Do macro-economic factors impact firms' credit risk?

Abstract

A host of researchers have proved that macro-economic factors have a strong impact on the sovereign bond ratings. In this study this linkage is extended to include corporate bonds. The core objective of this research is to find out the contributing factors behind bond downgrades of corporate sectors of top five emerging countries. The study analyses macro-economic factors' (Interest rate, GDP growth rate, stock index volatility of individual country, trade balance) linkages to bond downgrades in five (South Korea, China, India, Malaysia and Taiwan) chosen countries over a period of 14 years. It is observed that macroeconomic variables significantly impact bond downgrades for all the countries. However, the differential impact of these factors in each country chosen for the study can be driven by unique policy measurement and different economic structures.

1. Introduction

Credit rating (CR) is one of the major inputs in the choice of instrument both financial institutions and investors. Rating measures the relative credit risk associated with the debt instrument. Credit rating is a crucial parameter as it helps (a) an enterprise with relatively low risk profile will be able to raise funds at lower interest rate and (b) attract investors to such risk profile instruments owing to lower probability of default or delay in debt servicing.

Credit rating essentially depends on the individual firm's performance. Shin & Han (2001)stressed that the main process of rating starts with reviewing past financial reports to assess free cash flows to the firm. Empirical research suggests that rating model with strong predictive insights is predominantly based on financial ratios to analyze performance (Altman (1968; 2000; 2005), Shin & Han (2001), McKee & Lensberg (2002), Rus et al. (2009), Bhimani et al. (2010), Li & Sun (2011)). On the other hand there are several studies (Bensic et al. 2005; Bandyopadhyay 2006) where in addition to financial ratios the emphasis on non financial aspects like age of the firm, group ownership, ISO certification are used for arriving at ratings. A major departure was with, Kisgen's (2006,2009) study where capital structure was considered as the key factor underlining the change in CR.

A firm's debt rating will decide the credibility and strength of an enterprise. Despite a plethora of studies on factors affecting CR, a few of them have analyzed the macro-economic variables as factors of CR though it is predominantly used only for sovereign credit ratings.

Cantor et al. (1996) emphasized the need for a good sovereign rating not only from the point of less borrowing cost but also in enhancing the credit worthiness of the firms in that country. This study identifies six main country specific factors (GDP growth, inflation, external debt, level of economic development and default history) that play a major role in sovereign rating. Andritzky et al. (2007) proved that macro-economic data release and policy announcements have a huge impact on the sovereign bond's rating in emerging markets.

The macro-economic factors and policy announcements have not been considered as important parameters by most studies for credit rating. Collin-Dufresne and Goldstein (2001) and

Collin-Dufresne and Solnik (2001) concluded that country specific variables like interest rate may also help in explaining credit risk. This study extends the Collin-Dufresne and Goldstein (2001) study by including other macro-economic variables like GDP growth, stock index volatility and trade balance along with interest rate. The core objective of this research is to investigate the impact of changes in macro-economic factors and, policy announcements on corporate bond ratings in the context of emerging economies South Korea, China, Malaysia, India and Taiwan.

2. Theory

Corporate debt driven by the current pace of growth is one of the most sought after instruments for investment presently. This is true across all emerging Asian markets which is evident from Figure 1. Prompted by high returns the risk associated in these emerging bond markets is also very high. Among the top 10 emerging bond markets in the world, five (South Korea, China, Malaysia, India, Taiwan) are from Asia[1]. Eichengreen & Luengnaruemitchai (2004); Bhattacharyay (2013) also supported the fact that Asian countries are in the top among other emerging economies in the world. However, the nature of emerging economies' debt market is different from the debt markets of developed economies.

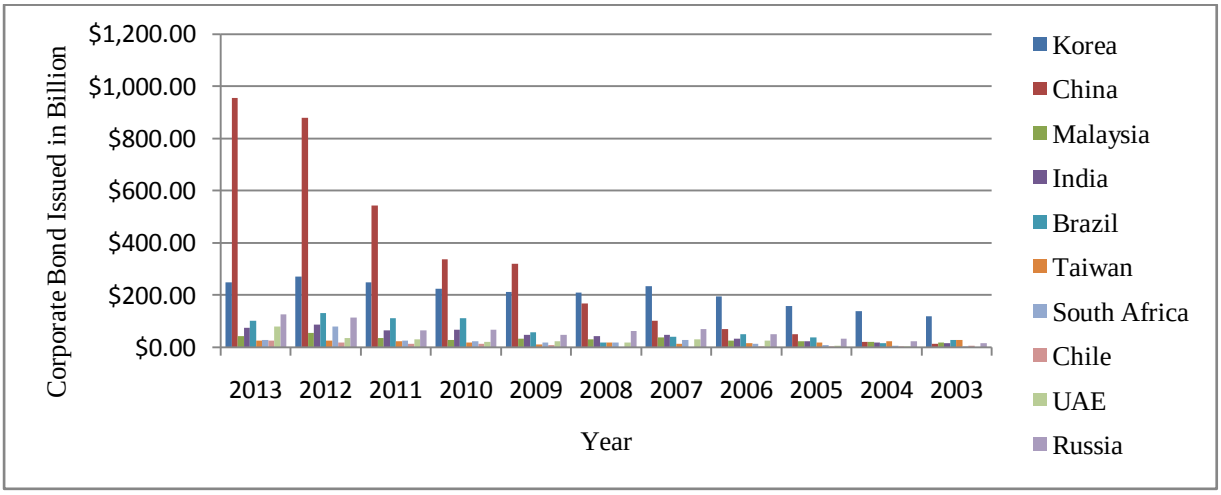


Figure 1
Size of the corporate bond market of top 10 emerging countries (Source: Bloomberg Portal)

According to Andritzky et al. (2007), "Emerging markets have a relatively short modern history of access to international capital markets, and their economies continue to undergo significant structural

[1] Source: Bloomberg Portal

changes. The uncertainty related to prospects for default is further exacerbated by the difficulties in gathering and interpreting information about emerging market economies and the effect that volatile political environments often have on domestic policies that crucially determine credit worthiness." The debt markets in these economies are nascent, volatile and are exposed to higher default risk.

Ferri et al. (2001) provided evidence that sovereign downgrading and firms downgrading are highly correlated in developing countries implying that factors of sovereign rating can play a dual role impacting and determining corporate rating. Kose et al. (2003) reported that country specific factors like output growth, consumption growth and investment growth have better explanatory power for business cycle fluctuation of developing countries compared to that of developed countries where the primary explanation is given by "world factor" (a dynamic factor common to all aggregates, regions and countries). However, the debt market is varied among emerging countries due to different term structure, policy and economy.

The objectives of this study is to examine the impact of macro-economic variables interest rate, GDP growth rate, stock market volatility and trade balance on the corporate bonds downgrades in the five Asian emerging economies viz. South Korea, China, Malaysia, India and Taiwan. This study explores the effect and interaction of each macro-economic factor individually on bond[2] downgrades for each country.

2.1. Measurement of Credit Risk

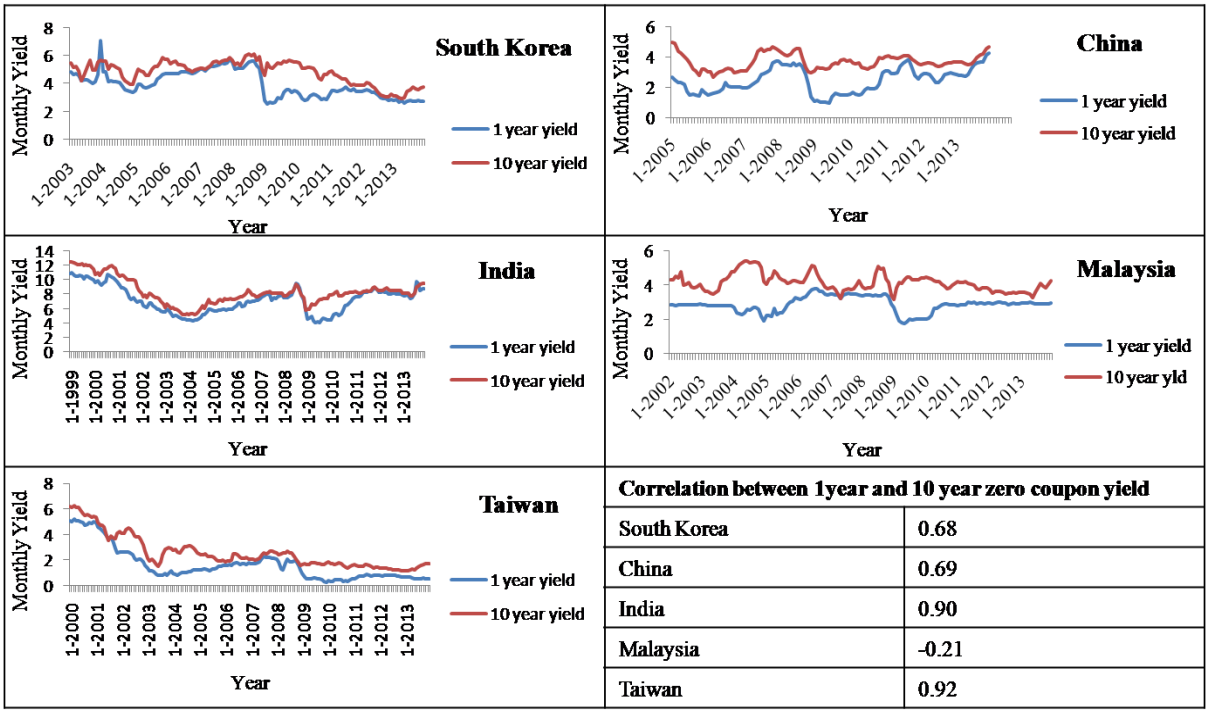
Credit rating provides the relative probability of default based on the credit risk for a debt instrument. Therefore any downgrade implies that the instrument's probability of default increases. In this study the number of corporate bond downgrades is used as a proxy for measuring credit risk. Off late the market has witnessed higher number of new bond issues as well as increased number of downgrades due to stricter regulatory mechanism with more number of investors entering the market. Given the level of disparity in new bond issues and the need to standardize for analysis, a ratio is arrived at by

[2] This paper only takes care of corporate bond. So, in the paper bond refers corporate bond only.

dividing the number of bond downgrades to number of corporate bonds issued[3] in each quarter for a given country. This ratio is denoted by 'Down-Issue' which is the dependent variable in the study.

2.2. Macro-economic Variables

2.2.1. Interest Rate: Interest rate of Treasury bond is an important tool used by the central bank for controlling country's inflation or macro-economic situation. This change in interest rate is a crucial factor affecting credit spread risk of the firm's debt instrument. However, magnitude of the credit spread risk or downgrade risk depends on correlation between interest rate factor and firm's asset value factor (Longstaff et al. 1995). Collin-Dufresne & Goldstein (2001) mentioned that positive



Correlation between 1year and 10 year zero coupon yield	
South Korea	0.68
China	0.69
India	0.90
Malaysia	-0.21
Taiwan	0.92

Figure 2
Co-movement of one year and 10 year yield in top 5 emerging countries

correlation is more risky whereas negative correlation is less risky because decrease in interest rate increases firm's value that works as a natural hedge for any firm. As a proxy for interest rate one year and 10year yield of zero coupon treasury bond have been used in the study. Both one and 10 year interest rate have been considered to check the change of short run and long run interest rate. However, it is observed that both the yields are moving together in four countries except Malaysia.

[3] The quarter-wise ratio of corporate bond downgraded amount in USD to corporate bond issued amount in USD is the better parameter to estimate credit risk. However, as that data is not available we took ratio of number of bonds downgraded to bonds issued.

The correlation between one year and 10 year yield of zero coupon treasury bond is also positive and strong except negative correlation in Malaysia.

2.2.2. GDP Growth Rate: A relatively high rate of economic growth suggests the existence of a favorable situation for enterprises to enhance their top and bottom line. Therefore, high growth for a period indicates the lower bond downgrades for that period.

2.2.3. Stock Index Volatility: This is used as a proxy for overall economic and market situation for a country and, investor's sentiment for the period under consideration.

2.2.4. Trade Balance: Any announcements or change in levy of import and export can influence revenue or profit of any firm. Therefore, it is indirectly related to credit rating through firm's performance. Change in country's net export or trade balance can capture the change in the trade related policy.

3. Data Source

In this study the chosen macroeconomic variable are percentage change of yield of one and 10 year zero coupon bond compared to previous quarter, GDP growth rate, stock index volatility and percentage change of trade balance. These variables are expected to either directly or indirectly cause downgrades of corporate bonds of any emerging countries.

Table 1
Description of Variables

Variable Name	Definition
Down-Issue	Ratio of the number of corporate bonds downgraded in each quarter to the number of corporate bonds issued in each quarter.
One Year Yield	Percentage change of average of daily yield of one year zero coupon treasury bond of current quarter to previous quarter
10 Year Yield	Percentage change of average of daily yield of 10 year zero coupon treasury bond of current quarter to previous quarter
GDP growth rate	Percentage change of quarterly GDP with respect to its previous quarter or GDP growth rate
Stock Index Volatility	Average quarterly volatility is calculated from daily volatility that is obtained from daily stock index return
Trade Balance	Percentage change of average of monthly trade balance of current quarter to previous quarter

Data of the listed macro-economic variables for all the five countries were obtained from Bloomberg Portal. The study is restricted to use of Quarterly data for all the countries. The description of measuring each variables furnished in Table 1. Owing to data insufficiency, data period varies among countries (Table 2). Column 2 of Table 2 has listed the stock indexes of the representative countries.

Table 2
Stock Index and Period of study

Countries	Stock Index	Period of the study	# of quarters
South Korea	Korea Composite Stock Price Index	2003- 2013	44
China	Sanghai Stock Exchange Composite Index	2005-2013	36
India	NSE Index	1999- 2012	56
Malaysia	FTSE Bursa Malaysia KLCI Index	2002-2013	48
Taiwan	TWSE Index	2000- 2013	56

4. Methodology

4.1. GARCH (1, 1)

To calculate the stock market volatility GARCH (1,1) model (Bollerslev 1986) is employed. It estimates daily conditional variance of daily log return of stock index.

$$R_t = \beta + \sum_{i=1}^{n} \phi_i R_{t-i} + u_t \varepsilon_t$$

$$E(u_t) = 0 \; and \; E(u_t^2) = h_t$$

$$h_t = \lambda_0 + \lambda_1 u_{t-1}^2 + \lambda_2 h_{t-1} + \varepsilon_t$$

In this set up mean equation includes a constant β and autoregressive terms of R_{t-i}. The residual variance consists of the constant $\lambda_0$and with ARCH and GARCH coefficient of λ_1 and λ_2.

Daily volatility is converted to quarterly volatility by using the following formula:

$$\sigma_{quarter} = E(\sigma_{daily}) * \sqrt{N}$$

Where N = No of days in the given quarter.

4.2 Unit Root Test:

We use Augmented Dickey-Fuller Test (Fuller 2009) to test the presence of unit root and identify order of integration for each variables.

$$\Delta y_t = \alpha + \beta_t + \Upsilon y_{t-1} + \delta_1 \Delta y_{t-1} + \cdots + \delta_{p-1} \Delta y_{t-p-1} + \varepsilon_t$$

H0: $\Upsilon = 0$

Null hypothesis is to prove the presence of unit root in the series and Dickey-Fuller test statistics is calculated using following formula.

$$DF_r = \frac{\bar{Y}}{SE(\bar{Y})}$$

4.3. Granger Causality Test

The rating change of any instrument comes into play after 3-6 months of changes of macro-economic factors. Therefore, bond downgrades depend on the 1-2 lag of all independent variables. The series are not integrated at same order, there is no presence of cointegration. Therefore, VAR model is suitable to test Granger causality. However some series are not stationary at level, Toda & Yamamoto (1995) procedure is followed for Granger-causality test.

$$Y_t = a_0 + a_1 Y_{t-1} + \cdots + a_p Y_{t-p} + b_1 X_{t-1} + \cdots + b_p X_{t-p} + u_t$$

$$X_t = c + c_1 X_{t-1} + \cdots + c_p X_{t-p} + d_1 Y_{t-1} + \cdots + d_p Y_{t-p} + v_t$$

Testing H0: $b_1 = b_2 = \cdots = b_p = 0$ for X does not Granger cause Y

Similarly H0: $d_1 = d_2 = \cdots = d_p = 0$ for Y does not Granger cause X

Similarly H0: $d_1 = d_2 = \cdots = d_p = 0$ for Y does not Granger cause X

Table 3 refers all the hypotheses to be tested to examine interaction between macro-economic variables and bond downgrades.

Table 3
Hypothesis for VAR Model to test Granger Causality

No	Null Hypothesis
1a	Change of yield of 1 year zero coupon treasury bond Granger causes bond downgrades.
1b	Bond downgrades Granger causes change of yield of 1 year zero coupon treasury bond
2a.	Change of yield of 10 year zero coupon treasury bond Granger causes bond downgrades.
2b	Bond downgrades Granger causes change of yield of 10 year zero coupon treasury bond
3a	Change in GDP growth rate Granger causes bond downgrades.
3b	Bond downgrades Granger causes change in GDP growth rate.
4a	Stock index volatility Granger causes bond downgrades.
4b	Bond downgrades Granger causes Stock index volatility.
5a	Change in trade balance of the country Granger causes bond downgrades.
5b	Bond downgrades Granger causes change in trade balance.

5. Result and Implication

This study explores the interactions between corporate bond downgrades and individual macro-economic variables in an emerging markets set up. The results of the study indicate significant impact of macroeconomic variables on corporate bond downgrades. Out of five chosen countries all except Malaysia and China support the impact of macro-economic variables on corporate bond downgrades.

Table 4 refers the country-wise outcome of the study and detailed Granger-causality test result is presented on appendix B. Result of unit root test to check stationarity of series is showcased in appendix A.

From the results presented in Table 4 it is clear that Korea, India, Taiwan support the hypothesis that changes in macro-economic variables Granger cause bond downgrades. For all the three countries, yield of one year and ten year zero coupon bond have significant impact. As mentioned in the theory, interest rate change directly changes the credit spread which is a key factor for change of bond rating.

It is also observed that both for India and Korea GDP growth rate does not have any impact. In addition, GDP does not have direct impact on bond downgrades for China, Malaysia. However, in Taiwan GDP growth has impact on bond downgrades. One possible reason is that the relatively small country size of Taiwan compared to India and Korea.

Table 4
Country-wise Result

Korea	
1a	Change of yield of 1 year zero coupon treasury bond Granger causes Bond downgrades.
2a	Change of yield of 10 years zero coupon treasury bond Granger causes Bond downgrades.
5a	Change in trade balance Granger causes bond downgrades.
China	
None of the macro-economic variable is significant.	
Malaysia	
4b	Bond downgrades Granger causes Stock Market Volatility.
India	
1a	Change of yield of 1 year zero coupon treasury bond Granger causes bond downgrades.
2a	Change of yield of 10 year zero coupon treasury bond Granger causes bond downgrades.
4a	Stock Market Volatility granger causes bond downgrades
5b	Bond downgrade Granger causes change in trade balance.
Taiwan	
2a	Change in 10 year yield Granger causes bond downgrades.
3a	Change in GDP Granger causes bond downgrades.
5a	Change in Trade Balance Granger causes bond downgrades.

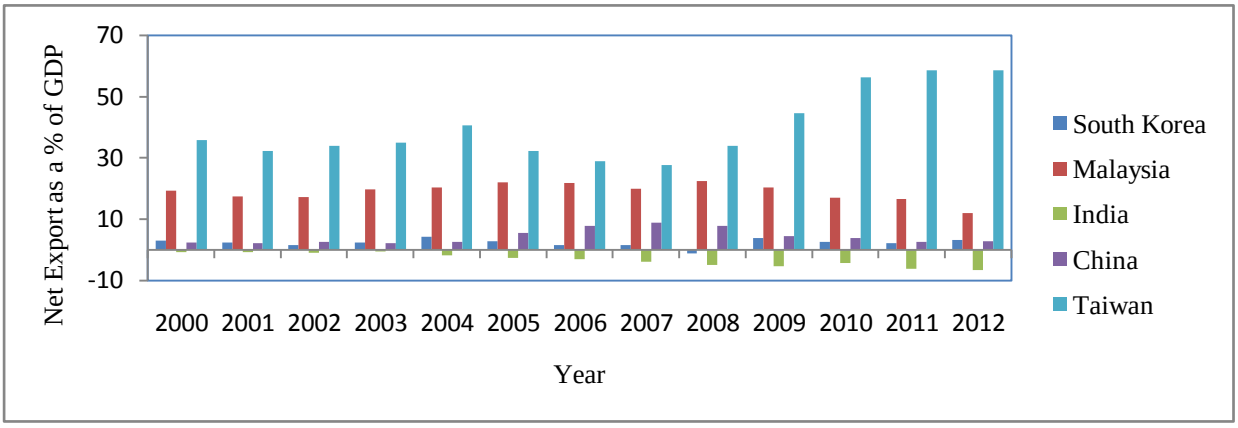


Figure 3
Net Export of South Korea, China, India, Malaysia, Taiwan (Source: Bloomberg Portal)

Stock market volatility has significant influence in corporate bond market only in India. Based on literature it can be argued that there is a strong linkage between stock and bond market in India (Kolluri & Wahab 2010). Bond markets of Korea and Taiwan are developed compared to India signifying lesser influence of stock market volatility in those countries.

Trade balance or net export of the country also has significant effect on Korea, India and Taiwan like other variables. From Figure 3, it is evident that Taiwan, Malaysia, South Korea and China have higher positive trade balance. Change in trade balance Granger causes bond downgrades in Korea and Taiwan possibly because both are export oriented countries in Asia whereas this is not true for Malaysia and China as the structure of the bond market in these countries are different. For India bond downgrade has an impact on trade balance. From Figure 3 it is very evident that export of goods and services of India is less as compared to Korea and Taiwan. Therefore, if firm's forex earning reduces the total profit will be affected leading to downgrade of its debt instrument. On the other hand, decrease of forex earning indicates country's revenue from export has come down which will lead to decrease of trade balance (net export of the country).

It can be observed that none of the macroeconomic variables barring to a milder extent stock market volatility Granger causes for Malaysia. A plausible explanation is the ideology of Malaysian bond market - "Islamic bonds based on Shari'a principle play a major role in Malaysia's capital market"[4]. Therefore, term structure of interest rate and economy may not have a similar impact like other countries considered. Additionally, equity market of Malaysia is small and weak. According to Shari'a principle, firm's main source of borrowing should be from bond market, not from equity market. This could be a probable reason that Malaysian stock market volatility depends on bond market as a significant portion of Malaysian capital market is bond market.

In China, none of the macro-economic variables have significant impact on bond downgrade. One plausible reason is that economic freedom is least in China compared to other 5 countries (Table 5).

Table 5
Economic Freedom Index for five countries[5]

Country	South Korea	China	India	Malaysia	Taiwan
Economic Freedom Index	71.2	52.5	55.7	69.6	73.9
Worldwide Ranking	31	137	120	37	17

[4] Source: Asian Development Bank
[5] Source: www.heritage.org

Moreover, the ranking of China according to economic freedom index is low among 186 countries[6] for which the index is analyzed. The index of economic freedom consists of rule of law, limited Government, regulatory efficiency, open markets. Though the ranking of India and China is not much different but the economic structure and political stability is not same for both the country. According to the source of economic freedom index, India has advanced economic freedom in last two decades by improving its rules and regulation in trade freedom (free import and export of goods and services). On the other hand, China's economic freedom has remained same for last 20 year. The political situation of China is main hindrance for economical reform. In addition, literature also supports that Chinese economy requires more flexibility and it should have minimum Government intervention (Xu 2001; Lu 2004; Bénassy-Quéré et al. 2013). As, all the macro-economic variables are not fully 'uncontrolled', therefore, before arriving at a decisive conclusion a detailed study on China is required on its corporate bond sector.

For the other economies from the result it is clear that macro-economic variables Granger-cause or have significant impact on bond downgrades.

Conclusion

The major findings of this study indicate macro-economic variables have significant impact on three out of the five chosen countries for the study. However, the result varies across the countries due to different economic policies or term structure.

Of the five countries considered in this study, the results of South Korea, India and Taiwan indicate macro-economic changes can downgrade corporate bond. The result differs for Malaysia as the Malaysian capital market is mainly driven by Shari'a principal. Hence the volatility spill over of equity market is mainly led by the bond market. The south-east Asian countries like Korea and Taiwan are export dominated countries and have significant impact on bond downgrades, but this is not true for China and Malaysia given the difference in structure.

This study offers insights for firms to anticipate and take appropriate measures to avoid bond downgrades based on macro-economic policies. This may subsequently aid in avoiding excess

[6] Source: www.heritage.org

borrowing cost for the future. This study can provide greater insights from investors' perspective to proactively implement investing strategies based on understanding the country's macro-economic variables.

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Appendix:

A. Unit Root Result

i. Korea

Variables	ADF Test	p-value	Comment
Down-Issue	-3.465034	0.0139**	Stationary
1 year yield	-5.691128	0.0000***	Stationary
10 year yield	-6.064914	0.0000***	Stationary
GDP growth rate	-4.719777	0.0004***	Stationary
Stock Market Volatility	-3.875108	0.0047***	Stationary
Trade Balance	-7.232397	0.0000***	Stationary

Note: *, **, *** denotes 1%, 5%, 10% significance level respectively.

ii. China

Variables	ADF Test	p-value	Comment
Down-Issue	-129.8225	0.0001***	Stationary
1 year yield	-4.196130	0.0001***	Stationary
10 year yield	-4.358693	0.0001***	Stationary
GDP growth rate	-2.771063	0.0741*	Stationary
Stock Market Volatility	-0.630138	0.4371	Non-Stationary
Trade Balance	-9.994732	0.0000***	Stationary
ΔStock Market Volatility[7]	-6.752930	0.0000***	Stationary

Note: *, **, *** denotes 1%, 5%, 10% significance level respectively.

iii. India

Variables	ADF Test	p-value	Comment
Down-Issue	-5.152742	0.0001***	Stationary
1 year yield	-5.058590	0.0001***	Stationary
10 year yield	-3.308984	0.0190**	Stationary
GDP growth rate	-3.752187	0.0058***	Stationary
Stock Market Volatility	-4.386567	0.0008***	Stationary
Trade Balance	-2.453890	0.1326	Non-Stationary
ΔTrade Balance	-12.20948	0.0000***	Stationary

Note: *, **, *** denotes 1%, 5%, 10% significance level respectively.

iv. Malaysia

Variables	ADF Test	p-value	Comment
Down-Issue	-7.171124	0.0000***	Stationary
1 year yield	-3.836405	0.0003***	Stationary
10 year yield	-6.151416	0.0000***	Stationary
GDP growth rate	-4.856869	0.0002***	Stationary
Stock Market Volatility	-6.052185	0.0000***	Stationary
Trade Balance	-8.528003	0.0000***	Stationary

Note: *, **, *** denotes 1%, 5%, 10% significance level respectively.

v. Taiwan

Variables	ADF Test	p-value	Comment
Down-Issue	-4.872666	0.0002***	Stationary
1 year yield	-2.317867	0.0211**	Stationary
10 year yield	-4.763101	0.0003***	Stationary
GDP growth rate	-5.090212	0.0001***	Stationary
Stock Market Volatility	-5.660567	0.0000***	Stationary
Trade Balance	-8.196553	0.0000***	Stationary

Note: *, **, *** denotes 1%, 5%, 10% significance level respectively.

[7] Δ represents first difference of the series.

B. Granger Causality Test

Hypothesis	Chi Square	p-value
Korea		
1a	6.547826	0.0105**
1b	2.422646	0.1196
2a	2.875588	0.0899*
2b	1.512263	0.2188
3a	0.535163	0.7652
3b	2.402351	0.3008
4a	1.685811	0.4305
4b	3.368244	0.1856
5a	7.559819	0.0060***
5b	0.637331	0.4247
China		
1a	NA	NA
1b	NA	NA
2a	NA	NA
2b	NA	NA
3a	4.136802	0.2471
3b	0.103745	0.9914
4a	0.453652	0.5006
4b	0.018474	0.8919
5a	NA	NA
5b	NA	NA
India		
1a	4.559323	0.0327**
1b	0.005324	0.9418
2a	6.704520	0.0350**
2b	1.934893	0.3801
3a	0.486207	0.4856
3b	0.066595	0.7964
4a	4.840207	0.0278**
4b	2.297179	0.1296
5a	1.488670	0.8286
5b	19.11844	0.0007***

Malaysia		
1a	NA	NA
1b	NA	NA
2a	NA	NA
2b	NA	NA
3a	1.330244	0.5142
3b	2.259136	0.3232
4a	1.580528	0.4537
4b	8.185589	0.0167**
5a	1.435003	0.4880
5b	0.216601	0.8974
Taiwan		
1a	0.059474	0.8073
1b	0.136386	0.7119
2a	3.202288	0.0735*
2b	0.164904	0.6847
3a	10.26647	0.0059***
3b	2.110459	0.3481
4a	1.196093	0.2741
4b	0.242609	0.6223
5a	162.1002	0.0000***
5b	0.000446	0.9832

Note: *, **, *** denotes 1%, 5%, 10% significance level respectively.

Note: NA denotes none of lag is significant in VAR model. So, Granger Causality test is not possible. It indicates that bond downgrade does not depend on lag of corresponding macro-economic variables.