ERASMUS UNIVERSITY ROTTERDAM Erasmus School of Economics

Master Thesis [International Economies]

Impact of Government Debt on Economic Growth Through the Channels of Sovereign Credit Rating Changes

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1. Introduction

Monetary policy had been the go-to solution to stimulate growth movements in the economy for decades. But since the monetary policy hit the zero bound last decade, the ineffectiveness of monetary policy beyond a certain threshold became evident. Since then, deficit spending has become the primary economic tool to boost growth, especially during recessions. This concept was introduced to modern economics by John Maynard Keynes in his 1936 book The General Theory of Employment, Interest, and Employment. He argued that a decline in consumer spending could be balanced by increasing government spending[1]. Even though this idea has been opposed by David Ricardo in his 1817 book, On the Principles of Political Economy and Taxation, and more recently by the Chicago School of Economics, Modern Monetary Theory has taken up Keynes' ideas on government debt in their core beliefs. They believe that large government debt does not lead to crisis, and developed economies can sustain much higher deficits amounts without worrying about the consequences. Economists may argue either way, but central government debt has been rising in the past few decades for both developed and developing economies. International markets have turned into a much more complex space since Keynes suggested the countercyclical fiscal policies eight decades ago, with the introduction of indicators of global investments' performances, like yield spreads and sovereign credit ratings.

Over the last 25 years, the credit rating agencies have expanded their analysis to more than 100 countries. Sovereign credit ratings have become an essential factor in directing global capital flows to a particular nation, given the rapidly expanding international financial market. Meanwhile, the rating agencies have also received criticism for their poor performance in predicting the collapse of the financial markets, like the Asian financial crisis of the late 1990s and the global financial crisis of 2008. Still, the credit rating agencies (CRAs) remain relevant as they assist the principal-agent problems by helping lenders see through the asymmetric information regarding investment decisions. Moreover, credit ratings remain an integral part of Basel IV analysis to establish credit risk weights and assess risk in other rules.[2]

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[1] Sarwat Jahan, Ahmed Saber Mahmud, Chris Papageorgiou. "What Is Keynesian Economics?" Pages 53-54. International Monetary Fund, Finance & Development, September 2014.

[2] External CRA were first introduced to Basel II standards. The latest Basel IV, due for implementation in January 2023, includes the ratings in their analysis despite the criticism rating agencies have received.

This paper uses four economic relationships to assess the impact of government debt on economic growth through the channels of changes in investment induced by sovereign credit ratings. Firstly, the paper aims at establishing an empirical relationship between government debt and economic growth. The paper introduces a dummy variable for crisis (as measured by Luc & Fabian, 2020) to estimate the effect during the periods of crisis. The second relationship is debt as a determinant of changes in sovereign credit rating. The paper draws on the methodologies used by the three major credit rating agencies, Moody's, Fitch, and S&P. All three agencies include government debt in calculating the ratings, suggesting an inverse relationship between the variables. The third hypothesis tests the impact of credit rating changes on investments. Lastly, the paper analyses whether investments have a significant effect on GDP.

The following paper is arranged in the following manner: Section 2 discusses the literature review. Section 3 explains the data used in the paper. Section 4 discusses the models and the methodology. Section 5 describes the individual findings. Section 6 presents the findings to conclude the paper with robustness checks and suggestions for future research. List of Abbreviations and Appendix follows.

2. Literature Review

This section explores literature for the four economic relations, establishing a theoretical base for the paper.

2.1 Economic Growth and Government Debt

Public debt affects the economy in both the short and the long run. The Keynesian belief is that debt increases demand and output, hence improving employment and prices. Whereas, in the long run, it is believed to crowd out capital and decrease output (Elmendorf & Mankiw, 1999).

The literature on the relationship between public debt and growth gained a significant amount of importance post the financial crisis of 2007–2008 and the European sovereign debt crisis. Reinhart & Rogoff (2010) established itself as a linchpin study in the field of debt and growth. They find that high debt-to-GDP levels (90 percent and higher) are associated with

less growth in advanced and emerging economies. Supporting Reinhart and Rogoff (2010)'s results, Kumar and Woo (2010) find that there exists an inverse relationship between initial debt and growth. Reinhart and Rogoff (2010) find that for countries with a debt-to-GDP ratio of higher than 90%, debt has a significant negative effect on growth, establishing non-linearity. Since these two papers were published, economists have tried to pinpoint the threshold for non-linearity beyond which debt has a significant damaging effect on growth rates. Checcherita-Westphal and Rother (2012); Afonso and Jalles (2013); Yolcu Karadam (2018), and Swamy (2020) find a negative relationship as well for thresholds of 95%, 59%, 106.6%, and 110%, respectively. Eberhardt and Presbitero (2015) and Chudik et al. (2017) find a negative relationship with no standard threshold. Eberhardt (2019) and Jacobs et al. (2020) find no relationship between government debt and growth for advanced and OECD economies, respectively. Existing studies range over a large sample of economies, with the work by Kumar and Woo (2010); Cecchetti et al. (2011); Baum, et al., (2013), and Panizza and Presbitero (2014) primarily focused on OECD and other high-income economics. Whereas Afonso and Jalles (2013); Eberhardt and Presbitero (2015); Yolcu Karadam (2018), and Swamy (2020) include more than 100 countries in their analysis.

Most of the results from the abovementioned papers are almost synonymous, suggesting that beyond a threshold of around 90-110% debt-to-GDP ratio, the relationship between debt and growth is significantly negative. Panizza and Presbitero (2013) find that these findings are either not robust to minor changes, meaning outliers drive the results, or they fail to test the coefficients on the pairwise linear terms. This means that the model does not significantly hold the conclusion of debt affecting GDP over a certain threshold.

2.2 Government Debt and Sovereign Credit Ratings (SCRs)

Cantor & Parker (1995) presented the first study measuring the determinants of SCRs. They suggested that the ratings can mainly be explained by per capita income, GDP growth, inflation, external debt, economic development, and credit default history. Bissoondoyal-Bheenick (2005) added the unemployment rate and the investment-to-GDP ratio as additional determinants to Cantor and Parker's work. Depken et al., (2007) expanded the previous works by introducing budget balance, government debt, corruption, and social indexes. Boumparis et al., (2015) find that "government debt and the cumulative current account have a stronger effect on rating post-2008 compared to the period before". Afonso et al. (2010) suggested that short-

term determinants of a country's credit ratings are GDP per capita, government debt, GDP growth, and government balance, whereas government effectiveness, external debt, foreign reserves, and default history are important long-run determinants. Later that year, Moody's officially released their comprehensive methodology used to determine sovereign credit ratings. Since then, S&P and Fitch have released their sovereign rating methodologies as well.

In the latest methodology publications by Moody's, S&P, and Fitch, government debt is included as an integral part of calculations of sovereign credit ratings under the public finances index. Methodologies from the three rating agencies inculcate government debt in their analysis, suggesting a negative impact on credit rating. As the variable of government debt is explicitly used in calculating ratings by the agencies themselves, this paper does not perform empirical analysis to prove it. Hence, an increase in government debt is assumed to have a negative effect on sovereign credit ratings from all three agencies.

The econometric approach towards SCRs used in this work aligns with Afonso (2003) and Butler and Fauver (2006). The ratings undergo linear transformation ranging from 20-0 for ratings AAA to CC (Ca for Moody's). For each year, the last rating for the given year is registered for the entire year. In the years in which no ratings were assigned, the rating for the previous rated year is extrapolated until a new rating is assigned. The numerical values of ratings from the three agencies are averaged for each given year to create a variable for sovereign credit rating. This is further discussed in the Data section. The alternative methodology used in the literature is ordered response models, as Bissoondoyal-Bheenick (2005) and Depken et al. (2007) used. As the generalization of ordered probit to panel data is complex due to country fixed effects, and because the robust analysis is challenging to perform as it would require partitioning the sample, this methodology has been used scarcely.

2.3 Sovereign Credit Ratings and Investments

SCRs provide an assessment of a country's creditworthiness, hence providing investors with an insight into the risks associated with investing in a country's debt. They play an essential role in determining the access to international capital markets for the rated countries, providing sovereign default probabilities (Reinhart 2002). Reinhart (2004) suggests that sovereign default risk, measured and signalled by SCRs, plays an essential role in determining capital flows from developing to emerging countries, positively affecting growth in the

emerging nations. Kim & Wu (2008) find that long-term foreign currency sovereign credit ratings simulate intermediary financial development through investor confidence and attract capital flows to an economy.

A sovereign rating downgrade can increase the cost of capital, hence affecting physical investment in the economy. As Chen et al., (2013) suggest, this can lead to flight-to-quality, thus shifting investments away from riskier options, which leads to an increase in outflow of capital from the economy (Bernanke et al., 1996; Hartmann et al., 2004; Pavlova and Rigobon, 2008). This effect increases the risk-free rate and is magnified due to the uncertainty of outcomes in the international financial market (Henry, 2000; Henry, 2003; Chen et al., 2013).

Gande and Parsley (2005) suggest that "financial flows are now the dominant vehicle of interdependence" (p.692), hence examining the influence of credit ratings on capital flows allowing a better understanding of the additional costs of debt-induced credit rating changes. Following the analysis used by Chen et al., (2013), we also introduce one of the three segments of the financial system –banking sector developments– to provide a perspective on the effects of rating changes on banking development. Several variables are used to capture the movements of this market, discussed further in the Data section.

2.4 Investment and Growth

Physical capital investment is an essential determinant of a county's long-run growth rate (Sala-I-Martin et al., 2004; Rancière et al., 2008). Endogenous growth theory suggested a substantial role of physical investment in a country's growth process (Romer, 1986; Romer, 1987; Lucas, 1988). The analysis of the impact of public and private investment has received significant attention over the last three decades. While there are conflicting views on the importance of the role played by the components on investment, investment as a whole has been deemed essential for a country's growth.

Across varied samples, methodologies, and proxies, researchers find that both public and private investment are essential to economic growth in developing countries. Some papers suggest the private investment is more important (Serven and Salimano (1989), Beddies (1999), Hague (2013)), while others suggest the public investment is better (Mallick (2002), Erden and Holcombe (2005), Bèdia (2007)). Regarding developing nations, studies suggest

that either public investment focused on stimulating infrastructure for private investment is more important to economic growth (Crowder and Himarios (1997), Lighthart (2000), Pereira (2001)) or both public and private investments play a substantial role in economic growth (Batina (1998), Yang (2006), Aubyn and Afonso (2008)). The dominant model specifications across various papers for this analysis have been either Cobb Douglas (Batina (1998), Beddies (1999), Hague (2013)) or stochastic process models like Vector Autoregression (VAR) or Vector Error Correction Model (VECM) (Crowder and Himarios (1997), Erden and Holcombe (2005), Pereira (2001)). Yang (2006) employs GMM to conduct the analysis, which allows solving endogeneity in the relationship.

3. Data

This paper aims to establish various economic relationships and present a logical argument based on their connected effects. One of the relationships is the effect of SCRs on investment variables. As the ratings have a limited amount of variation over time, analysing individual countries would lead to biased time series analysis, hence failing to provide meaningful information. To resolve this issue, we construct an unbalanced panel for the analysis. The paper uses annual data for 50 countries ranging from 1970-2018. The selection of the countries is mainly dependent on the availability of the data for all the variables. We divide the dataset into two parts, for developed and developing nations, to better understand the effects. The list of variables is mentioned in Appendix 1 and the list of countries with their respective status is mentioned in Appendix 2.

The variables real GDP per capita growth rate, central government debt, net FDI inflows, population growth rate, savings rate, trade, REER, current account balance, exports, and imports are taken from World Bank World Development Indicators (WDI) and Global Development Finance (GDF),. The variable trade openness is the sum of export and import as a percentage of GDP. Data on the banking crisis dummy is obtained from Luc & Fabian (2020). The data on debt market variables, i.e., private credit (loans) by deposit money banks and the total amount of domestic credit provided by the banking sector as a percentage of GDP, are obtained from the World Bank's Financial Structure and Development Database associated with Beck, Demirguc-Kunt and Levine (2000a). Private credit, domestic credit, exports, imports, savings are seasonally adjusted using the moving average method to keep the robustness in check.

This paper builds a database of ratings and outlook with sovereign foreign currency rating and local currency long-term ratings, based on three leading rating agencies, S&P, Moody's, and Fitch Ratings, for 1970–2018. The ratings are grouped into 20 categories ranging from AAA observations receiving the value 20 to CC receiving the value 1. The ratings for a year are calculated in the following manner:

$$LCLT_{it} = \frac{1}{n} \sum_{j=1}^{n} \left(LCLT_{i,t-1}^{j} \frac{m_{i,t}^{j}}{12} + LCLT_{i,t}^{j} \frac{12 - m_{i,t}^{j}}{12} \right)$$

$$FCLT_{it} = \frac{1}{n} \sum_{j=1}^{n} \left(FCLT_{i,t-1}^{j} \frac{m_{i,t}^{j}}{12} + FCLT_{i,t}^{j} \frac{12 - m_{i,t}^{j}}{12} \right)$$

where $LCLT_{it}$ and $FCLT_{it}$ are the averaged local currency long term ratings and averaged foreign currency long term rating for country i and year t respectively; j represents credit rating agencies $= \{1 = Moody's, 2 = Fitch, 3 = S\&P\}$; $m_{i,t}^{j}$ is the month in which the rating is announced by rating agency j for country i for year t. $LCLT_{i,t}^{j}$ and $FCLT_{i,t}^{j}$ are the local currency long term ratings and foreign currency long term rating for country i and year t provided by rating agency j, respectively. n is the number of rating agencies providing sovereign credit ratings for a country for a particular year. This allows us to better understand the effect of rating changes based on when they are announced in a year. For example, if a country receives a rating in December, the effects of the rating change would mostly be noticed in the next year. Hence to use that rating for the entire year will provide biased results. Therefore computing ratings using the abovementioned formulas provides 1/12th weightage of the rating change taking place in December and 11/12th to the rating prior to the change. The ratings are extrapolated with the last rated value until the country is rated again. They are then averaged across ratings by the three agencies to create a single variable for rating movement. For the years in which the ratings are only provided by one or two agencies, the average helps create a consistent database as the variation among the three agencies is limited.

Outlook is assigned values ranging from +0.5 to -0.5. Years in which multiple outlooks were assigned, outlook values are totalled and averaged across rating agencies to develop the variable *outlook*. Numerical values for all the ratings are mentioned in Appendix 3 and the transformation of outlook values in Appendix 4.

4. Methodology

The paper empirically investigates three relationships using two econometric models, (i) effect of debt on economic growth and the effect of investment on economic growth, combined into one model with growth variable as the dependent variable, (ii) effect on sovereign credit ratings on investment. The paper does not empirically investigate the fourth relationship of debt as a determinant of SCRs as the methodologies used by the three big rating firms explicitly include debt in the calculation of the sovereign ratings.

4.1 Effect of Government Debt and Investment on Economic Growth

The paper investigates the relationship between government per capita GDP growth rate, debt-to-GDP ratio, and investment variables (gross capital formation growth, foreign direct investment, equity, debt, and banking markets). We include the variable, $debt\_sq_{it}$, which is the square of gross central government debt as a share of GDP, to measure any non-linearity effects present in the data.

We run the following basic estimation technique using panel least square with fixed-effects, corrected for non-stationarity:

GDP_{it} $= \alpha + \gamma\,GDP_{it-1} + \beta_1\,debt_{it} + \beta_2\,debt\_sq_{it} + \varphi\,gcf_{it} + \lambda\,fdi\_in_{it} + \theta\,bank^n_{it} + control$ variables $(population\_growth_{it},\ savings_{it},\ trade_{it},\ openness_{it},\ consumption_{it},\ REER_{it}) + \mu_i + \nu_t$ $+ \varepsilon_{it}$ (1)

where GDP_{it} is the growth rate of GDP per capita; $debt_{it}$ is gross central government debt as a share of GDP; gcf_{it} is the total gross capital formation as a share to GDP, fdi_in_{it} is the net inflows of FDI as a share to GDP, the variable $bank^n_{it}$ measures the banking sector developments, where n = {(i) amounts of private credit (loans) by deposit money banks (*pricred*); (ii) total amount of domestic credit provided by the banking sector as a percentage of GDP (*depassests*)}. The index i ($i = 1,….,N$) denotes the country, the index t ($t = 1,….,N$) indicates the period. The control variables include population growth rate; *savings* is total national saving as a share of investment rate, *trade* is total trade as a percentage to GDP, *openness* is the sum of export and import shares in GDP, *REER* is the real effective exchange

rate which measures the external competitiveness. μ_i is country fixed effects; v_t is time fixed effects; ε_{it} is the error term.

We also run a cointegration analysis[3] using Fully Modified Ordinary Least Squares (FMOLS) to solve the issue of different levels of stationarity, which is measured using Levin, Lin & Chu, and ADF - Fisher Chi-square (probabilities for Fisher tests are computed using an asymptotic Chi). The stationary tests for all variables are mentioned in Appendix 5.

For panel data, as suggested by Hiebert et al. (2002), many studies on growth regressions have made use of the instrumental variable (IV) approach to deal with the issue of simultaneity bias. Hence we run an IV analysis to solve irregularities in the data. This paper either uses 2-SLS (two-stage least squares) or GMM estimators. With the GMM estimator, we also correct the possible heteroscedasticity and, most importantly, endogeneity in the error structure using the consistent estimator. As Westphal et al., (2012) suggests, "the two-step GMM provides some efficiency gains over the traditional IV/2-SLS estimator derived from the use of the optimal weighting matrix, the overidentifying restrictions of the model, and the relaxation of the independent and identical distribution assumption, see Baum et al. (2007)". Hence to make the analysis more robust, we follow an IV approach using GMM estimators. We instrument the independent variables for each country through their lagged values. The paper also instruments the channels through which debt could affect GDP like total factor productivity, public investment, and private. This change presents no substantial effect on the original equation.

4.1.1 Debt and Growth in Times of Crisis

To measure how debt affects GDP in times of crisis, we include a dummy variable for banking crisis (which also captures systematic crises), as computed by Luc & Fabian (2020). We do not check for non-linearity in this case as the periods of crisis are spread unevenly over time. We run this analysis using fixed effects regression and FMOLS to solve stationarity issues. Again, due to uneven periods of crisis, we do not run IV analysis as the instrumented

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[3] Cointegration is checked in all the following FMOLS models using Johansen Cointegration Test, with Kao Residuals and Variance Inflation Factors (VIF)

variables of lagged dependent variables would lead to a biased result. Following is the equation used to run the analysis:

$$GDP_{it} = \alpha + \gamma\,GDP_{it-1} + \beta_1\,debt_{it} + \beta_2\,debt_{it} * bank\_crisis + \varphi\,gcf_{it} + \lambda\,fdi\_in_{it} + \theta\,bank^n_{it}$$
$$+ \text{control variables } (population\_growth_{it},\ savings_{it},\ trade_{it},\ openness_{it},\ consumption_{it},\ REER_{it})$$
$$+ \mu_i + v_t + \varepsilon_{it} \tag{2}$$

where bank_crisis is the dummy variable for periods of the banking crisis, the remaining variables are the same as equation *(1)*.

4.2 Effect On Sovereign Credit Ratings On Investment

This methodology develops the relationship between investment variables and SCRs. The basic linear regression model used is as follows:

$$INVESTMENT^j_{it} = \alpha + \beta\,INVESTMENT^j_{i,t-1} + \gamma\,LCLT_{it} + \lambda\,FCLT_{it} + \theta\,OUTLOOK_{it} +$$
$$\text{control variables } (GDP_{it},\ inflation_{it},\ government\_debt_{it},\ current\_account\_balance_{it},$$
$$openssess_{it},\ consumption_{it},\ REER_{it}) + \mu_i + v_t + \varepsilon_{it} \tag{3}$$

where *INVESTMENT$^j_{it}$* are the investment variables for country *i* for time period *t* (j = total gross capital investment, net FDI inflows and banking variables, i.e., private credit (loans) by deposit money banks and the total amount of domestic credit provided by the banking sector both as a percentage of GDP); *INVESTMENT$^j_{i,t-1}$* is the lagged value of each respective *j*; LCLT is the local currency long term ratings; FLCT is the foreign currency long term rating; *OUTLOOK$_{it}$* in the numerical transformation of outlook changes; control variables include GDP per capita growth rate as wealthier countries are expected to have more stable institutions, inflation as it reduced the real stock of outstanding government debt and can also be interpreted for macroeconomic issues in some cases, government debt implies the higher burden of interest, current account balance could signal tendency to over-consumer or a swift increase in investment. Openness and consumption power can both mitigate the amount of investments in the economy. The exchange rate directly influences the cost of foreign investment, hence utilized in the calculation of FDI only. μ_i is country fixed effects; v_t is time fixed effects; ε_{it} is the error term.

As Afonso et al., (2009) suggest, this equation can be estimated using three ways: pooled OLS, fixed effects, and random effects estimation. Under conditions that the country-specific error is uncorrelated with the regressors, i.e., 0, the best estimation technique is the random-effects model, if not, the fixed effects estimate provides consistent estimates. In this case, it seems natural country-specific effects to be correlated with the regressors. But as there is a limited amount of variation in a country's rating, the investment variables can only be captured across time and over time. This could lead to inconsistency in the results. Hence, to check what effects to use in the analysis, we employ Hausman Test to test for correlated random effects. Based on the results, we choose fixed or random effects for each particular model.

We also test this relationship using cointegration analysis to overcome any stationarity issues. The presence of cointegration is established using Johansen cointegration analysis.

5. Empirical Analysis

This section provides the results based on the methodologies mentioned above and provides an interpretation for them.

5.1 Effect of Government Debt and Investment on Economic Growth

Table 1 consists of fixed effects pooled OLS, FMOLS, and IV analysis with 2-stage GMM estimators results. Central government debt has a negative and significant impact on GDP per capita growth. According to pooled OLS, a unit increase in debt decreases GDP by 0.0.18 in developed nations and 0.138 in developing nations. Similar to the findings of Reinhart & Rogoff (2010), there exists a non-linear relationship between debt and growth. As suggested by the two former tests, the sign of coefficient changes when the squared values of government debt are used. These results contradict the results of GMM estimates, as debt has a positive effect of 0.084 for unit change on GDP, whereas its square has a negative effect of 0.001. As GMM estimators solve for endogeneity, the paper bases the following conclusions in this section on the IV results while still observing the possible outcomes from the cointegration analysis and fixed effects, in the order of priority. The cointegration suggests that a unit change in government debt has a effect of -0.249 and -0.092 on debt in developed and developing economies respectively, suggesting the effect on developed economies being substantially higher than developed economies. The fixed effects pooled OLS analysis, however, suggests that the effects of debt on GDP is higher in developing nations.

Table 1
Debt and Investment as Determinants of Economic Growth

Dependant variable: Real GDP per capita growth	Fixed Effects-Pooled OLS			Cointegration Analysis - FMOLS			IV (with GMM Estimators)		
Sample	All	Developed	Developing	All	Developed	Developing	All	Developed	Developing
Test ID	1	2	3	4	5	6	7	8	9
gdp(-1)	0.190***	0.256***	0.129***	0.243***	0.324***	0.241***	-0.008	-0.076	-0.026
	0.022	0.033	0.034	0.022	0.030	0.033	0.042	0.069	0.065
debt	-0.097***	-0.018	-0.138***	-0.121***	-0.249***	-0.092***	0.084***	0.035	0.080
	0.019	0.024	0.029	0.020	0.029	0.029	0.036	0.047	0.058
debt_sq	0.001*	0.000	0.001**	0.001***	0.002***	0.000	-0.001***	0.000	-0.001*
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
gcf_growth	0.120***	0.130***	0.108***	0.139***	0.158***	0.136***	0.323***	0.347***	0.310***
	0.005	0.007	0.007	0.005	0.007	0.007	0.014	0.024	0.022
fdi_in	0.058***	0.033	0.046	0.084***	0.073***	0.056	0.062	0.162**	-0.193
	0.001	0.013	0.046	0.018	0.014	0.044	0.079	0.068	0.182
pricred	-0.009***	-0.001***	-0.023**	-0.006***	-0.006***	0.008	-0.011***	-0.007*	0.023
	0.00	0.002	0.010	0.002	0.002	0.009	0.016	0.004	0.021
depassests	-0.047***	-0.026***	-0.088***	-0.051***	-0.049***	-0.109***	-0.068***	-0.070***	-0.089**
	0.01	0.006	0.023	0.009	0.007	0.023	0.015	0.013	0.043
Country Fixed Effects	Yes	Yes	Yes	-	-	-	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	-	-	-	Yes	Yes	Yes
Observations	1165	609	556	1074	551	523	1135	595	540
Cross-Sections	37	20	17	33	17	16	37	20	17
R-squared	0.661	0.767	0.670	0.587	0.541	0.579	0.298	0.328	0.209

Note: The models are estimated by OLS (OLS-pooled) with fixed effects, Fully Modified Ordinary Least Squares and Insturment Analysis using Two-Step robust System GMM (SYS-GMM). For the last method, lagged regressors are used as suitable instruments. The dependent variable is real GDPpc growth, as identified in the first row. Robust standard errors are reported below each coefficient estimate. The standardised coefficients show the change of a standard deviation of GDPpc growth due to a one standard deviation change in a variable of interest. A constant term has been estimated but it is not reported for reasons of parsimony.
∗ Denotes significance at 10% level
∗∗ Denotes significance at 5% level
∗∗∗ Denotes significance at 1% level

The second important conclusion derived from Table 1 is that both gross capital formation and net FDI inflows positively impact the growth rate. All three tests suggest that the impact of gross capital formation is higher in developed nations. According to the IV estimates, a unit change in the gross capital formation growth rate leads to a 0.347 and 0.310 increase and a unit change in FDI inflows leads to a 0.062 and 0.162 increase, in developed and developing economies respectively. This might mean that governments in developing economies focus on capital formation to increase the infrastructure for investment, which has a multiplier effect on the initial investment. FDI inflows are, however, not found to be significant in developing economies while being positive and significant in developed countries. The variables of banking sector development, amounts of private credit (loans) by deposit money banks, and the total amount of domestic credit provided by the banking sector have a negative and significant effect on GDP growth. A unit change in private credit leads to a decrease of 0.007 in developed economies. A change in domestic credit leads to a decrease of 0.070 and 0.089 in developed and developing nations respectively. This result contradicts the expected

relationship between banking variables and growth rate but can be explained from the national private debt point of view. As private debt increases, the cost of capital increases, leading to a negative effect on the growth.

5.1.1 Debt and Growth in Times of Crisis

This section provides an interesting insight into how debt reacts to growth in times of banking crisis. The previous section suggested that debt has a negative impact on growth until a certain point of non-linearity. Surprisingly, it is found that a unit increase in debt leads to an increase of growth by 0.064 during the crisis periods in developed economies in Table 2. This can partly happen due to a decline in growth during the crisis period, but a significant relationship is established for the positive effect of debt on growth for developed economies during crisis periods. This suggests that debt has a positive impact on growth during a crisis, proving the expected results of counter-cyclical fiscal policies. This also falls in line with Modern Monetary Theory's beliefs of high debt levels being the source of growth for developed economies without complementing huge costs.

The last two sections provide the empirical base for two of the four arguments this paper aims to establish. Firstly, debt has a significant non-linear impact on growth, suggesting a positive effect below a certain threshold in both developing and developed countries. Secondly, investment variables, i.e., FDI inflows and gross capital formation, positively affect growth. While the former is found significant only in developed nations, the capital formation was found significant in both economies. The third relationship of debt and SCRs has been theoretically established in the Literature Review section. The last relationship between SCRs and investment is discussed in the next section.

1.1 Effect of Sovereign Credit Ratings on Investment

Table 3 reports the effects of rating and outlook changes on various investment variables. The IV analysis found that a unit change in local currency credit rating leads to an increase of 1.591 and 2.721 (acc. to IV estimates) in gross capital formation in developed and developing

economies respectively. Whereas the effect of foreign currency credit rating remains significant for only developed economies, where a unit change in FCLT leads to an increase of 1.489 in gross capital formation. The impact of local currency credit rating on capital formation is much more substantial in developing countries, which also is synonymous with a unit change in the lower slab of credit rating having a higher impact than a change in higher slabs of credit ratings as developed countries are, on average, rated higher (the investment grade).

Table 2
Debt and Growth in Times of Crisis

Dependant variable: Real GDP per capita growth	Fixed Effects-Pooled OLS			Cointegration Analysis - FMOLS		
Sample	All	Developed	Developing	All	Developed	Developing
Test ID	1	2	3	4	5	6
gdp(-1)	0.176***	0.239***	0.117***	0.335***	0.399***	0.336***
	0.023	0036	0.035	0.024	0.036	0.035
debt	-0.068***	-0.020	-0.081***	-0.045***	0.052**	-0.059***
	0.012	0.022	0.016	0.012	0.025	0.016
debt*bank_cri	0.001	-0.026	0.026	0.001	0.064**	0.014
	0.018	0.024	0.028	0.019	0.031	0.027
gcf_growth	0.123***	0.139***	0.111***	0.142***	0.153***	0.138***
	0.005	0.008	0.007	0.005	0.009	0.007
fdi_in	0.084***	0.055***	0.058	0.144***	0.157***	0.068
	0.022	0.018	0.050	0.026	0.025	0.049
pricred	-0.011***	0.000	-0.027**	-0.008***	-0.012***	0.007
	0.003	0.002	0.012	0.002	0.002	0.012
depassests	-0.047***	-0.028***	-0.097***	-0.052***	-0.035***	-0.108***
	0.009	0.007	0.024	0.010	0.008	0.025
Country Fixed Effects	Yes	Yes	Yes	-	-	-
Time Fixed Effects	Yes	Yes	Yes	-	-	-
Observations	1034	524	510	905	449	456
Cross-Sections	36	19	17	29	14	15
R-squared	0.667	0.778	0.675	0.616	0.626	0.604

Note: The models are estimated by OLS (OLS-pooled) with fixed effects and Fully Modified Ordinary Least Squares. The dependent variable is real GDPpc growth, as identified in the first row. Robust standard errors are reported below each coefficient estimate. The standardised coefficients show the change of a standard deviation of GDPpc growth due to a one standard deviation change in a variable of interest. A constant term has been estimated but it is not reported for reasons of parsimony.
∗ Denotes significance at 10% level
∗∗ Denotes significance at 5% level
∗∗∗ Denotes significance at 1% level

Outlook changes have a positive effect but are statistically insignificant throughout the three tests, for both developed and developing nations.

Table 3

Effect On Sovereign Credit Ratings On Investment Parameters

Gross Capital Formation	Pooled OLS			Cointegration Analysis - FMOLS			IV (with GMM Estimators)		
Sample	All	Developed	Developing	All	Developed	Developing	All	Developed	Developing
Test ID	1	2	3	4	5	6	7	8	9
gcf_growth(-1)	-0.079***	-0.033	-0.084***	0.055	0.096*	0.021	-0.021	0.027	-0.042
	0.027	0.038	0.073	0.043	0.06	0.044	0.031	0.047	0.041
LCLT	1.24**	1.9**	0.741	1.264*	2.326**	0.334	1.984***	1.593**	2.723**
	0.072	0.778	0.872	0.7	1.063	0.996	0.713	0.84	1.408
FCLT	-0.835	-1.504*	-0.615	-1.337	-2.164*	-1.617*	-0.991	1.491*	-0.857
	0.598	0.87	0.874	0.785	1.206	0.979	0.691	0.922	1.057
OUTLOOK	-0.011	-0.366	0.447	-0.397	-0.342	0.431	0.186	0.008	0.315
	4.644	0.267	0.506	0.393	0.357	0.683	0.667	0.474	2.28
Country Effects	Random	Random	Random	-	-	-	Random	Random	Random
Time Effects	None	None	None	-	-	-	None	None	None
Observations	893	436	457	517	192	325	892	435	457
Cross-Sections	47	20	27	29	10	19	47	20	27
R-squared	0.587	0.641	0.573	0.701	0.726	0.715	0.482	0.604	0.385

Net FDI Inflows	Pooled OLS			Cointegration Analysis - FMOLS			IV (with GMM Estimators)		
Sample	All	Developed	Developing	All	Developed	Developing	All	Developed	Developing
Test ID	10	11	12	13	14	15	16	17	18
fdi_in(-1)	0.328***	0.353***	0.215***	1.022***	1.075***	0.925***	0.32***	0.336***	0.196***
	0.037	0.053	0.05	0.049	0.076	0.059	0.04	0.054	0.06
LCLT	-0.009	0.222	-0.036	0.131	0.143	0.138	0.007	0.099	0.162
	0.151	0.313	0.136	0.176	0.379	0.141	0.197	0.425	0.037
FCLT	0.026	-0.127	0.111	-0.007	-0.058	-0.03	0.085	-0.354*	0.008
	0.074	0.141	0.088	0.089	0.181	0.09	0.101	0.21	0.14
OUTLOOK	-0.072	-0.342	0.139	0.02	-0.013	0.187	0.179	0.111	0.65
	0.123	0.211	0.131	0.139	0.251	0.139	0.413	0.685	1.318
Country Effects	Fixed	Fixed	Fixed	-	-	-	Fixed	Fixed	Fixed
Time Effects	Fixed	Fixed	Fixed	-	-	-	Fixed	Fixed	Fixed
Observations	895	437	458	621	263	358	894	436	358
Cross-Sections	47	20	27	34	13	21	47	20	27
R-squared	0.586	0.489	0.788	0.328	0.376	0.385	0.582	0.475	0.731

Note: The models are estimated by OLS (OLS-pooled) with fixed effects, Fully Modified Ordinary Least Squares and Insturment Analysis using Two-Step robust System GMM (SYS-GMM). For the last method, lagged regressors are used as suitable instruments. The dependent variable are gcf, fdi_in, depassets and pricecreds as identified in the respective first rows. Robust standard errors are reported below each coefficient estimate. The standardised coefficients show the change of a standard deviation of GDPpc growth due to a one standard deviation change in a variable of interest. A constant term has been estimated but it is not reported for reasons of parsimony. Country and time effects were determined using Hausam Test.

∗ Denotes significance at 10% level

∗∗ Denotes significance at 5% level

∗∗∗ Denotes significance at 1% level

Effects of rating changes and outlook indicators on FDI inflows are found insignificant in all models for both types of economies, except a negative effect of foreign currency credit ratings on net FDI inflows in developed economies under IV analysis. A unit increase in foreign currency long term rating leads to a decrease of 0.354 in FDI inflows. The explanatory power of the model is, however, limited as the R-squared value is 0.475. The lagged values of FDI have a positive and significant impact on FDI inflows throughout the model. The insignificant effect of ratings on FDI can be explained by the fixed and medium-term nature of the movement of FDI. Hence, the reasons for a downgrade in the rating could dissolve by the time any substantial changes in foreign investment take place. All discussed beta values are obtained from the IV model with GMM estimators.

Table 3 (continued)

Private Credit (loans)	Pooled OLS			Cointegration Analysis - FMOLS			IV (with GMM Estimators)		
Sample	All	Developed	Developing	All	Developed	Developing	All	Developed	Developing
Test ID	19	20	21	22	23	24	25	26	27
pricred(-1)	67.298***	92.542***	38.369***	68.811***	91.301***	32.721***	58.546**	93.059***	36.896***
	1.582	1.291	0.768	0.027	5.107	1.805	1.373	1.422	0.912
LCLT	1.542*	-0.059	0.814**	1.99***	-0.038	-0.6	3.671***	-0.444	3.104***
	0.844	1.634	0.352	0.046	3.042	0.553	1.364	1.699	1.115
FCLT	-1.928**	-0.753	-1.009***	-2.332***	-0.318	0.117	-3.252**	-0.272	-0.094
	861.001	1.775	0.389	0.047	3.446	0.569	1.366	1.861	0.857
OUTLOOK	-0.169	0.335	-1.05***	0.158**	-0.727	-0.658	0.842	0.472	-4.662*
	0.423	0.497	0.422	0.046	1.012	0.502	1.462	1.008	1.876
Country Effects	Fixed	None	None	-	-	-	None	None	None
Time Effects	Fixed	Random	Random	-	-	-	Random	Random	Random
Observations	880	422	482	502	149	353	879	421	458
Cross-Sections	47	20	27	28	8	20	47	20	27
R-squared	0.953	0.938	0.929	0.934	0.952	0.977	0.868	0.935	0.889

Total Domestic Credit by Banking Sector	Pooled OLS			Cointegration Analysis - FMOLS			IV (with GMM Estimators)		
Sample	All	Developed	Developing	All	Developed	Developing	All	Developed	Developing
Test ID	28	29	30	31	32	33	34	35	36
depassets(-1)	0.954***	0.933***	0.835***	0.964***	1.006***	0.887***	0.972***	0.972***	0.986***
	0.01	0.022	0.022	0.023	0.042	0.022	0.012	0.012	0.018
LCLT	-0.11	0.798	0.484***	-0.004	0.828	0.47***	-0.293	-0.032	0.261**
	0.252	0.893	0.148	0.487	1.467	0.17	0.264	0.677	0.11
FCLT	0.484**	0.729	-0.509**	0.0755	0.661	-0.425	0.669**	0.51	-2.156***
	0.25	0.892	0.231	0.478	1.411	0.294	0.267	0.633	0.739
OUTLOOK	0.022	-0.818*	0.096	0.191	-0.407	-0.387	0.482	0.626	0.302
	0.232	0.467	0.228	0.332	0.71	0.291	0.656	0.727	1.367
Country Effects	Random	Fixed	Fixed	-	-	-	Random	Random	Random
Time Effects	None	Fixed	Fixed	-	-	-	None	None	None
Observations	916	434	472	535	182	353	914	433	471
Cross-Sections	47	20	27	29	9	20	47	20	27
R-squared	0.981	0.973	0.991	0.983	0.961	0.993	0.984	0.961	0.956

Note: The models are estimated by OLS (OLS-pooled) with fixed effects, Fully Modified Ordinary Least Squares and Insturment Analysis using Two-Step robust System GMM (SYS-GMM). For the last method, lagged regressors are used as suitable instruments. The dependent variable are gcf, fdi_in, depassets and pricecreds as identified in the respective first rows. Robust standard errors are reported below each coefficient estimate. The standardised coefficients show the change of a standard deviation of GDPpc growth due to a one standard deviation change in a variable of interest. A constant term has been estimated but it is not reported for reasons of parsimony. Country and time effects were determined using Hausam Test.

∗ Denotes significance at 10% level
∗∗ Denotes significance at 5% level
∗∗∗ Denotes significance at 1% level

A unit increase in local currency credit rating leads to an increase of 3.104 in the amounts of private credit (loans) by deposit money banks in developing nations and an increase of 0.261 in domestic credit. Whereas foreign currency credit rating unit changes have a negative impact of 3.252 on private credit in *All* countries, and a negative impact of 2.156 on domestic credit in developing economies. This could mean that developing economies depend on foreign credit for financial needs, and a change in foreign currency credit rating can substantially affect the movement of domestic assets and loans. On the other hand, a positive impact of local currency credit rating can suggest an association between local ratings and the national banking sector. This would mean that assets and loans in the country can be mitigated by better local currency credit ratings.

2. Conclusion

In the last two sections, this paper has established four relationships. Government debt has a negative effect on economic growth beyond a particular threshold point of debt in developing and developed economies, whereas government debt increases growth in developed economies during times of crisis. An increase in debt decreases foreign and local sovereign credit ratings, including ratings for developed and developing economies, as mentioned in the methodologies of the three major credit rating agencies. A decrease in local and foreign currency sovereign credit rating decreases gross capital formation in developed and developing countries. A decrease in local ratings also reduces the amount of private credit (loans) generated by deposit money banks and total domestic credit (assets) in developing economies, while a decrease in foreign ratings leads to an increase in both of them. The fourth relationship is that a decrease in gross capital formation leads to a decrease in economic growth in developed and developing economies; an increase in private credit loans and total domestic credit leads to a decrease in economic growth in developed countries.

Therefore, by generating an intersection of these theoretical and empirical relationships, it can be suggested that an increase in debt, the primary goal of which is to boost economic growth, leads to a rating downgrade, which affects growth through reduced capital formation (investment) in both developing and developed economies. Hence, through externalities, adding to the negative impact of debt on growth in the long run.

Following are the multiple robustness checks employed at each stage of analysis to make the results as robust as possible:

(i)   Sample heterogeneity along the cross-sectional and time dimensions: This step involved removing outliers in debt, GDP, and investment variables one at a time, which included country with the highest and lowest debt ratios (Zambia and Finland), GDP per capita (Norway and India), GCF to GDP ratio (Nigeria and Zambia), FDI (Belgium and Iceland) for equations (1), (2) and (3) respectively. The changes did not yield any significant results and hence were not incorporated, as the cross-sections for the cointegration test would have been reduced to 5-8. Years from 1960-1970 were removed due to a lack of structured and sufficient data. The paper checks for a common correlated effect pooled (CCEP) estimator by Pearson

(2006) to test for cross-sectional dependence. Weight-pooled methods for FMOLS were tested but dropped due to negative (or zero) R-squared values of the models.

(ii)   Endogeneity: Equation (1) of growth, debt, and investment are likely to have endogeneity issues, magnified due to the possible two-way causation between growth and debt and growth and investment. Also, the variable for debt used is the debt to GDP ratio, as in most studies, resulting from output itself. Hence, country and time fixed effects were added to capture some of the omitted variables, explaining part of the error term. GMM tests were performed additionally to fixed-effects, as literature (Bruno 2005; Roodman 2009) suggests, the GMM estimators solve for endogeneity through the process of instrument variables. The instrument variables were carefully selected as the lagged value of regressors for stationary variables, and for non-stationary variables, the equations instrumented lagged value of first differentiated regressors.

This research can be expanded to study the discussed effects in further detail for each country. There are two particular suggestions for future research:

(i)   The transformation of sovereign credit ratings in this paper is linear. Researchers can expand this transformation by giving weights to change from each rating slab. This would help understand how being downgraded and upgraded varies over different ratings. This would, synonymously, provide insight into the cost of rating change to countries marked as emerging, developed, and developing.

(ii)   An interesting analysis would be to apply the notions of a nudge from behavioral economics to rating changes. The nudge can be two ways, first, the nudge to rating agencies to make a change in the rating, and second, more importantly, a nudge to investors through a change in the ratings. The later analysis could be highlighted using treatment and control groups using pre-and post-credit rating publication years (i.e., pre-and post-1970's).

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APPENDIX

List of abbreviations:

Abbreviation	Full Form
GDP	Gross Domestic Product
S&P	Standard and Poor
SCRs	Sovereign Credit Ratings
CRAs	Credit Rating Agencies
FMOLS	Fully Modified Ordinary Least Squares
GMM	Generalized Method of Moment
IV	Instrumental Variable
REER	Real Effective Exchange Rate
ADF	Augmented Dickey Fuller

Appendix 1: Stationary Tests

Variable Code	Explanation
bank_cri	Banking Crisis
consump	Final consumption expenditure (% of GDP)
currentacc_bal	Current account balance (% of GDP)
developed	Developed = 1, developing = 0
exch_usd	Exchange Rate (against USD)
expen	Gross national expenditure (% of GDP)
export	Exports of goods and services (constant 2010 US$)
export_gddp	Exports of goods and services (% of GDP)
fdp_in	Foreign direct investment, net inflows (% of GDP)
gcf	Gross capital formation (% of GDP)
gdp_percalgro	Real GDP per capita growth (annual %)
gen_govt_debt	General government debt (percent of GDP)
gfcf_pri	Gross fixed capital formation, private sector (% of GDP)
import_gdp	Imports of goods and services (% of GDP)
inf	Inflation, Annual % of average consumer prices
interest	Real interest rate (%)
open	Trade Openess (export+import)/GDP
outlook	Sum of all outlook by 3 companies
pop_growth	Population growth (annual %)
prbond	Private bond capitalization to GDP (%)
pri_debt	Total private debt, loans and debt securities (percent of GDP)
pubond	Public bond capitalization to GDP (%)
rating_foreign	Average of foreign ratings by all 3 agencies
rating_local	Average of local ratings by all 3 agencies
reer	Real effective exchange rate index (2010 = 100)
saving	Gross savings (% of GDP)
syst_cri	Systemic Crisis
trade	Trade (% of GDP)

Appendix 2: List of countries

Developed Economies	
Australia	Italy
Austria	Japan
Belgium	New Zealand
Canada	Norway
Denmark	Portugal
Finland	Spain
France	Sweden
Germany	Switzerland
Greece	United Kingdom
Iceland	United States

Developing Economies		
Argentina	Honduras	Peru
Bolivia	India	Singapore
Brazil	Kenya	South Africa
Chile	Korea	Sri Lanka
Colombia	Malaysia	Thailand
Costa Rica	Mexico	Tunisia
Egypt	Morocco	Turkey
El Salvador	Nicaragua	Uruguay
Ghana	Nigeria	Venezuela
Guatemala	Paraguay	Zambia

Appendix 3: Sovereign Credit Rating - Linear Transformation

Grade	Moody's	S&P	Fitch	Transformation
Prime	Aaa	AAA	AAA	20
High grade	Aa1	AA+	AA+	19
	Aa2	AA	AA	18
	Aa3	AA-	AA-	17
Upper medium grade	A1	A+	A+	16
	A2	A	A	15
	A3	A-	A-	14
Lower medium grade	Baa1	BBB+	BBB+	13
	Baa2	BBB	BBB	12
	Baa3	BBB-	BBB-	11
Non-investment grade speculative	Ba1	BB+	BB+	10
	Ba2	BB	BB	9
	Ba3	BB-	BB-	8
Highly speculative	B1	B+	B+	7
	B2	B	B	6
	B3	B-	B-	5
Substantial risks	Caa1	CCC+	CCC+	4
	Caa2	CCC	CCC	3
	Caa3	CCC-	CCC-	2
Extremely speculative	Ca	CC	CC	1
			C	0
In default with little prospect for recovery		SD	RD	0
				0
In default	C	D	D	0
			DD	0
			DDD	0
Not rated	WR	NR		0

Appendix 4: Sovereign Credit Outlook - Transformation

Rating outlook	Numerical value
Positive	0.5
Watch positive	0.25
Stable	0
Watch negative	−0.25
Negative	−0.5

Appendix 5: Stationary Tests

Variable	Levin, Lin & Chu t^			ADF - Fisher Chi-square^^		
	Order of Integration	Statistics	Prob.	Order of Integration	Statistics	Prob.
Banking Crisis	Level	-12.9242	0.0000	Level	324.4970	0.0000
Central government debt (percent of GDP)	*I(1)*	-26.9455	0.0000	*I(1)*	961.0232	0.0000
Central government debt (percent of GDP) ^ square	*I(1)*	-15.78539861	0.0000	*I(1)*	665.1491606	0.0000
Current account balance (% of GDP)	Level	-6.4308	0.0000	Level	251.7319	0.0000
Total amount of domestic credit provided by banking sector as % of GDP	*I(1)*	-20.7708	0.0000	*I(1)*	616.3828	0.0000
Foreign direct investment, net inflows (% of GDP)	Level	-12.8822	0.0000	Level	455.5861	0.0000
Gross capital formation (% of GDP)	Level	-6.0567	0.0000	Level	219.9436	0.0000
Gorss capital formation (year-to-year growth rate)	Level	27.1257	0.0000	Level	964.1660	0.0000
GDP per capita growth (annual %)	Level	-30.6212	0.0000	Level	976.9485	0.0000
Gross fixed capital formation, private sector (% of GDP)	Level	-3.2363	0.0006	Level	91.4726	0.0002
Inflation, Annual percentages of average consumer prices	Level	-10.3350	0.0000	Level	374.2377	0.0000
Trade Openess (export+import)/GDP	*I(1)*	-35.6064	0.0000	*I(1)*	1242.6874	0.0000
Population growth (annual %)	*I(1)*	-4.5903	0.0000	*I(1)*	554.4432	0.0000
Amounts of private credit (loans) by deposit money banks	Level	-1.6175	0.0529	Level	127.1958	0.0345
Average of foreign ratings by all 3 agencies	*I(1)*	-22.2390	0.0000	*I(1)*	603.1598	0.0000
Average of local ratings by all 3 agencies	*I(1)*	-37.1394	0.0000	*I(1)*	614.3906	0.0000
Real effective exchange rate index (2010 = 100)	Level	-1.5701	0.0582	Level	131.6547	0.0001
Gross savings (% of GDP)	Level	-4.2365	0.0000	Level	189.8951	0.0000
Trade (% of GDP)	Level	-2.1333	0.0164	Level	129.0292	0.0195
^Null: Unit root (assumes common unit root process)						
^^Null: Unit root (assumes individual unit root process)						
^^ Probabilities for Fisher tests are computed using an asympttotic Chi						