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On the Asymmetries of Sovereign Credit Rating Announcements and Financial Market Development in the European Region

Chunling Li ¹, Khansa Pervaiz ¹, Muhammad Asif Khan ^{2,*} , Faheem Ur Rehman ³  and Judit Oláh ⁴ 

¹ School of Economics and Management, Yanshan University, Qinhuangdao 066004, China; lclbbsyh@163.com (C.L.); khansapervaiz@outlook.com (K.P.)

² Department of Commerce, Faculty of Management Sciences, University of Kotli, Kotli, Azad Jammu and Kashmir 11100, Pakistan

³ School of Economics, Jilin University, Changchun 130112, China; faheem787@yahoo.com

⁴ Faculty of Economics and Business, Institute of Applied Informatics and Logistics, University of Debrecen, Debrecen 4032, Hungary; olah.judit@econ.unideb.hu

* Correspondence: khanasif82@hotmail.com or khanasif82@uokajk.edu.pk

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Abstract: In modeling the impact of sovereign credit rating (CR) on financial markets, a considerable amount of the literature to date has been devoted to examining the short-term impact of CR on financial markets via an event-study methodology. The argument has been established that financial markets are sensitive to CR announcements, and market reactions to such announcements (both upgrading and degrading) are not the same. Using the framework of an autoregressive distributed lag setting, the present study attempted to empirically test the linear and non-linear impacts of CR on financial market development (FMD) in the European region. Nonlinear specification is capable to capture asymmetries (upgrades and downgrades) in the estimation process, which have not been considered to date in financial market literature. Overall findings identified long-term asymmetries, while there was little evidence supporting the existence of short-term asymmetries. Thus, the present study has extended the financial market literature on the subject of the asymmetrical impact of a sovereign CR on European FMD and provides useful input for policy formation taking into account these nonlinearities. Policies solely based upon linear models may be misleading and detrimental.

Keywords: credit rating; financial market development; Standard and Poor's; Moody's; asymmetries

1. Introduction

Sovereign credit ratings (CR) are gaining importance in the economic and social sustainability of the world [1]. Such sustainable development is somewhat linked with the stability of financial markets through the output credit risk of particular debt securities, and the dispersion of credit information to market investors. Financial markets play a pivotal role in the sustainability of developing countries [2]. A CR agency considers the capacity of a defaulter, generally a firm, a business, or a government capability to meet interest payments on their debt, and the contingency of omission. Such announcements are very important to investors who need to have enough information to initiate investment decisions across borders. CR is an important factor to be considered by investors; companies with higher sustainability performance tend to have higher credit ratings [3]. Changes in sovereign CR indicate both the stock market and country risk [4]. CR agencies consequently play a stimulating role in mobilizing the growth and potency of global and domestic capital markets, offering various services to all stakeholders. For instance, they encourage investors and savers via default risk protection. Credit

ratings help borrowers and debt issuers by identifying high- and low-risk corporations, which in turn enables them to determine the appropriate level of risk premium. CR can act as a “credit passport” able to present an entity’s credit quality to investors and allow access to wider areas of capital markets. Investors foster dependable share prices and trim financial obstacles along with provocative effective investment [5], while CR agencies regulate entrance to capital markets for investors and debt market participants [6].

Few studies have assessed whether changes in the CR assigned by CR agencies affect stock and bond prices [7–11]. These studies have typically used event-study methods to analyze the immediate effects of announcements of rating changes on security prices and documented investors’ reactions to new information of rating changes. The available empirical literature has established that the financial market is sensitive to CR announcements. One group of researchers [4,12–17] relied on event-study methodology to capture the short-term impact of rating announcements on the financial markets (e.g., stock market). Furthermore, the literature reveals that the reaction of the financial market to CR upgrades and degrades is not the same. These asymmetries are evidenced by the fact that the market reacts strongly to downgraded rating announcements, while the response is not as strong for upgrade announcements (for example, see References [18–22]).

Surprisingly, a substantial amount of literature has been devoted to examining the short-term impact of CRs on the stock market via the event-study methodology. This study attempted to empirically answer two interesting questions. First, “Does a long-term relationship between sovereign CR and financial market development (FMD) exist in the European region?” Second, “Is the reaction to changing CR symmetrical or asymmetrical?” Thus, we used Standard and Poor’s and Moody’s credit outlooks to examine their symmetrical and asymmetrical impacts on the FMD of the European region from 1990 to 2018. Ultimately, the present study extended the financial market literature on the subject of symmetrical and asymmetrical impacts of sovereign CRs in the European region.

The rest of the paper is organized as follows. Section 2 provides a comprehensive review of the literature on sovereign CR and financial markets. Section 3 illustrates the materials and methods applied in this study. Section 4 provides detailed results and discussion, and Section 5 concludes the study.

2. Sovereign Credit Ratings and Financial Markets

Sovereign CR is calculated from the current assets, liabilities, and financial history of a country, and provides a forward-looking opinion about risk and provides investors with impartial reviews. Stock markets are greatly influenced by downgrades in sovereign ratings in neighboring countries during crises. Rating changes in one country affect stock market returns in other crisis-hit countries; sovereign CR changes have functioned as an additional channel of international financial contagion during Asian financial crises, as confirmed by Reference [23]. The long-term financial stability of a country is mainly maintained by the combination of foreign debt services, current account balances, the level of foreign debt, net international liquidity, and foreign exchange stability. Economic, financial, and political variables have been shown to have an impact on Turkey’s stock market movement in the long term [24], while in the short term, only the financial and political risk variables were significant.

Liquidity risk in a sample of European banks after the financial crisis was explained by characteristics of the banks such as size, capital, and business model. The empirical findings revealed that core banking activities based on the process of maturity transformation are the most exposed to liquidity risk [25]. Another study examined the dynamic relationship between credit risk and liquidity in the Italian sovereign bond market during the Eurozone crisis and the subsequent European Central Bank (ECB) interventions—the results showed that credit risk drove the liquidity of the market [26]. Moreover, analysis of debt maturity structure for borrowers with private information about their future credit rating has documented that borrowers with a high CR prefer short-term debt, and those with somewhat lower ratings prefer long-term debt [27].

The literature recommends that CR serve two main purposes: It verifies the financial condition of the country and signals a change in the prevailing financial condition (rating changes, i.e., upgrades

and downgrades). Another study [28] investigates the impact of CR on the stock prices of public companies listed in the Brazilian market and confirms that a rating announcement does have an information content, as it impacts on stock returns, causing abnormal returns, especially when they bring “bad news” to the market. It is contended that rating news adds to the boom-bust cycle in the financial markets [29]. This argument is, to a great extent, based on the perception that a country’s ratings really give new information to the financial markets. Few investigations report that improved changes in ratings significantly affect equity markets [30–34].

Rating improvements usually occur during financial market unification, while downgrades occur during a downturn in markets. Specifically, ref. [35] inspect how bond rating downgrades related to common stock prices in China during the period from 1 January 2008 to May 2016. The authors argue that downgrades due to decreasing capital forecasts have a negative consequence on stock prices and suggest that a CR given by the rating agencies has informational value and the market is efficient to react to such announcements. They also analyzed the effect of rating changes on the stock market of Iran using event study and cross-multivariate regression tests, concluding that only downgrades provide productive information to the stock market [36].

Liquidity plays a vital role in the determination of spreads but, somewhat surprisingly, credit quality is the more important determinant of spreads, even at horizons of less than one month [37]. The analysis of relations between CR and measures of equity market liquidity finds shows the evidence of adverse selection, which reflects a portion of the uncertainty about future firm value, are larger when CR is poorer [38]. An intensity-based model of euro-area sovereign spreads identifies the liquidity-pricing effects in the spreads between bonds issued by a German agency and their sovereign counterparts. The authors find that liquidity effects are found to account for a sizeable share of spreads’ fluctuations [39].

It is believed that (i) in general, rating agencies provide financial markets with new tradable information [34]; (ii) rating upgrades (downgrades) significantly increased (decreased) USD denominated stock market returns, as well as volatility [34]; (iii) national financial markets are efficacious regarding their response to rating changes, with no impact felt beyond the announcement window [34]. An extensive study of BRICS countries demonstrates that only the Chinese stock market is sensitive to political risk [40]. The impact of sovereign ratings on corporate borrowings does not stop at the sovereign rating process.

The disappearance of hurdles to international capital flows and the rapid improvement of communication and technology provided investors with a large potential for cross-country investment opportunities with low-cost information. Analyzing many inputs became essential for international portfolio creation and sovereign ratings have appeared as vital, among others. Another study discloses that the joint effects of rating announcements on pairwise correlations are not significant [41]. Additionally, the individual rating agency effect shows that announcements from Moody’s have more influence than Stand and Poor’s. Their findings suggest that a shock within a single country due to a sovereign rating change is generally not likely to spread. In other words, the region is less subject to systematic risk.

The study of the influence of a sovereign rating change on the internal equity market return explores the idea that sovereign rating news impacts its own country along with international portfolios and bond markets, and greatly affects the cost of capital [42]. Sovereign rating enhances the competence of emerging countries to be active in the international market through the attraction of foreign investments [43–45].

After the exposure of the 2008 global financial crisis, later studies centered on the impacts of sovereign rating changes on other relevant variables in addition to stock and bond markets. The role of CR agencies in international financial markets was investigated through an event study, which showed that sovereign score changes have an enormous impact on the size and volatility of bond marketplaces in developing economies [46]. According to [47], the study of 22 emerging markets in 2001–2009 shows that positive rating announcements are more likely to spill over into other emerging markets than

negative announcements. Evidence from the European bond market indicates a notable impact of sovereign rating news in 1995–2010 [48].

In the Asia-Pacific region, around the Asia Financial Crises, it was observed that the outcome of different sovereign rating announcements revealed a spillover impact on stock and currency markets [49]. They indicate that currency and stock markets react differently to rating announcements with the stock market being computably more responsive to rating news than currency markets. They find clear evidence that rating events have significant and asymmetric impacts on the second moments of both asset market return during normal market conditions and that national market aspects influence rating footprints during financial crises. The bond and stock prices move in the “eventual” route following both positive and negative announcements, even though the movements are small.

The researches in this paradigm use event study methods or regression equation models to analyze the immediate effects of CR-change announcements on the changes in security prices. The reasoning of these results is that if CR is beneficial, investors will respond to the new information regarding rating changes. Regarding our study, it is possible to think that these factors are fixed firmly in the political, financial, and economic risk components; it is probable to expect the asymmetric linear and non-linear relationship between CR announcements and FMD. Concluding the literature review, we postulate two hypotheses, which are:

Hypothesis 1: *“There exists a long-run relationship between sovereign CR and FMD in the European region”.*

Hypothesis 2: *“The reaction to changing CR is symmetric or asymmetric”.*

3. Materials and Methods

We use the panel data of 40 European countries from 1990 to 2018, as per the availability. The list of countries is appended in Table 1.

Table 1. List of sample countries from the European region.

S.No.	Country	S.No.	Country
1	Albania	21	Latvia
2	Austria	22	Lithuania
3	Belarus	23	Luxembourg
4	Belgium	24	Malta
5	Bosnia and Herzegovina	25	Moldova
6	Bulgaria	26	Montenegro
7	Croatia	27	Netherlands
8	Cyprus	28	Norway
9	Czech Republic	29	Poland
10	Denmark	30	Portugal
11	Estonia	31	Romania
12	Finland	32	Russia
13	France	33	Slovakia
14	Germany	34	Slovenia
15	Greece	35	Spain
16	Hungary	36	Sweden
17	Iceland	37	Switzerland
18	Ireland	38	Turkey
19	Isle of Man	39	Ukraine
20	Italy	40	United Kingdom

The choice of the European region is due to the relatively stable and developed financial sector of the region, compared with Africa and Asia, which are lagging a long way behind in this regard, and

whose financial markets are less developed. The African region is even more deteriorated. Figure 1 graphically illustrates the most developed financial markets relative to Asian and African regions.

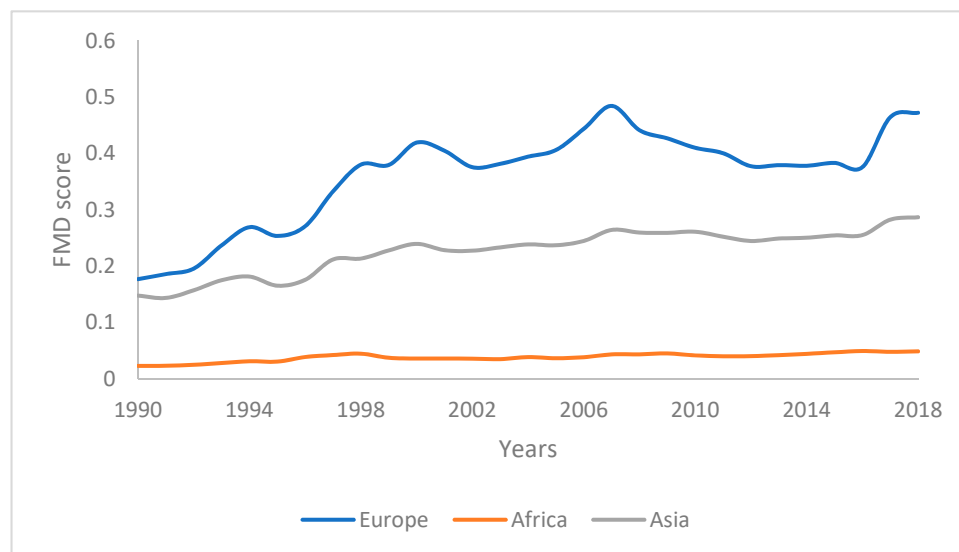


Figure 1. Average financial market development across major regions (1990–2018).

The study utilizes financial market development index (FMD) data, which are maintained by the IMF Strategy, Policy, and Review Department. The index comprises a number of subcomponents in three distinct areas: Financial markets access, depth, and efficiency. The numeric values assigned by the department range between 0 and 1; 0 shows the least developed financial markets and 1 shows a remarkable development in the sector. The index is rescaled to 100 for interpretation purposes. We use several traditional measures from the world development indicator (WDI) to constitute an alternative index of financial markets (FMX), which is the composite index generated using commonly used principal component analysis tools. We follow [50], who used this tool to generate a composite index of financial development from traditional measures.

Economic growth (EG) is measured as a natural logarithm of per capita GDP, openness (OP) is the sum of exports and imports proportionate to GDP, inflation (INF) is represented by the consumer price index; banking development (BD) is denoted by domestic credit to the private sector as percentage of GDP, and investment (INV) is proxied by the gross fixed capital formation ratio to GDP. The data for EG, OP, INF, BD, and INV are also sourced from WDI, while CR grades are obtained from Standard and Poor's and Moody's periodical outlooks, and numerical weights are assigned based on trading economics benchmarks. The weight ranges between 0 and 100, with the highest score acknowledging a low default risk of a country, while the lowest score makes it exposed to default risk. All the variables are transformed into a natural logarithm for efficient estimation. The descriptive statistics of all variables are provided in Table 2. The observations vary for CR_M, FMD, and the tradition index of FMX, which is used as an alternative measure because it is a composite index of several variables, all of which did not have a full dataset available for the same length of time, which potentially reduces the observations. CR_M and FMD are relatively low in terms of observations—this is due to the missing data for some of the years. We excluded some countries due to missing data; however, these missing observations in a few cases were negligible. We analyzed two measures of CR one by one, which differ in terms of observations, which causes different observations in different regressions.

Table 2. Descriptive statistics.

Variable	Obs	Mean	St.Dev.	Min	Max
CR_M	1131	4.154	0.455	2.303	4.605
CR_S	1160	4.15	0.474	1.609	4.605
FMD	1131	3.061	1.346	−3.687	4.605
FMX	899	0.02	1.00	−5.176	3.471
BD	1160	4.03	0.817	0.326	5.733
EG	1160	9.799	0.799	6.86	11.625
INF	1160	1.437	1.613	−4.791	8.463
OP	1160	4.198	0.448	2.889	5.198
INV	1160	3.076	0.217	1.503	3.669

After descriptive statistics, we proceed to compute the panel unit root within the framework of the first and second generation. The first-generation unit root overlooks the cross-section dependence, while this limitation is addressed by the second-generation unit-root proposed by Pesaran (2007) IPS. The panel unit-root result obtained using Levin–Lin–Chu (LLC) and IPS are reported in Table 3. Except for CR_M and BD, all other variables are found stationary at the level under LLC, while all satisfy the stationarity condition when converted to the first difference. The findings under IPS are considerably different at level, where only FMD and INF are stationary; however, they become stationary after conversion at first difference. Such a mixed order of integration ratifies the choice of cointegration such as panel autoregressive distributed lag (PARDL) modeling.

Table 3. Panel unit-root results.

	LLC		IPS	
	Level	1st Difference	Level	1st Difference
CR_M	−0.70	−20.23 ***	−0.97	−4.43 ***
CR_S	−8.71 ***	−16.91 ***	−1.15	−3.83 ***
FM_IMF	−10.51 ***	−36.34 ***	−3.35 ***	−5.38 ***
FMX	−2.87 ***	−25.01 ***	−1.87	−4.86 ***
BD	−0.82	−9.48 ***	−1.35	−3.72 ***
EG	−2.54 ***	−17.91 ***	−2.02	−4.03 ***
INF	−8.24 ***	−28.37 ***	−3.22 ***	−5.64 ***
OP	−2.51 ***	−26.48 ***	−1.73	−4.25 ***
INV	−7.65 ***	−20.39 ***	−2.00	−4.59 ***

*** indicates $p < 0.01$

3.1. Symmetric Panel ARDL (PARDL) Framework

The autoregressive distributed lag (ARDL) model [51] became renowned for investigating the short- and long-run relationships among variables of interest. In this approach, we do have the flexibility to see whether there is any long-run relationship among variables at different levels as formulated by [52]. The ARDL is more suitable without distinction as the cardinal regressor merely avoids the preliminary order of integration. The ARDL method opts as a mode of the assessment for the outputs given by the unit root tests, demonstrating that our data include a mixed integration order of $I(0)$ and $I(1)$. The motivational ARDL is flexible to a mixed integration order and convenient for small and precise sample size [51,53–55]. The baseline panel model is shown in Equation (1).

$$FMD_{it} = a + bCR_{it} + cEG_{it} + dOP_{it} + eINF_{it} + fBD_{it} + gINV_{it} + \mu_{it} \quad (1)$$

All the acronyms used in Equation (1) are defined in the description of variables. In order to obtain a stable relationship among variables, we must distinguish between long-run and short-run effects. This is done by twisting Equation (1) into an error-correction specification. This approach not

only provides substitution tests for cointegration, which yields the short-run and long-run effects in one step [51]. Likewise, we follow the PARDL approach and adopt the following specification:

$$\begin{aligned} \Delta FMD_{it} = & a_0 + \sum_{k=1}^{n1} a_{1k} \Delta FMD_{it-k} + \sum_{k=1}^{n2} a_{2k} \Delta CR_{it-k} + \sum_{k=1}^{n3} a_{3k} \Delta EG_{it-k} \\ & + \sum_{k=1}^{n4} a_{4k} \Delta OP_{it-k} + \sum_{k=1}^{n5} a_{5k} \Delta INF_{it-k} + \sum_{k=1}^{n6} a_{6k} \Delta BD_{it-k} \\ & + \sum_{k=1}^{n7} \alpha_{7k} \Delta INV_{it-k} + \beta_0 FMD_{it-k} + \beta_1 CR_{it-k} + \beta_2 EG_{it-k} + \beta_3 OP_{it-k} \\ & + \beta_4 INF_{it-k} + \beta_5 BD_{it-k} + \beta_6 INV_{it-k} + \mu_{it}. \end{aligned} \quad (2)$$

In the above model, the short-run effects of every variable are initiated in the measurement of the coefficient attached to the first differenced variables. The moment cointegration is determined and long-run effects are acquired by the estimates of $\beta_1 - \beta_6$ normalized on β_0 . To test whether the effect of the long-run relationship is genuine, an F-test is employed. Ascertaining the joint significance of the lagged level variables as a sign of cointegration is recommended by [51].

The F-test in this context has new critical values that account for the degree of integration of variables. It can also keep the additional advantage that it can be applied irrespective of the regressors, supposing all variables to be I(1) and I(0). All the variables in error-correction specification in Equation (2) are supposed to have symmetric (linear) effects on output (FMD).

3.2. Asymmetric Panel ARDL Framework

Due to nonlinearities in time series, we conduct the present study in nonlinear settings centralizing the long- and short-term asymmetries between variables. The asymmetric augmentation of the above linear PARDL is developed by [56]. It is also referred to as nonlinear PARDL (NARDL). The purpose of this research is to inspect the asymmetric (nonlinear) long- and short-run relationships between the CR and FMD. Secondly, NARDL does not require the same order of integration among the variables. It can be exerted regardless of the regressors' order of integration I(0) or I(1). The estimation method is based on contemporary advances in error-correction modeling and cointegration. In order to observe the symmetric and asymmetric impacts of CR, we follow [56] and isolate upgrades from degrades. First, we separate the changes in the real CR as ΔCR , which includes positive changes marked by ΔCR^+ and negative changes marked by ΔCR^- . We then forge two new series, one symbolizing upgrades (indicated by POS) and the other symbolizing degrades (indicated by NEG). These are defined as the partial sum of positive and negative changes respectively, which are as follows:

$$POS_{it} = \sum_{j=1}^{it} \Delta CR_j^+ = \sum_{j=1}^{it} \max(\Delta CR_j, 0) \quad NEG_{it} = \sum_{j=1}^{it} \Delta CR_j^- = \sum_{j=1}^{it} \min(\Delta CR_j, 0). \quad (3)$$

The PNARDL approach [56] endorsed the asymmetric error correction model as follows:

$$\begin{aligned} \Delta FMD_{it} = & \theta_0 + \sum_{k=1}^{n1} \theta_{1k} \Delta FMD_{it-k} + \sum_{k=0}^{n2} \theta_{2k} \Delta CR_POS_{it-k} + \sum_{k=0}^{n3} \theta_{3k} \Delta CR_NEG_{it-k} \\ & + \sum_{k=0}^{n4} \theta_{4k} \Delta EG_{it-k} + \sum_{k=0}^{n5} \theta_{5k} \Delta OP_{it-k} + \sum_{k=0}^{n6} \theta_{6k} \Delta INF_{it-k} + \sum_{k=0}^{n7} \theta_{7k} \Delta BD_{it-k} \\ & + \sum_{k=0}^{n8} \theta_{8k} \Delta INV_{it-k} + \lambda_0 FMD_{it-k} + \lambda_1 CR_POS_{it-k} + \lambda_2 CR_NEG_{it-k} + \lambda_4 EG_{it-k} \\ & + \lambda_5 OP_{it-k} + \lambda_6 INF_{it-k} + \lambda_7 BD_{it-k} + \lambda_8 INV_{it-k} + \mu_{it}. \end{aligned} \quad (4)$$

Specification (4) is an error correction model (ECM), which [56] calls an asymmetric (non-linear) PARDL, because of the method of making partial sum variables. [51]. Once Equation (4) is estimated and cointegration is established, the various hypothesis with respect to the asymmetric effects of

CR changes on the FMD can be determined. We can assess types of asymmetries. First, short-run asymmetry is conducted if $\sum \theta_{4k} \neq \sum \theta_{5k}$ for a respective individual k . Second, long-run asymmetry is conducted if $\lambda_3 \neq \lambda_4$. Therefore, two hypotheses are tested by applying a Wald test for the short and long run.

4. Results

4.1. Symmetric and Asymmetric Impact of CR on FMD

Table 4 reports the results of PARDL under both the symmetric and asymmetric framework. Significant and negative coefficients of the error correction term (ECT) in all four models estimated clearly demonstrates that CR co-moves with FMD in the long run in the European region. The symmetric side shows that a disequilibrium in the previous period (year) is corrected at annual speeds of adjustment of 30% (CR_S) and 22% (CR_M), while asymmetric dynamics document an annual speed of adjustment of 32% (CR_S) and 31% (CR_M), respectively. Under both outlooks provided by Standard and Poor's and Moody's, the FMD reacts differently in the region, which may be due to the CR assessment differences in both outlooks. In the short run, the results do not confirm a not significant change in FMD; however, in the long run, the CR_M impact is significant. Likewise, a positive change in both CR_S and CR_M brings a negative change in FMD over the long run. This is possible because credit upgrades signal a low default risk of a country, which ultimately reduces the risk premium, which is an essential part of security prices.

On the other hand, an improvement in CR also makes fixed-income securities a cheaper source of finance for companies in that country, which shifts the focus from equity securities to the bond market. Thus, financial market activities in the long-run slowdown. On the contrary, we find that a degrade announcement in both types of CR positively drives the FMD in the region. FMD reacts positively to the CR_M in the short run. This implies that an improving credit outlook gives confidence to investors to become involved in trading activities, which in turn accelerates trading volume and market capitalization. Thus, the European financial market flourishes in the short run. There is another reason behind this short-run uplift, in that most of the participants are involved in trading activities among respective stock markets, which are sensitive to new information. A positive outlook by Standard and Poor's and Moody's give them the confidence to actively trade, while a high trading volume raises the stock market index. Importantly, diagnostic testing supports the potential of the linear ARDL model in estimating the linearities between CR and European FMD. ECT in Pesaran's and Shin cointegration test validates the long-run association of CR and FMD.

Table 4. Impact of credit rating (CR) and financial market development (FMD) with and without asymmetries.

Dependent variable: FMD				
Variables	Symmetry		Asymmetry	
	(1)	(2)	(3)	(4)
CR_S		CR_M	CR_S	CR_M
ECT	−0.301 *** (−6.95)	−0.217 *** (−5.89)	−0.317 *** (−7.45)	−0.311 *** (−6.40)
ΔCR	−0.161 (−0.75)	0.042 (0.26)		
ΔCR_POS			−0.531 (−1.54)	0.258 (1.39)
ΔCR_NEG			0.058 (0.18)	0.714 (1.09)
ΔBD	0.245 ** (2.14)	0.194 (1.64)	0.232 ** (1.99)	0.256 ** (2.09)

Table 4. Cont.

	Dependent variable: FMD			
	Symmetry		Asymmetry	
	(1)	(2)	(3)	(4)
ΔEG	0.117 (0.31)	0.251 (0.87)	0.079 (0.21)	0.179 (0.52)
ΔINF	−0.007 (−0.48)	−0.015 (−1.14)	0.010 (0.67)	−0.003 (−0.21)
ΔOP	0.141 (1.09)	0.249 ** (2.03)	0.072 (0.51)	0.198 * (1.67)
ΔINV	0.164 (0.98)	0.190 (1.19)	0.235 (1.29)	0.109 (0.64)
CR	0.185 (1.39)	0.977 *** (5.48)		
CR_POS			−1.102 *** (−4.45)	−0.233 ** (−2.40)
CR_NEG			0.341 ** (1.97)	0.015 (0.17)
BD	0.160 *** (3.10)	−0.102 * (−1.86)	−0.041 (−0.92)	0.166 *** (3.84)
EG	−0.050 (−1.06)	0.041 (0.55)	0.082 * (1.74)	0.024 (0.54)
INF	−0.034 ** (−1.99)	0.005 (0.22)	−0.060 *** (−4.91)	−0.053 *** (−4.57)
OP	−0.274 *** (−2.61)	−1.132 *** (−6.67)	0.000 (0.01)	−0.467 *** (−5.01)
INV	0.338 *** (2.95)	−0.607 *** (−3.56)	0.051 (0.56)	0.035 (0.41)
Constant	1.090 *** (7.01)	1.152 *** (5.79)	0.807 *** (5.96)	1.249 *** (6.12)
Observations	1064	1092	1092	1092
Hausman	3.34	2.68	2.24	2.55
Loglikelihood	508.21	521.77	562.74	546.65

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, t-statistics in parentheses.

4.2. Robustness: Using an Alternative Measure

To check the robustness, we use an index of traditional measures of FMD, which is explained in the variable description. On the same line, we tested the symmetric and asymmetric impact of CR on FMX; particularly, we intend to estimate the nonlinear ARDL model [56] for both outlooks to detect the possible presence of asymmetries (which are reported in Table 5). The results in Table 5, using an alternative measure of FMX, are consistent with those reported in Table 3, in terms of ECT, which is negative and significant. The speed of the disequilibrium correction is very near to that earlier reported in Table 3. European FMD does not react significantly to changes to both outlooks immediately, while a significant influence is observed in the case of an upgrade in CR_M under an asymmetric setting. Furthermore, the long-run coefficient in Table 4 indicates that CR upgrades bring a positive change in FMX and a downgrade is followed by a negative change in the long-run when S&P's outlook is used as a measure of CR. A Moody's upgrade negatively affects European FMD in the long run. Interestingly, a downgrade in CR_S brings a positive translation in FMX; the possible reasons are a rise in security prices due to a rise in risk, which makes financial products attractive for speculators, which in turn produces an overall increase in trading activities.

Table 5. Robustness: Alternative traditional measures of FMD.

<i>Variables</i>	Dependent Variable: FMD			
	Symmetry		Asymmetry	
	(1)	(2)	(3)	(4)
	CR_S	CR_M	CR_S	CR_M
<i>ECT</i>	−0.312 *** (−5.74)	−0.215 *** (−5.01)	−0.336 *** (−6.57)	−0.300 *** (−5.88)
ΔCR	−0.521 (−1.06)	0.188 (0.68)		
ΔCR_{POS}			0.034 (0.16)	0.497 ** (2.06)
ΔCR_{NEG}			0.043 (0.07)	0.420 (1.18)
ΔBD	0.502 *** (2.62)	0.091 (0.45)	0.491 *** (2.62)	0.403 *** (2.73)
ΔEG	0.137 (0.36)	0.118 (0.30)	0.084 (0.23)	0.252 (0.79)
ΔINF	−0.008 (−0.40)	−0.043 ** (−1.97)	−0.009 (−0.53)	−0.012 (−0.70)
ΔOP	−0.090 (−0.75)	−0.055 (−0.36)	−0.236 (−1.61)	−0.111 (−0.74)
ΔINV	0.341 * (1.73)	0.478 ** (2.03)	0.330 * (1.78)	0.346 * (1.73)
<i>CR</i>	0.495 *** (7.06)	1.883 *** (5.66)		
CR_{POS}			−0.232 (−1.53)	−0.940 *** (−4.41)
CR_{NEG}			0.281 *** (3.37)	0.112 (0.65)
<i>BD</i>	−0.123 * (−1.77)	0.137 ** (2.09)	−0.012 (−0.16)	0.221 *** (3.02)
<i>EG</i>	−0.153 * (−1.68)	1.095 *** (7.82)	−0.158 ** (−2.17)	0.052 (0.60)
<i>INF</i>	−0.144 *** (−4.40)	−0.114 *** (−3.80)	−0.185 *** (−6.21)	−0.169 *** (−5.55)
<i>OP</i>	−0.010 (−0.10)	−1.443 *** (−6.82)	0.748 *** (6.08)	0.181 (1.49)
<i>INV</i>	−0.208 (−1.23)	−0.395 (−1.41)	−0.251 * (−1.72)	−0.334 ** (−1.99)
<i>Constant</i>	0.276 *** (4.81)	−2.655 *** (−4.95)	−0.051 (−0.95)	−0.232 *** (−4.27)
<i>Observations</i>	868	868	868	868
<i>Hausman</i>	3.39	8.83	2.64	1.89
<i>LogLikelihood</i>	287.98	273.64	311.48	288.93

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, t-statistics in parentheses.

The results of asymmetric dynamics shown in Table 6 indicate the existence of asymmetric cointegration among the variables. In particular, both measures of CR show that the effects of an upgrade and downgrade are not equal. The asymmetric findings are an invaluable addition to the financial market literature, as most of the related studies relied heavily on event study methodology to capture the short-run influence of CR changes on financial market indicators (more specifically, a few stock market factors). The absence of short-run asymmetries strengthens the argument that the event study approach investigates only the temporary dynamics of financial markets, while the long-run implication is much more important. These interesting findings provide useful policy insights for investors, financial market participants, and regulators. In addition, these results confirm the importance of taking asymmetries into account while studying the association between CR and FMD.

Table 6. Summary of asymmetries.

Dependent Variable	FMD_IMF		FMD_X	
	(1)	(2)	(3)	(4)
	CR_S	CR_M	CR_S	CR_M
Long run asymmetry	9.49 ***	11.72 ***	22.96 ***	30.5 ***
Short run asymmetry	1.45	0.49	4.95 ***	0.01

*** indicates $p < 0.01$

5. Conclusions

In this paper, we answer two important questions identified in the previous literature and outlined in the introduction section. First, whether there exists a long-run relationship between sovereign CR and financial market development (FMD) in the European region, and second, whether the reaction to changing CR is symmetric or asymmetric. To address these questions, a panel dataset of 40 European countries from 1990–2018 is utilized. We concentrate on the European region because of the stable and developed financial markets in the region relative to Africa and Asia. Most of the previous studies related to the issue are based upon event study methodology that examines the short-run impact of the announcement of credit outlook changes and reveals nothing about long-run implications. We enlarged the literature on financial market modeling by using a non-linear panel cointegration methodology called the PNARDL approach that enables the analysis of the asymmetric effect; both in the long run and short run. Linear ARDL [51,54] is applied to estimate short- and long-run relationships, which is confirmed by ECT, which provides the answer to the first question, that the FMD of Europe is elastic to changes in the CR score assigned by S&P and Moody's, and there exists a linear and non-linear cointegration relationship between both. This implies that CR and FMD co-move in the long run, and a previous period disequilibrium is corrected at an annual rate of 22% and 30% under asymmetric setting, and 31% and 32% under an asymmetric setting, using CR_M, and CR_S, respectively (see Table 4). The diagnostic tests affirm the strengths of the model in both specifications (CR_M, and CR_S). In addition, to check the presence of the asymmetric influence of CR on FMD, we employed the PNARDL model [56] in our analysis.

Interestingly, to answer the second question empirically, the study performed a Wald test, which demonstrates that there is an asymmetric impact of CR changes on FMD in the long run (see Table 6). This implies that an upgrade in CR either by S&P or Moody's is not equivalent to a downgrade in terms of its impact on FMD in the European region. This implies that analysts, investors, regulators, and policymakers should carefully interpret the sovereign CR announcements as these may not carry the same implications, because a downgrade appears to have a relatively stronger influence on FMD compared with an upgrade. Policy attention is also needed to understand the magnitude and trickle-down effect of a negative change in CR.

A sovereign rating is an uninterrupted evaluation and assessment of the chances that a country will not pay back its debt; in other words, the chances of default [57], while in the context of an enterprise CR is employed to measure its probability of defaulting on a debt [58]. Improved CR enhances the output of a production unit [59]. If a country wants to upgrade its sovereign rating, it should focus on minimizing external debt and maximizing foreign reserves [60]. Given the pivotal role the financial system plays in the sustainability of developing countries [2,50,54] and the equally critical sustainable role of CR agencies and announcements, it is worthwhile to understand the short-run and long-run asymmetries the CR brings to the macroeconomic environment. The asymmetric framework of [56] is very useful to look beyond the linear setting, while its capability to gauge the asymmetric (both positive and negative) nature of the relationship would be beneficial for policy actions. One of the limitations associated with the current study is that it does not consider the local CR score assigned by local CR agencies. A future research agenda may consider the local CR under asymmetric settings,

which may provide interesting policy inputs. Moreover, the evidence from other regions maybe even more interesting due to differences in financial sector development.

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