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Government Debt and Economic Growth: Another Neoclassical Growth Approach

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Abstract

Since the Great Recession, the topic of financial debt has gained renewed attention. The literature is replete with empirical models that estimate the effects of external debt of developing countries on economic growth. This research adds to the literature by providing an augmented Solow Model, incorporating public debt as an exogenous variable. The model's results indicate a negative effect of an economy's steady-state human and physical capital levels and output. Cointegration and error-correction models are estimated for each country. The empirical finding suggests that, while there are negative short-run and long-run causal effects of deficit spending on physical capital and economic growth, their magnitudes differ for low-debt and high-debt countries.

Keywords: Economic growth, Public debt

JEL Codes: H540, E660, O470

1. Introduction

Fiscal policy is an important component of any economy. Government expenditures are required to provide public goods, such as building infrastructure to improve firm productivity and public education to increase the stock of human capital of its citizenry. There are only a few arguments against the provision of these services when the public sector operates under a balanced budget. However, the discussion of deficit financing of public goods has opponents on both sides. Opponents of deficit spending, debt accumulation, argue that among other things, increased debt levels inhibit economic growth.

The 2007-8 Global Financial Crisis caused by the real estate market brought light to this phenomenon. The collapse of the capital market and increase of financial risk brought about by real estate markets led to stagnant economies and lower income levels. This global crisis suppressed tax revenues, causing public budget deficits and increased public debt levels. Marked increases in debt levels nearly caused a shut-down of the federal government of the United States

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(Schildknecht 2015). Extraordinarily high debt levels of Greece have pushed it into near insolvency. The government of Puerto Rico has recently defaulted on some of its outstanding debts while experiencing a collapsing economy[2]. Suffering from the same malaise, African countries borrowed extensively to jump-start their economies, only to find themselves under the weight of crushing debt levels. It is apparent that debt has been a major factor in central planning and in the trajectory of economic growth of most countries – particularly on the heels of the Great Recession.

While emerging and developed economies borrow for similar reasons--to spend money they do not currently have--their sources of creditors vary. Owing to more refined and developed capital markets and lower default risk levels, developed countries tend to borrow from internal and external financial markets. Developing countries, for reasons from the other end of the risk spectrum, tend have a large share of their debts from external lenders. Regardless the source of credit, their effect appears to be similar.

Researchers have delved into this topic with vigor. They have brought various econometric models to bear on this subject, while forwarding few theoretical models to explain the effects of debt on economic growth. Before I introduce an economic model to contribute to the body of literature, I begin by reviewing a sample of works-conducted on this topic in the next section.

2. Literature Review

Country indebtedness has been the sleeping giant around the world. Used to finance world wars, global debt had been on the decline around the world, particularly since world war II. The global financial collapse piqued a lot of interest in the effect of public debt on the economy. Until this era, excessive public debts and the financial risks that typically ensues were concerns relegated to developing countries. Catherine Bonser-Neal (2015) provides a great review of the literature on this subject.

Examining the correlation between public debt and economic growth, Reinhart and Rogoff's (2010) seminal work revealed a negative relationship between debt and economic growth. This cross-sectional analysis of developed and developing countries categorizes countries into four groups, by average debt levels, from 1790 to 2007. Their results are mixed. Highly indebted countries grow at lower rates than those with lower levels. While these results are a cause for concern for countries with higher debt levels, the study was largely empirical and lacked a theoretical base.

Using a panel data set of 38 developing and developed countries, Kumar and Woo (2015) also found heterogeneity in the effect of debt on economic growth. Debt coefficients differ based on country groupings. Nevertheless, Kumar and Woo found a non-linear relationship as the level of debt-to-GDP ratio reached 90%. To control for a variety of factors, Checherita-Westphal and Rother (2012) analyzed the crowding effect of central government debt on GDP. Their results determined that an increase in debt placed upward pressure on real interest rates, reducing investment and economic growth.

[2] Jennifer Wolff chronicles how the continuing debt crisis in Puerto Rico has threatened its solvency and created a haven for hedge fund managers.

Mohamed (2013) performs a cointegration and error correction model using time series data from1970 to 2010 ~~on~~ for Tunisia. Mohamed finds unidirectional short and long-run causality of external debt on economic growth. The findings are robust with the inclusion of corruption and other standard relevant variables. A test of nonlinearity reveals a concave short-run causal relationship of debt on economic growth. While most of the literature consists mainly of empirical analyses in nature, several have incorporated a theoretical construct. Building on the works of Barro (1995), these models incorporate public debt in earlier optimizing models of Solow and Ramsey. These models provide a solid foundation to the empirical works that exist in the literature.

Patrick Villieu (2009) develops an endogenous growth model that proposes and tests the “crowding out” theory. He shows that long-run economic growth is higher with balanced budget government expenditures. While short-run gains can be had in the short-run, long-run growth is inhibited because long-run effects, as manifested by higher interest rates and higher costs of investment, negate economic growth in the long-run.

Peter A. Diamond (1965), in a seminal a utility-maximizing neoclassical growth model, makes a distinction between internal and external debt in efficient and inefficient markets. The author shows that internal and external debt work negatively on economic growth, via increased real interest rates and higher taxes.

This research will add to the literature on neoclassical growth by developing an augmented Solow neoclassical growth model with human capital and public debt. I will develop the model in the next session, followed by a discussion on methodology and data. The results will be analyzed, followed by a brief conclusion.

3. The Model

The central government has two principal means of financing its expenditures (G); tax receipts (T) and debt issuance (D). If G < T, then the central government spends within its means and does not intervene in the capital markets for funds. However, if G > T, the central government runs a budget deficit, and enters the capital market. When the central government borrows capital from the market, this places upward pressure on real interest rates -- making borrowing costlier to firms in the economy. This is known as the crowding-out theory.

The level of public debt is the sum of periodic budget deficits. Let D_T equal the level of public debt at time T, then $D_T=\sum_{i=1}^{T}(G_i - T_i)$. It can be shown that budget deficits have two relevant effects on the capital funds market. First, deficit spending decreases national savings and increases the real interest rate. Second, continued deficit spending increases the level of national debt. When the central debt level exceeds a “comfortable” threshold, it increases the central government’s financial risk. Relatively large debt levels make it more difficult for the central government to implement fiscal policy. Because each country’s debt tolerance is unique, the effect on fiscal policy is heterogeneous. On the heels of the global financial crisis, the European Commission enacted the Stability Growth Pact (SGP). Primarily aimed to control member countries from implementing disastrous fiscal policies that will deleteriously affect the European Union, it also aims to control member country debt limits. To accommodate each country’s debt satiation and risk aversion, the SGP takes a heterogenous approach to the Pact, detailing specific rules to fit each economy.

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To the contrary, The United States employs a legislative debt limit to the level of debt issued by the United States Treasury. This level is exogenously determined by the legislature and requires the passage of laws to increase it. This imposes a transactions cost and can limit the amount of deficit spending by the Federal government. When government expenditures are reduced, this has a negative effect on economic growth. These two effects explain the crowding out and multiplier effects of central debt on the economic growth. Deficit financing increases public debt and reduces national savings, holding all else constant. A reduction in national savings increases real interest rates, making investments more expensive. This leads to lower investment levels. Continued borrowing by the central government exposes its citizens to potential bankruptcy risks, making additional spending more difficult and further increasing real interest rates. This paper analyzes the crowding out effect on an economy's long run economic growth.

3.1 Government Debt and Capital Accumulation

The central theme of this model is the assumption of a concave relationship of public debt and the production function. Firms participate in a closed economy described as,

$$Y_t = C_t + I_t + G_t, \tag{1}$$

Where Y, C, and G are exogenously determined. The level of national investments, I = I(r), is determined endogenously by the level of real interest rate and other exogenous variables, such as investment tax credits, expectations, etc. Let's introduce taxation, T, into the model, to provide a financing means of the government's expenditures.

$$Y_t - T_t - C_t + T_t - G_t = I_t \tag{2}$$

At equilibrium, national savings (NS) equates national investments.

$$NS_t = I_t \tag{3}$$

National savings is the sum of private savings ($Y_t - T_t - C_{t_t}$) and public savings ($T_t - G_t$). Dividing equation (3) by Y, we get:

$$\frac{NS_t}{Y_t} = \frac{I_t}{Y_t} \tag{4}$$

The share of GDP attributed to total capital, I/Y , is identically equal to the share of gross domestic product that is saved, NS/Y. I assume that total investment, I, is comprised of physical capital and human capital[3]. That is, total investment at a point in time, $I_t = \Delta K_t + \Delta H_t$. Writing this expression as share of GDP, $\frac{I_t}{Y_t} = \frac{\Delta K_t}{Y_t} + \frac{\Delta H_t}{Y_t}$. The central government debt-free GDP share of total invested capital ~~as~~ is the sum of GDP share of physical invested capital and human invested capital, e.g. S= $S_K + S_H$. I now define $\tilde{S}_K = \tilde{S}_K(D)$ *and* $\tilde{S}_H = \tilde{S}_H(D)$ as central debt influenced shares of physical and human capital to GDP, respectively. I assume that $\frac{d\tilde{S}_K}{dD} < 0$ *and* $\frac{d\tilde{S}_H}{dD} < 0$.

[3] For an open economy model, the right-hand side of the equation would be I +NFI (net foreign investment).

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Contrary to the debt overhand theory strand of the literature, this assumption requires that debt is strictly negatively related to capital accumulation. Additional debt strictly decreases capital accumulation. Debt-influenced shares of GDP are defined structurally as,

$$\tilde{S}_K = S_K e^{-\gamma D} \quad (5)$$

$$\tilde{S}_H = S_H e^{-\gamma D} \quad (6)$$

A country's central debt level is measured as D and its risk-aversion is γ. Both $\gamma$and D are non-negative real numbers; $0 \leq \gamma \leq \infty$ and $0 \leq D \leq \infty$. A country with zero central debt (D = 0) will revert to zero-debt level capital accumulation, $\tilde{S}_K = S_K$ and $\tilde{S}_H = S_H$. As an economy begins to amass central government debt, its level of effect on capital accumulation will depend on γ, the risk-aversion parameter.

$$\frac{d\tilde{S}_K}{dD} = -\gamma S_K e^{-\gamma D} \quad (7)$$

$$\frac{d\tilde{S}_H}{dD} = -\gamma S_H e^{-\gamma D} \quad (8)$$

Equations (7) and (8) show that a higher level of risk-aversion (γ) has a larger effect on capital accumulation. A country that is completely risk-neutral will have a value of $\gamma = 0$, again reverting to the Mankiw et al (1992) model.

3.2 Effect of Public Debt on GDP Levels

I begin with the standard Augmented Solow model[4] . The functional form of the production function is Cobb-Douglas:

$$Y_t = {K_t}^{\alpha} {H_t}^{\beta} [A_t L_t]^{1-\alpha-\beta} \quad (9)$$

where Y_t is the aggregate level of real income, K_t is the level of physical capital, H_t is the level of human capital, L_t is the amount of labor employed, and A_t is the level of multifactor productivity. Assume $\alpha + \beta < 1$ so that Equation (9) assures a well-behaved, concave neoclassical production function with constant returns to scale and diminishing returns to each input.

The economy's production function can be written in its intensive form by dividing Equation (9) by the number of effective labor, $A_t L_t$;

$$y_t = {k_t}^{\alpha} {h_t}^{\beta} \quad (10)$$

The per capita state equations are:

$$\dot{k}_t = (S_k e^{-\gamma D}) y_t - (n + \delta_k + g) k_t \quad (11)$$

$$\dot{h}_t = (S_h e^{-\gamma D}) y_t - (n + \delta_h + g) h_t \quad (12)$$

where s_K, s_H, δ_K, and δ_H are exogenous parameters that represent, respectively, shares of income that are allocated to physical capital investment, human capital investment, and depreciation rates

[4] For examples using the Cobb-Douglass functions as a production function, refer to Barro (1995), Mankiw et al (1992) and Coupet (2009).

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of physical and human capital. Population is exogenously determined and defined as $L_t = L_0e^{nt}$ so that population growth is constant over time, $(dL/dt)/L_t = n$. Multifactor productivity, defined as $A_t = A_0e^{gt}$, has a growth rate of g. At steady state, the stock of physical and human capital levels remains constant and investments are made only to sustain themselves from population growth, technological growth, and depreciation. This creates a system of three equations. The reduced form system can be solved for steady state levels of physical capital, human capital, and output.

$$h^* = \left(\frac{s_h}{n+\delta+g}\right)^{\frac{1-\alpha}{1-\alpha-\beta}} \left(\frac{s_k}{n+\delta+g}\right)^{\frac{\alpha}{1-\alpha-\beta}} e^{\frac{-\gamma D}{1-\alpha-\beta}} \tag{13}$$

$$k^* = \left(\frac{s_k}{n+\delta+g}\right)^{\frac{1-\beta}{1-\alpha-\beta}} \left(\frac{s_h}{n+\delta+g}\right)^{\frac{\beta}{1-\alpha-\beta}} e^{\frac{-\gamma D}{1-\alpha-\beta}} \tag{14}$$

$$y^* = \left(\frac{s_k}{n+\delta+g}\right)^{\frac{\alpha}{1-\alpha-\beta}} \left(\frac{s_h}{n+\delta+g}\right)^{\frac{\beta}{1-\alpha-\beta}} e^{\frac{-(\alpha+\beta)\gamma D}{1-\alpha-\beta}} \tag{15}$$

Equations (13), (14), and (15) postulate that steady-state levels of human and physical capital are negatively related to the level of national public debt. Because α and β are positive and less than unity, an increase in the level of debt decreases the level of steady state levels of human and physical capital levels and output. Moreover, the results are like that of MRW (1992), except for the attenuating debt function. The MRW results are obtained and unconstrained steady state levels are obtained with zero debt or no risk-aversion. Note also that debt doesn't affect all economies in the same way. Varying levels of γ determine the overall effect of debt levels. A value of $\gamma = 0$ buffers the economy from the ill effects of debts. Higher levels of γ magnifies the effect of debt. Taking natural logs of the steady state output equation (15) leads to:

$$\ln\left(\frac{Y_t}{L_t}\right) = \ln(A_o) + gt + \frac{\alpha}{1-\alpha-\beta} ln(s_k) + \frac{\beta}{1-\alpha-\beta} ln(s_H) - \frac{\alpha+\beta}{1-\alpha-\beta}\ln(n+\delta+g) - \frac{(\alpha+\beta)\gamma}{1-\alpha-\beta} D \tag{16}$$

Similarly, at steady-state level of physical and human capital per capita are as follows:

$$\ln\left(\frac{K_t}{L_t}\right) = \ln(A_o) + gt + \frac{1-\beta}{1-\alpha-\beta} ln(s_k) + \frac{\beta}{1-\alpha-\beta} ln(s_H) - \frac{1}{1-\alpha-\beta}\ln(n+\delta+g) - \frac{\gamma}{1-\alpha-\beta} D \tag{17}$$

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$$\ln\left(\frac{H_t}{L_t}\right) = \ln(A_o) + gt + \frac{\alpha}{1-\alpha-\beta} ln(s_k) + \frac{1-\alpha}{1-\alpha-\beta} ln(s_H) - \frac{1}{1-\alpha-\beta}\ln(n+\delta+g) - \frac{\gamma}{1-\alpha-\beta} D \quad (18)$$

4. Methodology and Data

Using the national accounts data for OECD countries from the Penn world Table 9.0 and total debt data from the World Bank, I divided the countries into two groups: high debt and low debt.

Consistent with many of the studies conducted on the effects of debt on economic growth, I shall use the Engle-Granger Methodology (EGM). Using time series data of two separate OECD countries, I shall try to test the significance of the structural models developed in the previous section of the paper. The EGM tests for short-run and long-run causality and equilibrium among multi-equation time series.

In accordance to the EGM, I will use the specification defined in Equations (16) and (17) to estimate Error Correction Models. The EGM identify four steps to determine if a system of equations is cointegrated of order (1,1) and to estimate a vector error correction model, VECM.

- Each series in the system equation is pretested for its order of integration. I will use the augmented Dickey-Fuller and Phillips-Perron tests on the levels of each series to test for unit roots. The Augmented Dickey-Fuller tests is as follows:

  $$\Delta y_t = a_0 + a_2 t + \tau y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-1+i} + \varepsilon_t \ ;$$

  Where, $\varepsilon_t$is a stationary and serially uncorrelated disturbance term. The series is said to be integrated of order (1) if we cannot reject the null hypothesis of a unit root in the level equation, but reject the hypothesis of a unit-root after first-differencing this equation. In short, the level equation must contain at least one-unit root and its first difference is stationary. If all series are integrated of order (1), then the system of equations could be cointegrated of order (1,1).

- After confirming that each series is I (1), estimate the long-run equilibrium relationship by estimating the OLS equation:

  $$\ln(\frac{GDP}{capita})_{it} = \beta_0 + \sum \beta_i x_{it} + e_{it};$$

  Where each x_i is an explanatory variable determined to be I (1) in the first step. The necessary next step in determining if the variables are CI (1,1) is by performing a Dickey-Fuller or the Phillips-Perron test to determine if the error series, e_t, is stationary. If we can reject the null

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hypothesis of a unit using either the ADF or PP test, we can determine that the equation is cointegrated of order (1,1).

- Given that the system of equations is CI (1,1), estimate the error correction model as follows:

$$\Delta\ln(\frac{GDP}{capita})_t = \beta_0 + \ln(\frac{GDP}{capita})_{t-1} + \alpha_1\hat{e}_{t-1} + \sum_{i=1}\alpha_{2i}\,\Delta\ln(INV)_{t-i} + \sum_{i=1}\alpha_{3i}\,\Delta\ln(HC)_{t-i} + \sum_{i=1}\alpha_{4i}\,\Delta\ln(n+\delta)_{t-i} + \sum_{i=1}\alpha_2\,Debt_{t-i} + \epsilon_t$$

  Where ϵ_t is stationary and serially uncorrelated disturbance term. OLS will be used to estimate the included parameters.

- Long-run equilibrium and the speed of adjustment will be determined by the coefficient of $\hat{e}_{t-1}$. Per Enders (1995) and Engle and Granger (1987), long-run equilibrium requires that the coefficient is negative and statistically significant. The value of the coefficient provides the annual path toward equilibrium GDP in the long-run. Adequate lag length included in the regression can be confirmed with a test of the disturbance term, ϵ_t. If the error series is serially uncorrelated and indicative of a white noise process, then then included lag lengths are adequate.

I will analyze the effect of public debt on physical capital and economic growth for the United States and Switzerland. To differentiate the effect of debt on capital stock and economic growth, Penn World Table OECD countries were divided into subsamples: high debt and low debt countries. The arbitrary cutoff for debt level is determined to be 50%. OECD countries with average debt/GDP ratios of less than 50% are grouped together as low debt and the remainder are high debt. Countries in both subsamples were then selected based on data availability and longer series length. Refer to Table A1 of Appendix A for listing of the final groupings[5].

National accounts data are taken from the Penn World Table 9.0 and central government debts are taken from the World Bank. After a cointegration test, I selected the United States and Switzerland as representative high and low-debt countries, respectively. These two countries best represent relatively heavily indebted and low in debt, respectively.[6] Equations (16) and (17) will be estimated using the data from the Penn World Table. The descriptions are available in Table 1 and a graphical illustration of each series is available in Figure 1.

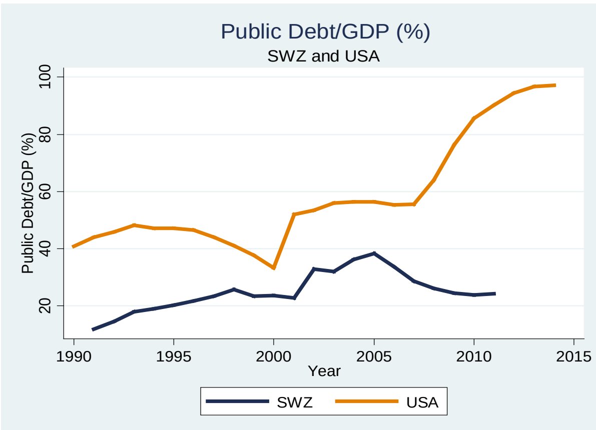
Table 1: Data Description

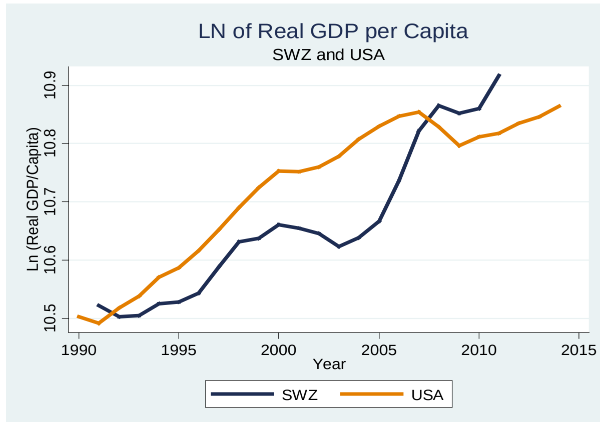
Variable	*Description*	*Source*
RGDP	Output-side real GDP at chained PPPs (in mil. 2011 US$) per capita	Penn World Table 9.0

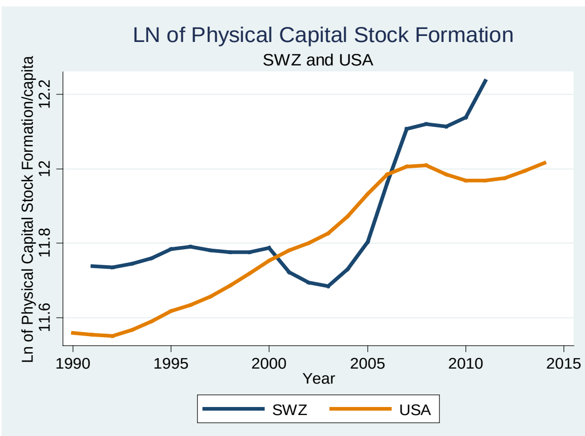
[5] This contrasts with Cecchetti, Mohanty, and Zampolli who used 12 of the OECD countries in a similar study. This is in large part due to the human capital index variable used in this study.

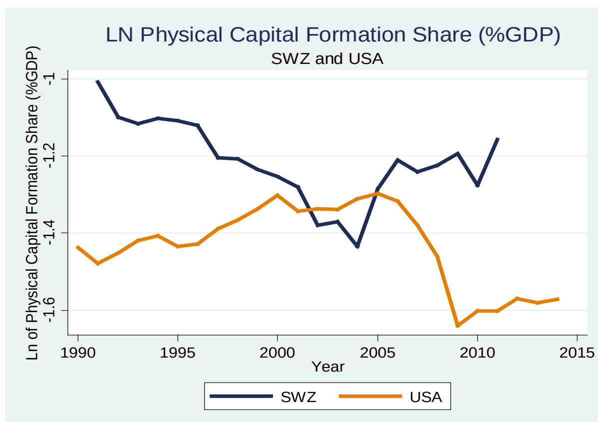
[6] To maximize the number of observations and power of tests conducted, I grouped the OECD countries by magnitude of debt. I created two balanced panel data sets: A high debt group consisting of the United States, Canada, GBR, Netherlands, and Spain; and a low debt constituting Belgium, Switzerland, and the Czech Republic. A Levin-Lin Chu unit root test was conducted on all the relevant series in Equation 16. The high debt series failed to reject the null hypothesis of the existence of a unit root in the difference of the log of human capital. This suggests that the system of equation is not cointegrated using the panel data. The same panel data failed to reject the null hypothesis of no cointegration using the Westerlund (2008) Cointegration Test.

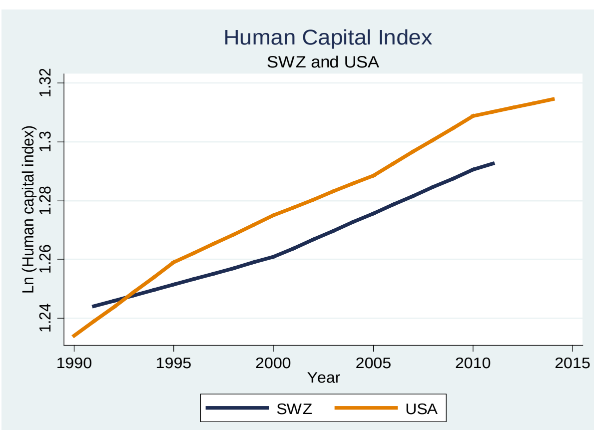
S_K	Share of gross capital formation at current PPPs	Penn World Table 9.0
HC	Human capital index, based on years of schooling and returns to education.	Penn World Table 9.0
Pop	Population (in millions)	Penn World Table 9.0
n	$(Pop_t - Pop_{t-1})/Pop_{t-1}$	Author (Using PWT 9.0)
Delta	Average depreciation rate of the capital stock	Penn World Table 9.0
Debt	Central government debt, total (% of GDP). Foreign and domestic debt.	International Monetary Fund, Government Finance Statistics Yearbook and data files, and World Bank and OECD GDP estimates.











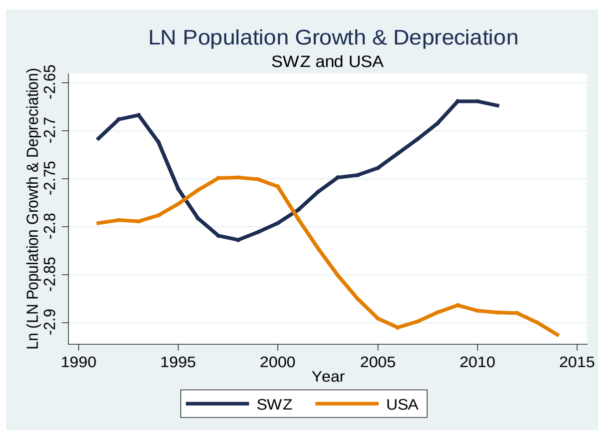
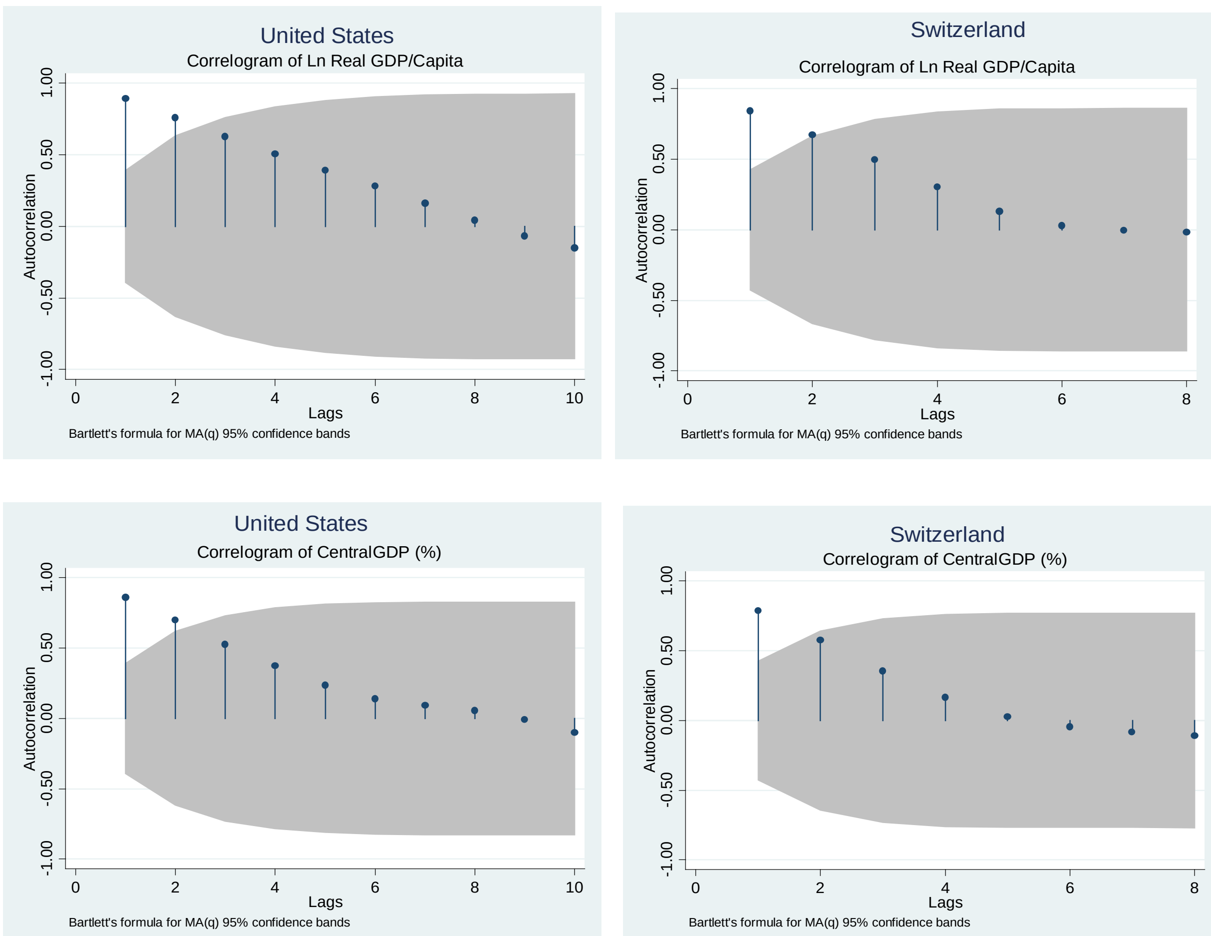


Figure 1: Levels graphs of included variables utilized in Equations (16) and (17)

5. Results

Per the Engel-Granger Cointegration Methodology, the first necessary condition for a system to be cointegrated is that each series much be integrated of the same order. Therefore, the first step is to confirm that each series in the system has a unit root in the level, but not in the first difference. To accomplish this, the Augmented Dickey-Fuller and Phillips-Perron tests are conducted on each series. Both unit root tests are conducted under the null hypothesis that each series has at least one-unit root. The null hypothesis of a unit root is rejected if the test statistics is less than the critical values. In that case, the alternative hypothesis of no unit root is accepted. Lag lengths for the ADF are determined by Engle and Granger (1987).



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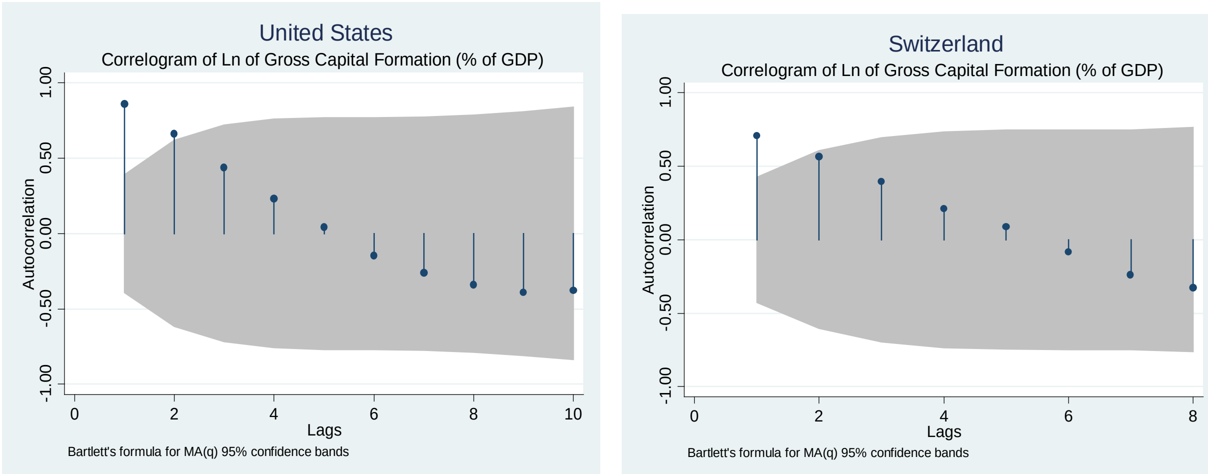

Figure 2: Correlogram of Ln of GDP, INV Share, and Central Government Debt

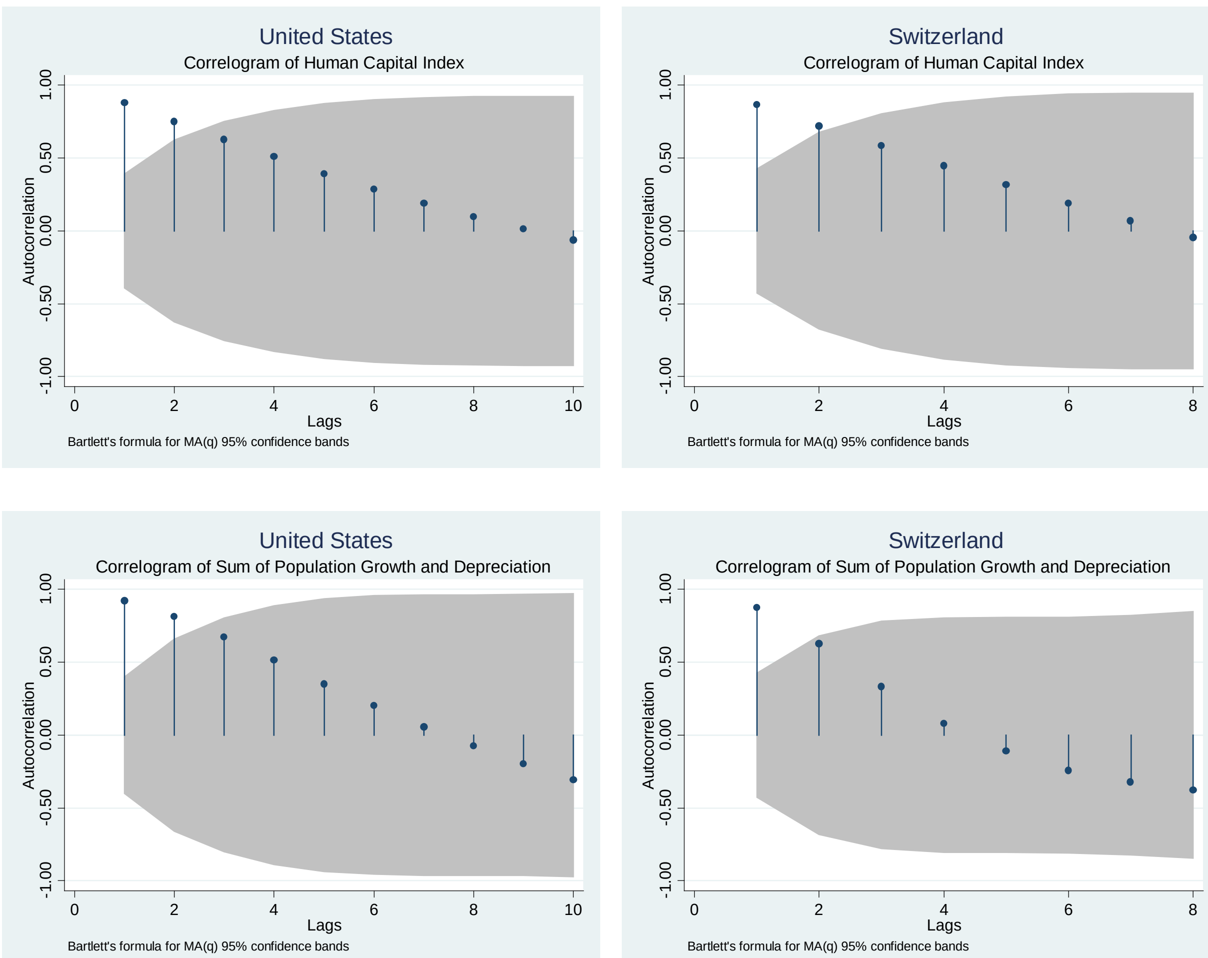

Figure 3 Correlogram of Human Capital and sum of population and depreciation

Consistent with the Enders (2009), a graphical illustration of the data is paramount. Figure 2 contains correlograms for each series utilized in the United States and Switzerland specifications. These autocorrelation coefficients dampen out with each successive lag. With the shaded 95%

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confidence region indicated in grey, the autocorrelation coefficients die-out, but not consistently to zero. This is indicative of the presence of a unit root. As a more formal test of stationarity, Tables 2 and 3 summarize the results of the unit-root tests on the United States and Switzerland series.

Per Enders (1995), to be cointegrated, a group of variables must be integrated of the same order. This can be established using either the augmented Dickey-Fuller Test or the Phillips-Perron Test. The variables are integrated of order 1 if the level of those variables is nonstationary and when first-differenced, they become stationary. Augmented-Dickey Fuller and Phillips-Perron Unit Root Tests are displayed for the United States in Table 2 and Switzerland in Table 3. For all variables, the null hypothesis of a unit root cannot be rejected in their levels using both tests. However, once differenced, either the ADF or PP test reject the null hypothesis of a unit root at the 5% level of significance. I can conclude that all of the relevant variables are integrated of order 1, I(1) – a necessary condition for cointegration. Per Engle and Granger (1987), all series must be integrated of the same order to be cointegrated.

Table 2: Unit Root Tests of United States Series

United States Unit Root Tests					
Augmented-Dickey Fuller Test			*Phillips-Perron Test*		
Variables	Z(t)	Trend	PP	Trend	Order of Integration
Ln(rGDP/Capita)	2.119	Y	-1.657	Y	I(1)
	(---)		(---)		
Δ Ln(rGDP/Capita)	-1.589	N	-3.063**	N	I(0)
	(---)		(-3.00)		
Ln(Inv/GDP)	.514	N	-1.072	N	I(1)
	(---)		(---)		
ΔLn(Inv/GDP)	-2.481**	N	-3.616**	N	I(0)
	(-1.950)		(-3.00)		
Ln(HC Index)	-2.035	Y	-1.643	Y	I(1)
	(---)		(---)		
ΔLn(HC Index)	-3.571**	N	-2.471**	N	I(0)
	(-3.00)		(-1.950)		
Ln(Popgr + δ)	-1.441	N	-1.967	Y	I(1)
	(---)		(---)		
ΔLn(Popgr + δ)	-3.165**	N	-1.635	N	I(0)
	(-3.00)		(---)		
Ln(K/cap)	-1.529	N	-0.663	N	I(1)
	(---)		(---)		
ΔLn(K/cap)	-3.386**	N	-2.214	N	I(0)
	(-3.000)		(---)		
Ln(Debt/GDP)	-1.576	Y	-1.263	Y	I(1)
	(-3.600)		(---)		
ΔLn(Debt/GDP)	-2.249**	N	-3.599**	N	I(0)
	(-1.950)		(-3.00)		

Notes: Z(t) and PP are Dickey-Fuller and Phillips-Perron statistics, respectively. Both models are run with a max lag of four and the optimal lag length is found by reducing the lags to find the greatest value of test statistic. ** indicates of the coefficient at the 5% level. (---) indicates that the variable is not significant at the 10% level. Critical values of Z(t) and PP statistics are indicated in parentheses at their significant level.

Table 3: Unit Root tests for Switzerland Series

Switzerland Unit Root Tests					
Augmented-Dickey Fuller Test			*Phillips-Perron Test*		
Variables	Z(t)	Trend	PP	Trend	Order of Integration
Ln(rGDP/Capita)	-2.230	Y	-1.834	Y	I(1)
	(---)		(---)		
Δ Ln(rGDP/Capita)	-3.117**	N	-2.583	N	I(0)
	(-3.00)		(---)		
Ln(Inv/GDP)	-1.622	N	-2.226	N	I(1)

	(---)		(---)		
ΔLn(Inv/GDP)	-2.847**	N	-4.597***	N	I(0)
	(-1.950)		(-3.00)		
Ln(HC Index)	-2.466	Y	-1.437	Y	I(1)
	(---)		(---)		
ΔLn(HC Index)	-3.422**	N	-3.471**	N	I(0)
	(-3.00)		(-3.00)		
Ln(Popgr + Delta)	0.194	N	-1.214	Y	I(1)
	(---)		(---)		
ΔLn(Popgr + Delta)	-2.620**	N	-2.09**	N	I(0)
	(-1.950)		(-1.950)		
Ln(K/cap)	-0.256	N	0.370	N	I(1)
	(---_		(---)		
ΔLn(K/cap)	-2.661*	N	-1.991	N	I(0)
	(-2.630)		(---)		
Ln(Debt/GDP)	-1.950	N	-2.103	Y	I(1)
	(---)		(---)		
ΔLn(Debt/GDP)	-2.299**	N	-3.622**	N	I(0)
	(-1.950)		(-3.00)		

Notes: Z(t) and PP are Dickey-Fuller and Phillips-Perron statistics, respectively. Both models are run with a max lag of four and the optimal lag length is found by reducing the lags to find the greatest value of test statistic. ** indicates significance of the coefficient at the 5% level. * indicates significance of the coefficient at the 1% level. (---) indicates that the variable is not significant at the 10% level. Critical values of Z(t) and PP statistics are indicated in parentheses at their critical values.

5.1 High Debt Country: The Case of the USA

Cointegration of the systems of equations will be tested for long-run equilibrium. Engle (1995) recommends running OLS and testing for stationarity of the residuals and diagnostically testing to ensure OLS assumptions. Therefore, equations (16) and (17) will be estimated and their results posted in Tables 4 and 5 of this section. In each Table, model 1 will be the baseline specification, comparable to Mankiw et al (1992). Model 2 will introduce the debt variable, followed by models 3 and 4 to test for robustness and nonlinearity of the debt variable.

The baseline models for physical capital and GDP are produce expected signs and are statistically significant at the 1% level. The exception exists for the coefficient of Ln (n & δ) for the physical capital model. Its coefficient is negative, but is statistically insignificant. Long-run equilibrium is assured in both models because Phillips-Perron Tests results reject the null hypothesis of a unit root in the residuals at the 5% level and 1% level, for Physical capital and GDP, respectively. The Chi-Square test for the GDP specification (16) suggests that the residuals are normally distributed and non-autoregressive. While the same case exists for the physical capital specification, there is some sign of auto-regression in the physical capital specification.

When the government debt ratio is introduced, an explicit test of specifications (16), there is significant improvement from model 1. The coefficients from model 1 carry the correct signs and are statistically significant, at least at the 5% level. Most importantly, the coefficient of the debt variable is negative and statistically significant at the 1% level. The coefficient of -.001 suggests that a 1 unit in the debt/GDP ratio of the USA, decreases real GDP per capita by 10 basis points. The long run elasticity of debt to GDP partly explains the tepid growth of the USA from the recent financial crisis. At the margin, it drags on the gains from investments in physical and human capital. As in the baseline model, the residuals accepted to be normally distributed, non-autoregressive, and stationary.

Model 2 for the physical capital produces a similar result for the debt coefficient. However, it suggests a stronger relationship between the debt ratio and physical capital. The coefficient of -.004, also statistically negative at the 1% level, results in a four-fold effect on physical capital. This is strong support for the crowding out theory of fiscal policy. Again, based on diagnostics,

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the we can accept the results that the residuals are normally distributed, non-autoregressive, and

United States Cointegrating Equation: Ln(K/cap)$_t$				
	(1)	(2)	(3)	(4)
Constant	2.25	-0.459	-1.227	-0.529
	(0.305) ***	(0.400)	(0.587) *	(0.433)
Ln(Inv)$_t$	0.241	-0.096	0.032	-1.000
	(0.055) ***	(0.054)	(0.089)	(0.064)
Ln(HC)$_t$	5.84	7.052	7.41	7.029
	(0.408) ***	(0.269) ***	(0.332) ***	(0.280) ***
Ln (n + δ)$_t$	-0.855	-1.171	-1.366	-1.22
	(0.152) ***	(0.090) ***	(0.142) ***	(-0.172) *
Ln(X/M)$_t$	…..	……	0.144	……
			(0.084)	
Debt$_t$	…..	-0.004	-0.004	-0.005
		(0.0005) ***	(0.0005) ***	(0.003) *
Debt$_t^2$	…...	…….	……	-0.000
				(0.000)
Adj. R^2	0.98	0.99	0.99	0.99
No. Obs.	24	24	24	24
Normality Test (Prob > χ^2)	.635	.48	.04	.20
Aug. DF	-3.472**	-3.959***	-4.052***	-4.142***
(2 Newey West lags)	(-3.000)	(-3.000)	(-3.750)	(-3.750)
Breusch-G. Prob > χ^2	.001	0.24	0.83	

Robust standard errors in parentheses
***1% statistical significance
**5% statistical significance
* 10% statistical significance

stationary. We can accept the null hypothesis that the system of variables in specification (17) are cointegrated of order (1,1).

As a test of robustness, the natural log the level openness is included and is displayed in model (3). In both specifications, the coefficient of the openness variable is not statistically different from zero. However, the signs of the coefficients of the other variables remain stable and statistically significant. Most importantly, that of the debt variable remain unaffected.

As a test of non-linearity in the effect of debt on real GDP, we include the square of the debt variable in model (4). This methodology is consistent with the "debt overhang" strand of the literature. The coefficient of the square of debt is negative, but statistically insignificant. This does not support the theory of debt overhang in the United States sample.

Table 4: Cointegration Equations of Capital Stock (USA)

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Table 5: Co-integration Model (USA)

	United States Cointegrating Equation: Ln(GDP/cap) $_t$			
	(1)	(2)	(3)	(4)
Constant	3.995 (0.157) ***	3.290 (0.200) ***	3.3092 (0.341) ***	3.184 (0.295) ***
$Ln(Inv)_t$	0.422 (0.024) ***	0.334 (0.03) ***	0.368 (0.058) ***	0.328 (0.041) ***
$Ln(HC)_t$	5.635 (0.229) ***	5.886 (0.214) ***	6.045 (0.217) ***	5.916 (0.214) ***
$Ln (n + \delta)_t$	-0.042 (0.058)	-0.124 (0.059) **	-0.175 (0.095) *	-0.194 (0.096) *
$Ln(X/M)_t$	…..	……	0.037 (0.044)	……
$Debt_t$	…..	-0.001 (0.0002) ***	-0.001 (0.0003) ***	-0.003 (0.001) *
$Debt_t^2$	…...	…….	……	-0.000 (0.000)
Adj. R^2	0.99	0.99	0.99	0.99
No. Obs.	24	24	24	24
Alt D.W. (Prob > χ^2) (2 lags)	.30	.27	.51	.78
Normality Test (Prob > χ^2)	.635	.969	.959	.894
Phillips Perron (2 Newey West lags)	-3.756*** (-2.660)	-3.793*** (-2.660)	-4.367*** (-2.660)	-4.367*** (-3.750)

Robust standard errors in parentheses
***1% statistical significance
**5% statistical significance
* 10% statistical significance

5.1.1 Error-Correction Models

Section 5.1.1 established that variables indicated in Equations 16 and 17 are CI (1, 1). This suggests that there is a long-run relationship in the systems of equations. However, to determine if there are long-run and short-run causal relationships, we estimate the error-correction models, presented by Engle and Granger (1987). Table 6 contains the cointegration model 2 for the physical capital and GDP specifications in Tables 4 and 5.

The lag of the residuals from models 2 in Table 4 and 5 are used in the error-correction models in Tables 6. The coefficients of the error-correction terms are negative and statistically significant. This provides additional support for cointegration and long-run equilibrium in the systems of equations in Tables 4 and 5. Moreover, approximately 51% and 54% of shocks from long run equilibrium from the prior periods are corrected in the current year for physical capital and GDP, respectively. In the short run, there is short-term Granger causality running from debt to the log of physical capital formation and GDP. In the short run, approximately .1% of GDP and physical capital are reduced by a 1-unit increase in the debt/GDP ratio. Diagnostics of these models suggest the residuals are normally distributed, non-autoregressive and stationary.

Table 6: United States Error-Correction Model

United States Engle-Granger Error Correction Models		
Dependent Var.:	$\Delta ln(K/cap)_t$	$\Delta ln(GDP/cap)_t$
Constant	.005	.008
	(0.004)	(.005)
$\hat{\varepsilon}_{t-1}$	-0.505***	-0.535**
	(.108)	(.228)
$\Delta\ ln(GDP/cap)_{t-1}$	0.573***	0.056
	(0.084)	(.093)
$\Delta Ln(S_K)_t$	0.057	0.267***
	(0.040)	(.037)
$\Delta Ln(HC)_t$	1.374	2.88**
	(1.206)	(1.39)
$\Delta Ln(n + \delta)_t$	-0.533***	-0.167
	(0.129)	(.134)
$\Delta(Debt)_t$	-0.001***	-0.001***
	(0.0004)	.0004)
Adj. R^2	.91	.91
Alt Durbin W. (Prob > χ^2)	.27	.33
Breusch-G Prob > χ^2	.28	.32
Phillips Perron	-5.142***	-6.137***
	(-2.660)	(-2.660)
Normality Test (Prob > χ^2)	.29	.52

Robust standard error in parentheses
***1% statistical significance
**5% statistical significance
* 10% statistical significance

5.2 Low-Debt Level Country: The Case of Switzerland

5.2.1 Basic Cointegration Equation

The cointegration models for physical capital formation and real GDP per capita are like the high debt case in section 5.1. However, one noticeable difference is in the long-run size effect of debt on physical capital and output. Table 8 contains the baseline specification in model 1. Like the high debt country case, the baseline model is consistent with the Mankiw et al. (1992). There is a positive relationship with capital and physical investments, and a negative relationship with the log of population growth and depreciation. The Alternative Durbin Watson Chi Square test fails to reject the null hypothesis of no first-order autocorrelation of the residuals. The Phillips-Perron Test statistic of -2.592 leads to a rejection of the null hypothesis at the 1% level that the residuals contain a unit root. This leads us to accept the alternative hypothesis of stationarity and a system of variables that is cointegrated of order (1,1).

Model 2 of Table 7 contains the debt variable. Like the United States case, the model is improved over its respective baseline, as its adjusted R square is improved, while retaining the signs and statistical significance of the other explanatory variables. The Phillips-Perron test of the residuals rejects the existence of a unit root at the 5% level, while also failing to reject the null hypothesis of serial correlation with a p-value of 66% for the Alternative Durbin Watson statistics. This cointegration model suggests a long-run relationship in the system of equation. The debt coefficient is negative and statistically significant at the 1% level. The coefficient has a value of -.006, which indicates that a one-unit increase in the percentage of Switzerland's debt-to-GDP level will decrease its real GDP per capita by .6% --- 6 times the level of that of the United States. Perhaps this is a contributing factor why Switzerland uses less debt to finance its expenditures. Model 4 includes the square of the debt variable. It indicates no statistical evidence of nonlinearity in the effect of debt on output. The inclusion of the debt square term increases the size of the standard error of the debt coefficient, as well as its level. This is indicative of some level of collinearity between the two variables. Thus, model (7) is inferior to (6).

Table 7: Capital Stock Cointegration Models (Switzerland)

	Switzerland Cointegrating Equation: Ln(K/cap)$_t$			
	(1)	(2)	(3)	(4)
Constant	-3.405	-5.103	-3.194	-1.844
	(1.790)	(1.801) **	(2.156)	(0.2.329)
Ln(Inv)$_t$	1.053	0.8118	0.825	0.849***
	(0.142) ***	(0.170)***	(0.164)***	(0.157)
Ln(HC)$_t$	12.77	13.714	11.897	11.81
	(1.022) ***	(1.023)***	(1.566)***	(1.343)***
Ln $(n + \delta)_t$	-0.135	-0.268	-0.421	0.159
	(0.290)	(0.270)	(0.280)	(0.628)
Ln(X/M)$_t$	…..	……	0.609	……
			(0.408)	
Debt$_t$	…..	-0.006	-0.008	0.021
		(0.003)**	(0.003)**	(0.014)
Debt$_t^2$	…...	…….	……	-0.0005
				(0.0002)*
Adj. R2	0.93	0.94	0.94	0.95
No. Obs.	21	21	21	21
Normality Test (Prob > χ^2)	.001	.001	.01	.001
Aug. DF	-4.745***	-3.445***	-4.789***	-5.303***
(2 Newey West lags)	(-2.660)	(-2.660)	(-2.660)	(-3.750)
Breusch-G. Prob > χ^2	.807	0.70	0.61	0.32

Robust standard errors in parentheses
***1% statistical significance
**5% statistical significance
* 10% statistical significance

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Table 8: Cointegration Model (Switzerland)

Switzerland Cointegration Model: $Ln(GDP/cap)_t$			
	(1)	(2)	(3)
Constant	-2.052	-3.75	-3.429
	(0.855)**	(0.738)***	(0.891)***
$Ln(Inv)_t$	0.328	0.086	0.089
	(0.083)***	(0.092)	(0.097)
$Ln(HC)_t$	9.606	10.549	10.359
	(0.473)***	(0.452)***	(0.560)***
$Ln(n + \delta)_t$	-0.347	-0.481	-0.438
	(0.163)**	(0.135)***	(0.142)***
$Debt_t$	…..	-0.006	-0.003
		(0.001)***	(0.006)
$Debt_t^2$	…...	……	-0.000
			(0.000)
Adj. R^2	0.95	0.97	0.97
No. Obs.	21	21	21
Alt D.W. (Prob > χ^2)			
(2 lags)	.65	.66	.43
Phillips Perron.	-2.592**	-3.445***	-3.345***
(2 Newey West lags)	(-1.950)	(-1.950)	(-1.950)
No. Obs.	20	20	20

Robust standard errors in parentheses
***1% statistical significance
**5% statistical significance
* 10% statistical significance

5.2.2 Error Correction Models

The error correction models for the low debt economy (Switzerland) are found in Table 9.

Table 9: Error-corrections models (Switzerland)

Switzerland *Engle-Granger Error Correction Model*		
	$\Delta\ln(K/cap)_t$	$\Delta\ln(GDP/cap)_t$
Constant	0.098	0.055
	(0.033) ***	(0.025)
$\hat{\varepsilon}_{t-1}$	-1.289***	-0.703***
	(.165)	(.115)
$\Delta\ ln(K/cap)_{t-1}$	0.777***	0.454**
	(.135)	(.152)
$\Delta Ln(S_K)_t$	0.503***	0.071
	(0.085)	(0.085)
$\Delta Ln(HC)_t$	-32.72**	-17.059
	(13.46)	(9.514)
$\Delta Ln(n + \delta)_t$	0.157	0.525
	(0.351)	(0.251) **
$\Delta(Debt)_t$	-0.002	0.000
	(.002)	(.001)
Adj. R^2	.87	.77
Alt Durbin W. (Prob > χ^2)	.10	.15
Breusch-P, Prob > χ^2	.102	.16
Phillips Perron	-3.17***	-3.82***
	(2.660)	(2.660)
Normality Test (Prob > χ^2)	.000	.847

Robust standard error in parentheses
***1% statistical significance
**5% statistical significance
* 10% statistical significance

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The error correction terms are negative and statistically significant at the 1% level. There is also short-run negative Granger causality of real GDP per capita from and real GDP. The coefficients of the human and physical capital investment are statistically insignificant. In the long-run, the economy converges towards its long-run equilibrium at a rate of 70% per year, more rapidly than its higher debt counterpart.

The debt variable for the Switzerland models do not provide any evidence of short-run Granger causality of debt to real physical capital and GDP per capita. The levels of the coefficient are very small (approximately zero) and not statistically significant. While the system of equation defined by equation (16) for the Switzerland sample provides evidence of a long-run negative relationship of debt and real GDP, there is no evidence of short-run Granger causality.

6. Discussion and Conclusions

Using the Cobb-Douglas production function, I develop a steady state function for physical capital and economic growth per capita that incorporates the effect of public debt. Uniquely and exogenously determined based on each country's risk-tolerance, defined as γ, public debt negatively effects a country's capital formation and economic growth in different magnitudes. I argue that capital formation becomes costlier monotonically with deficit spending.

Using the data from two OECD countries with diametrically opposed average levels of public debt as a function of GDP, we estimate a cointegration and error-correction equations using structural functions of steady state physical capital and GDP per capital levels. Based on these results, both countries show a negative effect of public debt and physical capital and GDP levels. In the case of the United States, a 1% increase in the debt/GDP ratio, Granger causes a .1% reduction of output per capita. Moreover, using same data for Switzerland, a lower debt country, the debt/ratio effect on economic growth is stronger. In the long-run, a 1% increase in Switzerland's debt/GDP ratio produces a .6% reduction in GDP per capita. This effect is 6 times as debilitating as in the USA. The results support the crowding effect theory in that additional debt reduces investments in physical capital, leading to lower levels of economic output.

The results of this study have policy implications. It is incumbent upon policy makers to determine each country's risk-aversion. Countries that are more risk-averse will be more opposed to its use, reducing the use of deficit spending fiscal policies. This will negatively affect economic growth. This study, while adding to the body of research on the effects of debt on economic growth, does surface a few questions. What are common characteristics of countries that determine the degree of risk-aversion and how is that manifested in a country's institutional infrastructure. Are democratic societies more opposed to debt accumulation? Does a country's government structure impact the way that public debt and deficit spending are employed? Do developed countries react similarly to debt accumulation? Answers to these questions will provide more direction and support to policy makers.

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8. Appendix A

A. 1 Low-Debt Countries Descriptive Summary

Select OECD Countries with Low Debt/GDP ratios						
Country	*Variable*	*#Obs*	*Mean*	*S.D.*	*Min*	*Max*
Belgium	Ln(rGDP)	19	10.45	0.12	10.22	10.64
	Ln(INV)	19	-1.26	0.11	-1.49	-1.07
	Ln(HC)	19	1.10	0.03	1.04	1.13
	Ln(n & δ)	19	-2.96	0.03	-3.02	-2.92
	Debt/GDP	19	6.27	0.97	4.49	7.59
Switzerland	Ln(rGDP)	19	10.68	0.13	10.51	10.92
	Ln(INV)	19	-1.23	0.09	-1.44	-1.10
	Ln(HC)	19	1.27	0.01	1.25	1.29
	Ln(n & δ)	19	-2.74	0.05	-2.81	-2.67
	Debt/GDP	19	26.20	5.82	17.82	38.26
Czech Republic	Ln(rGDP)	19	10.04	0.15	9.81	10.27
	Ln(INV)	19	-1.34	0.11	-1.59	-1.12
	Ln(HC)	19	1.26	0.03	1.18	1.29
	Ln(n & δ)	19	-3.25	0.13	-3.40	-3.02
	Debt/GDP	19	18.55	8.00	9.79	36.26

A. 2 High Debt Countries Descriptive Summary

Select OECD Countries with High Debt/GDP ratios						
Country	*Variable*	*#obs*	*Mean*	*S.D.*	*Min*	*Max*
Canada	Ln(rGDP)	23	10.51	0.12	10.29	10.65
	Ln(INV)	23	-1.38	0.05	-1.46	-1.28
	Ln(HC)	23	1.26	0.03	1.20	1.30
	Ln(n & δ)	23	-2.98	0.03	-3.06	-2.94
	Debt/GDP	23	59.14	12.55	38.78	78.10
Spain	Ln(rGDP)	23	10.20	0.22	9.83	10.47
	Ln(INV)	23	-1.24	0.12	-1.41	-0.97
	Ln(HC)	23	0.98	0.05	0.90	1.05
	Ln(n & δ)	23	-3.10	0.12	-3.35	-2.93
	Debt/GDP	23	50.97	15.78	29.72	96.47
GBR	Ln(rGDP)	23	10.42	0.17	10.11	10.60
	Ln(INV)	23	-1.56	0.07	-1.72	-1.42
	Ln(HC)	23	1.26	0.05	1.17	1.32
	Ln(n & δ)	23	-3.04	0.06	-3.14	-2.94
	Debt/GDP	23	52.22	21.68	29.19	101.29
Netherlands	Ln(rGDP)	23	10.54	0.19	10.21	10.76
	Ln(INV)	23	-1.48	0.09	-1.67	-1.34
	Ln(HC)	23	1.15	0.03	1.10	1.20
	Ln(n & δ)	23	-3.07	0.06	-3.15	-2.97
	Debt/GDP	23	55.65	8.52	40.22	68.48
United States	Ln(rGDP)	23	10.73	0.12	10.49	10.85
	Ln(INV)	23	-1.43	0.11	-1.64	-1.30
	Ln(HC)	23	1.28	0.02	1.24	1.31
	Ln(n & δ)	23	-2.83	0.06	-2.90	-2.75
	Debt/GDP	23	57.69	18.32	33.16	96.61

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A. 3 Low-Debt Country Unit Root Tests

	Low-Debt OECD Countries Panel Unit Root Tests					
	LLC (Adj. t)	*Breitung (Lamda)*	*Im-Perasan-Shin ($\bar{w}_t$)*	*Hadri LM (Z)*	*H-T (Rho)*	*Order of Integration*
Ln(rGDP)	-0.20	2.18	1.92	17.58***	0.98	I(1)
ΔLn(rGDP)	-3.14***	-3.13***	-2.25**	-0.33	0.22***	I(0)
Ln(INV)	-0.98	-1.24	-0.31	7.14***	0.74	I(1)
ΔLn(INV)	-3.17***	-2.10**	-2.52***	0.46	0.09***	I(0)
Ln(HC)	-1.07	-0.79	-0.41	17.07***	0.89	---
ΔLn(HC)	-2.05**	0.21	-0.42	14.52***	0.83	---
Ln(n & delta)	-0.21	-1.35	-0.29	8.80***	0.76	---
ΔLn(n & delta)	-0.12	-0.66	-1.13	3.41***	0.18***	---
Debt	0.55	0.89	0.86	12.35***	1.00	I(1)
ΔDebt	-1.70**	-0.98	-0.98	3.55***	0.25***	I(0)

LLC, Breitung, and IPS panel unit root tests have as a null hypothesis
H_0: panels contain unit roots; H_A: panels are stationary; Hadri LM:panel unit root test:
H_0: All panels are stationary; H_A: Some panels contain unit root --- ***1% level significance, **5% level significance
Countries in panel: Belgium, Czech Republic, and Switzerland
Years included: 1993-2011
Low debt is defined as Average debt/GDP level <50%

A. 4 High Debt Country Unit Root Tests

	High-Debt OECD Countries Panel Unit Root Tests					
	LLC (Adj. t)	*Breitung (Lamda)*	*Im-Perasan-Shin ($\bar{w}_t$)*	*Hadri LM (Z)*	*H-T (Rho)*	*Order of Integration*
Ln(rGDP)	-3.49***	0.94	-1.09	27.66***	0.93	I(1)
ΔLn(rGDP)	-2.65***	-3.89***	-2.15**	4.95***	.47***	I(0)
Ln(INV)	-0.81	-1.94**	-0.56	6.18***	0.82	I(1)
ΔLn(INV)	-3.27***	-3.21***	-3.55***	0.15	0.13***	I(0)
Ln(HC)	-1.24	0.87	0.45	30.09***	0.97	---
ΔLn(HC)	-1.20	0.15	0.61	21.08***	0.92	---
Ln(n & delta)	-2.56***	-2.17**	-0.69	13.77***	1.03	I(0)
ΔLn(n & delta)	-3.31***	-3.42***	-2.51***	11.52***	0.88	I(0)
Debt	0.32	-1.03	0.81	16.35***	1.04	I(1)
ΔDebt	-1.30*	-2.72***	-1.33*	4.00***	0.48***	I(0)

LLC, Breitung, H-T, and IPS panel unit root tests have as a null hypothesis
H_0: *panels contain unit roots*; H_A: *panels are stationary*;
Hadri LM:panel unit root test: H_0: *All panels are stationary*; H_A: *Some panels contain unit root* ---
***1% level significance, **5% level significance, *10% level significance
Countries in panel: Canada, Great Britain, Netherlands, Spain, United States
Years included: 1991-2013
High debt is defined as Average debt/GDP level > 50%

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