A Comparative Analysis of the Investment- and Speculative-Sovereign Credit Ratings

Kok-Tiong Lim[a], **Kim-Leng Goh**[b] and **Kian-Teng Kwek**[c]

[a] Faculty of Business and Economics, University of Malaya, 50603 Kuala Lumpur, Malaysia.
Email: kttlim@yahoo.com ORCiD: https://orcid.org/0000-0003-1148-615X
[b] Faculty of Business and Economics, University of Malaya, 50603 Kuala Lumpur, Malaysia.
Email: klgoh@um.edu.my (Corresponding author). ORCiD: https://orcid.org/0000-0002-2367-8303
[c] Faculty of Business and Economics, University of Malaya, 50603 Kuala Lumpur, Malaysia.
Email: ktkwek@um.edu.my ORCiD: https://orcid.org/0000-0001-5738-9422

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Abstract

This paper examines the variability of emphasis on sovereign credit ratings (SCRs) issued by three leading credit rating agencies: Moody's, S&P, and Fitch. Using the sample of 55 countries with observations from year 1998 to 2017, this study reveals a clear variation of emphasis on these determinants in assessing the investment-grade versus speculative-grade rated countries. For the speculative-grade rated countries, only determinants representing the Institutional and Susceptibility to External Event factors matter during the post-global financial crisis (GFC) period. Despite the observed variabilities, there is no evidence to support the argument that the CRAs changed their criteria in SCR determination after the global financial crisis. The seven-determinant model continues to have high predictive power for SCRs of all three leading issuers in a rage of 68 to 71% for investment-grade ratings and 81 to 87% for speculative-grade ratings.

Keywords: Global financial crisis, Sovereign credit ratings, Debt burden.
JEL Classification – G01, G24
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1. Introduction

The sovereign credit ratings (SCRs) are tagging assigned to rated countries on the hierarchy of creditworthiness. Technically, the SCRs issued by Moody's are known as sovereign bond ratings, in the form of alpha-numeric notches (i.e., Aaa, Aa1, Aa2, Aa3, etc.) (Moody's 2021). The SCRs issued by S&P are known as sovereign ratings (Poor's 2018), those issued by Fitch are known as sovereign issuer default ratings (FitchRatings 2021a), and both are in the form of alpha-symbol (i.e., AAA, AA+, AA, AA-, etc.). A total of 159 countries are rated by at least one of these three leading credit rating agencies [1]. They form a combined 99% market share on 1.7 million outstanding government debts in 2018[2]. It is therefore undisputable that the SCRs issued by these three leading CRAs have been an integral part of risk pricing in the global financial system. Naturally, how these SCRs are determined has become a

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[1] The list of rated countries is obtained from www.moodys.com as at August 21st 2020, www.capitaliq.com as at July 2nd 2019, and www.fitchratings.com as at August 22nd 2020.
[2] The information is retrieved from https://www.sec.gov/files/2018-annual-report-on-nrsros.pdf.

worthy research subject, and whether these SCR determinants have evolved over time are essential to policymakers.

The empirical results of this paper show that the seven selected economic variables of GDP growth, GDP per capita, government effectiveness index, inflation, fiscal balance, debt to GDP, and financial development index, that represent the four key factors of economics, institution, fiscal position, and susceptibility to external events are statistically significant determinants of SCRs issued by Moody's, S&P, and Fitch. The seven determinant ordered logit model (OLM) can predict SCRs issued by the respective CRAs with accuracy of between 57% to 61%. When investment grade versus speculative grade and the time dimension on pre- and post-global financial crisis are taken into consideration, the empirical results revealed that there is greater variability of emphasis on SCRs determination amongst Moody's, S&P, and Fitch.

This paper is organized as follows. Section 2 lists out the literature reviewed for this paper. The data and methodology are explained in Section 3. Section 4 reports the empirical estimates, and discussions are presented in Section 5. Finally, Section 6 concludes the study.

2. Literature Review

The most cited and perhaps one of the earliest works was furnished by Cantor and Packer (1996). Their eight economic variable model was able to explain 90% of the SCRs issued by Moody's and S&P. The eight economic variables were GDP per capita, GDP growth, inflation, external debt, fiscal balance, current account balance, economic development index, and default indicator. Following the same approach, new economic variables and countries were added by subsequent studies with comparable model explanatory power, and majority of the determinants that were proven statistically significant revolved around the same set of eight economic variables employed by Cantor and Parker (Cantor and Packer 1996, Rowland 2004, Afonso 2003).

Acknowledging the inappropriateness of using linear regression methods as highlighted by Wooldridge (2002), Bissondoyal-Bheenick (2005) was one of the earliest to adopt an ordered response model to study the determinants of SCRs. Using seven economic variables in an ordered probit model (OPM) on the sample of 95 countries with observations from 1995 to 1999, the GNP per capita and inflation were concluded to be the most relevant determinants. The work of Mellios and Paget-Blanc (2006) that adopted ordered logit model found that among the 13 selected economic variables, the statistically significant determinants were GDP per capita, government income, real exchange rate, inflation and default history. As more economic variables are being examined as potential determinants, researchers have categorized determinants into principal component and non-principal component variables such the work of Afonso,

Gomes, and Rother (2009). With a set of 24 principal component and non-principal component variables, those proven statistically significant were mainly variables derived from principal component, which closely resemble the initial set of eight economic variables employed by Cantor and Packer (1996). In a separate paper (Afonso, Gomes, and Rother 2011), the researchers reclassified the economic variables into short-term and long-term determinants, and found that the significant determinants in contemporary value and 3-year average value did not deviate much, and were mainly the principal component variables.

The study of variability in SCRs determinants over time could be traced back to the work of Ferri, Liu, and Stiglitz (1999). The paper focused on the effect of the 1997 Asia financial crisis (AFC) on SCRs issued by Moody's and S&P. Their study involved Indonesia, South Korea, Malaysia, and Thailand to examine the pre- and post-AFC potential variations on the determination of SCRs. The work of Bissondoyal-Bheenick (2005) examined the variability of selected determinants in explaining the SCRs of high rated countries versus low rated countries. Giacomino (2013) aimed to address the pro-cyclicality of SCRs with pre- and post-crisis datasets that consist of observations from 2001 to 2006 and from 2007 to 2011, respectively. The research found no evidence to back the claim that the CRAs exercised procyclical behaviour by assigning unduly conservative SCR notches during crisis period. The work of Amstad and Packer (2015) examined the potential variability of SCRs determination between advanced and emerging economies using a sample of 28 advanced countries and 69 emerging economies, with observations spanning from 2007 to 2015. The research reported that there were some variations of emphasis on SCRs determinants but no evidence to suggest significant variation between the advanced and emerging economies. A more recent paper by Reusens and Croux (2017) assessed the structural break event of European debt crisis in 2009 on the variability of 10 determinants in explaining the SCRs of 85 countries rated by S&P, 90 countries rated by Moody's, and 69 countries rated by Fitch. Their empirical results showed that financial balance, economic development, and external debts had gained strength as significant determinants in the post-debt crisis period as evidence on variability on SCRs determinants over time.

This paper builds on the literature stated above to study the variability of SCRs determinants with three distinct contributions. First, the use of a sample of 55 countries that are multi-rated and common determinants considered by all three leading CRAs allow the variability in emphasis amongst the CRAs to be examined and compared.

Second, the study is extended to examine the variability in emphasis on investment-grade versus speculative-grade SCRs amongst the CRAs, which has never been examined before. The closest study was conducted by Bissondoyal-Bheenick (2005) that examined high rated countries (Aaa/AAA rated) versus low rated countries (below Aaa/AAA rated). Third, the variability in emphasis is also compared for the pre- and post-GFC periods. Earlier studies examined the pre- and post-GFC on SCRs

determinants in the context of event study with 2008/2009 as structural break and the samples used were only up to 2015 (Reusens and Croux 2017, Amstad and Packer 2015). The detailed breakdowns between pre- and post-GFC periods with greater observations spanning from 1998 to 2017 in this paper reveals information that are otherwise masked by analysis at the aggregated level.

3. Research Methodology

The data and methods employed for this empirical study are elaborated in the following sub-sections.

3.1 Data

The sample for this empirical study consists of sovereign credit ratings (SCRs) issued by Moody's, S&P, and Fitch on 55 countries, of which 31 are developed countries and 24 are developing countries. The SCRs were gathered from Bloomberg on annual interval spanning from 1998 to 2017 or T = 20 years. The list of selected countries is presented on Table 1. The selection of the 55 countries is based data availability from 1998 to 2017 and that each country is rated by all the three CRAs.

On the determinants of SCRs, seven variables are selected to represent the four key factors, namely economics, institution, fiscal position, and susceptibility to external events, as comprehended from the literature (Moody's 2016, Poor's 2017, FitchRatings 2021b). The seven variables are GDP growth, GDP per capita, government effectiveness index, inflation, fiscal balance, debt to GDP, and financial development index, which have been proven to be significant determinants of SCRs in earlier studies (Afonso, Furceri, and Gomes 2012, Afonso, Gomes, and Rother 2011, Bissondoyal-Bheenick 2005, Bissondoyal-Bheenick, Brooks, and Yip 2006, Mellios and Paget-Blanc 2006, Cantor and Packer 1996, Hill, Brooks, and Faff 2010, Reusens and Croux 2017, Ferri, Liu, and Stiglitz 1999, Amstad and Packer 2015, Giacomino 2013, Boumparis, Milas, and Panagiotidis 2015). The data for these variables are extracted from World Bank and International Monetary Fund.

Table 1: List of 55 developed and developing countries

Argentina	Croatia*	Ireland*	Netherlands*	Slovakia*
Australia*	Czech*	Israel	Norway*	Slovenia*
Austria*	Denmark*	Italy*	New Zealand*	South Korea
Belgium*	Egypt	Japan*	Panama	Spain*
Brazil	Salvador	Kazakhstan	Peru	Sweden*
Bulgaria*	Finland*	Kuwait	Philippines	Switzerland*
Canada*	France*	Latvia*	Poland*	Thailand
Chile	Germany*	Lebanon	Portugal*	Tunisia
China	Hungary*	Lithuania*	Romania*	Turkey
Colombia	Iceland*	Malaysia	Russia	United Kingdom*
Costa Rica	India	Mexico	Singapore	United States*

Note: * indicates developed countries and others are developing countries as per the UN classification retrieved from
https://www.un.org/en/development/desa/policy/wesp/wesp_current/2014wesp_country_classification.pdf

For each selected determinant, the expected sign of its effect on SCRs, irrespective of the CRAs, is based on the following rationale:

Economic Factor – In accordance with the SCR methodology (Moody's 2016, Poor's 2017, FitchRatings 2021b), the gross development product (GDP) appeared to be the base in measuring a country's repayment ability. The two key variables consistently employed by all three CRAs and proven significant by earlier researchers are GDP growth rate and GDP per capita (Afonso, Furceri, and Gomes 2012, Afonso, Gomes, and Rother 2011, Bissondoyal-Bheenick 2005, Bissondoyal-Bheenick, Brooks, and Yip 2006, Mellios and Paget-Blanc 2006, Cantor and Packer 1996, Hill, Brooks, and Faff 2010, Reusens and Croux 2017). Intuitively, both variables contribute positively to a country's SCR where the former attributes to the economic activities and the latter on the productivity.

Institution Factor – This refers to the strength of the government in promoting economic growth and social welfare. While all three CRAs employed almost the complete set of World Development Indicators furnished by World Bank (WB) in accordance to Moody's (2016), Poor's (2018), and FitchRating (2021b), the government effectiveness index was commonly employed in earlier studies (Afonso, Gomes, and Rother 2011, Afonso, Gomes, and Rother 2009). The other variable is the inflation, which has been the proxy used to assess government's efficiency in implementing fiscal and monetary policies that translate to real economy growth without fuelling prices (Bissondoyal-Bheenick 2005, Afonso, Gomes, and Rother 2011, Afonso, Gomes, and Rother 2009, Cantor and Packer 1996). Therefore, the government effectiveness index is expected to be positively correlated while the inflation rate negatively correlated with SCRs.

Fiscal Factor – This factor determines the debt capacity of the country. The general inputs considered by all three CRAs in this factor are fiscal balance and debt to GDP (Moody's 2016, Poor's 2017, FitchRatings 2021b). On fiscal balance, the assessment is to determine whether the near future GDP growth is going to be revenue-funded or debt-funded. Countries operating in fiscal deficit would naturally incur a higher debt burden. The debt to GDP ratio is employed to determine a country's debt capacity. In accordance with the SCRs methodology of CRAs, total debts are categorized into external and internal debts to gauge the near-term capacity and ability to service the external debts or foreign currency denominated debts. For this empirical study, fiscal balance and debt to GDP ratio are selected as proxies for this factor. The fiscal balance variable is expected to have a positive correlation while debt to GDP is expected to have a negative correlation with SCRs.

Susceptibility to External Events Factor – It is difficult to address this factor comprehensively because of the unknown macro events. From the CRAs' perspective (Moody's 2016, Poor's 2017, FitchRatings 2021b), the emphasis on this factor is to gauge whether a rated country with the given economic, institution and fiscal setup has the ability and capacity to continue servicing and/or repaying its debts under less favourable environment (e.g., Asia financial crisis 1997/1998, US Subprime crisis 2008/2009, European Debt Crisis 2010). The domestic financial system is one of the key inputs where the CRAs rely on, and the proxy on the domestic financial system is the corporate ratings of banks issued by respective CRAs. For this study, the financial development index sourced from IMF is selected as substitute for bank ratings unlike the government effectiveness index which is included in earlier studies (Mellios and Paget-Blanc 2006, Afonso, Gomes, and Rother 2011, Afonso, Gomes, and Rother 2009); the financial development index is being examined for the first time in this paper. The financial development index is expected to be positively correlated with SCRs. The descriptive statistics of the seven selected determinants are presented in Table 2.

Table 2: Descriptive statistics

	GDP Growth	GDP Per Capita	Gov. Effect. Ind.	Fin. Dev. Ind.	Debt to GDP	Fiscal Balance	Inflation
Minimum	-14.814	0.415	0.143	0.107	0.000	-29.900	-3.700
Median	3.091	14.343	0.771	0.513	46.350	-0.900	2.500
Maximum	25.117	103.059	1.000	1.000	236.400	45.500	85.700
Mean	3.232	22.044	0.740	0.533	54.793	-0.018	3.991
Standard deviation	3.419	19.646	0.196	0.220	35.534	7.768	6.478
No. of observations	1100	1100	1100	1100	1100	1100	1100

Note: The observations of 1100 are annual datapoints from year 1998 to 2017 of 55 selected countries. The economic variables GDP growth, GDP per capita, Gov. Effect. Ind. (Government Effectiveness Index), Fin. Dev. Ind. (Financial Development Index), debt to GDP, fiscal balance, and inflation are sourced from World Bank and cross-referenced from IMF on some missing datapoints. GDP per capita is in thousand USD. Fiscal balance is measured as a ratio to GDP.

3.2 Methodology

The SCRs of all three CRAs are sourced from Bloomberg and cross-referenced with Thomson Reuters. These categorical SCRs are first converted into an ordinal scale following the common convention adopted in similar studies (Afonso, Gomes, and Rother 2011, Bissondoyal-Bheenick 2005, Canuto, Santos, and Porto 2012, Hill, Brooks, and Faff 2010, Mellios and Paget-Blanc 2006, Reusens and Croux 2017, Cantor and Packer 1996). For this study, the broad ordinal scale is adopted and is presented in Table 3.

Since the alpha-numeric and alpha-symbol SCRs (i.e., Aaa/AAA, Aa1/AA+, Aa2/AA, Aa3/AA-, etc.) are categorical and ranked, a linear model such as the cross-section model adopted by Cantor and Packer (1996), Afonso (2003), and Rowland (2004) is not appropriate as pointed out by Wooldridge (2002). The ordinal scales of SCRs will likely cause the linearly estimated coefficients to be biased. The ordered response model (OPM) is a better method for handling the monotonous ranking feature and discreet characteristic of SCRs.

Table 3: List of ordinal scaled SCRs

Description	Moody's	S&P	Fitch	Broad Scale
Investment Grade				
Highest credit quality	Aaa	AAA	AAA	8
Very high credit quality	Aa1	AA+	AA+	7
	Aa2	AA	AA	7
	Aa3	AA-	AA-	7
High credit quality	A1	A+	A+	6
	A2	A	A	6
	A3	A-	A-	6
Good credit quality	Baa1	BBB+	BBB+	5
	Baa2	BBB	BBB	5
	Baa3	BBB-	BBB-	5
Speculative Grade				
Speculative	Ba1	BB+	BB+	4
	Ba2	BB	BB	4
	Ba3	BB-	BB-	4
Highly speculative	B1	B+	B+	3
	B2	B	B	3
	B3	B-	B-	3
Substantial credit risk	Caa1	CCC+		2
	Caa2	CCC	CCC	2
	Caa3	CCC-		2
Very high level of credit risk / Near default	Ca	CC	CC	1
	C		C	1
Default		SD	RD	1
		D	D	1

Note: Moody's does not provide rating on defaulted countries.
Source: *Bloomberg*

The OPM was first adopted by Bissondoyal-Bheenick (2005) to study determinants of SCRs. Mellios and Paget-Blanc (2006) examined the potential determinants of SCRs using ordered logit model. The work of Afonso, Gomes, and Rother (2009) examined the appropriateness of ordered probit, ordered logit, and random effect ordered probit for studying SCRs determinants. In a more recent paper, Reusens and Croux (2017) adopted the multi-year ordered probit model to study the time variation of SCRs determinants.

To study the variability of emphasis on the seven selected economic variables as proxies of the four key factors of SCRs amongst the three leading CRAs, the empirical regressions follow the ordered response model approach. The model is expressed in the following latent regression equation:

$$y_{it}^* = \beta' x_{it} + \varepsilon_{it} \tag{1}$$

for i in 1, …,N and t in 1, …,T, where N is the number of countries and T is the number of time periods, y_{it}^* is an unobserved latent variable of country i at time t, x_{it} is a vector of explanatory variables of country i at time t, β is a vector of unknown parameters at time t, and v_{it} is the error term of country i at time t. If the ordered probit model is chosen, then ε_{it} is assumed to be normally distributed. Otherwise, if the ordered logit model is employed, then ε_{it} is assumed to follow a logistic distribution.

The predicted variable y_i, which represents the predicted SCRs issued by Moody's, S&P and Fitch, is based on the following threshold specification:

$$y_{it} = \begin{cases} Aaa\,or\,AAA = 8 \ if \varepsilon_t^7 < y_i^* \\ Aa\,or\,AA = 7 \ if \varepsilon_t^6 < y_i^* \leq \varepsilon_t^7 \\ A\,or\,A = 6 \ if \varepsilon_t^5 < y_i^* \leq \varepsilon_t^6 \\ \vdots \\ Below\,Caa\,or\,CCC = 1 \ if y_i^* < \varepsilon_t^2 \end{cases} \tag{2}$$

where y_{it}^* is the unobserved latent variable related to y_{it}, and ε_t^n ($\varepsilon_t^1 < \varepsilon_t^2 < \varepsilon_t^3 < \cdots < \varepsilon_t^7$) denotes the estimated threshold parameters.

Therefore, the model to be estimated for studying the variability of emphasis on the seven selected economic variables amongst the three leading SCRs is expressed as follows:

$$y_{it} = \mu + \beta_1 GDPGrowth_{it} + \beta_2 GDPPerCapita_{it} + \beta_3 Gov.Effect.Ind._{it} + \beta_4 Inflation_{it} + \beta_5 FiscalBal._{it} + \beta_6 DebttoGDP._{it} + \beta_7 Fin.Dev.Ind._{it} + \varepsilon_{it}$$

$$\tag{3}$$

The estimation covers the period from 1998 to 2017. Both ordered probit and ordered logit models are estimated for comparison. Only the better fitted model is adopted for subsequent analysis.

Two further analyses are conducted. One of them is to examine the second variability of emphasis amongst the three CRAs between the investment grade and speculative grade SCRs. The variable y_{it} constitutes of only Aaa/AAA to Baa/BBB rated

countries for investment grade category, and countries rated with Ba/BB to Ca/CC for speculative grade, with t spanning from 1998 to 2017.

The third variability of emphasis amongst the three CRAs is compared between the investment grade and speculative grade for the pre- and post-GFC sub-periods. The pre-crisis period covers $t = 1998$ to 2007 and the post-crisis period covers $t = 2008$ to 2017.

4. Empirical Results

The empirical results for this study are derived using the full dataset and sub-datasets. The sub-datasets are clustered by investment-grade versus speculative-grade SCRs and by pre- and post- GFC periods. The results are compiled and reported in the following sub-sections.

4.1 Full Sample

The ordered probit and ordered logit models are estimated on the full sample of SCRs issued by Moody's, S&P, and Fitch. The results are compiled in Table 4. The results show that six out of seven selected economic variables are significant at 5% level and their coefficients have the expected signs on SCRs issued by all three CRAs. The variable fiscal balance is the only exception that is significant on SCRs issued by S&P and Fitch but insignificant on SCRs issued by Moody's. It is worth nothing that this determinant was proven significant in earlier studies (Cantor and Packer 1996, Bissondoyal-Bheenick 2005, Afonso, Gomes, and Rother 2011, Afonso, Gomes, and Rother 2009, Hill, Brooks, and Faff 2010).

The results of both the estimated ordered probit and ordered logit models are consistent. The results demonstrated that all the three leading CRAs determine their respective SCRs based on the four key factors: economics, institution, fiscal, and susceptibility to external events as specified in the proprietary rating methodologies (Moody's 2016, Poor's 2017, FitchRatings 2021b). The predictive power of the selected seven economic variables compiled in Table 5 show that the prediction accuracy is in the range of 56% to 61%, which is significantly higher as compared to the models examined by Afonso, Gomes, and Rother (2009) that have accuracy in the range of 36% to 47%, or the models examined by Reusens and Croux (2017) that have accuracy in the range of 17% to 39%.

Between the OPM and OLM, the results are consistent on both the selected determinants and the models' predictive power. However, the Pseudo R^2 and log likelihood values suggest that OLM has a better fit. The estimated OLM has also better

predictive power than OPM. Therefore, the subsequent analyses shall be conducted using the estimated OLM.

Table 4: Ordered probit model and ordered logit model estimates on SCRs by CRAs for the full sample.

Key Factors	Variables	Moody's		S&P		Fitch	
		OPM	OLM	OPM	OLM	OPM	OLM
Economics	GDP GROWTH	0.027*** (0.01)	0.058*** (0.019)	0.021** (0.01)	0.038** (0.019)	0.037*** (0.01)	0.074*** (0.02)
	GDP PER CAPITA	0.04*** (0.004)	0.086*** (0.008)	0.032*** (0.004)	0.063*** (0.007)	0.041*** (0.004)	0.086*** (0.008)
Institution	GOV EFFECT	3.976*** (0.316)	7.009*** (0.562)	4.923*** (0.330)	8.633*** (0.587)	4.17*** (0.325)	7.503*** (0.579)
	INFLATION	-0.035*** (0.006)	-0.069*** (0.011)	-0.043*** (0.006)	-0.082*** (0.011)	-0.036*** (0.006)	-0.071*** (0.011)
Fiscal	FISCAL BAL	0.428 (0.489)	0.001 (0.008)	2.299*** (0.486)	0.039*** (0.009)	2.12*** (0.482)	0.036*** (0.008)
	DEBT TO GDP	-0.016*** (0.001)	-2.817*** (0.209)	-0.015*** (0.001)	-2.555*** (0.202)	-0.014*** (0.001)	-2.558*** (0.200)
Susceptibility to External Events	FIN DEV	3.182*** (0.281)	5.301*** (0.507)	3.452*** (0.280)	5.753*** (0.507)	3.353*** (0.280)	5.82*** (0.517)
Pseudo R^2		0.412	0.422	0.441	0.445	0.435	0.451
Log likelihood		-1922	-1111	-1091	-1085	-1068	-1038

Note: The full sample consists of 55 countries for the period 1998-2017. The dependent variable is SCRs issued by Moody's, S&P, and Fitch that are converted into ordinal scale following the definition in Table 3. The abbreviations are: OPM = ordered probit model, OLM=ordered logit model, FISCAL BAL = fiscal balance, GOVT EFFECT=government effectiveness index, and FIN DEV = financial development index. Figures in parentheses are standard errors. ***, **, * indicate significance at 1, 5, and 10 percent level, respectively.

Table 5: Models' predictive power by CRAs

		Prediction Error by Notches							Obs.	Correctly Predicted
		> 2	2	1	0	-1	-2	<-2		
Moody's	OPM	12	45	170	649	208	16	0	1100	59%
	OLM	13	46	175	650	201	15	0	1100	59%
S&P	OPM	11	40	185	615	236	13	0	1100	56%
	OLM	11	41	190	632	216	10	0	1100	57%
Fitch	OPM	13	31	161	641	225	3	0	1074	60%
	OLM	15	30	168	653	206	2	0	1074	61%

Note: OPM = ordered probit model, OLM = ordered logit model, and Obs. = number of observations. Correctly predicted refers to the percentage of observations that are predicted with zero notch error.

4.2 Investment Grade versus Speculative Grade SCRs

The OLM estimates on investment grade and speculative grade SCRs for the three CRAs are compiled in Table 6. Among the seven selected economic variables, the government effectiveness index, inflation, debt to GDP, and financial development index are significant at 5% level. The coefficients have the anticipated signs, and the results are consistent for the investment as well as speculative grades across the three CRAs. GDP growth is significant at 10% level for both investment grade and speculative grade SCRs issued by Moody's only. Although GDP per capita is significant for all the three CRAs, but its coefficients for the speculative grade SCRS issued by all three CRAs do not have the positive sign as expected. Fiscal balance is significant at 5% level for both investment grade and speculative grade SCRs issued by S&P and Fitch but not Moody's. On speculative grade SCRs issued by S&P and Fitch, the estimated coefficients of fiscal balance are not positive as expected. Overall, the variables are significant and have the expected signs for investment grade, but the case is less obvious for speculative grade. These anomalies will be discussed further in Section 5.

Despite the highlighted variations in the results between the investment grade and speculative grade SCRs, the seven-determinant models' prediction power on investment grade SCRs ranges from 68% to 71%, and 81% to 87% for the speculative grade SCRs as reported in Table 7.

Table 6: Estimates on investment grade versus speculative grade SCRs by CRAs

Key Factors	Variables	Moody's		S&P		Fitch	
		Invest. Grade	Spec. Grade	Invest. Grade	Spec. Grade	Invest. Grade	Spec. Grade
Economics	GDP GROWTH	0.049* (0.026)	0.073* (0.043)	-0.035 (0.027)	0.047 (0.043)	0.008 (0.028)	0.054 (0.043)
	GDP PER CAPITA	0.081*** (0.009)	-0.061* (0.033)	0.045*** (0.008)	-0.251*** (0.063)	0.073*** (0.008)	-0.14*** (0.045)
Institution	GOV EFFECT	9.040*** (0.834)	5.393*** (1.470)	11.471*** (0.918)	7.241*** (1.558)	9.741*** (0.877)	5.635*** (1.552)
	INFLATION	-0.089** (0.038)	-0.052*** (0.013)	-0.109*** (0.042)	-0.08*** (0.014)	-0.126*** (0.042)	-0.060*** (0.013)
Fiscal	FISCAL BAL	0.003 (0.010)	-0.001 (0.029)	0.062*** (0.011)	-0.075** (0.035)	0.054*** (0.011)	-0.070** (0.033)
	DEBT TO GDP	-2.230*** (0.259)	-2.293*** (0.539)	-2.057*** (0.248)	-3.850*** (0.651)	-2.106*** (0.254)	-3.564*** (0.620)
Susceptibility to External Events	FIN DEV	4.887*** (0.611)	5.702*** (2.074)	5.424*** (0.617)	11.057*** (2.586)	5.357*** (0.623)	6.155*** (2.284)
Pseudo R^2		0.458	0.225	0.465	0.339	0.478	0.282
Log likelihood		-628	-148	-621	-131	-598	-129

Note: The dependent variable is SCRs issued by Moody's, S&P, and Fitch that are converted into ordinal scale following the definition in Table 3. Refers to Table 3 for investment and speculative grade classifications. The abbreviations are: Invest. Grade=investment grade, Spec. Grade=speculative grade, FISCAL BAL=fiscal balance, GOVT EFFECT=government effectiveness index, and FIN DEV=financial development index. Figures in parentheses are standard errors. ***, **, * indicate significance at 1, 5, and 10 percent level, respectively.

Table 7: Models' predictive power on investment grade versus speculative grade SCRs by CRAs

		Prediction Error by Notches							**Obs.**	**Correctly Predicted**
		> 2	**2**	**1**	**0**	**-1**	**-2**	**<-2**		
Moody's	Invest. Grade	7	20	102	612	114	7	0	862	71%
	Spec. Grade	4	1	36	193	3	1	0	238	81%
S&P	Invest. Grade	1	25	116	574	123	8	0	847	68%
	Spec. Grade	6	4	21	221	1	0	0	253	87%
Fitch	Invest. Grade	3	21	97	589	127	2	0	839	70%
	Spec. Grade	7	3	21	198	6	0	0	235	84%

Note: Invest. Grade = investment grade, Spec. Grade = speculative grade, and Obs. = number of observations. Correctly predicted refers to the percentage of observations that are predicted with zero notch error. The estimates are from the ordered logit model.

Table 8: Estimates on investment grade SCRs by CRAs for pre- and post-GFC.

Key Factors	Variables	**Moody's**		**S&P**		**Fitch**	
		Pre-GFC	**Post-GFC**	**Pre-GFC**	**Post-GFC**	**Pre-GFC**	**Post-GFC**
Economics	GDP GROWTH	0.118** (0.051)	-0.027 (0.034)	-0.1** (0.049)	-0.045 (0.035)	0.045 (0.050)	-0.083** (0.035)
	GDP PER CAPITA	0.195*** (0.020)	0.068*** (0.012)	0.110*** (0.016)	0.047*** (0.011)	0.140*** (0.017)	0.073*** (0.012)
Institution	GOV EFFECT	9.517*** (1.465)	8.155*** (1.217)	11.856*** (1.553)	10.517*** (1.325)	8.319*** (1.399)	9.434*** (1.353)
	INFLATION	-0.167*** (0.065)	-0.059 (0.052)	-0.175*** (0.067)	-0.109* (0.059)	-0.186*** (0.065)	-0.13** (0.059)
Fiscal	FISCAL BAL	-0.058*** (0.016)	0.029* (0.015)	0.031** (0.016)	0.073*** (0.016)	0.032** (0.015)	0.067*** (0.016)
	DEBT TO GDP	-1.240*** (0.470)	-2.493*** (0.339)	-1.164*** (0.429)	-2.404*** (0.334)	-1.318*** (0.434)	-2.470*** (0.340)
Susceptibility to External Events	FIN DEV	5.203*** (1.044)	4.639*** (0.820)	6.867*** (1.051)	4.559*** (0.834)	5.663*** (0.994)	5.248*** (0.869)
Pseudo R^2		0.581	0.440	0.557	0.454	0.530	0.500
Log likelihood		-228	-340	-244	-331	-248	-304

Note: The dependent variable is SCRs issued by Moody's, S&P, and Fitch that are converted into ordinal scale following the definition in Table 3. Refers to Table 3 for the investment grade classification. Pre-GFC includes observations from 1998 to 2007, and post-GFC includes observations from 2008 to 2017. The abbreviations are: FISCAL BAL=fiscal balance, GOVT EFFECT=government effectiveness index, and FIN DEV=financial development index. Figures in parentheses are standard errors. ***, **, * indicate significance at 1, 5, and 10 percent level, respectively. The estimates are from the ordered logit model.

4.3 Investment Grade versus Speculative Grade SCRs for Pre- and Post-GFC

Table 8 reports the estimated results of the OLM model for explaining the investment grade SCRs issued by Moody's, S&P, and Fitch in the pre- and post GFC context. The results show that four out of seven selected economic variables are significant at 5% level and with the anticipated signs for all the three CRAs and both sub-periods. These four variables are GDP per capita, government effectiveness index, debt to GDP, and financial development index. GDP growth is of the right sign and significant only for the SCRs issued by Moody's in the pre-GFC period. Inflation has the expected negative sign, and it is significant for the pre-GFC period. In the post-GFC period, inflation is significant only for the SCRs issued by Fitch. The estimated coefficient of fiscal balance is significant at 5% level with the expected positive sign for all the cases except the SCRs issued by Moody's. Generally, apart from the GDP growth variable, the model works well for all the three CRAs and for both the pre- and post-GFC periods.

There are more variations of emphasis on the selected economic variables in explaining the speculative grade SCRs issued by Moody's, S&P, and Fitch in the pre- and post- GFC periods as reported in Table 9. None of the seven selected economic variables are consistently significant with the anticipated signs. GDP growth is only significant at 5% with positive sign for the SCRs issued by Moody's. The estimated coefficients of GDP per capita have the wrong sign for explaining the SCRs, irrespective of the CRAs and pre- or post-GFC periods. The estimated coefficients of government effectiveness index are significant with the expected positive sign on the SCRs issue by the three CRAs but mainly in the post-GFC context. On the contrary, the estimated coefficients of inflation are significant across all the three CRAs but only in the pre-GFC period. Fiscal balance has the wrong sign throughout. The estimated coefficients of debt to GDP are mainly significant in the pre-GFC period but insignificant in the post-GFC period except for the SCRS issued by Fitch. The estimated coefficients of financial development index are significant at 5% level with the anticipated positive sign except for the SCRs issued by Moody's in the pre-GFC period. While more variables are pertinent for explaining the SCRs in the pre-GFC period, the results remain clear that the government effectiveness index and financial development index are the main important determinants for SCRs evaluation in the post-GFC period.

Table 9: Estimates on speculative grade SCRs by CRAs for pre- and post-GFC.

Key Factors	Variables	Moody's		S&P		Fitch	
		Pre-GFC	Post-GFC	Pre-GFC	Post-GFC	Pre-GFC	Post-GFC
Economics	GDP GROWTH	0.106**	0.078	0.085	0.08	0.064	0.057
		(0.052)	(0.102)	(0.067)	(0.079)	(0.057)	(0.075)
	GDP PER CAPITA	-0.271**	-0.335***	-0.439**	-0.393***	-0.394**	-0.213***
		(0.122)	(0.095)	(0.173)	(0.116)	(0.157)	(0.065)
Institution	GOV EFFECT	2.562	19.713***	5.12**	15.316***	2.565	11.106***
		(2.080)	(4.781)	(2.495)	(3.676)	(2.364)	(3.209)
	INFLATION	-0.061***	-0.069	-0.109***	-0.013	-0.071***	-0.016
		(0.015)	(0.061)	(0.021)	(0.054)	(0.016)	(0.055)
Fiscal	FISCAL BAL.	-0.002	-0.029	-0.162**	-0.019	-0.150**	-0.109*
		(0.046)	(0.068)	(0.073)	(0.065)	(0.063)	(0.057)
	DEBT TO GDP	-2.502***	-0.938	-5.252***	-1.146	-4.129***	-3.805**
		(0.665)	(1.806)	(1.018)	(1.619)	(0.834)	(1.497)
Susceptibility to External Events	FIN DEV	2.538	19.418***	9.188**	22.993***	6.623*	9.07**
		(2.617)	(6.971)	(3.727)	(7.597)	(3.393)	(4.011)
Pseudo R^2		0.216	0.472	0.442	0.417	0.332	0.33
Log likelihood		-86	-42	-59	-54	-68	-51

Note: The dependent variable is SCRs issued by Moody's, S&P, and Fitch that are converted into ordinal scale following the definition in Table 3. Refers to Table 3 for the speculative grade classification. Pre-GFC includes observations from 1998 to 2007, and post-GFC includes observations from 2008 to 2017. The abbreviations are: FISCAL BAL=fiscal balance, GOVT EFFECT=government effectiveness index, and FIN DEV=financial development index. Figures in parentheses are standard errors. ***, **, * indicate significance at 1, 5, and 10 percent level, respectively. The estimates are from the ordered logit model.

Table 10: Models' predictive power on investment grade versus speculative grade SCRs by CRAs for pre- and post-GFC.

			Prediction Error by Notches							Obs.	Correctly Predicted
			> 2	2	1	0	-1	-2	<-2		
Moody's	**Invest. Grade**	Pre-GFC	0	2	27	260	73	45	7	414	63%
		Post-GFC	11	14	38	276	74	34	1	448	62%
	Spec. Grade	Pre-GFC	0	2	28	111	1	0	0	142	78%
		Post-GFC	0	3	5	84	4	0	0	96	88%
S&P	**Invest. Grade**	Pre-GFC	0	6	41	227	82	41	5	402	56%
		Post-GFC	6	16	53	258	69	42	1	445	58%
	Spec. Grade	Pre-GFC	1	2	11	133	2	0	0	149	89%
		Post-GFC	3	4	5	87	4	1	0	104	84%
Fitch	**Invest. Grade**	Pre-GFC	0	3	50	216	80	45	1	395	55%
		Post-GFC	14	14	52	272	75	17	0	444	61%
	Spec. Grade	Pre-GFC	1	3	13	119	3	0	0	139	86%
		Post-GFC	2	4	7	80	3	0	0	96	83%

Note: Invest. Grade=investment grade, Spec. Grade=speculative grade, and Obs. = number of observations. Pre-GFC includes observations from 1998 to 2007, and post-GFC includes observations from 2008 to 2017. Correctly predicted refers to the percentage of observations that are predicted with zero notch error. The estimates are from the ordered logit model.

The seven-determinant OLM models explain investment grade SCRs with a prediction accuracy in the range of 62% to 63% for SCRs issued by Moody's, 56% to 58% for SCRs issued by S&P, and 55% to 61% for SCRs issued by Fitch as reported in Table 10. Although there are greater variations of emphasis on the determinants for explaining the speculative grade SCRs, the OLM models generated better prediction accuracy in the range of 78% to 88% for SCRs issued by Moody's, 84% to 89% for SCRs issued by S&P, and 83% to 86% for SCRs issued by Fitch.

5. Discussion

The estimated results from the OLM reported in Section 4 are summarized in Table 11. The results show that the seven selected economic variables that represent the four key factors of economics, institution, fiscal position, and susceptibility to external events generally explain the determinations of SCRs by the three leading CRAs from 1998 to 2017. Variations in the emphasis by the three CRAs on the factors that determine SCRs, however, occur when detailed breakdown is analysed.
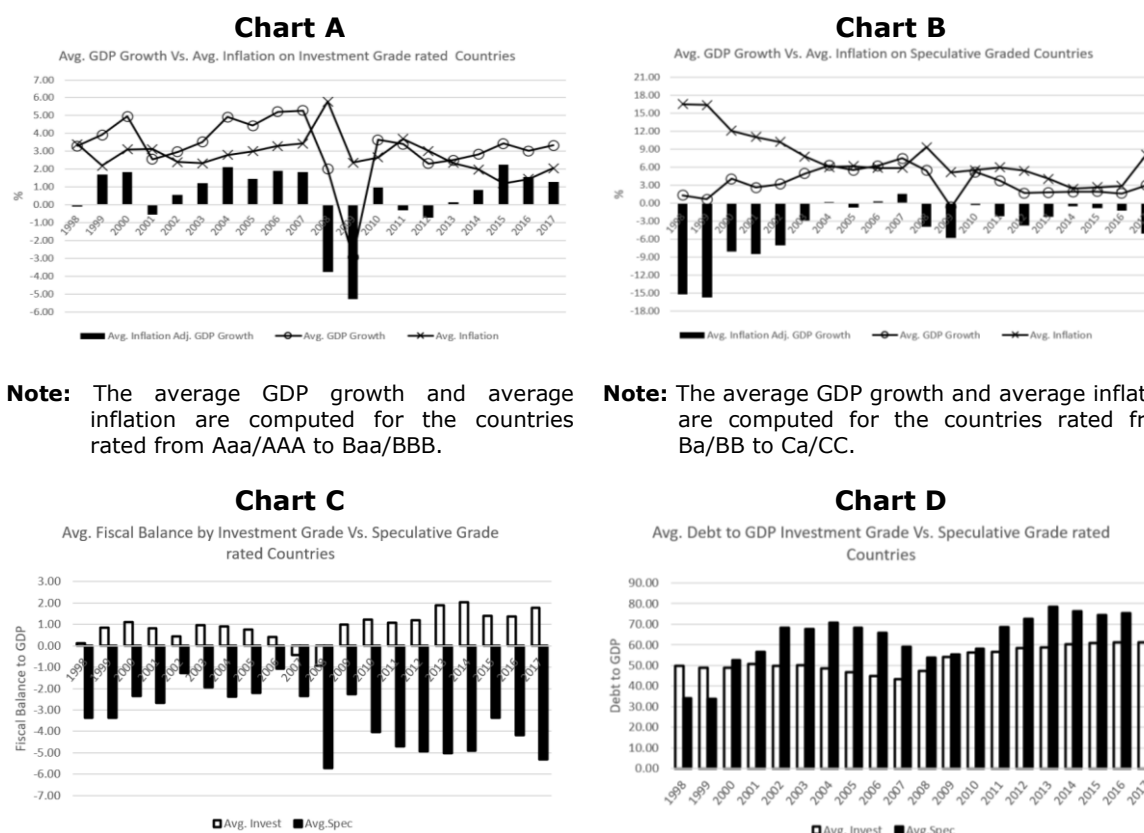
A comparison between investment grade SCRs (i.e., Aaa/AAA to Baa/BBB) versus speculative grade SCRs (i.e., Ba/BB to Ca/CC) show that there are less statistically significant determinants reported on speculative grade SCRs as compared to investment grade SCRs. GDP per capita and fiscal balance are the two variables that lost their significance. The insignificance of GDP growth occurs for both the investment and speculative grades, but the insignificance of fiscal balance affects mainly the SCRs that are speculative grades. GDP per capita remains relevant for explaining the SCRs of the investment grade rated countries, but not the countries with speculative grades. These are new insights regarding the determinants of investment versus speculative grade SCRs that are missing from earlier studies such as Afonso et al. (2009), Afonso et al. (2011), Bissondoyal-Bheenick (2005), Ferri et al. (1999), and Reusens and Croux (2017).

When the time dimension of pre- and post-GFC is included in the analysis, the variations of emphasis on the determinants of SCRs amongst the CRAs and between the investment grade and speculative grade SCRs are more revealing. On the pre-GFC investment grade SCRs, all the seven determinants are generally significant at 5% level with the expected signs except in very few cases that are due to GDP growth. In the post-GFC period, GDP growth and inflation become insignificant or have the wrong sign for explaining investment grade SCRs issued by at least one of the CRAs.

Table 11: Summary of the significance and signs of coefficients for the OLM estimates.

Factor:	Economics		Institution		Fiscal		Susceptibility to External Events	Correctly Predicted %
Variables:	GDP GROWTH	GDP PER CAPITA	GOV EFFECT	INFLATION	FISCAL BAL	DEBT TO GDP	FIN DEV	
Moody's	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**59%**
Invest. Grade	**No**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**71%**
Pre-GFC	Yes	Yes	Yes	Yes	No	Yes	Yes	63%
Post-GFC	No	Yes	Yes	No	No	Yes	Yes	62%
Spec. Grade	**No**	**No**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**81%**
Pre-GFC	Yes	No	No	Yes	No	Yes	No	78%
Post-GFC	No	No	Yes	No	No	No	Yes	88%
S&P	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**57%**
Invest. Grade	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**68%**
Pre-GFC	No	Yes	Yes	Yes	Yes	Yes	Yes	56%
Post-GFC	No	Yes	Yes	No	Yes	Yes	Yes	58%
Spec. Grade	**No**	**No**	**Yes**	**No**	**No**	**Yes**	**Yes**	**87%**
Pre-GFC	No	No	Yes	Yes	No	Yes	Yes	89%
Post-GFC	No	No	Yes	No	No	No	Yes	84%
Fitch	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**61%**
Invest. Grade	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**70%**
Pre-GFC	No	Yes	Yes	Yes	Yes	Yes	Yes	55%
Post-GFC	No	Yes	Yes	Yes	Yes	Yes	Yes	61%
Spec. Grade	**No**	**No**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**84%**
Pre-GFC	No	No	No	Yes	No	Yes	Yes	86%
Post-GFC	No	No	Yes	No	No	Yes	Yes	83%

Note: This table summarizes the results from Tables 4, 5, 8 and 9. The label "Yes" means the estimated coefficient is significant with the correct sign, and "No" means the estimated coefficient is not significant or has the wrong sign. Pre-GFC includes observations from 1998 to 2007, while post-GFC includes observations from 2008 to 2017. The abbreviations are Invest. Grade=Investment Grade, Spec. Grade=Speculative Grade, GOV EFFECT= government effectiveness index, FISCAL BAL=fiscal balance, and FIN DEV=financial development index.

Figure 1: GDP growth, inflation, fiscal balance, and debt to GDP ratio

Chart A

Avg. GDP Growth Vs. Avg. Inflation on Investment Grade rated Countries

Note: The average GDP growth and average inflation are computed for the countries rated from Aaa/AAA to Baa/BBB.

Chart B

Avg. GDP Growth Vs. Avg. Inflation on Speculative Graded Countries

Note: The average GDP growth and average inflation are computed for the countries rated from Ba/BB to Ca/CC.

Chart C

Avg. Fiscal Balance by Investment Grade Vs. Speculative Grade rated Countries

Note: The average fiscal balance is computed for countries rated from Aaa/AAA to Baa/BBB (investment grade), and countries rated from Ba/BB to Ca/CC (speculative grade).

Chart D

Avg. Debt to GDP Investment Grade Vs. Speculative Grade rated Countries

Note: The average debt to GDP ratio is computed for countries rated from Aaa/AAA to Baa/BBB (investment grade), and countries rated from Ba/BB to Ca/CC (speculative grade).

Table 12: GDP growth as the level of debt to GDP clusters

Debt to GDP Clusters:		Below 30%		30% to 60%		61% to 90%		Above 90%	
		No. of Countries	GDP Growth	No. of Countries	GDP Growth	No. of Countries	GDP Growth	No. of Countries	GDP Growth
Benchmark: 1946 to 2009[#]									
Advanced Economies	Mean	20	4.1	20	2.8	20	2,8	20	-0.1
	Median		4.2		3.0		2.9		1.6
Emerging Economies	Mean	24	4.3	24	4.8	24	4.1	24	1.3
	Median		5.0		4.7		4.6		2.9
Sample of 55 Countries									
1998 to 2007	Mean	12	5.6	30	3.8	8	3.7	5	2.1
	Median		4.0		3.9		3.7		3.7
2008 to 2017	Mean	7	2.7	26	2.7	15	2.0	7	1.5
	Median		1.9		1.9		1.9		1.9

Note: [#] The Mean and Median of the Benchmark are restated from Reinhart and Rogoff (2010). The Mean and Median derived from the sample of 55 countries are listed in Table 1.

This evidence of insignificance or the wrong sign is even stronger for countries assigned with the speculative grades. The findings contradicted with the earlier studies (Reusens and Croux 2017, Afonso, Gomes, and Rother 2011, Afonso, Gomes, and Rother 2009, Bissondoyal-Bheenick 2005, Ferri, Liu, and Stiglitz 1999) that did not analyse the same breakdown. The potential explanation could be deduced from Chart A in Figure 1. Since 2008, the average inflation had been under deflationary pressure from 6% in 2008 to about 1% in 2015, and the average growth rate that barely recovered from the contraction recorded in 2008 and 2009 was treading the average inflation trend. This observation is reinforced by comparing the GDP growth rate of the countries included in this study with the benchmark GDP growth rate computed by Reinhart and Rogoff (2010) for different debt to GDP categories as shown in Table 12. Growth has been suppressed by high debt to GDP ratio, and the situation has worsened after the GFC. In the post-GFC period, the countries that are given speculative grades have inflation rates that exceed their growth rates (see Chart B, Figure 1). The empirical outcome on inflation becoming insignificant in explaining SCRs is aligned with the finding reported by Reusens and Croux (2017).

Fiscal balance is significant for explaining the SCRs of the countries with investment grades issued by two of the CRAs. The variable, however, has no significant explanatory power for both the pre-and post-crisis speculative grades. The results are not aligned with the claim presented by Boumparis, Milas, and Panagiotidis (2015) that did not distinguish the two categories of SCRs. Chart C in Figure 1 shows that the countries rated with speculative grades experienced fiscal deficits which became worse after the GFC. This led to high debt to GDP ratios as shown in Chart D.
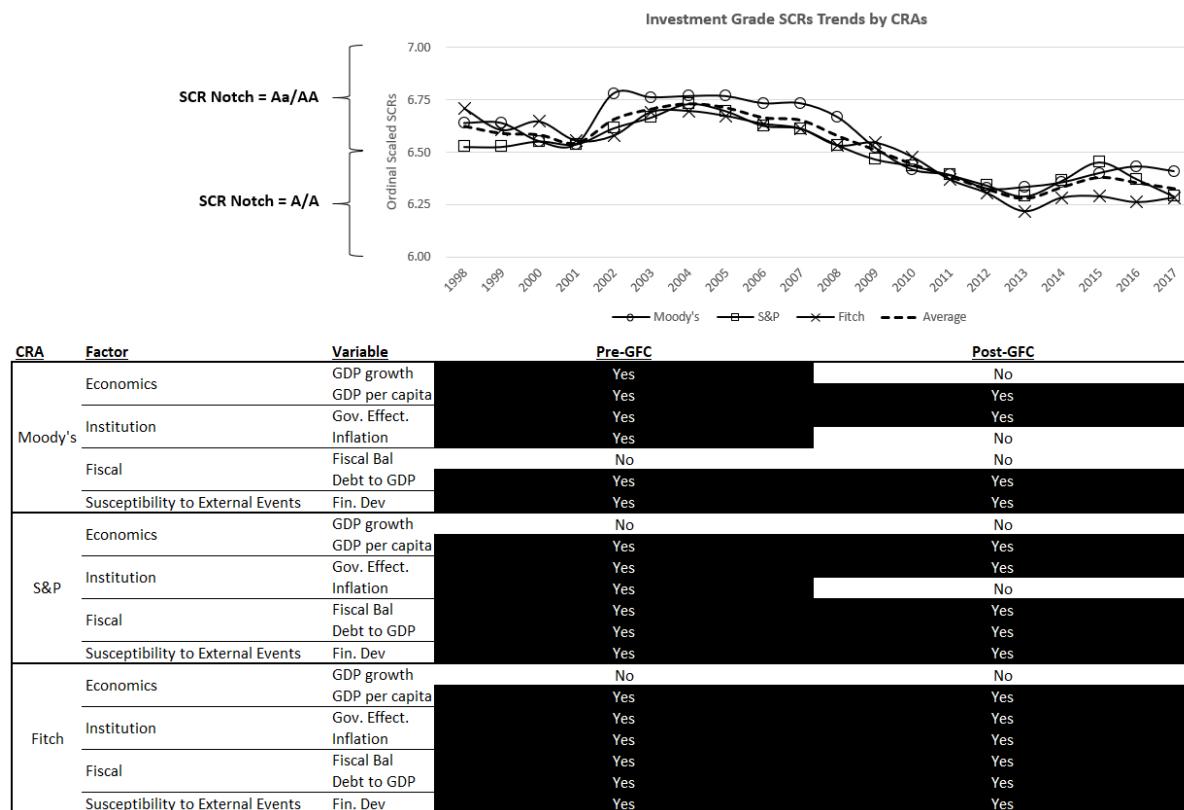
These high ratios reveal the reasons to the insignificance of the debt to GDP ratio for explaining the speculative grade SCRs issued by two CRAs post-GFC. The results are contrary to those reported by Giacomino (2013), Boumparis, Milas, and Panagiotidis (2015), Amstad and Packer (2015), and Reusens and Croux (2017) that the debt to GDP ratio had become more significant in post-GFC. These studies, however, did not examine the difference between investment versus speculative grades. It could be conjectured that the speculative grade rated countries already exceeded the debts burden threshold of 70% since 2012 as depicted in Chart D. According to Reinhart and Rogoff (2010), countries with debt to GDP ratio in excess of 60% are classified as high debt countries with approximately two thirds maximum threshold on external debts.

This could also be the reason that why government effectiveness index and financial development index remain significant post-GFC for explaining the issuance of SCRs by all the three CRAs. This argument is especially true for the countries of speculative grades where all the other five variables have generally failed to explain their SCRs after the GFC. These suggest that the speculative grade rated countries' ability to service and repay their debts, as expected from all the three leading CRAs,

can only come from a sound revenue collection (e.g., taxation) and domestic financial system.

The summary in Figure 2 shows an overall downgrade trend in the SCRs of the investment grade countries in the post-GFC period. Although there were variations in emphasis in terms of variable significance, it remains clear that all the four key factors of economics, institution, fiscal position, and susceptibility to external events remain relevant to the three CRAs in assessing the creditworthiness of investment grade rated countries. This suggests that investment grade rated countries have more avenues to address their debt burden in CRAs' perspectives. Any future changes in the SCRs of investment grade rated countries hinge on the country's ability to juggle among the four key factors.
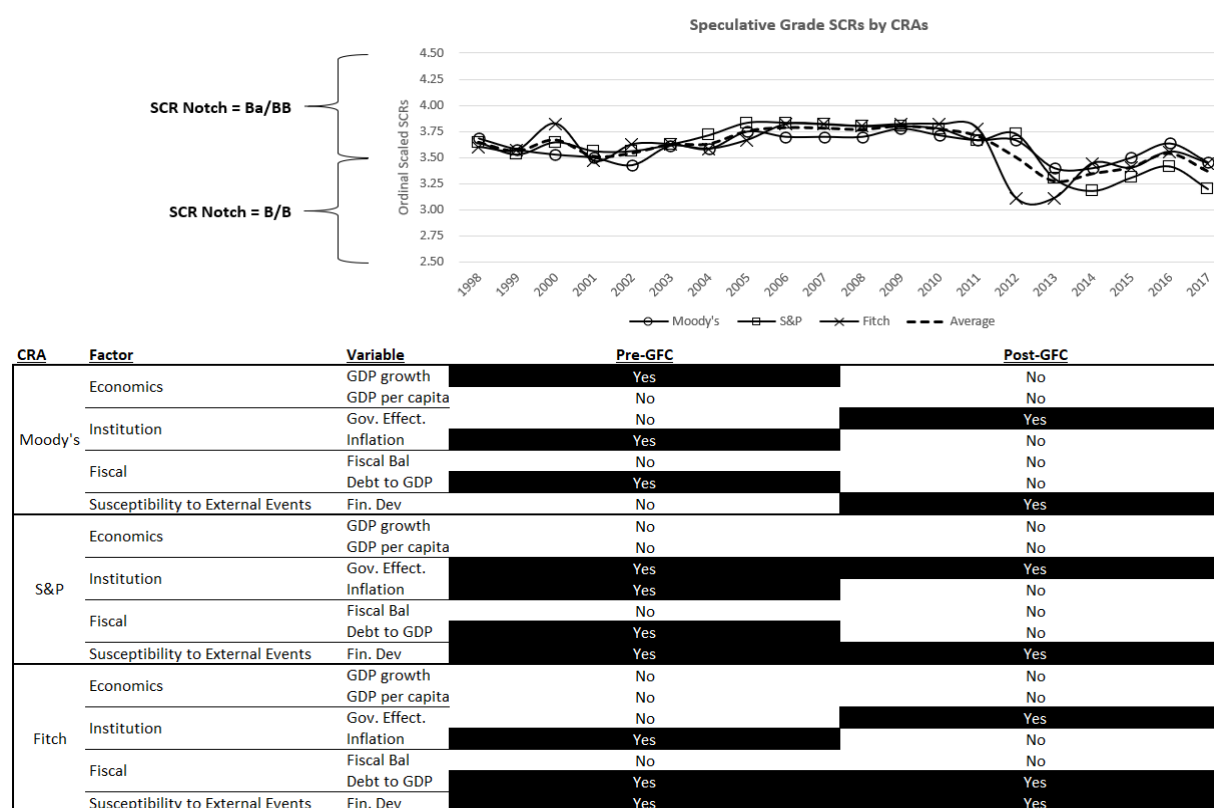
Figure 2: Trends and determinants by CRAs for investment grade SCRs

CRA	Factor	Variable	Pre-GFC	Post-GFC
Moody's	Economics	GDP growth	Yes	No
		GDP per capita	Yes	Yes
	Institution	Gov. Effect.	Yes	Yes
		Inflation	Yes	No
	Fiscal	Fiscal Bal	No	No
		Debt to GDP	Yes	Yes
	Susceptibility to External Events	Fin. Dev	Yes	Yes
S&P	Economics	GDP growth	No	No
		GDP per capita	Yes	Yes
	Institution	Gov. Effect.	Yes	Yes
		Inflation	Yes	No
	Fiscal	Fiscal Bal	Yes	Yes
		Debt to GDP	Yes	Yes
	Susceptibility to External Events	Fin. Dev	Yes	Yes
Fitch	Economics	GDP growth	No	No
		GDP per capita	Yes	Yes
	Institution	Gov. Effect.	Yes	Yes
		Inflation	Yes	Yes
	Fiscal	Fiscal Bal	Yes	Yes
		Debt to GDP	Yes	Yes
	Susceptibility to External Events	Fin. Dev	Yes	Yes

Note: The average investment grade SCRs trend by CRAs are computed for the countries rated from Aaa/AAA to Baa/BBB. This figure summarizes the results from Table 8. The label "Yes" means the estimated coefficient is significant with the correct sign, and "No" means the estimated coefficient is not significant or has the wrong sign. Pre-GFC includes observations from 1998 to 2007, while post-GFC includes observations from 2008 to 2017. The abbreviations are GOV EFFECT=government effectiveness index, FISCAL BAL=fiscal balance, and FIN DEV=financial development index.

For speculative grade rated countries, there was a slight improvement on the overall creditworthiness observable in the pre-GFC period, but it was marginal and short-lived as shown in Figure 3. In the post-GFC period, the average creditworthiness of the speculative grade rated countries deteriorated from Ba/BB to B/B. Only government effectiveness index and financial development index are significant determinants in explaining speculative grade SCRs issued by all three CRAs. They relate to only two out of the four key factors, i.e., institution and susceptibility to external events. This reiterates the earlier suggestion that speculative grade rated countries could only rely on domestic avenues to address the overstretched debt burden and a sound financial system that can withstand external shocks. This means the conditions such as fiscal austerity, taxation, potential political stability, and the capacity of the domestic financial system would determine the likelihood of a sovereign default.

Figure 3: Trends and determinants by CRAs for speculative grade SCRs

CRA	Factor	Variable	Pre-GFC	Post-GFC
Moody's	Economics	GDP growth	Yes	No
		GDP per capita	No	No
	Institution	Gov. Effect.	No	Yes
		Inflation	Yes	No
	Fiscal	Fiscal Bal	No	No
		Debt to GDP	Yes	No
	Susceptibility to External Events	Fin. Dev	No	Yes
S&P	Economics	GDP growth	No	No
		GDP per capita	No	No
	Institution	Gov. Effect.	Yes	Yes
		Inflation	Yes	No
	Fiscal	Fiscal Bal	No	No
		Debt to GDP	Yes	No
	Susceptibility to External Events	Fin. Dev	Yes	Yes
Fitch	Economics	GDP growth	No	No
		GDP per capita	No	No
	Institution	Gov. Effect.	No	Yes
		Inflation	Yes	No
	Fiscal	Fiscal Bal	No	No
		Debt to GDP	Yes	Yes
	Susceptibility to External Events	Fin. Dev	Yes	Yes

Note: The average speculative grade SCRs trend by CRAs are computed for the countries rated from Ba/BB to Ca/CC. This figure summarizes the results from Table 9. The label "Yes" means the estimated coefficient is significant with the correct sign, and "No" means the estimated coefficient is not significant or has the wrong sign. Pre-GFC includes observations from 1998 to 2007, while post-GFC includes observations from 2008 to 2017. The abbreviations are GOV EFFECT=government effectiveness index, FISCAL BAL=fiscal balance, and FIN DEV = financial development index.

6. Conclusion

This paper used a sample of 55 countries that constituted of developed and developing countries that are multi-rated by Moody's, S&P and Fitch to examine the determinants of their SCRs for comparing the variability of emphasis amongst the three CRAs. Seven determinants representing the economics, institution, fiscal, and susceptibility to external event factors that were proven statistically significant in earlier studies were considered. These determinants are GDP growth, GDP per capita, government effectiveness index, inflation, fiscal balance, debt to GDP, and financial development index. The financial development index being introduced for the first time as proxy on susceptibility to external event factor has proven to be a robust determinant on SCRs issued by all three CRAs.

The results show that the seven determinants are all significant and have the expected signs in explaining the SCRs issued by all the three CRAs for the period 1998 to 2017. These variables continue to be reliable determinants of SCRs. Since the examined determinants do not deviate much from the set of determinants employed by Cantor and Packer (1996), there is no strong evidence indicating that CRAs have changed their respective rating methodology in the post-GFC period as suggested by some earlier studies (Reusens and Croux 2017, Amstad and Packer 2015).

Variations in the emphasis placed on the determinants, however, are revealed when a comparison is made between the investment grade and speculative grade SCRs. Overall, four out of the seven determinants are statistically significant and consistent in explaining both the grade categories issued by all three CRAs. These variables are government effectiveness index, inflation, debt to GDP, and financial development index. GDP growth becomes insignificant for SCRs issued by all the three CRAs, irrespective of investment grade or speculative grade SCRs. GDP per capita and fiscal balance remain significant for the investment grade SCRs issued by all and two of the CRAs, respectively, but they are not significant for the speculative grade SCRs issued by any CRAs. Despite lesser statistically significant determinants particularly for the speculative grade SCRs, the seven-determinant OLM model demonstrated good predictive accuracy. These results indicate that all three CRAs impose different emphasis between investment grade and speculative grade on SCRs determination.

Further variations are displayed when the pre- and post-GFC periods are compared. GDP growth had some relevance in the pre-crisis period only for Moody's SCRs, but not in all other cases. The variables that lost their significance include inflation in the post-GFC period for both the investment and speculative grade SCRs, and debt to GDP ratio in the post-GFC period for speculative grade SCRs issued by two CRAs. The government effectiveness index has shown to be a more important determinant in the post-GFC period as compared to the pre-GFC period for the speculative grade SCRs.

Economic growth slowed down after the GFC. It affected all the countries, and more so on those given speculative grades. The speculative graded countries also suffered severe budget deficits, and inflation outstripped their GDP growth. The debt burden was at the alarming level of 60% and above 70% for investment grade and speculative grade rated countries, respectively. These conditions explain why the CRAs has shifted their emphasis away from GDP growth and inflation for investment grade SCRs determination and these two variables as well as the debt to GDP and fiscal balance for speculative grade SCRs determination especially in the post-GFC period. Although the financial development index and the government effectiveness index remain significant for both the investment and speculative grade SCRs issued by the three CRAs, the latter emerges to be a more important determinant in the post-crisis than pre-crisis period for the speculative grade SCRs.

While the seven-determinant model's predictive power on investment grade and speculative grade SCRs remains robust in pre- and post-GFC context, the empirical estimates indicated that all three leading CRAs have aligned their emphasis on debt burden in post-GFC. This means going forward the emphasis for investment grade rated countries is on debt management as indicated by debt to GDP becoming more significant in post-GFC. For speculative grade rated countries, government effectiveness index and financial development index becoming more significant in post-GFC period indicated that all the three CRAs expect the country's ability to service and repay the debts to be sourced domestically through the revenue collection system (e.g., taxation) and domestic financial system. These suggest that there could be more SCRs downgrades among the investment grade rated countries and potential default among the speculative grade countries in the horizon if the debt to GDP ratio does not improve, there is a slack in government effectiveness and a sound financial system cannot be maintained. These are critical insights for policy makers and institutional investors.

Despite the usefulness of the seven-determinant OLM model for explaining and predicting SCRs issued by Moody's, S&P, and Fitch, the seven-determinant model cannot be construed as complete proxy of SCRs. This is because the selected variables, like those in earlier studies, only represent the subset of the inputs of publicly available information component. The non-disclosure-agreement information and the proprietary sovereign credit rating methodology components of the SCRs function as suggested by Moody's (2016), Poor's (2017), and FitchRating (2021b) are not represented. The pro-cyclicality and potential endogeneity between assigned SCRs and SCRs determinants as highlighted in earlier studies (Ferri, Liu, and Stiglitz 1999, Giacomino 2013, Chen, Chen, Chang, et al. 2016, Chen, Chen, Yang, et al. 2016) are not explicitly addressed in this paper.

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Appendix

A robustness check is presented by estimating equation (3) with y_{it} redefined as SCRs that are converted into 21 fine ordinal scales (i.e., Aaa/AAA = 21, Aa1/AA+ = 20, Aa2/AA = 19, and so on) following the convention adopted in the work of Bissondoyal-Bheenick (2005), Boumparis, Milas, and Panagiotidis (2015), and Reusens and Croux (2017) in Model 1. In Model 2, the reserves to GDP ratio is introduced as additional regressor to the original set of seven determinants while maintaining the y_{it} as SCRs converted into 8 broad ordinal scales as defined in Table 3.The results reported in Table A1 on the estimated coefficients are consistent with the main model of the paper in Table 4. All the seven determinants are significant at 5% level (except for one case) and have the expected signs in Model 1. The estimated coefficients of reserves to GDP ratio, the additional regressor, are insignificant or have the wrong sign.

The predictive power of Model 1 is shown in Table A2. The seven-determinant model has a predictive accuracy in the range of 30% to 32% for predictions with zero notch error, and the range of 54% to 55% for predictions with one notch error. Given that finer scales are used in Model 1, the results are largely robust.

Table A1: Ordered logit model estimates on Model 1 and Model 2.

Key Factors	Variables	Moody's		S&P		Fitch	
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
conomics	GDP GROWTH	0.049*** (0.018)	0.060*** (0.019)	0.052*** (0.018)	0.037* (0.019)	0.060*** (0.018)	0.079*** (0.020)
	GDP PER CAPITA	0.086*** (0.007)	0.084*** (0.008)	0.07*** (0.007)	0.063*** (0.007)	0.086*** (0.007)	0.083*** (0.008)
Institution	GOV EFFECT	7.293*** (0.519)	7.002*** (0.563)	8.225*** (0.528)	8.636*** (0.587)	7.609*** (0.531)	7.500*** (0.581)
	INFLATION	-0.059*** (0.009)	-0.07*** (0.012)	-0.069*** (0.009)	-0.082*** (0.011)	-0.066*** (0.009)	-0.075*** (0.011)
Fiscal	FISCAL BAL	0.385 (0.786)	0.257 (0.858)	3.253*** (0.804)	3.847*** (0.861)	3.354*** (0.812)	3.878*** (0.860)
	DEBT TO GDP	-0.027*** (0.002)	-0.028*** (0.002)	-0.027*** (0.002)	-0.026*** (0.002)	-0.027*** (0.002)	-0.025*** (0.002)
Susceptibility to External Events	FIN DEV	5.248*** (0.477)	5.306*** (0.507)	5.947*** (0.472)	5.755*** (0.508)	5.919*** (0.483)	5.835*** (0.516)
	RESERVES TO GDP		-0.351 (0.387)		0.093 (0.383)		-0.777** (0.383)
	Pseudo R-squared	0.31	0.422	0.321	0.445	0.332	0.452
	Log likelihood	-1904	-1110	-1938	-1085	-1827	-1036

Note: In Model 1, the dependent variables of SCRs issued by Moody's, S&P, and Fitch are converted into 21 fine ordinal scales (i.e., Aaa/AAA = 21, Aa1/AA+=20, Aa2, AA=19, and so on). In Model 2, the SCRs are converted into 8 broad ordinal scales following the convention defined on Table 3 and the reserves to GDP ratio is introduced as an additional regressor.   The abbreviations are: FISCAL_BAL=fiscal balance, GOVT_EFFECT=government effectiveness index, and FIN_DEV=financial development index. Figures in parentheses are standard errors. ***, **, * indicate significance at 1, 5, and 10 percent level, respectively.

Table A2: Summary of models' predictive power for Model 1

	Prediction Error by Notches $(y_{it}^* - y_{it})$							Obs.	Correctly Predicted by Notch Error		
	> 2	2	1	0	-1	-2	<-2		0	+/- 1	+/- 2
Moody's	269	151	151	352	103	51	23	1100	32%	55%	73%
S&P	264	168	175	331	99	46	17	1100	30%	55%	74%
Fitch	261	165	160	325	93	57	9	1070	30%	54%	75%

Note: Correctly predicted refers to the percentage of correct prediction in each category using Model 1 reported in Table 8. OLM is ordered logit model.