,02	
/cut12	-2,62	0,00	-2,83	0,00	-3,57	0,00	-3,02	0,00	-2,26	0,00	-2,20	0,00	-1,92	0,00	-1,89	0,00			2,34	0,00	-1,87	0,00	-1,96	
/cut13	-2,31	0,00	-2,80	0,00	-3,40	0,00	-2,86	0,00	-2,23	0,00	-2,20	0,00	-1,86	0,00	-1,83	0,00			3,78	0,00	-1,84	0,00	-1,94	
/cut14	-1,66	0,00	-2,72	0,00	-3,25	0,00	-2,73	0,00	-2,23	0,00	-2,18	0,00	-1,86	0,00	-1,83	0,00			4,89	0,00	-1,79	0,00	-1,89	
/cut15	-0,81	0,00	-2,45	0,00	-3,17	0,00	-2,65	0,00	-2,21	0,00	-2,18	0,00	-1,80	0,00	-1,77	0,00					-1,72	0,00	-1,84	
/cut16	1,56	0,00	-2,12	0,00	-3,09	0,00	-2,57	0,00	-2,21	0,00	-2,16	0,00	-1,78	0,00	-1,75	0,00					-1,56	0,00	-1,71	
/cut17	3,05	0,00	-1,72	0,00	-2,96	0,00	-2,45	0,00	-2,21	0,00	-2,16	0,00	-1,78	0,00	-1,75	0,00					-1,31	0,00	-1,42	
/cut18	3,81	0,00	-1,00	0,00	-2,72	0,00	-2,24	0,00	-2,21	0,00	-2,14	0,00	-1,78	0,00	-1,75	0,00					2,10	0,00	2,05	
/cut19	4,03	0,00	1,58	0,00	-2,42	0,00	-1,96	0,00	-2,20	0,00	-2,14	0,00	-1,76	0,00	-1,73	0,00					2,38	0,00	2,34	
/cut20	4,08	0,00	2,62	0,00	-1,84	0,00	-1,46	0,00	-2,20	0,00	-2,14	0,00	-1,76	0,00	-1,73	0,00					2,43	0,00	2,44	
/cut21	4,13	0,00	3,30	0,00	0,64	0,00	0,95	0,00	-2,20	0,00	-2,14	0,00	-1,76	0,00	-1,73	0,00					2,45	0,00	2,47	
/cut22	5,56	0,00	3,42	0,00	1,02	0,00	1,36	0,00	-2,19	0,00	-2,14	0,00	-1,75	0,00	-1,71	0,00					2,49	0,00	2,51	
/cut23	5,79	0,00	3,42	0,00	1,25	0,00	1,59	0,00	-2,19	0,00	-2,14	0,00	-1,75	0,00	-1,71	0,00					2,52	0,00	2,53	
/cut24	6,49	0,00	3,43	0,00	1,41	0,00	1,76	0,00	-2,19	0,00	-2,14	0,00	-1,74	0,00	-1,71	0,00					2,55	0,00	2,57	
/cut25			3,45	0,00	1,51	0,00	1,86	0,00	-2,19	0,00	-2,13	0,00	-1,74	0,00	-1,71	0,00					2,57	0,00	2,61	
/cut26			3,47	0,00	1,60	0,00	1,97	0,00	-2,18	0,00	-2,13	0,00	-1,74	0,00	-1,71	0,00					2,58	0,00	2,63	
/cut27			3,59	0,00	1,70	0,00	2,02	0,00	-2,18	0,00	-2,13	0,00	-1,73	0,00	-1,70	0,00					2,65	0,00	2,70	
/cut28			4,34	0,00	1,88	0,00	2,18	0,00	-2,15	0,00	-2,12	0,00	-1,73	0,00	-1,70	0,00					3,18	0,00	3,17	
/cut29			4,81	0,00	2,10	0,00	2,37	0,00	-2,15	0,00	-2,12	0,00	-1,73	0,00	-1,70	0,00					3,36	0,00	3,34	
/cut30			4,93	0,00	2,37	0,00	2,59	0,00	-2,09	0,00	-2,12	0,00	-1,73	0,00	-1,70	0,00					3,40	0,00	3,41	
/cut31			4,95	0,00	2,54	0,00	2,73	0,00	-2,08	0,00	-2,12	0,00	-1,73	0,00	-1,70	0,00					3,52	0,00	3,55	
/cut32			5,22	0,00	2,78	0,00	2,94	0,00	1,78	0,00	-2,10	0,00	-1,72	0,00	-1,69	0,00					3,73	0,00	3,78	
/cut33					3,03	0,00	3,16	0,00	1,78	0,00	-2,10	0,00	-1,71	0,00	-1,68	0,00					3,81	0,00	3,99	

The mentioned situation created the need to check the significance of the bank-to-corporate credit ratings spillover effect by taking into account the location and the business cycle for the estimated sample. The results are presented in Table 9, which indicate that the credit ratings changes of countries had a statistically significant impact on the corporate notes of European companies in the case of the GFC period for Moody and Fitch; in particular, a stronger reaction was noticed for Moody. The ratings of the mentioned agency were similarly sensitive to bank notes changes during the GFC crisis and the stable period. As mentioned before, stability of the bank credit ratings has a very low impact on the corporate notes changes during the stable period regarding the bank notes for European Fitch and DRBS subsamples, the American Moody notes, and DRBS in the crisis periods.

The American corporate credit ratings were sensitive only to the decrease in bank notes during the stable period. The mentioned reaction is connected with the impact of lagged decisions on the bank-to-corporate credit ratings spillover effect.

The analysis of the significance of the bank-to-corporate credit ratings spillover effect in the case of European companies indicated that the decrease in bank notes had an important impact if the DRBS made decisions based on the downgrading of notes by one degree during the stable period. In the case of the Moody notes, a statistically significant impact was observed for a decrease of bank ratings by at least two degrees during the COVID-19 pandemic and stable period; furthermore, in the case of the GFC period, this impact was noticed for one degree. The strongest reaction was observed for the COVID-19 pandemic. The increase in bank notes was important for corporate notes changes during the stable period for the Moody subsample.

Table 9. Estimation of spillover effect between European sovereign and bank credit ratings for Moody, Fitch, and DRBS notes according to the crisis period.

Y	Europe														US																				
	Moody						Fitch				DRBS				Moody				Fitch				DRBS												
	COVID-19		GFC		no crisis		COVID-19		GFC		no crisis		COVID-19		no crisis		COVID-19		GFC		no crisis		COVID-19		GFC		no crisis								
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z							
CR	0,01	0,16	0,02	0,03	0,02	0,00	0,00	0,58	0,00	0,03	0,00	0,66	0,01	1,00	-0,03	0,83																			
BR2-	-0,07	0,05	0,01	0,87	-0,01	0,00			0,00	0,91	0,00	1,00			-0,04	0,46			-0,02	0,14	0,11	0,01													
BR1-	0,01	0,54	-0,01	0,05	0,00	0,89					-0,08	0,35			-0,04	0,08	0,05	0,63	0,00	0,82	0,01	0,68													
BR	0,01	0,19	-0,38	0,28	0,00	0,72	0,00	0,71	0,00	0,66	0,00	0,04	0,05	0,05	-0,01	0,02			-0,06	0,19	0,05	0,04	-0,02	0,85	0,00	0,57	-0,01	0,23	0,35	0,23	-0,16	0,02	0,02	0,51	
BR1+	-0,01	0,66			-0,01	0,00									-0,03	0,35	0,05	0,63			0,00	0,92									0,17	0,00			
BR2+	-0,05	0,33			-0,11	0,40	0,03	0,96	-0,05	0,95	0,03	0,39									-0,03	0,42													
/cut1	-7,38	0,00	-5,47	0,00	-7,09	0,00	-5,85	0,00	-7,28	0,00	-6,83	0,00	-8,40	0,00	-4,79	0,00	-6,78	0,00	-7,10	0,00	-5,90	0,00	-6,35	0,00	-5,88	0,00	-5,73	0,00	-3,76	0,00	-4,68	0,00	-3,58	0,00	
/cut2	-6,73	0,00	-3,66	0,00	-5,06	0,00	-4,66	0,00	-5,07	0,00	-5,03	0,00	-7,06	0,00	-3,79	0,00	-5,47	0,00	-6,11	0,00	-5,19	0,00	-4,96	0,00	-5,17	0,00	-4,94	0,00	-3,37	0,00	-4,40	0,00	-3,51	0,00	
/cut3	-6,30	0,00	-3,50	0,00	-4,65	0,00	-4,27	0,00	-3,94	0,00	-3,97	0,00	-4,02	0,00	-3,67	0,00	-4,96	0,00	-5,52	0,00	-4,64	0,00	-4,31	0,00	-4,33	0,00	-4,22	0,00	-3,24	0,00	-3,98	0,00	-3,33	0,00	
/cut4	-5,77	0,00	-3,12	0,00	-4,23	0,00	-3,53	0,00	-3,53	0,00	-3,55	0,00	-2,23	0,02	-2,91	0,00	-3,99	0,00	-4,49	0,00	-3,89	0,00	-3,31	0,00	-3,45	0,00	-3,36	0,00	-3,18	0,00	-3,94	0,00	-3,03	0,00	
/cut5	-5,21	0,00	-2,93	0,00	-4,07	0,00	-2,97	0,00	-3,10	0,00	-2,99	0,00	-0,84	0,24	-2,79	0,00	-3,64	0,00	-4,35	0,00	-3,71	0,00	-3,30	0,00	-3,44	0,00	-3,36	0,00	-2,73	0,00	-3,91	0,00	-2,88	0,00	
/cut6	-4,95	0,00	-2,62	0,00	-3,53	0,00	-2,79	0,00	-2,79	0,00	-2,65	0,00	3,32	0,00	-1,52	0,00	-3,49	0,00	-4,15	0,00	-3,54	0,00	-2,87	0,00	-3,12	0,00	-3,07	0,00	-2,64	0,00	-3,47	0,00	-2,81	0,00	
/cut7	-4,89	0,00	-2,55	0,00	-3,13	0,00	-2,38	0,00	-2,39	0,00	-2,37	0,00	4,81	0,00	1,04	0,00	-3,26	0,00	-4,01	0,00	-3,39	0,00	-2,41	0,00	-2,62	0,00	-2,58	0,00	-2,30	0,00	-3,32	0,00	-2,68	0,00	
/cut8	-4,83	0,00	-2,21	0,00	-3,11	0,00	-2,04	0,00	-2,06	0,00	-2,08	0,00			1,65	0,00	-2,99	0,00	-3,74	0,00	-3,18	0,00	-2,09	0,00	-2,27	0,00	-2,23	0,00	3,27	0,00	-3,02	0,00	-2,30	0,00	
/cut9	-4,46	0,00	-2,16	0,00	-3,03	0,00	-2,02	0,00	-2,05	0,00	-2,08	0,00			1,88	0,00	-2,89	0,00	-3,52	0,00	-2,98	0,00	-1,82	0,00	-1,98	0,00	-1,94	0,00	3,84	0,00	-2,84	0,00	-2,24	0,00	
/cut10	-3,85	0,00	-2,12	0,00	-3,02	0,00	-1,79	0,00	-1,77	0,00	-1,83	0,00			3,15	0,00	-2,77	0,00	-3,39	0,00	-2,86	0,00	-1,81	0,00	-1,98	0,00	-1,93	0,00	4,04	0,00	-2,77	0,00	-2,20	0,00	
/cut11	-3,47	0,00	-1,54	0,00	-3,00	0,00	-1,71	0,00	-1,71	0,00	-1,77	0,00			4,02	0,00	-2,58	0,00	-3,13	0,00	-2,63	0,00	-1,68	0,00	-1,79	0,00	-1,77	0,00	4,27	0,00	-2,73	0,00	-2,17	0,00	
/cut12	-2,97	0,00	-0,80	0,00	-2,98	0,00	-1,70	0,00	-1,68	0,00	-1,74	0,00					-2,45	0,00	-2,91	0,00	-2,46	0,00	-1,61	0,00	-1,73	0,00	-1,69	0,00	4,40	0,00	-2,68	0,00	-2,11	0,00	
/cut13	-2,01	0,00	0,83	0,00	-2,89	0,00	-1,68	0,00	-1,67	0,00	-1,74	0,00					-2,27	0,00	-2,75	0,00	-2,32	0,00	-1,57	0,00	-1,66	0,00	-1,69	0,00	4,88	0,00	-2,60	0,00	-2,00	0,00	
/cut14	2,12	0,00	2,03	0,00	-2,62	0,00	-1,67	0,00	-1,66	0,00	-1,73	0,00					-2,22	0,00	-2,66	0,00	-2,24	0,00	-1,53	0,00	-1,64	0,00	-1,63	0,00	5,50	0,00	-2,55	0,00	-1,82	0,00	
/cut15	4,50	0,00	2,20	0,00	-2,32	0,00	-1,65	0,00			-1,72	0,00					-2,09	0,00	-2,59	0,00	-2,16	0,00	-1,50	0,00	-1,62	0,00	-1,61	0,00			-2,42	0,00	-1,47	0,00	
/cut16	5,74	0,00	2,24	0,00	-1,83	0,00					-1,72	0,00					-2,05	0,00	-2,40	0,00	-2,02	0,00	-1,50	0,00	-1,60	0,00	-1,61	0,00	2,19	0,00	2,41	0,00	2,41	0,00	
/cut17	6,56	0,00	2,39	0,00	-1,03	0,00					-1,72	0,00					-1,88	0,00	-2,24	0,00	-1,85	0,00	-1,48	0,00	-1,60	0,00	-1,59	0,00	2,48	0,00	2,87	0,00	2,87	0,00	
/cut18	7,04	0,00	3,06	0,00	1,80	0,00					-1,72	0,00					-1,50	0,00	-1,93	0,00	-1,59	0,00	-1,48	0,00	-1,58	0,00	-1,57	0,00	2,82	0,00	3,03	0,00	3,03	0,00	
/cut19			4,20	0,00	2,98	0,00					-1,71	0,00					-0,98	0,00	-1,25	0,00	-1,13	0,00	-1,47	0,00	-1,57	0,00	-1,56	0,00	4,36	0,00	3,17	0,00	3,17	0,00	
/cut20					3,48	0,00											3,43	0,00	2,29	0,00	2,35	0,00	-1,46	0,00	-1,56	0,00	-1,55	0,00	5,21	0,00	3,26	0,00	3,26	0,00	
/cut21					3,68	0,00														3,12	0,00	3,43	0,00			6,51	0,00	-1,54	0,00	5,73	0,00	3,31	0,00	3,31	0,00
/cut22					3,71	0,00														5,62	0,00	3,50	0,00	4,01	0,00	6,59	0,00	-1,54	0,00			3,41	0,00	3,41	0,00
/cut23					3,86	0,00														6,81	0,00	3,78	0,00	4,44	0,00	7,13	0,00	8,83	0,00			3,56	0,00	3,56	0,00
/cut24					5,10	0,00														7,18	0,00	3,98	0,00	4,69	0,00	9,08	0,00	10,22	0,00			3,60	0,00	3,60	0,00
/cut25																				7,34	0,00	4,22	0,00	4,80	0,00							3,65	0,00	3,65	0,00
/cut26																				8,05	0,00	4,30	0,00	4,81	0,00							3,97	0,00	3,97	0,00
/cut27																						4,34	0,00	4,86	0,00							3,99	0,00	3,99	0,00
/cut28																						4,41	0,00	4,92	0,00							4,13	0,00	4,13	0,00
/cut29																						4,63	0,00	5,13	0,00							4,42	0,00	4,42	0,00
/cut30																						4,84	0,00	5,57	0,00							4,95	0,00	4,95	0,00
no obs	626		238		3365		1242		2721		8148		77		228		2190		5908		16342		2716		7328		24622		348		529		2604		
no group	348		121		768		641		875		924		64		106		914		922		960		1310		1383		1387		206		168		262		
Wald	0		0		0		0,9241		0		0		0		0,1796		0,6271		0		0		0,8479		0,5661		0,2251		0,2320		0		0		

$BR1_{cjt}^+$ is a number bank's rating upgrade on one note by credit rating agency c (in country j in period t ; $BR2_{cjt}^+$ is a number bank's rating upgrade on more than one note by credit rating agency c (in country j in period t ; $BR1_{cjt}^-$ is a number bank's rating downgrade on one note by credit rating agency c (in country j in period t ; $BR2_{cjt}^-$ is a number bank's rating downgrade on more than one note by credit rating agency c (in country j in

4.4. Bank-to-corporate credit rating spillover effect taking into account financial indicators

The next step of the analysis relied on testing the bank-to-corporate credit rating spillover effect by taking into account various financial indicators. The estimation results are presented in Table 10, which indicate that a certain group of variables had significant impacts on the corporate credit ratings changes. The DRBS European notes were sensitive to the decrease in bank ratings by at least two degrees and by one degree in the case of American companies. The credit ratings changes of American companies were sensitive to the decline of bank notes and growth by at least one degree. In the case of Fitch ratings, a stronger reaction was observed for American than European ratings. The company's notes were more sensitive to the increase in ratings than for their decrease. The mentioned ratings were sensitive to the decrease in the corporate notes by at least two degrees for the European companies, and by at least one degree for American companies. In the case of improved bank ratings, the reaction was stronger for an increase by at least one degree.

Higher ratings were received by bigger European companies, when assessed according to Moody. In the case of U.S. non-financial firms, if the mentioned entities were bigger, they received lower ratings from Fitch and DRBS.

The next part of the analysis relied on testing the impact of the profitability indicators, including the EBITDA margin and the income tax rate. The EBITDA margin had a positive and significant impact on the European companies assessed by Moody and American entities assessed by Fitch. A positive impact on U.S. companies was also observed for the income tax rate, when ratings were estimated by Fitch. Earning power indicators include the assets turnover ratio, the return on equity ratio, and the earnings retention rate. From the mentioned group of indicators, a statistically significant impact was observed for earnings retention rate. The mentioned variable had an important impact on the European corporate credit ratings changes given by Moody and U.S. companies' notes presented by DRBS. The liquidity ratio indicators include the current ratio, the average payable days, and the net income to liabilities ratio. The current ratio, on one hand, measures a company's ability to pay their short-term obligations. On the other hand, a high value of this factor may suggest that management may not be using its assets efficiently. As a result, it had a negative significant impact on the Fitch European company's credit ratings changes and a positive impact on the Fitch U.S. notes, as well as those presented by DRBS. The average payable days did not have a statistically significant impact on the corporate credit ratings changes, while the net income to liabilities ratio had a positive influence on the Moody European credit ratings changes. The leverage ratio indicators include the return on long-term capital ratio, the fixed assets turnover ratio, the history net debt to EBITDA ratio, long-term debt to equity ratio, total assets to common equity ratio, and the interest coverage ratio. The total assets to common equity ratio had a negative impact on the corporate credit ratings changes, with a significant impact on the default risk of American companies assessed by Moody and European companies examined by Fitch. The interest coverage ratio had a negative influence on the Moody European corporate credit ratings changes. The long-term debt to equity ratio had a negative impact on the American notes assessed by Fitch. The history net debt to EBITDA ratio negatively influenced the European ratings examined by Fitch and Moody, as well as American DRBS ratings changes. The fixed assets turnover ratio also negatively influenced the American DRBS ratings changes. The return on long-term capital ratio had a positive impact on the American Moody and Fitch company ratings changes. The operating ratio indicators include the inventory turnover ratio, a higher value of which led to lower Moody corporate credit ratings.

Table 10. Estimation of spillover effect between sovereign and bank credit ratings for Moody, Fitch, and DRBS by considering the financial condition of corporates and the region of their headquarters.

Y	Moody				Fitch				DRBS			
	EUROPE		US		EUROPE		US		EUROPE		US	
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z
CR	.0065273	0.561			.0190259	0.000			.0046913	0.986		
BR2-	.0011953	0.946	-.0155282	0.406	.0053481	0.000	.0504122	0.000	5.666609	0.010		
BR1-	-.0311352	0.360	-.1465022	0.000	.0968728	0.117	2.834192	0.000	-1.071307	0.262		
BR	-.0291423	0.383	-.0121398	0.171	-.0004241	0.397	-.0382556	0.000	-.0108286	0.576	.1955015	0.000
BR1+	.0104551	0.400	.1413534	0.000	.0165143	0.000	2.158936	0.000			.2098037	0.009
BR2+	.085539	0.863	-.2850692	0.000	.0435191	0.060	1.670806	0.000				
dEBIT	.1092658	0.002	-.0011594	0.661	-.0154841	0.138	.0053321	0.042	.0358837	0.829	-.0287957	0.137
dTAX	-.0002717	0.706	-.0000418	0.490	-.000049	0.938	.0000966	0.097	.0714805	0.185	-.0007806	0.376
dTUR	-14.48714	0.245	.6985089	0.215	4.400067	0.229	.0654988	0.936	-41.23835	0.727	2.973904	0.529
dEQ	.0320313	0.952	-.0045066	0.074	-.4981944	0.003	.0002336	0.779	.312334	0.863	.0362043	0.495
dROE	-.04819	0.754	-.0003308	0.549	-.0227675	0.313	.0002671	0.361	-.202265	0.654	-.0134341	0.407
dEAR	.1304089	0.097	.0015847	0.885	-.001249	0.927	-.0117341	0.198	-.5109877	0.412	.0409887	0.052
dCUR	1.189075	0.201	.0107277	0.859	-1.494482	0.000	.1483606	0.052	18.27995	0.006	.4665127	0.005
dCOV	-.0495125	0.001	.0011607	0.164	-.0001547	0.908	8.23e-06	0.878	-.0139309	0.529	-.0001792	0.801
dDEBT	-.0119514	0.579	.0048496	0.238	.017818	0.169	-.0097645	0.057	-.2226497	0.323	-.017711	0.313
dHIS	-.000344	0.008	.0006653	0.784	-.0380292	0.011	.0016894	0.552	.1243067	0.502	-.0335807	0.000
dART	2.093694	0.021	.000238	0.897	-.0079953	0.935	-.0207875	0.411	-.5614552	0.894	.1071748	0.522
dVEN	-.404248	0.088	-.0145728	0.080	-.1074772	0.319	-.0004018	0.876	-1.03708	0.500	.0179791	0.837
dFIX	1.23051	0.648	-.0586349	0.363	.083505	0.890	-.0639161	0.246	19.404	0.464	-1.79136	0.001
dRET	.1384772	0.547	.0256518	0.087	.0235723	0.746	.0384391	0.016	1.626568	0.410	.1355923	0.105
dASS	6.170281	0.013	-.0809868	0.694	1.212104	0.122	-.9470845	0.000	-9.622135	0.400	-1.976168	0.020
dCYC	-.0038538	0.225	.0003499	0.360	.0013809	0.138	.0002646	0.588	.0375859	0.714	-.0021569	0.425
/cut1	-5.655221	0.000	-6.440818	0.000	-5.68796	0.000	-7.515876	0.000	-4.6373	0.000	-4.433065	0.000
/cut2	-4.541276	0.000	-6.278101	0.000	-4.822176	0.000	-4.936499	0.000	-3.569938	0.000	-4.248852	0.000
/cut3	-4.247775	0.000	-5.8886	0.000	-3.231381	0.000	-3.92268	0.000	-3.435295	0.000	-3.957716	0.000
/cut4	-3.044098	0.000	-5.389339	0.000	-2.815212	0.000	-3.199219	0.000	-1.864046	0.008	-3.665458	0.000
/cut5	-2.948675	0.000	-5.034666	0.000	-2.616472	0.000	-3.183914	0.000	.8609295	0.201	-3.489286	0.000
/cut6	-2.697332	0.000	-4.836485	0.000	-2.591126	0.000	-2.834246	0.000	1.282733	0.060	-3.436121	0.000
/cut7	-2.488248	0.000	-4.446605	0.000	-2.459446	0.000	-2.512982	0.000	2.273014	0.002	-2.478861	0.000
/cut8	-1.96667	0.000	-4.118078	0.000	-2.281389	0.000	-2.259929	0.000	5.550426	0.000	-2.414671	0.000
/cut9	-1.459205	0.000	-3.959872	0.000	-2.169304	0.000	-2.031879	0.000			-2.322992	0.000
/cut10	2.366368	0.000	-3.868675	0.000	-2.123869	0.000	-1.919061	0.000			-1.730958	0.000
/cut11	3.366215	0.000	-3.545312	0.000	-2.07412	0.000	-1.864714	0.000			2.160748	0.000
/cut12	3.53833	0.000	-3.350765	0.000	-2.06267	0.000	-1.862075	0.000			2.614808	0.000
/cut13	3.742622	0.000	-3.243552	0.000	-2.042846	0.000	-1.817918	0.000			2.696412	0.000
/cut14	4.328981	0.000	-3.154316	0.000	2.213322	0.000	-1.804666	0.000			2.800277	0.000
/cut15			-3.076119	0.000	2.221516	0.000	-1.802131	0.000			2.894882	0.000
/cut16			-2.906387	0.000	2.225625	0.000	-1.786505	0.000			2.912766	0.000
/cut17			-2.637868	0.000	2.22974	0.000	-1.776007	0.000			2.977242	0.000
/cut18			-2.219983	0.000	2.242113	0.000	-1.775509	0.000			3.054569	0.000
/cut19			-1.468352	0.000	2.304828	0.000	-1.775011	0.000			3.064518	0.000
/cut20	1.077411	0.000	2.516427	0.000	2.516427	0.000	-1.770042	0.000			3.501136	0.000
/cut21			1.581669	0.000	2.916862	0.000	-1.768554	0.000			3.635534	0.000
/cut22			1.906592	0.000	3.0606	0.000	-1.765585	0.000			3.751718	0.000
/cut23			2.113133	0.000	3.087861	0.000	-1.765091	0.000			3.769342	0.000
/cut24			2.204663	0.000	3.115646	0.000	-1.757207	0.000			4.228899	0.000
/cut25			2.250278	0.000	5.385141	0.000	-1.753771	0.000				
/cut26			2.286105	0.000			-1.752792	0.000				
/cut27			2.457303	0.000			-1.746932	0.000				
/cut28			2.621528	0.000			-1.745472	0.000				
/cut29			2.868029	0.000			-1.744985	0.000				
/cut30			2.970135	0.000			-1.743042	0.000				
/cut31			3.164716	0.000			-1.740617	0.000				
/cut32			3.495425	0.000			-1.739649	0.000				
/cut33			3.709167	0.000			-1.717115	0.000				
/cut34			3.922933	0.000			2.324678	0.000				
/cut35			4.390479	0.000			2.351166	0.000				
/cut36			5.078622	0.000			2.351886	0.000				
/cut37			5.479708	0.000			2.352606	0.000				
/cut38			5.752329	0.000			2.358358	0.000				
/cut39							2.36195	0.000				
/cut40							2.364106	0.000				

/cut41					2.379991	0.000			
/cut42					2.384348	0.000			
/cut43					2.390896	0.000			
/cut44					2.392352	0.000			
/cut45					2.39308	0.000			
/cut46					2.393808	0.000			
/cut47					2.404738	0.000			
/cut48					2.405467	0.000			
/cut49					2.407655	0.000			
/cut50					2.411311	0.000			
/cut51					2.428918	0.000			
/cut52					2.429653	0.000			
/cut53					2.436271	0.000			
/cut54					2.438479	0.000			
/cut55					2.487381	0.000			
/cut56					2.619224	0.000			
/cut57					2.622303	0.000			
/cut58					2.725471	0.000			
/cut59					2.914226	0.000			
/cut60					3.356116	0.000			
/cut61					3.652746	0.000			
/cut62					4.052259	0.000			
/cut63					4.713951	0.000			
/cut64					4.745155	0.000			
/cut65					5.715956	0.000			
/cut66					5.856897	0.000			
no obs	227	16739	2872	16604	151	1589			
no group	102	626	264	803	65	163			
Wald	0	0	0	0	0	0			

$BR1_{cjt}^+$ is a number bank's rating upgrade on one note by credit rating agency c (in country j in period t ; 0 otherwise; $BR2_{cjt}^+$ is a number bank's rating upgrade on more than one note by credit rating agency c (in country j in period t ; 0 otherwise; $BR1_{cjt}^-$ is a number bank's rating downgrade on one note by credit rating agency c (in country j in period t ; 0 otherwise; $BR2_{cjt}^-$ is a number bank's rating downgrade on more than one note by credit rating agency c (in country j in period t ; 0 otherwise; ΔCR_{jt} is a sovereign credit rating change given by credit rating agency c (i.e. Moody, S&P, Fitch, measured separately) in country j in period t ; $EBIT_{it}$ is the EBITDA margin; TAX_{it} is the income tax rate; TUR_{it} is the assets turnover ratio; ROE_{it} is the return on equity ratio; EQ_{it} is the total assets to common equity ratio; EAR_{it} is the earnings retention rate; CUR_{it} is the current ratio; COV_{it} is the interest coverage ratio; CYC_{it} is the average payable days; $DEBT_{it}$ is the long-term debt to equity ratio; HIS_{it} is the history net debt to EBITDA ratio; ART_{it} is the net income to liabilities ratio; VEN_{it} is the inventory turnover ratio; FIX_{it} is the fixed assets turnover ratio; RET_{it} is the return on long term capital ratio. Source: own calculations.

An analysis was prepared to assess the impact of lagged variables on the corporate credit ratings changes, which showed that the European corporate credit ratings changes were sensitive to the one quarter-lagged decisions regarding the decrease in bank notes by one degree during the stable period and the COVID-19 crisis. The American company credit ratings were sensitive to a decline of bank ratings by at least two degrees. An increase in bank notes by one degree had a significant impact on corporate ratings during the GFC period while, during the stable period, an increase by at least two degrees had such an impact. The bank-to-corporate credit rating spillover effect was noticed during the stable period, as an effect of the increase in bank ratings. The bank-to-corporate credit rating spillover effect was not observed in the case of the Fitch notes, both in the case of the European and American companies.

The next part of the analysis relied on testing the impact of the profitability indicators, including the EBITDA margin and the income tax rate. The EBITDA margin had a positive significant impact on the European and American companies during the COVID-19 period and during the stable period and the financial crisis for the American entities. The reaction of the European companies was stronger. The income tax rate also had a positive impact on the U.S. companies during the COVID-19 crisis. In the case of Fitch corporate, a statistically significant reaction was noticed for the impact of the income tax rate during the GFC period for the American companies.

The earning power indicators include the assets turnover ratio, the return on equity ratio, and the earnings retention rate. From the mentioned group of indicators, the assets turnover ratio had a statistically

significant impact. A stronger reaction was noticed for European companies, compared to American ones, during the COVID-19 crisis. The presented relationship was weaker for the GFC period than for the pandemic crisis for the European non-financial companies. In the case of the Fitch ratings reaction, a significant impact of the assets turnover ratio was noticed during the GFC period for both European and American companies, where a stronger reaction was observed for the first group of entities. The return on equity ratio has an impact only during the COVID-19 period for the European entities in the case of the Moody's notes. For Fitch, the mentioned variable was important to assess the default risk of American entities during the GFC period. The earnings retention rate had a negative impact on the corporate credit ratings changes, and the reaction was stronger for the European entities during the stable period for the Moody sub-sample. The mentioned index was important for analyzing the default risk during the stable period for American corporate ratings changes presented by Fitch.

The liquidity ratio indicators include the current ratio, the average payable days, and the net income to liabilities ratio. Regarding the current ratio, negative significant impacts were observed for the Moody's European companies' credit ratings changes during the GFC period and the stable period, while a positive impact was observed for the American entities during the COVID-19 pandemic. A similar reaction was observed for the impact of the average payable days. The net income to liabilities ratio had a positive influence on the Moody's European credit ratings changes during the COVID-19 period. The lagged changes of the liquidity indicators did not play a significant role in assessing the changes in the Fitch ratings changes for the analyzed periods of the business cycle.

The leverage ratio indicators include the return on long-term capital ratio, the fixed assets turnover ratio, the history net debt to EBITDA ratio, long-term debt to equity ratio, total assets to common equity ratio, and the interest coverage ratio. In the case of the Moody sub-sample, the total assets to common equity ratio had a positive impact on the corporate credit ratings changes, which was strongest during the GFC. Fitch placed attention on the mentioned changes when analyzing the corporate credit ratings changes during the stability period. In the case of the Moody sub-sample, the interest coverage ratio had the highest impact during the GFC period for both European and American companies. The weakest impact was noted for European entities during the stable period. The mentioned index also had an influence on the credit ratings changes of American companies prepared by Fitch during the GFC period. The long-term debt to equity ratio had a statistically significant impact on the European companies during the stability period and on American entities during the COVID-19 pandemic, when are assessed by Moody. The history net debt to EBITDA ratio had a significant influence on the European ratings during the crises and on the American entities during the COVID-19 pandemic, when are assessed by Moody. The mentioned indicator also had a statistically significant impact during the analysis of the default risk of European companies estimated by Fitch during the GFC period. The return on long-term capital ratio had a positive impact on the American Moody's corporates ratings changes during crises. The same situation was observed for the changes of notes presented by Fitch for U.S. companies during the GFC period.

The operating ratio indicators include the inventory turnover ratio, the higher value of which, the lower the European Moody corporate credit ratings were during the GFC crisis and COVID-19 pandemic and American notes during the stable period.

Higher Moody corporate notes were observed during the stable period for the European companies; however, this reaction was not observed for the Fitch ratings changes.

Table 11. Estimation of spillover effect between sovereign and bank credit ratings for Moody by considering the financial condition of corporates, the region of their headquarters, and the stage of the financial crisis.

Y	EUROPE												US							
	ALL				COVID-19		GFC		STABLE				ALL		COVID-19		GFC		STABLE	
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z
L1.CR	.004684	0.731								.0141434	0.343									
L1.BR2-	-.0031383	0.901	-.0035669	0.001	-.9705423	0.411	.2041573	0.404	.0067205	0.797	-.0017996	0.111	-.0257111	0.179			-.0384774	0.174	.1192796	0.081
L1.BR1-	-.0721994	0.030	.0006248	0.292	.0033825	0.068	.1181237	0.222	-.1147989	0.002	-.0030837	0.000	-.1469175	0.000	.2461153	0.533	.0027075	0.943	-.0019701	0.927
L1.BR	-.0553147	0.069	.0011706	0.113	-.1166096	0.390	-.0001715	0.934	-.0567904	0.120	-.0181171	0.301	-.0278055	0.002			-.0127877	0.881	.0103044	0.786
L1.BR1+	-.0130226	0.438	.0140636	0.001	.0376581	0.250	10.04586	0.000	-.0091106	0.626	-.0089882	0.303	.1274184	0.000	-.2547413	0.164			.1439247	0.009
L1.BR2+	-.407827	0.539	.0015439	0.015	-.1172811	0.573			-.0826149	0.919	.0039221	0.000	-.2529652	0.000	-.2689121	0.630			-.1209702	0.032
L1.dEBIT	.0663251	0.080	.0000131	0.998	.1011371	0.064	-.0233151	0.761	.0581003	0.186	-.0028566	0.691	.0059669	0.020	.0337584	0.037	-.0084981	0.663	.0094189	0.004
L1.dTAX	-.0002902	0.683	-.0003179	0.256	-.00018	0.816	-.0050315	0.495	-.0013196	0.200	-.0007193	0.102	-.0001679	0.008	.0055817	0.016	.0001907	0.923	-.0005268	0.190
L1.dTUR	3.288673	0.811	2.613645	0.016	21.87965	0.003	17.53811	0.054	-22.61932	0.408	1.504757	0.325	1.00962	0.074	11.70275	0.016	1.502176	0.549	-.0085573	0.995
L1.dEQ	.1477309	0.781	.2524736	0.000	.1921225	0.098	.7692906	0.084	.7794148	0.231	.2741098	0.001	.0062791	0.041	-.0055633	0.528	.1112684	0.100	.0039948	0.470
L1.dROE	.0849435	0.583	.000989	0.869	-.1294143	0.006	.1054625	0.284	.2397012	0.182	-.0007594	0.913	-.00006	0.926	-.0014182	0.868	.0081803	0.397	-.0001454	0.872
L1.dEAR	-.3532787	0.000	-.0123164	0.107	.0216745	0.652	-.1015681	0.638	-.3779072	0.000	-.0204965	0.012	-.0035102	0.740	.0170581	0.874	.025264	0.145	-.0889639	0.000
L1.dCUR	1.284978	0.169	-.2158696	0.093	.4800658	0.533	-2.739351	0.011	1.477087	0.173	-.56234	0.001	.061488	0.304	.7533615	0.054	.0695631	0.787	-.132803	0.117
L1.dCOV	-.0482487	0.002	-.0047345	0.281	.0520216	0.005	.1045732	0.091	-.0435054	0.013	-.0084731	0.127	.0015525	0.073	-.0012128	0.508	.0096852	0.063	.001632	0.295
L1.dDEBT	.0145384	0.548	.0005324	0.933	-.0911848	0.198	.0338358	0.618	.0090518	0.728	.0277322	0.002	.0018391	0.648	.0720698	0.013	-.0217411	0.104	.0026918	0.720
L1.dHIS	.0002419	0.133	5.88e-06	0.904	.299683	0.000	.2523088	0.024	.0002216	0.213	-1.34e-06	0.981	-.0016538	0.442	.0645841	0.000	-.0256087	0.318	-.0022934	0.377
L1.dART	1.046462	0.244	.0094964	0.533	.3864946	0.067	-.4721002	0.284	1.145208	0.274	.0116471	0.491	.0004461	0.816	-.0101457	0.713	.0015222	0.669	-.0005863	0.852
L1.dVEN	-.189326	0.431	.0190912	0.067	-.148414	0.003	-1.478829	0.000	-.1735855	0.531	.0149983	0.380	.0183533	0.036	.0296605	0.778	-.0659838	0.116	-.0583867	0.020
L1.dFIX	1.517291	0.624	.0002976	0.835	.0041823	0.466	.2288927	0.900	6.554263	0.418	.0038674	0.755	-.1201151	0.056	-.2164312	0.469	.0755457	0.778	.0082505	0.960
L1.dRET	-.0618213	0.790	-.0194635	0.316	-.1984526	0.313	-.0769549	0.815	-.2743837	0.300	-.0115226	0.624	-.0528133	0.000	.2074925	0.038	.1259204	0.030	-.0312658	0.229
L1.dASS	7.687981	0.005	-.0385319	0.929	.3151221	0.916	-3.138148	0.378	6.804304	0.083	.5770141	0.440	.0541963	0.788	-.4404495	0.845	-1.031975	0.199	-.3133105	0.419
L1.dCYC	-.0072123	0.021	-.0000367	0.921	.0000276	0.990	-.0037264	0.000	-.0067632	0.061	.0000797	0.888	.0005554	0.110	.0076894	0.022	.0026818	0.510	.0012448	0.148
/cut1	-5.993316	0.000	-7.677316	0.000	-8.411995	0.000	-8.014475	0.000	-6.25512	0.000	-8.405442	0.000	-6.385016	0.000	-9.422491	0.000	-6.928658	0.000	-5.546818	0.000
/cut2	-4.886218	0.000	-6.260341	0.000	-6.647753	0.000	-3.515622	0.000	-5.551814	0.000	-7.017549	0.000	-6.139524	0.000	-8.718132	0.000	-6.21388	0.000	-5.310448	0.000
/cut3	-4.348629	0.000	-5.995074	0.000	-6.458272	0.000	-3.044806	0.000	-4.773469	0.000	-6.6111	0.000	-5.609967	0.000	-7.244235	0.000	-5.310405	0.000	-4.810449	0.000
/cut4	-3.391966	0.000	-5.78542	0.000	-6.151377	0.000	-2.203674	0.000	-3.586801	0.000	-6.45632	0.000	-5.202438	0.000	-6.121386	0.000	-5.02257	0.000	-4.433544	0.000
/cut5	-3.301473	0.000	-4.26387	0.000	-5.472144	0.000	-2.14163	0.000	-3.486349	0.000	-4.694112	0.000	-4.979545	0.000	-5.236731	0.000	-4.831317	0.000	-4.320593	0.000
/cut6	-3.136901	0.000	-3.634461	0.000	-4.739328	0.000	-2.081561	0.000	-3.230869	0.000	-3.859871	0.000	-4.791241	0.000	-4.968788	0.000	-4.700225	0.000	-4.139612	0.000
/cut7	-2.929103	0.000	-2.437468	0.000	-4.146242	0.000	-1.926409	0.000	-2.823862	0.000	-2.504342	0.000	-4.41204	0.000	-4.536203	0.000	-4.098596	0.000	-3.821742	0.000
/cut8	-2.589251	0.000	-2.243054	0.000	-4.085642	0.000	-1.869784	0.000	-1.900704	0.000	-2.293676	0.000	-4.10512	0.000	-4.092776	0.000	-3.732056	0.000	-3.535515	0.000
/cut9	-1.774774	0.000	-1.904941	0.000	-4.026323	0.000	3.833268	0.000	2.506649	0.000	-1.92444	0.000	-3.961931	0.000	-3.907352	0.000	-3.630898	0.000	-3.389326	0.000
/cut10	2.355357	0.000	-1.901436	0.000	-3.753688	0.000	6.05983	0.000	3.658928	0.000	-1.904781	0.000	-3.873176	0.000	-3.781305	0.000	-3.537519	0.000	-3.326446	0.000
/cut11	3.445734	0.000	-1.899686	0.000	-3.703864	0.000	6.326119	0.000	4.707209	0.000	-1.902339	0.000	-3.550897	0.000	-3.555633	0.000	-3.504274	0.000	-3.00721	0.000
/cut12	3.564722	0.000	-1.844772	0.000	-2.904507	0.000	6.477512	0.000			-1.868536	0.000	-3.367285	0.000	-3.358509	0.000	-3.259224	0.000	-2.855362	0.000
/cut13	4.56663	0.000	-1.826356	0.000	1.983648	0.000	7.481289	0.000			-1.823852	0.000	-3.270679	0.000	-3.312984	0.000	-3.024943	0.000	-2.770425	0.000
/cut14			-1.777304	0.000	2.854423	0.000	7.657389	0.000			-1.735857	0.000	-3.177984	0.000	-3.170403	0.000	-2.424404	0.000	-2.678644	0.000
/cut15			-1.654365	0.000	2.961056	0.000					-1.337893	0.000	-3.108611	0.000	-3.037639	0.000	-1.258837	0.000	-2.603638	0.000
/cut16			-1.545208	0.000	3.56759	0.000					1.504632	0.000	-2.936884	0.000	-3.011874	0.000	2.286985	0.000	-2.390811	0.000
/cut17			-1.174379	0.000	3.593093	0.000					2.071827	0.000	-2.64555	0.000	-2.848544	0.000	2.901464	0.000	-2.163122	0.000
/cut18			1.244699	0.000	3.645034	0.000					2.138657	0.000	-2.215996	0.000	-2.190832	0.000	3.441702	0.000	-1.748153	0.000
/cut19			1.720217	0.000	6.488931	0.000					2.369364	0.000	-1.472237	0.000	-1.480499	0.002	3.554845	0.000	-1.017687	0.000

/cut20		1.82696	0.000	6.84744	0.000					2.392905	0.000	1.080322	0.000	3.271736	0.000	3.627808	0.000	1.974945	0.000
/cut21		2.008407	0.000							2.416852	0.000	1.582421	0.000	5.113447	0.000	3.802852	0.000	3.093241	0.000
/cut22		2.062523	0.000							2.512547	0.000	1.911261	0.000	6.806862	0.000	3.893141	0.000	3.794864	0.000
/cut23		2.079774	0.000							2.592277	0.000	2.119864	0.000	7.88497	0.000	3.924753	0.000	4.223777	0.000
/cut24		2.128925	0.000							kwi.52	0.000	2.218744	0.000	8.300389	0.000	4.02519	0.000	4.434104	0.000
/cut25		2.165506	0.000							5.374651	0.000	2.262979	0.000			4.361449	0.000	kwi.86	0.000
/cut26		2.387754	0.000									2.296953	0.000			4.407353	0.000	4.557071	0.000
/cut27		2.697385	0.000									2.464755	0.000					4.634352	0.000
/cut28		4.688594	0.000									2.62481	0.000					4.706872	0.000
/cut29		5.252304	0.000									2.855278	0.000					4.919401	0.000
/cut30		cze.29	0.000									2.952656	0.000					5.311316	0.000
/cut31		7.491105	0.000									3.146984	0.000					8.265532	0.000
/cut32												3.470676	0.000						
/cut33												3.657088	0.000						
/cut34												3.876155	0.000						
/cut35												4.41351	0.000						
/cut36												5.152117	0.000						
/cut37												5.565932	0.000						
/cut38												5.922607	0.000						
no obs	215	5103		447		471		185		3254		16543		972		2104		6213	
no group	103	427		213		163		97		412		624		473		425		530	
Wald	0.0002	0		0		0		0.0004		0		0		0		0		0	

$BR1_{cjt}^+$ is a number bank's rating upgrade on one note by credit rating agency c (in country j in period t); $BR2_{cjt}^+$ is a number bank's rating upgrade on more than one note by credit rating agency c (in country j in period t); $BR1_{cjt}^-$ is a number bank's rating downgrade on one note by credit rating agency c (in country j in period t); $BR2_{cjt}^-$ is a number bank's rating downgrade on more than one note by credit rating agency c (in country j in period t); ΔCR_{jt} is a sovereign credit rating change given by credit rating agency c (i.e. Moody, S&P, Fitch, measured separately) in country j in period t ; $L1_t$ means the lagged variable; $EBIT_{it}$ is the EBITDA margin; TAX_{it} is the income tax rate; TUR_{it} is the assets turnover ratio; ROE_{it} is the return on equity ratio; EQ_{it} is the total assets to common equity ratio; EAR_{it} is the earnings retention rate; CUR_{it} is the current ratio; COV_{it} is the interest coverage ratio; CYC_{it} is the average payable days; $DEBT_{it}$ is the long-term debt to equity ratio; HIS_{it} is the history net debt to EBITDA ratio; ART_{it} is the net income to liabilities ratio; VEN_{it} is the inventory turnover ratio; FIX_{it} is the fixed assets turnover ratio; RET_{it} is the return on long term capital ratio.

Source: own calculations.

Table 12. Estimation of spillover effect between sovereign and bank credit ratings for Fitch by considering the financial condition of corporates, the region of their headquarters, and the stage of the financial crisis.

Y	EUROPE										US									
	ALL				COVID-19		GFC		STABLE		ALL				COVID-19		GFC		STABLE	
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z
L1.CR	.0166556	0.000								.0124048	0.000									
L1.BR2-	.0049562	0.000	.0042001	0.000				.0128152	0.641	.0716616	0.113	.032631	0.001	.0068695	0.310					
L1.BR1-	.0956034	0.115	.2301564	0.000						-.5214478	0.029	2.069006	0.000	2.787756	0.000					
L1.BR	-.0001726	0.722	-.0008951	0.020	.002295	0.608	.0003273	0.688	.0009495	0.279	-.0167241	0.020	-.0258968	0.000	.1086905	0.820	-.0087233	0.599	.0282335	0.108
L1.BR1+	.0151948	0.000	.0140889	0.000				.0159776	0.991			1.511119	0.000	1.738461	0.000					
L1.BR2+	.0332769	0.130	.0446617	0.005	-.0129247	0.989	1.46389	0.123	.0112622	0.644			1.638622	0.000						
L1.dEBIT	-.0029454	0.775	-.0027232	0.740	-.0179738	0.868	.0550475	0.458	.0168677	0.285	.0011355	0.743	.0018589	0.475	.0247015	0.240	.0346968	0.122	.0017053	0.671
L1.dTAX	.0004433	0.479	.0002729	0.580	-.0048754	0.431	.0100403	0.592	.0008875	0.354	-.0002678	0.008	-.0000308	0.663	.0007081	0.323	-.0064849	0.072	-.0001682	0.519
L1.dTUR	6.841574	0.055	3.661423	0.031	-2.066323	0.901	-21.93591	0.081	.7461258	0.831	.0740336	0.952	-1.064803	0.193	-6.153991	0.366	-5.157812	0.092	.1368251	0.932
L1.dEQ	-.5976218	0.001	-.4526571	0.000	-.181536	0.873	-.6626574	0.166	-.1156695	0.656	.0017221	0.447	.0008168	0.496	-.0017062	0.911	-.1123169	0.349	.0060325	0.048
L1.dROE	-.0125467	0.579	-.0098382	0.600	-.0571712	0.515	-.1679599	0.264	-.0412813	0.335	.0010254	0.019	.000594	0.035	-.0061153	0.576	.0315856	0.054	.0002967	0.353
L1.dEAR	.0006416	0.437	.0000699	0.857	-.0204129	0.690	-.0738843	0.631	.0003302	0.567	.0042103	0.753	.0047012	0.612	-.1160458	0.115	.0205115	0.313	.0306509	0.047
L1.dCUR	-.4476904	0.319	-.3511865	0.249	4.158045	0.159	-.9798756	0.622	.5760616	0.287	.0428762	0.692	.1248315	0.101	.7546342	0.119	-.189978	0.559	.0333312	0.748
L1.dCOV	-.0005236	0.698	-.0008799	0.347	.0416464	0.489	-.0397846	0.325	.0003304	0.807	-.0001022	0.010	-.0000543	0.147	.000041	0.983	.0193873	0.010	-.0000545	0.170
L1.dDEBT	-.0123503	0.352	-.0086483	0.437	-.1953093	0.274	.0448937	0.438	-.0006194	0.972	-.0165596	0.038	-.0033503	0.523	.0090612	0.814	-.0097214	0.668	-.0058316	0.521
L1.dHS	-.0225724	0.137	-.0255833	0.039	-.1900669	0.316	.2553763	0.028	.0459347	0.321	.0004913	0.900	.0017125	0.539	.0108218	0.325	-.0076794	0.808	-.0046474	0.349
L1.dART	.037411	0.675	.0216225	0.734	-.4156549	0.813	.2885177	0.289	.1733827	0.258	.0121272	0.745	.054377	0.027	-.1146217	0.436	.1679024	0.149	.0164447	0.734
L1.dVEN	.0151988	0.878	.0014107	0.986	.2225955	0.734	-.0680469	0.881	-.0571158	0.789	-.0003613	0.829	-.0000864	0.954	.2192478	0.151	.0219645	0.646	-.0042984	0.529
L1.dFIX	-.3913266	0.476	-.0015896	0.234	-.0047144	0.950	5.031369	0.155	-.0004455	0.877	.0141671	0.864	-.0198124	0.722	.3027219	0.441	.1876885	0.514	-.1022363	0.261
L1.dRET	-.0959103	0.190	-.0877801	0.148	-.1210387	0.635	.6614944	0.191	.0354688	0.757	-.0573516	0.016	.0025335	0.873	.1028256	0.304	-.2493096	0.010	-.0245391	0.310
L1.dASS	1.935795	0.013	.9486314	0.128	1.631316	0.723	-3.240016	0.282	-2.611067	0.197	-.4519877	0.166	-1.10249	0.000	1.944245	0.453	-1.039016	0.219	-.5592119	0.142
L1.dCYC	.0009334	0.152	.0003673	0.412	-.0078372	0.762	-.0018371	0.577	-.0002482	0.789	.0010555	0.329	.0008242	0.135	.0056106	0.308	-.0064363	0.177	.0004301	0.533
/cut1	-5.92925	0.000	-5.580806	0.000	-5.098331	0.000	-4.747909	0.000	-5.139609	0.000	-7.080918	0.000	-7.323046	0.000	-5.98592	0.000	-7.581333	0.000	-7.340599	0.000
/cut2	-5.008367	0.000	-4.567964	0.000	-4.172385	0.000	-3.139985	0.000	-4.198496	0.000	-5.092825	0.000	-4.997931	0.000	-4.582661	0.000	-5.428123	0.000	-4.765867	0.000
/cut3	-3.242845	0.000	-3.095642	0.000	-2.727982	0.000	-2.878773	0.000	-2.842292	0.000	-4.016838	0.000	-3.92553	0.000	-3.399835	0.000	-4.099128	0.000	-3.704885	0.000
/cut4	-2.809601	0.000	-2.623227	0.000	-2.481374	0.000	-2.607075	0.000	-2.350344	0.000	-3.346501	0.000	-3.226218	0.000	-2.657886	0.005	-3.519811	0.000	-3.013111	0.000
/cut5	-2.5901	0.000	-2.406789	0.000	-2.436629	0.000	-2.553358	0.000	-2.129971	0.000	-3.321802	0.000	-3.21198	0.000	-2.64201	0.005	-3.484917	0.000	-3.010544	0.000
/cut6	-2.56418	0.000	-2.380142	0.000	-2.39297	0.000	-2.33346	0.000	-2.110877	0.000	-2.982935	0.000	-2.870852	0.000	-2.463303	0.009	-2.984267	0.000	-2.672322	0.000
/cut7	-2.446005	0.000	-2.231334	0.000	-2.089397	0.000	-2.162192	0.000	-1.98883	0.000	-2.653543	0.000	-2.551878	0.000	-2.151103	0.023	-2.632517	0.000	-2.341296	0.000
/cut8	-2.288601	0.000	-2.049417	0.000	-1.869076	0.000	-2.063623	0.000	-1.807313	0.000	-2.410039	0.000	-2.314658	0.000	-1.952654	0.039	-2.427125	0.000	-2.086114	0.000
/cut9	-2.172685	0.000	-1.942429	0.000	-1.755475	0.000	-1.95242	0.000	-1.705318	0.000	-2.182675	0.000	-2.086898	0.000	-1.759794	0.063	-2.180447	0.000	-1.845742	0.000
/cut10	-2.125713	0.000	-1.896358	0.000	-1.675487	0.000	-1.815122	0.000	-1.656908	0.000	-2.055863	0.000	-1.961621	0.000	-1.683784	0.075	-2.063645	0.000	-1.708262	0.000
/cut11	-2.086228	0.000	-1.862724	0.000			-1.79875	0.000	-1.63328	0.000	-2.001121	0.000	-1.906925	0.000	-1.602947	0.090	-2.008076	0.000	-1.646744	0.000
/cut12	-2.059549	0.000	-1.834208	0.000			-1.782596	0.000	-1.606738	0.000	-1.998971	0.000	-1.904188	0.000	-1.495754	0.114	-1.954214	0.000	-1.643143	0.000
/cut13	-2.033399	0.000	-1.832038	0.000			-1.766641	0.000	-1.603455	0.000	-1.937924	0.000	-1.846289	0.000	-1.459004	0.123	-1.942885	0.000	-1.581421	0.000
/cut14	-2.030525	0.000	-1.808379	0.000					-1.5839	0.000	-1.932774	0.000	-1.838948	0.000	-1.444516	0.126	-1.9279	0.000	-1.571936	0.000
/cut15	-2.027659	0.000	-1.806247	0.000							-1.928667	0.000	-1.836858	0.000	-1.430154	0.130	6.177373	0.000	-1.570218	0.000
/cut16	2.391867	0.000	-1.804119	0.000							-1.919466	0.000	-1.824892	0.000	-1.423024	0.132	8.13704	0.000	-1.559091	0.000
/cut17	2.400996	0.000	2.21108	0.000							-1.905253	0.000	-1.812503	0.000					-1.545492	0.000
/cut18	2.410168	0.000	2.216773	0.000							-1.904242	0.000	-1.811989	0.000					-1.540422	0.000
/cut19	2.414772	0.000	2.222483	0.000							-1.903232	0.000	-1.811475	0.000					-1.531167	0.000

5. Conclusions

The aim of the paper was to analyze the impact of the COVID-19 crisis on the spillover effect between European and American banks and the long-term issuer credit ratings of non-financial companies. A literature review was prepared and, as a result, three hypotheses were proposed. During the COVID-19 crisis, the long-term issuer credit ratings of non-financial companies presented the high volatility, which increased during the later period of the crisis. The analyzed raw data indicated that, during the COVID-19 crisis, higher volatility of the corporate credit ratings changes was observed than during the stable period for the financial markets. The presented situation was stronger for the bigger agencies than for the smaller one. The analysis of the presented data also revealed that, for example, during the last few years, Fitch made less decisions about credit ratings changes than before. Higher volatility in the credit ratings of non-financial companies was noticed in Europe than in the U.S., confirming the presented hypothesis. Furthermore, stronger spillover effects were noticed in Europe than in the U.S., but not in all cases.

The obtained results indicated that there exists a relationship between changes in the credit ratings of countries and corporates (the strongest relationship was noticed in the case of Fitch, followed by Moody, and the lowest for the DRBS), which is related to the use of macroeconomic variables to assess the default risk of non-financial companies by agencies, as well as the differences in the methodologies utilized by particular credit rating agencies. The obtained results revealed the similarities between changes in corporate credit ratings; notably, a similar reaction was observed between the Fitch and Moody's credit ratings changes. Next, it was noted that the relationship between DRBS and Fitch notes varies, while the mutual reaction between corporate credit ratings changes presented by DRBS and Moody was much weaker. As mentioned above, this is connected to the sample of estimated entities and the methodology that was used.

The obtained results also demonstrated that there exists a spillover effect from bank to corporate credit ratings, and we noted the impact of the credit ratings changes of countries on company notes. The mentioned relationship was observed for all the considered agencies, with the strongest reaction observed for the DRBS notes. This confirms the presence of the country ceiling effect.

The obtained findings revealed certain effects. First, the significance of the bank-to-corporate credit rating spillover effect varied according to the particular credit agency, being stronger for bigger agencies, and depends on the methodology used and the number of credit ratings changes. Next, a significant impact was observed regarding the direction of the changes. A stronger effect was noticed in the case of downgrading than upgrading of notes, which is in agreement with perspective theory. In the case of the decreasing by at least two degrees, the reaction was stronger than for the one degree, which is connected with the deepening reaction to instability on the financial market. The bank-to-corporate credit ratings spillover effect varied when taking into account the impact on the decrease or increase in corporate credit ratings.

The analysis of the significance of the bank-to-corporate credit ratings spillover effect, taking into consideration the stage of the business cycle, indicated that the bank-to-corporate credit ratings spillover effect varies with the stage. Taking into account the stage of the business cycle, the increase in bank notes did not have a statistically significant impact on the changes in corporate notes presented by Fitch. In the case of Moody, the mentioned relationship was observed when the agency increased bank's notes by at least one degree. The growth of bank credit ratings had an impact only in the period characterized by stability of the financial market. Stable bank credit ratings did not have an impact on corporate notes. As a result, there existed a bank-to-corporate credit ratings spillover effect when taking into consideration the stage of the business cycle only for the Moody ratings changes. The effect of downgrading of bank notes was noticed for all stages of the business cycle, but the strongest reaction was noticed during crises, especially the COVID-19 pandemic crisis; meanwhile, the upgrading of bank notes was only significant during the stable period. As such, the reaction to positive information is weaker than that to negative information. The mentioned relationship may be an effect of perspective theory and the fear of transferring the default risk of banks to corporates, thus creating a bankruptcy spiral transferred between financial and non-financial sectors, which serves to deepen the financial crisis. The presented findings demonstrate that the strength of the bank-to-corporate credit ratings spillover effect is strictly connected with the methodology used the agencies and the frequency of the decisions taken by a particular agency.

We observed differences between the reactions of European and American companies to bank credit ratings changes. A significant impact was also observed with respect to the previous decisions made by the agencies regarding the default risk of banks.

The presented findings indicate the significance of the bank-to-corporate credit ratings spillover effect. The mentioned situation also demonstrates the lagged reaction of non-financial sector credit ratings changes on the situation of the banking sector. This suggests that decisions connected with the downgrading of bank notes can deepen the situation on the financial market and transfer the bank default risk to corporates.

The received results may be useful for supervisors, banks, and investors, as they indicate the transfer of default risk assessed by credit ratings from one sector to another. In the next stage of our research, studies will be conducted to test the significance of the spillover effect between corporates and banks, paired with comparison of the received results.

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Appendix 1. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Ymoo	150,787	.0160491	26.67813	-105	105
Yfit	138,098	.0659657	38.66083	-105	105
Ydom	15,141	.0181626	34.82732	-105	105
CRmo	213,732	-.0231131	19.6766	-80	80
CRf	684,08	.0199904	45.4407	-105	105
CRd	307,335	-.0021605	2.741359	-36	36
$BR2_{MOOjt}^-$	699,301	1.042339	9.868518	0	201
$BR1_{MOOjt}^+$	699,301	3.343273	19.76645	0	203
$BR0_{MOOjt}$	699,301	3.27213	17.49355	0	203
$BR1_{MOOjt}^+$	699,301	1.341976	6.07106	0	85
$BR2_{MOOjt}^+$	699,301	1.205109	15.35096	0	238
$BR2_{FITjt}$	725,745	3.012496	25.76158	0	503
$BR1_{FITjt}^-$	725,745	.1968956	2.040565	0	58
$BR0_{FITjt}$	725,745	9.683295	40.74583	0	683
$BR1_{FITjt}^+$	725,745	.7302372	9.032912	0	200
$BR2_{FITjt}^+$	725,745	.0662547	.6977422	0	16
EBIT	1,288,854	-2.35e+13	1.47e+16	-1.10e+19	1836320
TUR	1,265,402	-4.273914	6831.316	-7533126	1512222
EQ	1,236,532	4.773561	301.5056	-144.9798	300505
ROE	1,214,103	-10.23994	1282.588	-578906.1	206152.8
TAX	876,891	-3.33e+09	3.12e+12	-2.92e+15	500106
EAR	864,966	-.0775412	43.6159	-12651.78	311.2041
CUR	1230897	3.70907	106.0804	-1.908284	66920.75
COV	703550	-310.9209	1E+05	-6.28e+07	3183956
ART	1,236,005	4.774992	301.5695	0	300505
DEBT	1,284,913	35.10612	2419.926	0	2169724
HIS	721,406	28.91734	741.0279	.0001048	304186.9
VEN	887,023	20.95853	2568.455	-29693	2136428
CYC	828,214	1028.046	125959.7	-1.10e+07	4.02e+07
FIX	1,183,892	9.49118	436.4596	-12371	159619
RET	1,247,452	-10.64986	1218.015	-638600	140640

$BR1_{MOOjt}^+$ is a number bank's rating upgrade on one note by Moody (in country j in period t; $BR2_{MOOjt}^+$ is a number bank's rating upgrade on more than one note by Moody (in country j in period t; $BR1_{MOOjt}^-$ is a number bank's rating downgrade on one note by Moody (in country j in period t; $BR2_{MOOjt}^-$ is a number bank's rating downgrade on more than one note by Moody (in country j in period t; $BR0_{MOOjt}$ is a number bank's no ratings changes by Moody (in country j in period t; $BR1_{FITjt}^+$ is a number bank's rating upgrade on one note by Fitch (in country j in period t; $BR2_{FITjt}^+$ is a number bank's rating upgrade on more than one note by Fitch (in country j in period t; $BR1_{FITjt}^-$ is a number bank's rating downgrade on one note by Fitch (in country j in period t; $BR2_{FITjt}^-$ is a number bank's rating downgrade on more than one note by Fitch (in country j in period t; $BR0_{FITjt}$ is a number bank's no ratings changes by Fitch (in country j in period t; Ydom – DRBS corporate credit ratings changes, Yfit – Fitch corporate credit ratings changes, Ymoo – Moody's corporate credit ratings changes, CRd - DRBS

sovereign credit ratings changes, CR_f - Fitch sovereign credit ratings changes; CR_{mo} - Moody's sovereign credit ratings changes; $EBIT_{it}$ is the EBITDA margin; TAX_{it} is the income tax rate; TUR_{it} is the assets turnover ratio; ROE_{it} is the return on equity ratio; EQ_{it} is the total assets to common equity ratio; EAR_{it} is the earnings retention rate; CUR_{it} is the current ratio; COV_{it} is the interest coverage ratio; CYC_{it} is the average payable days; $DEBT_{it}$ is the long-term debt to equity ratio; HIS_{it} is the history net debt to EBITDA ratio; ART_{it} is the net income to liabilities ratio; VEN_{it} is the inventory turnover ratio; FIX_{it} is the fixed assets turnover ratio; RET_{it} is the return on long term capital ratio. Source: own elaboration.