THE EFFECTS OF GOVERNMENT DEBT AND THE ECONOMIC FACTORS THAT INFLUENCE ITS SIZE

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Abstract

This study examines the question: does government debt affect economic growth? Theory suggests that countries may turn to money growth and inflation to manage debt levels, and that this in turn decreases growth in GDP. The results of this research show that, controlling for endogeneity and panel data effects, only low income countries use inflation and money growth to manage debt, while higher income countries do not. The results suggest that low income countries may use money growth and inflation as an alternative to taxation, and simultaneously borrow to finance government expenditures. Additionally, this study indicates that there is no statistically significant relationship between the *level* of debt/GDP and subsequent growth in GDP. However, in the short-run of five years there is some evidence of a negative relationship between the *change* of debt/GDP and growth in GDP in the following years, but the size of the impact is relatively small.

1 Introduction

The work of Carmen Reinhart and Kenneth Rogoff on economic growth and public debt led to a revival of the question: does government debt affect economic growth? While the several elements of this question were discussed by economists like Diamond (1965), Barro (1979), Lucas and Stokey (1983), Olson (1993), and Buchanan (1987), the resurgence of interest in recent years has been driven primarily by the controversy over Reinhart and Rogoff (2010b), who found a negative correlation between increasing public debt levels, and economic growth. Herndon et al. (2013) then made some critiques on Reinhart and Rogoff's suggesting that the effects were not quite as strong as had been presented as the result of how a few observations had been handled. The Reinhart and Rogoff (2010b) results were based on forty-four countries, covered approximately two hundred years, and focused on the contemporary correlation between public debt and economic growth. Since then, a number of papers have been written that address several other factors: endogeneity, institutions, inclusion of a broader swath of countries, heterogeneity in country-level data, and inter-temporal correlation. Panizza and Presbitero (2013) specifically point to cross-country heterogeneity and arbitrary debt brackets as areas that need to be resolved. This study will focus on; extending the literature, employing a

number of econometric models to combine these concerns, and evaluating the effect of public debt on economic growth using alternative methods.

This study will address the following major issues. First, is there evidence of a causal relationship between government debt and money growth and inflation? Second, is there a causal relationship between debt and economic growth? Third, are the potential impacts of debt on performance different between high and low income countries?

The first step will focus on inflation and money growth at the national level as a method for managing government debt, to determine empirically if countries do in fact use inflationary policy to manage debt levels. Reinhart and Sbrancia (2011) explain that when inflation is coupled with what they call financial repression[1] government debt can be reduced. Some key attributes of this method of debt-management is that inflationary policy may not face the same political unpopularity that raising taxes, or reducing future government spending might face, further, it would perhaps allow a country to avoid default in the event that debt restructure is unavailable. A drawback, however, is that high inflation rates are often viewed as a sign of financial crisis (Reinhart and Rogoff, 2010c), since the possibility of the devaluing of the domestic currency would cause "a fiscal deadlock with unpredictable consequences" and undermine the confidence of investors (Rubin et al., 2004). The results from the literature on the area of inflation and economic growth indicate that higher inflation rates lead directly to lower economic growth. Having linked higher inflation to lower growth, this paper will study if higher debt is in fact linked higher inflation, and examine some of the characteristics of the countries that use inflation to manage debt.

The next step is a shift back to the primary question to be examined by this paper: are higher levels of government debt correlated with lower long-term growth in subsequent years? There are a number of works that cover the topic of default being a result of high debt levels, but what happens when debt levels are high and a default is not on the table? This study will separate out the inflation-related effects from the growth models to determine if debt itself undermines consumer confidence, because investors and consumers know debt must eventually be paid. Recent literature on debt and growth gives a framework on which to build. Papers by Reinhart and Rogoff (2010c,b) suggest that modest decreases in growth are correlated with

[1]Financial repression is defined by several features: "(i) Explicit or indirect caps or ceiling on interest rates, particularly those on government debt... (ii) Creation and maintenance of a captive domestic audience" directing domestic moneys towards covering government debt... (iii) Government ownership of financial institutions, and restricted entry into financial markets. (Reinhart and Sbrancia, 2011).

increased contemporary debt/GDP levels. This analysis will examine the topic to see if there is empirical evidence of an intertemporal (across-time) relationship with the use of a broad swath of countries to study trends across income levels.

This study will examine "common" trends in the relationship between debt/GDP ratios and growth across countries. Observations will be pooled across countries[2] by income level, and techniques will be employed to control for potential endogeniety and heterogeneity in the data. The analysis of the M1/inflation and the growth sections will begin with a base model using ordinary least square (OLS) regressions, and will then provide comparison models controlling for fixed effects (FE) and then generalized method of moments (GMM) as the standard approach to the endogeneity problem. Finally, a dynamic panel model (DPM) with GMM estimators will be used when the cross-sectional independence assumption is relaxed. While the effects of long-term growth[3] have been examined by others, they have not used dynamic panel techniques. Combining models that control for institutions, panel effects, inter-temporal correlation, and the specific study of M1 growth and inflation rates as a cause of slower growth, are all contributions of this research.

2 Government Debt and Economic Growth: A Review of the Literature

A number of researchers have found a negative relationship between debt and economic growth, (Reinhart and Rogoff (2010b,c); Reinhart and Sbrancia (2011); Woo and Kumar (2015); Checherita-Westphal and Rother (2012)). The Reinhart and Herndon papers have sparked the most recent policy debates. Both find a negative correlation between debt levels and economic growth, particularly when the debt/GDP ratios exceed 90%, and that the debt/GDP acts through inflation to affect the growth. The Reinhart and Rogoff study focuses on central government debt, but also includes external debt. The authors use debt/GDP ratios of 30%, 60%, 90%, and above 90%, as the benchmarks to look at the relationship between debt and economic growth. Though the Reinhart and Rogoff (2010b) analysis examines correlation and not causal effects, their findings indicate that economies having debt/GDP ratios under 30% have average GDP growth rates of 3.7% (median=3.9%). Ratios ranging from 30-60% had an average growth rate of 3.0% (median=3.1%), ratios ranging from 60-90% have average growth rates of 3.4%

[2]See Eberhardt and Presibitero (2013), Pesaran and Tosetti (2011) and Phillips and Sul (2003).
[3]See (Woo and Kumar, 2015).

(median=2.8%) and lastly, countries with debt/GDP ratios over 90% exhibit average growth rates of 1.7% (median=1.9%). These findings suggest that there is a negative non-linear relationship between debt and economic growth, where economies with debt/GDP ratios above 90 have sharply lower GDP growth rates.

When Herndon et al. (2013) attempted to replicate the analysis using the data from Reinhart and Rogoff (2010b,c), they found that there is in fact a slightly weaker negative and more linear relationship between government debt and growth. The results of the Herndon et al. study are[4] that the average real GDP growth rates are 4.2% for less-than-30% bracket, 3.1% for the 30-to-60% bracket, 3.2% for the 60-to-90% bracket, and 2.2% for the above-90% bracket. This suggests a negative linear effect of debt on growth, where the impact of debt levels above 90% of GDP do not slow growth as much as Reinhart and Rogoff (2010b) indicated. Rubin et al. (2004) describes the situation in the U.S. as following the same pattern, where high government debt appears to have negative long-term effects on economic growth. Concerning the determination of a critical point at which debt/GDP ratios become burdensome, Ball and Mankiw (1995) theorize that once a country passes an unspecified level of debt/GDP, there could be a "hard landing" in which demand for assets drops off suddenly. The negative relationship is also found in OECD[5] countries as Checherita-Westphal and Rother (2012) and Baum et al. (2013) report.

In contrast to the studies above, some research suggests that there is little evidence of a negative causal relationship between government debt measured as a share of GDP, and economic growth. This branch of the literature mostly focuses on the panel data heterogeneity, endogeneity, controls for certain variables, and critiques the lack of inter-temporal analysis (Irons and Bivens, 2010). Eberhardt and Presibitero (2013) analyze income levels (split by low, medium, and high) as a way to examine cross-country heterogeneity. They do not find any evidence of a threshold effect across countries over time. Irons and Bivens (2010) argue that debt/GDP ratios have no effect on modern economies until a debt crisis occurs[6]. Égert (2015) performs a more detailed analysis in the vein of Reinhart and Rogoff, looking at trends in the debt/GDP categories of 0-30%, 30-60%, 60-90%, and over 90%, and they note that the results are sensitive to modeling choice, data coverage, and that the non-linearities that Reinhart and

[4]With corrections for spreadsheet errors, adjusted weights, excluded country-year observations, and transcription errors in the 2010 Reinhart and Rogoff paper.

[5]Organization for Economic Co-operation and Development.

[6]See Rubin et al. (2004), Ball and Mankiw (1995), and Reinhart and Rogoff (2010a). The literature on debt crisis, or default, is considered separate from the literature on the incremental effects of increasing levels of debt/GDP, however, due to the sometimes close relationship, it is discussed and referenced in the debt/GDP vs. growth literature.

Rogoff (2010b) find are rare. Finally, Panizza and Presbitero (2014) use instrumental variable (IV) techniques and find that once endogeneity is accounted for, the relationship between debt and growth disappears.

3 Data and Econometrics

3.1 Data

The data used in this research form an unbalanced panel spanning from 1970 to 2009[7] that was compiled primarily from the World Bank and the International Monetary Fund[8]. Figure 1 presents the number of countries, included by year, for the moving averaged data. The independent variable of interest is the debt to GDP ratio which is available through the IMF Historical Public Debt Database. The goal of the data collection process was to obtain variables that measure both the results of government actions aimed at managing debt, and to account for country-specific effects for a reduced-form approach for the analysis. The data used includes measures of the M1 money supply, inflation rates, debt/GDP ratios, income per-capita, and information on debt forgiveness. The variables included are listed in Table 1, along with a description of each.

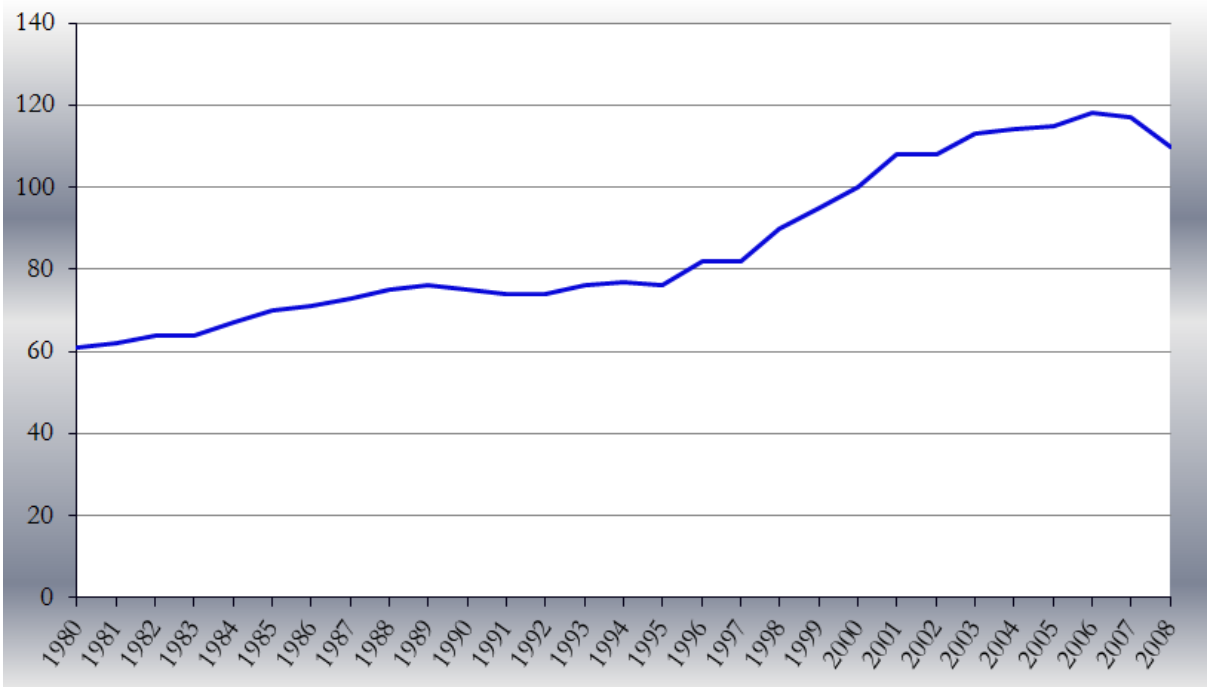

Figure 1: Number of Countries by Year

[7]Debt data was extremely limited prior to 1970, with only 43 countries with debt data in 1960 but in some instances large skips in the data until 1970. To date this has only been updated to the year 2012.

[8]See Appendix for Data Source Table.

To look at trends over five-, ten-, and fifteen- year periods (instead of short-term annual fluctuations) the data was transformed with moving averages (MA) over these time periods[9]. In the data there are more observations for the OLS, FE, and DPM regressions, and less observations in the GMM models. This discrepancy in the number of observations between the inflation and money growth models, and the debt and growth models is due to the data availability between the variables included in each model[10]. Particularly, the use of instruments for the GMM IV models to control for the possible endogeneity, though the results are fairly consistent across models regardless. The descriptive statistics of the M1 data are presented in Table 2, the descriptive statistics for the growth data are presented in Table 3.

In other related papers, there has been some discussion about which observations have been excluded from the analysis [11]. In the data used in this study, there are a number of observations for which the five-year moving-average inflation rate is above 500%. The first concern with these observations is that the results would be biased by these extreme observations. Conversely, excluding the observations would be leaving valuable information out of the analysis. For the purpose of this research, a cap of 500% was chosen for inflation. For example, if the five-year moving-average inflation rate was in fact 1000% this value was replaced with 500% instead. This allows the data to capture the high levels of inflation, while restricting the impact of the extreme observations. This approach was used for M1 growth rates as well.

Since the upper-bound of 500% for the five year moving average was chosen somewhat arbitrarily, the question arises: how are the results affected as the cap is lowered? As a robustness check of the 500% cap, this value was decreased to 100% with essentially no difference in the qualitative results of the analysis. At around 50%, results weaken significantly for M1 growth analysis Fixed Effects, but are still consistent for the OLS regressions. With an upper-bound set at 20%, the results are still consistent with the findings under the 500% cap for inflation rates, but not so for M1 growth rates. With this in mind, given the range of inflation rates, money growth rates, and the relative insensitivity to changes in the cap, for the results given in this research, the cap of 500% will be used.

Turning to the variation in debt/GDP ratios, there are 26 countries included in the analysis in which the five-year moving average of debt/GDP ratios rises above 90%. This constitutes

[9]The timeline for the moving averages is discussed in detail in Section 3.2.

[10]Variables in the growth models were not available for all countries/years where data was available for the M1 and Inflation models. See the discussion in the Appendix for more details.

[11]See the Herndon et al. (2013) discussion of Reinhart and Rogoff (2010c,b) in relation to debt and growth.

205 observations with debt/GDP ratios above 90%. Table 4 presents the observation count by income level where the five-year moving average debt/GDP is above 90%. Since the data stops in the year 2009, debt levels that have been observed following the financial crises in various countries are not considered in this analysis.

With the focus of this research largely on the sign of the coefficient on the government debt variable, one must define what is meant by the term "government debt". The debt variable was compiled in A Historical Public Debt Database, collected by Abbas et al. (2010). This data was chosen for the study due to the wide scope of countries included, relevant timespan covered, and data availability. The target variable of the Abbas et al. paper was "gross general government debt, but in many cases (especially for the period before 1980) only central government data was available and this is what is reported". They combined this measure of government debt with nominal measures of GDP[12] (adjusted by Purchasing Power Parity) to construct debt-to-GDP ratios. While some countries measure their government debt in the billions, others measure debt in trillions. Debt alone does not take into account the productivity of a country's economy, or the ability of a country to repay debt, so the ratio of debt to GDP is used to scale the debt to the size of the economy of a country. This provides a basis to better analyze debt between countries.

3.2 Econometric Design

A facet of this study is the design of the model applied to the empirical study of debt/GDP ratios, money growth, inflation, and GDP growth over a large swath of countries with robustness checks for cross-sectional dependence. The setup is a reduced-form inter-temporal correlation analysis, where the data has been transformed using moving averages. First, the lags used in this method are such that there is no overlap in time of the independent variable and the debt/GDP variable. Since the goal of Section 4.1 is to specifically target the correlation (if any) between government debt and *subsequent* growth in the money supply or inflation, the lags are important in separating the cause-and-effect aspect between the variables over time. Figure 2 gives a graphical representation of the time-related setup of the data used in the regression analysis.

Since data that has been transformed by moving averages is being used while also attempting

[12]When GDP was not available, NNP (Net National Product) was used, but this was almost exclusively in the time period before the data used in this study.

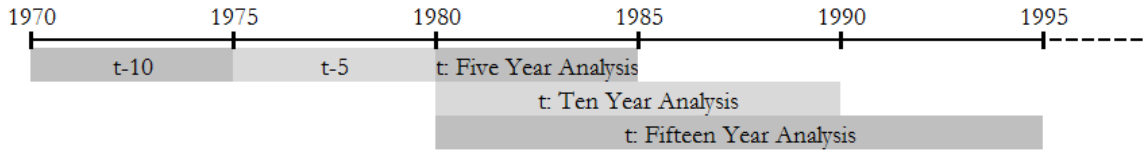

Figure 2: Variable Time-Line

to tease out inter-temporal correlation, the time-related factors of the analysis require some explanation. Let t be the five-year average centered on the year 1982 so that the average then contains data from the years 1980-84. Then variables from the time period $t-5$ are the five-year average centered on the year 1977, containing data from 1975 through 1979. Similarly, variables with subscript $t-10$ are the five-year average centered on the year 1972, and include data from the years 1970 to 1974. When ten- or fifteen-year analysis is being referred to, the only change that is being made is that the *dependent* variable becomes a ten- or fifteen-year moving average which begins, (in this example), in 1980 and continues to 1989 and 1994, respectively. Using this setup excludes time over-laps between variables in different time periods, even with the use of moving averages, for a given observation.

Why is the moving average data transformation used in this analysis? First, the use of moving averages smooths the data, allowing the study of long-run "average" trends in the data over five, ten or fifteen years while filtering extreme observations to some extent. Second, the moving average permits more observations to be included in the analysis, and minimizes the loss of information caused by using blocks of averages constrained by a given five, ten, or fifteen year structure and inter-temporal correlation. With the design of the analysis (presented in Figure 2), the moving average data may advance one year at a time and does not need to exclude an entire bracket of time when data is missing. Including these features, the base OLS regression model used for this analysis is presented in Equation 1 with money growth as the dependent variable:

$$M1\_g_t = \alpha + \beta_1 \frac{Debt}{GDP}_{it-5} * Hi + \beta_2 \frac{Debt}{GDP}_{it-5} * UpMid + \beta_3 \frac{Debt}{GDP}_{it-5} * LowMid + \beta_4 \frac{Debt}{GDP}_{it-5} * Low$$
$$+ \beta_5 \triangle \frac{Debt}{GDP}_{it-5} * Hi + \beta_6 \triangle \frac{Debt}{GDP}_{it-5} * UpMid + \beta_7 \triangle \frac{Debt}{GDP}_{it-5} * LowMid + \beta_8 \triangle \frac{Debt}{GDP}_{it-5} * Low$$
$$+ \beta_9 M1\_g_{t-10} + \beta_{10} Debt\_Forgive_t + \beta_{11} Debt\_Forgive_{t-5} + \beta_{12} GNI\_per\_cap_{t-5}$$
$$+ \nu_t + e_{it} \quad (1)$$

For the inflation rate analysis, the model is nearly identical. The few changes include (i) the dependent variable is the inflation rate in time t, and instead of controlling for past levels of M1 growth, past inflation is included as an independent variable. (ii) The residuals from the money growth OLS are included to account for shocks to the money supply that are not related to debt/GDP. Note that not only is the moving average of debt/GDP included, but also the change in the level (not average) of debt/GDP over the time period $t-5$. This change in debt/GDP variable measures whether there is an increase or decrease over the five-year period $t-5$, and is used as a control variable for the direction in which debt ratios are moving.

Equation 2 presents the fixed effects model for the inflation analysis. This is similar to the money growth fixed effects model, but with inclusion of the residuals from the M1 analysis, and substitution of the inflation rate variables for the money growth variables.

$$\Pi_{it} = \alpha + \beta_1 \frac{Debt}{GDP}_{it-5} * Hi + \beta_2 \frac{Debt}{GDP}_{it-5} * UpMid + \beta_3 \frac{Debt}{GDP}_{it-5} * LowMid + \beta_4 \frac{Debt}{GDP}_{it-5} * Low$$
$$+ \beta_5 \triangle \frac{Debt}{GDP}_{it-5} * Hi + \beta_6 \triangle \frac{Debt}{GDP}_{it-5} * UpMid + \beta_7 \triangle \frac{Debt}{GDP}_{it-5} * LowMid + \beta_8 \triangle \frac{Debt}{GDP}_{it-5} * Low$$
$$+ \beta_9 \Pi_{it-10} + \beta_{10} Debt\_Forgive_{it} + \beta_{11} Debt\_Forgive_{it-5} + \beta_{12} GNI\_per\_cap_{it-5} + \rho[M1\_Residuals]$$
$$+ \theta_i + \nu_t + e_{it} \quad (2)$$

Another point to be discussed in this subsection is the issue of accounting for differences in incomes across countries as a broad measure of country-level differences (or similarities). First, income per capita in time $t-5$ is included in the analysis by using the annual observation at the beginning of the $t-5$ period to control for the income levels at the start of the period in which debt/GDP is measured, (the five year period before the dependent variable is measured[13]).

[13] Another possibility would be to use the annual income per capita data from the *end* of the $t-5$ time period,

Since income per-capita does not vary significantly over a number of years and create extreme observations, no moving average data transformation was needed.

Second, the World Bank's income categories for high-income, upper-middle income, lower-middle income, and low income countries are used. These are divided by Gross National Incomes (GNI), measured in U.S. dollars. The low income category is less than $1,045; lower-middle income is between $1,045 and $4,125; Upper-middle income countries are those with a GNI between $4,125 and $12,746, and high income countries have a GNI above $12,746[14]. As shown in Equations 1 and 2, gross national income is included in the model, and interaction variables for each individual WDI-defined income category. This allows for differences in intercepts and slopes, in and between, income groups.

The OLS model used to examine the effects of higher levels of government debt on subsequent growth in GDP per-capita is presented in Equation 3.

$$GDP\_per\_cap\_growth_t = \alpha + \beta_1 \frac{Debt}{GDP}_{t-5} * Hi + \beta_2 \frac{Debt}{GDP}_{t-5} * UpMid + \beta_3 \frac{Debt}{GDP}_{t-5} * LowMid + \beta_4 \frac{Debt}{GDP}_{t-5} * Low + \beta_5 \triangle \frac{Debt}{GDP}_{t-5} * Hi + \beta_6 \triangle \frac{Debt}{GDP}_{t-5} * UpMid + \beta_7 \triangle \frac{Debt}{GDP}_{t-5} * LowMid + \beta_8 \triangle \frac{Debt}{GDP}_{t-5} * Low + \beta_9 Secondary\_Comp_t + \beta_{10} Debt\_Forgive_t + \beta_{11} \%\_\triangle\_Pop.\_25\_59\_YO_t + \beta_{12} Infl\_Resids_t + \beta_{13} EFW\_Chain_t + \beta_{14} Log\{GNI\_per\_cap_{t-5}\} + \nu_t + e_{it} \quad (3)$$

3.2.1 OLS, FE, GMM, and DP Models

Four different econometric models are used in this study. The first two, OLS and FE, have been presented above, but each address slightly different issues in this research. OLS models are used here to examine conditional correlations between the dependent and independent variables. While there are other concerns that OLS does not address, it is important to establish some basic level of correlation between variables. Fixed effects models are used to calculate correlations while controlling for country-level effects in the data, where within-country variation over time is used to estimate the coefficients, and not across-country variation.

Third, when endogeneity could theoretically be a problem, GMM models are most often used in the literature. Endogeneity exists when there is a correlation between an independent varia-

but robustness checks indicate this has no impact on the results due to the relatively low annual variation in the data.

[14]Source: Bank (2014).

ble, and the error term in the model. This can occur for a number of reasons: autocorrelation in the error terms, omitted variables, and simultaneity. By construction, there is autocorrelation in the data used here when it was transformed with moving averages. While technically, OLS is a specific form of GMM, here GMM refers to a single-equation instrumental-variables regression with clustering (fixed country effects). Essentially, instrumental variables are chosen which are outside the auto-correlation window of the error terms. The instruments used here are lags of the potentially endogenous variable. With the five-year moving averages, the auto-correlation in the error term was found to be five years using the Arellano-Bond (Arellano and Bond, 1991) test.

Fourth, there is the Dynamic Panel Model which adjusts for fixed country effects, and the standard errors are adjusted using the Windmeijer (2005) corrections. The adjustments are designed to be better suited to the interdependence that may exist, such as spillover effects. Specifically, DP models "include p lags of the dependent variable as covariates, and contain unobserved panel-level fixed effects. By construction, the unobserved panel-level effects are correlated with the lagged dependent variables, making the standard estimators inconsistent" Stata (2013). Plainly, DPM adjusts the standard errors for the auto-regressive nature of the moving-averaged panel data using standard error adjustments described by Windmeijer (2005) given that the errors follow a moving average process.

4 Results

4.1 Inflation and Monetary Growth as a Method to Manage Government Debt

Tables 5 - 7 present the money supply results for the five-, ten- and fifteen-year analysis. For low income countries there is a positive and statistically significant relationship between the income interaction debt/GDP variables and money growth in subsequent years, but not for high, upper-middle or lower-middle income countries. This pattern is present in the five-, ten-, and fifteen-year analysis. The positive and statistically significant relationship in the five-year analysis yields coefficients on the level of debt/GDP interaction variable, ranging from .229 to .513 across the OLS, FE, GMM, and DP models. This means that a 1% increase in the debt/GDP ratio is correlated with an increase in the five-year moving average money supply of anywhere from .229% to .513%. The coefficient on the $\Delta Debt/GDP_{t-5}$ variable for low income

countries presents a larger correlation, ranging from .392 to .663. This indicates that a 1% increase in debt/GDP ratios is correlated with an increase in the five-year MA of M1 growth of somewhere from .392% to .513%. For high income, upper-middle, and lower-middle income countries, there is no statistically significant correlation between debt/GDP and subsequent money growth, either through levels or change in debt/GDP ratios.

Table 5 presents the five-year M1 growth analysis. The results indicate that there is a positive and significant relationship between levels and changes in debt/GDP ratios and subsequent M1 growth for low income countries, but not for lower-middle, upper-middle, or high income countries. For low income countries, the coefficients are 0.356%, .513%, 0.229%, and 0.242% from the OLS, FE, GMM, and DP models, respectively (each is statistically significant at a 99% level). The $\Delta Debt/GDP_{t-5}$ estimates for low income countries are also positive and significant with coefficients of 0.649%, 0.663%, 0.547% and 0.392% across the same models. The main focus of this paper, however, is not the size of the impact necessarily, but the *sign* of the coefficient, which will provide insight into whether a country uses money growth to reduce debt.

Note that in each regression analysis in this study, the sign of the coefficient on money growth in time period $t-10$ may in theory be either positive or negative. The reason is, a country that has high money growth rates may continue policies that maintain the high money growth, or they may seek to curb an increasing money supply and the associated inflation. This is closely related to the Debt not LDC_{t-5}[15] variable and its sign. If a government is short-sighted then it may try to finance debt and print money to pay for immediate domestic goods and services, essentially doing anything possible to spend the most in the current time period. The idea is that both money growth and higher debt are ways to spend money without increasing taxes, and this is most likely the cause for the coefficients on the low-income debt/GDP variable in the M1 analysis. High income countries do not exhibit this relationship because they can borrow from sources that are sensitive to credit ratings.

For the ten-year analysis (Table 6), the trend is consistent with the five-year results. High, upper-middle and lower-middle income countries have no statistically significant relationship between debt/GDP ratios and subsequent money growth. Low income countries show evidence of a positive relationship in all but the DPM models in the level, and across all econometric models in the change of debt/GDP ratios. As with the five-year analysis, the change exhibits a stronger positive relationship for low-income countries, but in this case, not for any of the other

[15] As indicated in Table 1, this is the percentage of debt not in locally denominated currency.

income levels, which again suggests that changes, not levels, may have a stronger correlation on subsequent growth in money supply. Low income coefficients for the level of debt/GDP are 0.373, 0.290 and 0.224 for OLS, FE and GMM models. For the change in debt/GDP variable: 0.721, 0.562, 0.558, and 0.353; only slightly smaller than the five-year results.

Table 7 presents the fifteen-year results. These follow the pattern of the five- and ten-year analysis, but with smaller coefficients in the level variable. Low income estimates of the level of debt/GDP across the econometric models are positive and significant, ranging from 0.103% to 0.347%. The change in debt/GDP coefficient ranges from 0.405% in the DP model, to 0.751% in the OLS model. The correlation between changes in debt/GDP ratios over the prior five years, and the subsequent MA of the money growth rate stays fairly constant, but the correlation for the level debt/GDP variable decreases over time.

Moving to the inflation analysis, the five-year analysis results in Table 8 show a negative and significant relationship with high income Δ debt/GDP estimates of -0.302, -0.163, and -0.655 for OLS, GMM, and DP models respectively. Similarly, for the upper-middle estimates of the same variable, the coefficients are also negative; -0.203, -0.350, -0.313 and -1.647 across each of the econometric models. Lower-middle estimates are mixed and do not show a pattern. For low income countries there is a positive and significant correlation between the five-year average debt/GDP level and inflation rates in the following five years. The estimates range from 0.246 in the DP model, to 0.544 in the FE model. The low income Δ debt/GDP estimates are all between 0.338 and 0.627. This means that a 1% increase in debt/GDP levels is correlated with an increase in the five-year MA inflation rate of 0.246-0.544%, and a 1% increase in the Δ debt/GDP ratios over the prior five years leads to a 0.338-0.627% increase in the five-year MA inflation rate. The specific five-year low income coefficients by model are: 0.409, 0.544, 0.246 and 0.280. For the Δ debt/GDP variable the coefficients are 0.627, 0.627, 0.515 and 0.338 for the OLS, FE, GMM, and DP models. As with the M1 studies, the Δ debt/GDP variables have larger coefficients than the level debt/GDP variables.

The ten-year inflation results in Table 9 show that low income countries exhibit inflation rates of 0.115%-0.452% higher over the ten years following an average debt/GDP level increase of 1%. The Δ debt/GDP coefficients are larger (0.280-0.724) indicating that if the debt/GDP changes by 1% over the time period $t-5$ the average inflation rate over the following ten years will be higher by 0.280-0.724%. High, upper-middle and lower-middle income countries do not indicate any consistent evidence of a pattern in the relationship between debt/GDP and

inflation.

Lastly, Table 10 shows that debt/GDP *levels* exhibit a weaker economic impact in the fifteen-year analysis than those of either the ten-, or five-year results with coefficients of 0.109-0.443 from the FE and OLS models, respectively. However, the coefficients of the *change* in debt/GDP ratio variable are similar to those from the five- and ten-year analysis.

Why might low income countries increase the money supply and use inflationary policy? Low income countries may find it to be an alternative to taxation. Taxes are typically applied to income or sales transactions. Low income countries with a large percentage of the population at subsistence level and working in the agricultural industry, perhaps with low literacy rates, would find it relatively more attractive to print money as a method of resource extraction, rather than taxation. With these conditions most of the transactions are likely to be cash transactions, or perhaps barter transactions, and it is likely the case that neither a buyer nor seller would keep records of the transactions. The cost of trying to tax the income or sales transactions in these situations would be costly, inefficient, and perhaps most importantly, ineffective. The solution: print money instead of levying taxes. This would be considerably more effective for a government that cannot otherwise monitor or determine the incomes and value of transactions of its taxable population. This is the primary explanation as to why higher money growth and inflation rates are correlated with higher debt/GDP ratios in subsequent years for low income countries.

4.2 Economic Growth and Government Debt

Tables 11 - 13 present the results of the GDP growth-per-capita and debt/GDP models. The trend in the analysis is that Δ debt/GDP exhibits a positive and statistically significant relationship for low income countries, but that the size of the coefficient is relatively small. Further, there is no evidence that the level of debt/GDP has any impact on subsequent economic growth for any income category.

The results of the five-year GDP growth analysis are presented in Table 11. All income categories show very little evidence of a relationship between *levels* of debt/GDP and GDP growth-per-capita. The Δ debt/GDP income interaction variables produce negative coefficients for all income groups in the five-year analysis. The estimates range from -0.021% to -0.049%, -0.052% to -0.072%, -0.034% to -0.078% and -0.003% to -0.010% for the high, upper-middle, lower-middle, and low income groups, respectively. Here, the middle-income groups are affected

the most by the Δ debt/GDP variable, and the low income countries are affected the least.

Examining the estimates for the other five-year variables, results show a negative coefficient on the log of income per-capita. One explanation is related to convergence in growth rates. Accounting for the institutional factors with the Economic Freedom of the World variables and a measure of human capital, one would expect to find that as income increases for a given country the growth rate decreases. At first, it is relatively cheap to increase income for a country, as it mimics other more advanced countries, or has a number of more obvious options to affect the growth and income in a country. However, as these options are taken, there is less "low hanging fruit", thereby making it more difficult for a country to increase income per capita.

The debt forgiveness variable in time $t-5$ exhibits no statistically significant relationship to GDP growth, however, the percent change in the population between the ages of 25 and 59 years old is consistently correlated with higher levels of growth. The reasoning is simple, these are prime working years, and if the percentage of the population that is working increases, one may expect that growth will increase. While in the five-year analysis the DPM coefficient is negative and significant, in the OLS, FE and GMM equations it is positive and significant. Over the following ten and fifteen years, the coefficient is positive for DPM regressions as well (see Tables 12 and 13). The five-year effect may reflect, in part, the ability of economies to efficiently employ entries into the lower boundary of this group.

Since the Reinhart and Rogoff (2010b) research, the literature has focused not only on better accounting for inter-temporal correlation and econometric techniques, but also on examining the impact of economic institutions on growth. The EFW chain summary variable used in this study exhibits a positive correlation to growth with five-year coefficient estimates ranging from 0.781 to 1.486. This indicates that a one point increase in the EFW rating is correlated to a 0.781%-1.486% increase in the five-year average real growth of GDP per-capita. Another control variable is the percent of the population that is fifteen years old or older and has completed secondary education. One might expect a positive relationship between education and growth, and indeed, the results in all but the DPM models suggest that is the case.

The ten-year analysis shown in Table 12 indicates that the correlation between Δ debt/GDP and growth no longer holds for upper-middle income countries, and is only significant in the OLS and DP models for lower-middle income countries, (coefficients of -0.009% and -0.011%, respectively). However, the high income group shows estimates of -0.022, -0.011 and -0.021

for the FE, GMM and DP equations. This indicates that a 1% change in debt/GDP over five years is correlated to a 0.011% to 0.022% decrease in growth. For the low income group, the coefficients are much smaller at -0.006, -0.004 and -0.003 (with no significant FE estimate). While this relationship is statistically significant,it is also relatively small. In the case of the OLS estimate, a 100% increase in Δ debt/GDP over a five year period would be associated with only a 0.6% decrease in growth. As in the five-year analysis, the level of debt/GDP does not show a consistent relationship with subsequent growth.

Do these patterns hold for the fifteen-year analysis? Table 13 presents the fifteen-year results, and the conclusion is that the Δ debt/GDP coefficients are smaller in magnitude than those in the five- or ten-year analysis and have conflicting signs for both lower-middle and low income countries. High income countries show significant results for the Δ debt/GDP variable of -0.022 and -0.018 for the FE and DP models, and the upper-middle income countries indicate no relationship. The coefficients on the level of debt/GDP indicate no statistical pattern to support the idea that higher debt/GDP ratios are correlated with slower growth-per-capita in the following fifteen years.

5 Summary and Conclusion

There is controversy in the literature about the potential impact of the debt/GDP ratio on GDP growth. This study sheds light on this controversy and several related issues. Specifically, this research addresses several econometric and modeling concerns cited by other researchers and examines inter-temporal relationships, rather than merely contemporary correlations. Panizza and Presbitero (2013) address endogeneity, but do not account for institutions in detail or for long-term growth. They did not find evidence of a relationship between debt/GDP and growth. Similarly, Eberhardt and Presbitero (2015) adjust for endogeneity and examine heterogeneity (cross-sectional dependence), but do not adjust for various country-level characteristics or economic institutions. Their results suggest that there is no common debt threshold at which growth is slowed, but indicate some evidence that long-run GDP growth is negatively related to higher debt/GDP levels. Exploring the question over different levels of development, Woo and Kumar (2015) find a negative and significant relationship between high levels of debt/GDP and subsequent growth. However, they did not address the possibility of cross-sectional dependence or long-term growth. In order to provide a more thorough analysis, this research uses OLS

and FE as control models, adding GMM models to account for endogeneity, and DP models to control for the possible auto-regressive and heterogeneity concerns. Three major findings are generated by this research.

First, this research indicates that there is a positive relationship between the debt/GDP ratio and subsequent rates of money growth and inflation in the case of low-income countries. But, there is no evidence that this relationship is present for countries outside of the low-income group. This suggests that low income countries use debt, money growth, and inflation as a means to extract resources from their citizenry. While this is theoretically an available option for all countries, there is no evidence that high and middle income countries have higher money growth rates in the years following higher debt/GDP ratios. The linkage between debt and subsequent money growth and inflation in the case of low income countries has policy implications that bear consideration for organizations that seek to provide aid and extend loans to low income countries. This is an important contribution because close examination of the channels through which debt impacts growth is largely absent from current literature. Since a number of papers discuss the adverse growth effects of rising inflation, (Reinhart and Rogoff (2010b); Sarel (1995); Mohsin S. Khan (2001); Barro et al. (1996) and Fischer (1983)), it is not addressed specifically in this study, but is referenced to connect the impact of debt/GDP ratios on growth through inflation and money growth.

The findings for low income countries with regard to money growth and inflation rates may be surprising to some. One might expect that low income countries would have limitations on both their access to credit markets and to face restrictions on borrowing. However, there is a possible explanation: low income countries use money growth and inflation as an alternative to taxation, and simultaneously borrow to finance government expenditures. Specifically, in countries where the economic institutions are not developed to the extent that makes the tracking of income and sales transactions feasible, taxation would be costly and ineffective. Money growth and inflation essentially becomes a method by which a government can extract resources from its citizens when a tax collection system cannot be maintained.

Second, once the impact of inflationary shocks unrelated to debt are accounted for[16], the results of Section 4.2 indicate that, for countries in all income groups, *changes* in debt/GDP are negatively correlated with GDP growth in the short-run (five-years). However, the ten-

[16]This was done by including the residuals from the Inflation analysis equations as an independent variable in the growth analysis equations.

and fifteen-year analysis indicates that the negative correlation between changes in debt and subsequent growth is present only in the case of low income countries. Even in this case, the negative impact of higher debt levels on growth is small. This suggests only a short-term effect of debt/GDP on GDP growth rates once the effects of inflation and money growth have been considered.

Third, the analysis of Section 4.2 also indicates that there is no statistically significant pattern between the *level* of the debt/GDP ratio and subsequent growth in GDP for countries in any income group. While some of the models in the ten- and fifteen-year growth analysis present some statistically significant coefficients, these estimates show no consistent pattern of a relationship. The analysis indicates a statistically significant relationship between the *change* in debt/GDP and growth in GDP in the short-term of five years, but the size of the impact is relatively small.

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Table 1: Moving-Averaged Data - Variables and definitions

M1 Growth$_t$	Moving average over five, ten, or fifteen years of the annual growth in the M1 money supply.
Inflation$_t$	Moving average over five, ten, or fifteen years of the annual inflation rate.
rGDPg$_t$	Moving average over five, ten, or fifteen years of the annual real growth in GDP per-capita.
Debt/GDP$_{t-5}$	The moving average of debt to gross national product ratio in the five years prior to the year the dependent variable begins.
Δ in Debt/GDP$_{t-5}$	The change in debt/GDP ratio calculated as [debt/GDP$_{endof t-5}$ - debt/GDP$_{beginningof t-5}$]. Positive values indicate that debt/GDP ratios are increasing over this time, negative values indicate a decline in debt relative to GDP levels.
M1 Growth$_{t-10}$	Moving average of the annual growth in the M1 money supply over a five year period, ten years before the dependent variable begins.
Inflation$_{t-10}$	Moving average of the annual inflation rate over a five year period, ten years before the dependent variable begins.
rGDPg$_{t-10}$	Moving average of the annual real growth in GDP per-capita over a five year period, ten years before the dependent variable begins.
% Debt in FC$_{t-5}$	The percent of government debt that is held in foreign currency, in year that the moving average of Debt/GDP$_{t-5}$ is calculated.
Debt Forgive$_{t-5}$	Binary variable: 1 indicates that there was some form of debt forgiveness or debt grants in the five years prior the year the dependent variable begins.
GNI Per Capita$_{t-5}$	Gross national income per capita measured in the five year prior to the year the dependent variable begins.
% Δ in Pop. 25-59 Y.O.$_t$	The change in the percentage of the population between the ages of 25 and 59 years old.
EFW Chain Summary$_t$	The Economic Freedom of the World chain summary variable. This indicates the level of economic freedom of a country rated from 0 to 10.
% Pop 15 y.o. + Secondary Edu$_t$	The percentage of the population that is 15 years old, or older, that has completed at least a Secondary Education.

Table 2: Descriptive Statistics of MA M1/Inflation Data - All Incomes

	Mean	Median	Sd	Min	Max
5yr MA M1 Growth Rate$_t$ (%)	27.58	15.64	63.80	-14.42	500.00
10yr MA M1 Growth Rate$_t$ (%)	30.68	15.26	75.54	-7.26	500.00
15yr MA M1 Growth Rate$_t$ (%)	32.21	15.39	79.54	-1.79	500.00
5yr MA Inflation Rate$_t$ (%)	20.93	7.96	64.95	-8.02	500.00
10yr MA Inflation Rate$_t$ (%)	23.37	7.40	75.57	-4.66	500.00
15yr MA Inflation Rate$_t$ (%)	23.78	7.28	77.83	-3.82	500.00
Debt/GDP$_{t-5}$	66.29	55.74	57.57	0.46	796.28
Δ Debt/GDP$_{t-5}$	0.30	1.17	37.48	-455.92	549.20
% Debt in FC$_{t-5}$	56.07	65.43	29.85	0.00	99.26
Debt Forgive$_{t-5}$	0.41	0.00	0.49	0.00	1.00
GNI per Capita	5025.35	1278.00	9491.46	126.00	79302.50
N	2111				

Table 3: Descriptive Statistics of Moving Averaged Growth Data

	Mean	Median	Sd	Min	Max
5yr MA M1 Growth Rate$_t$ (%)	27.90	15.47	64.78	-14.42	500.00
10yr MA M1 Growth Rate$_t$ (%)	30.75	14.98	75.65	-7.26	500.00
15yr MA M1 Growth Rate$_t$ (%)	33.11	15.02	83.30	-1.79	500.00
5yr MA Inflation Rate$_t$ (%)	21.86	7.99	66.29	-8.02	500.00
10yr MA Inflation Rate$_t$ (%)	23.79	7.35	75.13	-4.66	500.00
15yr MA Inflation Rate$_t$ (%)	24.30	7.18	77.92	-3.82	500.00
5yr MA rGDP Growth-Per-Cap$_t$ (%)	1.62	1.73	2.66	-8.39	10.33
10yr MA rGDP Growth-Per-Cap$_t$ (%)	1.65	1.70	2.06	-6.62	8.19
15yr MA rGDP Growth-Per-Cap$_t$ (%)	1.73	1.71	1.85	-6.62	6.58
Debt/GDP$_{t-5}$	63.29	53.21	56.23	0.46	796.28
Δ Debt/GDP$_{t-5}$	1.57	1.90	39.19	-455.92	549.20
Debt Forgive$_{t-5}$	0.39	0.00	0.49	0.00	1.00
Debt not LDC$_{t-5}$	56.84	66.19	29.80	0.00	99.26
% Δ in Pop. 25-59 Y.O.$_t$	1.21	1.27	1.31	-2.63	5.93
Log Income-per-Capita$_{t-5}$	3.23	3.19	0.64	2.08	4.93
EFW Chain Summary$_t$	5.97	5.99	1.27	1.78	8.90
% Pop 15 y.o. + Secondary Edu$_t$	21.66	17.03	16.80	0.30	71.60
N	1716				

Table 4: Five-Year Moving Average Debt/GDP Ratio 90 or Above

	No. Obs.
High Income	39
Upper-Middle Income	23
Lower-Middle Income	66
Low Income	314
N	442

Table 5: M1 Models - Five-Year
(Dep Var: M1 Growth$_t$)

	(1)	(2)	(3)	(4)
Regression	OLS	FE	GMM	DPM
Debt/GDP$_{t-5}$ Hi	0.021	-0.053	-0.010	-0.278
	(0.17)	(-0.33)	(-0.13)	(-0.55)
Debt/GDP$_{t-5}$ Upmid	-0.041	-0.375*	-0.323	0.299
	(-0.35)	(-2.33)	(-1.25)	(0.38)
Debt/GDP$_{t-5}$ Lowmid	-0.199*	0.136	-0.322	0.172
	(-2.14)	(1.21)	(-0.51)	(0.59)
Debt/GDP$_{t-5}$ Low	0.356***	0.513***	0.229***	0.242***
	(12.14)	(12.16)	(7.15)	(3.86)
Δ Debt/GDP$_{t-5}$ Hi	-0.241	-0.151	-0.061	-0.588
	(-0.94)	(-0.63)	(-0.60)	(-0.85)
Δ Debt/GDP$_{t-5}$ Upmid	-0.134	-0.289	-0.164	-1.571
	(-0.59)	(-1.10)	(-0.67)	(-1.28)
Δ Debt/GDP$_{t-5}$ Lowmid	0.103	0.065	-0.188	-0.380
	(0.77)	(0.53)	(-0.46)	(-0.92)
Δ Debt/GDP$_{t-5}$ Low	0.649***	0.663***	0.547***	0.392***
	(15.35)	(16.85)	(8.20)	(5.05)
% Debt in FC$_{t-5}$	0.423***	0.025	0.220	-0.977
	(6.11)	(0.21)	(1.71)	(-1.19)
Upper-Mid Income Dummy$_t$	0.196	16.017	4.348	-17.451
	(0.02)	(1.28)	(0.31)	(-0.34)
Low-Mid Income Dummy$_t$	15.464	26.045	12.227	4.152
	(1.25)	(1.89)	(0.37)	(0.12)
Low Income Dummy$_t$	-29.451*	9.204	-25.277*	-11.862
	(-2.46)	(0.65)	(-2.31)	(-0.33)
Debt Forgive$_{t-5}$	-9.334*	-16.641***	-1.869	-63.002**
	(-2.24)	(-3.98)	(-0.29)	(-2.74)
M1 Growth$_{t-10}$	0.064***	-0.298***	0.120***	-0.064*
	(3.72)	(-15.54)	(4.28)	(-1.96)
Income-per-Capita$_{t-5}$	0.000	-0.000	-0.000	-0.001
	(0.80)	(-1.05)	(-0.84)	(-1.25)
N	2111	2111	1403	2111
R^2	0.191	0.288	0.187	

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: M1 Models - Ten-Year
(Dep Var: M1 Growth$_t$)

	(1)	(2)	(3)	(4)
Regression	OLS	FE	GMM	DPM
Debt/GDP$_{t-5}$ Hi	0.064	-0.029	0.066	-0.139
	(0.43)	(-0.16)	(0.95)	(-0.38)
Debt/GDP$_{t-5}$ Upmid	-0.040	-0.353	-0.167	0.427
	(-0.28)	(-1.94)	(-1.00)	(0.58)
Debt/GDP$_{t-5}$ Lowmid	-0.201	0.120	-0.636	0.387
	(-1.79)	(0.93)	(-0.99)	(1.73)
Debt/GDP$_{t-5}$ Low	0.373***	0.290***	0.224***	0.145
	(10.54)	(6.05)	(4.66)	(1.74)
Δ Debt/GDP$_{t-5}$ Hi	-0.314	-0.155	-0.118	-0.402
	(-1.01)	(-0.57)	(-1.34)	(-0.77)
Δ Debt/GDP$_{t-5}$ Upmid	-0.117	-0.143	-0.124	-1.326
	(-0.43)	(-0.48)	(-0.88)	(-1.15)
Δ Debt/GDP$_{t-5}$ Lowmid	0.139	0.212	-0.356	-0.115
	(0.86)	(1.51)	(-0.92)	(-0.38)
Δ Debt/GDP$_{t-5}$ Low	0.721***	0.562***	0.558***	0.353***
	(14.12)	(12.57)	(10.95)	(4.19)
% Debt in FC$_{t-5}$	0.495***	0.153	0.160	-0.100
	(5.93)	(1.16)	(1.56)	(-0.12)
Upper-Mid Income Dummy$_t$	-0.916	13.398	1.737	-26.662
	(-0.06)	(0.94)	(0.18)	(-0.53)
Low-Mid Income Dummy$_t$	16.276	24.941	35.400	-12.302
	(1.09)	(1.60)	(1.00)	(-0.30)
Low Income Dummy$_t$	-25.091	26.130	-19.383	0.037
	(-1.74)	(1.63)	(-1.79)	(0.00)
Debt Forgive$_{t-5}$	-7.879	-12.142*	3.520	-51.831**
	(-1.56)	(-2.55)	(0.64)	(-2.71)
M1 Growth$_{t-10}$	0.038	-0.422***	0.104***	-0.070*
	(1.84)	(-19.40)	(5.65)	(-2.23)
Income-per-Capita$_{t-5}$	0.000	-0.000	-0.000	0.000
	(1.05)	(-0.36)	(-0.48)	(0.01)
N	2111	2111	1403	2111
R^2	0.159	0.290	0.133	

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: M1 Models - Fifteen-Year
(Dep Var: M1 Growth$_t$)

	(1)	(2)	(3)	(4)
Regression	OLS	FE	GMM	DPM
Debt/GDP$_{t-5}$ Hi	0.070	0.030	0.083	0.110
	(0.44)	(0.17)	(1.22)	(0.36)
Debt/GDP$_{t-5}$ Upmid	-0.039	-0.229	-0.325	0.717
	(-0.26)	(-1.30)	(-1.21)	(0.91)
Debt/GDP$_{t-5}$ Lowmid	-0.233	0.074	-0.651	0.196
	(-1.96)	(0.60)	(-1.25)	(0.91)
Debt/GDP$_{t-5}$ Low	0.347***	0.103*	0.192***	0.144*
	(9.24)	(2.23)	(4.49)	(2.03)
Δ Debt/GDP$_{t-5}$ Hi	-0.308	-0.102	-0.135	-0.146
	(-0.94)	(-0.39)	(-1.89)	(-0.30)
Δ Debt/GDP$_{t-5}$ Upmid	-0.092	0.061	-0.174	-0.893
	(-0.32)	(0.21)	(-0.96)	(-1.07)
Δ Debt/GDP$_{t-5}$ Lowmid	0.090	0.270*	-0.465	-0.190
	(0.52)	(2.00)	(-1.35)	(-0.77)
Δ Debt/GDP$_{t-5}$ Low	0.751***	0.485***	0.561***	0.405***
	(13.86)	(11.25)	(9.85)	(6.53)
% Debt in FC$_{t-5}$	0.501***	0.208	0.187*	0.340
	(5.65)	(1.63)	(1.98)	(0.42)
Upper-Mid Income Dummy$_t$	-2.314	8.609	10.028	-26.785
	(-0.15)	(0.63)	(0.73)	(-0.57)
Low-Mid Income Dummy$_t$	15.668	22.294	34.875	22.958
	(0.99)	(1.48)	(1.24)	(0.69)
Low Income Dummy$_t$	-21.073	37.709*	-13.737	16.651
	(-1.37)	(2.43)	(-1.48)	(0.63)
Debt Forgive$_{t-5}$	-5.936	-6.157	6.297	-45.341*
	(-1.11)	(-1.34)	(1.11)	(-2.45)
M1 Growth$_{t-10}$	0.024	-0.456***	0.079***	-0.067*
	(1.09)	(-21.72)	(5.60)	(-2.04)
Income-per-Capita$_{t-5}$	0.000	-0.000	0.000	0.000
	(0.93)	(-0.20)	(0.14)	(0.07)
N	2111	2111	1403	2111
R^2	0.146	0.320	0.124	

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8: Inflation Models - Five-Year
(Dep Var: Inflation Rate$_t$)

	(1)	(2)	(3)	(4)
Regression	OLS	FE	GMM	DPM
Debt/GDP$_{t-5}$ Hi	0.040	-0.052	0.079*	-0.464**
	(1.01)	(-0.77)	(2.07)	(-2.61)
Debt/GDP$_{t-5}$ Upmid	-0.021	-0.374***	-0.291**	0.271*
	(-0.57)	(-5.59)	(-3.24)	(2.34)
Debt/GDP$_{t-5}$ Lowmid	-0.210***	0.070	-0.344***	0.068
	(-7.06)	(1.49)	(-3.61)	(0.68)
Debt/GDP$_{t-5}$ Low	0.409***	0.544***	0.246***	0.280***
	(44.15)	(31.19)	(20.47)	(7.09)
Δ Debt/GDP$_{t-5}$ Hi	-0.302***	-0.146	-0.163**	-0.655*
	(-3.69)	(-1.46)	(-3.17)	(-2.49)
Δ Debt/GDP$_{t-5}$ Upmid	-0.203**	-0.350**	-0.313***	-1.647***
	(-2.81)	(-3.20)	(-4.34)	(-7.67)
Δ Debt/GDP$_{t-5}$ Lowmid	0.136**	0.034	-0.186*	-0.402***
	(3.17)	(0.66)	(-2.57)	(-5.43)
Δ Debt/GDP$_{t-5}$ Low	0.627***	0.627***	0.515***	0.338***
	(46.40)	(38.40)	(59.24)	(10.25)
% Debt in FC$_{t-5}$	0.488***	0.165***	0.265***	-0.971***
	(21.95)	(3.42)	(8.77)	(-3.87)
Upper-Mid Income Dummy$_t$	5.724	20.498***	13.975**	-17.693
	(1.47)	(3.95)	(2.64)	(-1.54)
Low-Mid Income Dummy$_t$	22.086***	39.967***	25.602***	7.878
	(5.60)	(7.02)	(4.39)	(0.77)
Low Income Dummy$_t$	-29.739***	13.585*	-14.880***	-29.503*
	(-7.78)	(2.32)	(-4.82)	(-2.05)
M1 Residuals$_{t-5}$	0.949***	0.911***	0.927***	1.082***
	(135.07)	(97.33)	(21.89)	(17.08)
Debt Forgive$_{t-5}$	-9.044***	-16.261***	-1.005	-83.579***
	(-6.79)	(-9.36)	(-0.67)	(-6.81)
Inflation Rate$_{t-10}$	0.038***	-0.270***	0.109***	-0.053***
	(7.67)	(-36.72)	(13.78)	(-6.72)
Income-per-Capita$_{t-5}$	0.001***	0.000	0.000**	-0.001**
	(5.67)	(0.24)	(3.24)	(-3.00)
N	2111	2111	1403	2111
R^2	0.920	0.881	0.905	

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: Inflation Models - Ten-Year
(Dep Var: Inflation Rate$_t$)

	(1)	(2)	(3)	(4)
Regression	OLS	FE	GMM	DPM
Debt/GDP$_{t-5}$ Hi	0.083	0.000	0.161***	-0.231
	(1.41)	(0.00)	(3.46)	(-1.30)
Debt/GDP$_{t-5}$ Upmid	-0.017	-0.281**	-0.345	0.530***
	(-0.32)	(-3.16)	(-1.84)	(4.33)
Debt/GDP$_{t-5}$ Lowmid	-0.223***	-0.010	-0.471	0.245*
	(-5.06)	(-0.16)	(-1.21)	(2.10)
Debt/GDP$_{t-5}$ Low	0.452***	0.310***	0.245***	0.155***
	(32.96)	(13.35)	(13.11)	(5.39)
Δ Debt/GDP$_{t-5}$ Hi	-0.392**	-0.158	-0.175***	-0.472
	(-3.24)	(-1.19)	(-4.22)	(-1.61)
Δ Debt/GDP$_{t-5}$ Upmid	-0.126	-0.038	-0.263	-1.182***
	(-1.18)	(-0.26)	(-1.67)	(-6.43)
Δ Debt/GDP$_{t-5}$ Lowmid	0.148*	0.123	-0.242	-0.103
	(2.34)	(1.81)	(-0.90)	(-1.05)
Δ Debt/GDP$_{t-5}$ Low	0.724***	0.528***	0.538***	0.280***
	(36.20)	(24.30)	(40.58)	(6.69)
% Debt in FC$_{t-5}$	0.595***	0.368***	0.226***	-0.026
	(18.07)	(5.74)	(4.70)	(-0.11)
Upper-Mid Income Dummy$_t$	3.683	14.927*	20.725*	-30.687**
	(0.64)	(2.16)	(2.20)	(-2.82)
Low-Mid Income Dummy$_t$	23.071***	46.043***	39.161	-2.081
	(3.95)	(6.08)	(1.82)	(-0.26)
Low Income Dummy$_t$	-29.738***	33.564***	-9.794	-12.139
	(-5.26)	(4.31)	(-1.91)	(-0.74)
M1 Residuals$_{t-5}$	0.889***	0.827***	0.808***	1.035***
	(103.20)	(75.51)	(8.69)	(18.73)
Debt Forgive$_{t-5}$	-11.326***	-14.561***	1.277	-69.471***
	(-5.75)	(-6.31)	(0.45)	(-5.48)
Inflation Rate$_{t-10}$	0.026***	-0.381***	0.108***	-0.068***
	(3.52)	(-39.02)	(10.52)	(-7.74)
Income-per-Capita$_{t-5}$	0.001***	0.000	0.000***	0.000
	(4.86)	(1.36)	(3.31)	(0.80)
N	2111	2111	1403	2111
R^2	0.871	0.830	0.808	

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: Inflation Models - Fifteen-Year
(Dep Var: Inflation Rate$_t$)

	(1)	(2)	(3)	(4)
Regression	OLS	FE	GMM	DPM
Debt/GDP$_{t-5}$ Hi	0.097	0.062	0.136**	-0.015
	(1.30)	(0.65)	(3.09)	(-0.13)
Debt/GDP$_{t-5}$ Upmid	-0.006	-0.123	-0.300***	0.788***
	(-0.08)	(-1.28)	(-3.33)	(6.52)
Debt/GDP$_{t-5}$ Lowmid	-0.256***	-0.100	-0.446	-0.021
	(-4.61)	(-1.49)	(-1.17)	(-0.17)
Debt/GDP$_{t-5}$ Low	0.443***	0.109***	0.238***	0.135***
	(25.63)	(4.38)	(10.42)	(4.37)
Δ Debt/GDP$_{t-5}$ Hi	-0.404**	-0.128	-0.169**	-0.283
	(-2.65)	(-0.89)	(-3.21)	(-1.36)
Δ Debt/GDP$_{t-5}$ Upmid	-0.101	0.218	-0.213*	-0.812***
	(-0.75)	(1.39)	(-2.50)	(-5.18)
Δ Debt/GDP$_{t-5}$ Lowmid	0.056	0.118	-0.319	-0.337***
	(0.70)	(1.61)	(-1.17)	(-4.69)
Δ Debt/GDP$_{t-5}$ Low	0.771***	0.449***	0.574***	0.345***
	(30.59)	(19.17)	(30.64)	(7.98)
% Debt in FC$_{t-5}$	0.631***	0.457***	0.261***	0.062
	(15.22)	(6.61)	(3.75)	(0.18)
Upper-Mid Income Dummy$_t$	0.120	6.556	16.316**	-37.484***
	(0.02)	(0.88)	(2.80)	(-4.03)
Low-Mid Income Dummy$_t$	20.802**	42.435***	33.042	20.996*
	(2.83)	(5.20)	(1.72)	(2.40)
Low Income Dummy$_t$	-30.192***	41.687***	-10.936	-2.785
	(-4.24)	(4.96)	(-1.78)	(-0.20)
M1 Residuals$_{t-5}$	0.818***	0.774***	0.599***	1.101***
	(80.05)	(63.18)	(6.12)	(9.50)
Debt Forgive$_{t-5}$	-11.673***	-11.128***	-0.200	-62.931***
	(-4.70)	(-4.47)	(-0.05)	(-8.30)
Inflation Rate$_{t-10}$	0.015	-0.422***	0.078***	-0.059***
	(1.64)	(-40.08)	(10.22)	(-8.83)
Income-per-Capita$_{t-5}$	0.001***	0.000	0.000**	0.000
	(3.72)	(1.72)	(2.89)	(0.86)
N	2111	2111	1403	2111
R^2	0.808	0.798	0.692	

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: Growth Models - Five-Year
(Dep Var: Real GDP Growth-Per-Capita$_t$)

	(1)	(2)	(3)	(4)
Regression	OLS	FE	GMM	DPM
Debt/GDP$_{t-5}$ Hi	0.007*	-0.005	0.004	-0.006
	(1.99)	(-0.70)	(0.35)	(-0.51)
Debt/GDP$_{t-5}$ Upmid	-0.009	-0.002	0.138	0.010
	(-1.65)	(-0.24)	(1.42)	(0.99)
Debt/GDP$_{t-5}$ Lowmid	-0.007	-0.002	-0.058	-0.012*
	(-1.75)	(-0.33)	(-1.83)	(-1.98)
Debt/GDP$_{t-5}$ Low	-0.003*	0.002	0.003	-0.001
	(-2.42)	(1.02)	(0.93)	(-0.42)
Δ Debt/GDP$_{t-5}$ Hi	-0.025***	-0.049***	-0.021***	-0.047**
	(-3.63)	(-4.55)	(-3.63)	(-2.90)
Δ Debt/GDP$_{t-5}$ Upmid	-0.052***	-0.058***	0.026	-0.072***
	(-4.55)	(-5.11)	(0.54)	(-5.66)
Δ Debt/GDP$_{t-5}$ Lowmid	-0.040***	-0.034***	-0.078**	-0.057***
	(-6.77)	(-6.65)	(-2.70)	(-9.15)
Δ Debt/GDP$_{t-5}$ Low	-0.010***	-0.005**	-0.007**	-0.003*
	(-5.88)	(-2.80)	(-2.96)	(-1.98)
Upper-Mid Income Dummy$_t$	1.865***	0.471	-5.670	-0.956
	(4.12)	(0.85)	(-1.07)	(-1.22)
Low-Mid Income Dummy$_t$	1.589**	0.642	3.649	-0.087
	(3.26)	(1.06)	(1.81)	(-0.09)
Low Income Dummy$_t$	0.852	0.115	-0.394	-0.971
	(1.38)	(0.18)	(-0.29)	(-1.01)
Inflation Residuals$_{t-5}$	-0.003	-0.004	-0.000	-0.026***
	(-0.53)	(-1.79)	(-0.03)	(-5.70)
Debt Forgive$_{t-5}$	-0.426*	-0.252	-0.060	0.310
	(-2.37)	(-1.42)	(-0.17)	(1.24)
Real Growth$_{t-10}$	0.036	-0.060**	0.070	0.040*
	(1.42)	(-3.11)	(1.15)	(2.24)
% Δ in Pop. 25-59 Y.O.$_t$	0.467***	0.132*	0.593***	-0.259**
	(8.48)	(2.20)	(3.84)	(-3.08)
EFW Chain Summary$_t$	0.804***	1.364***	0.781***	1.486***
	(10.83)	(14.10)	(4.13)	(7.20)
% Pop 15 Y.O. + Secondary Edu$_t$	0.039***	-0.015	0.057**	-0.023
	(6.72)	(-1.08)	(3.08)	(-0.85)
Log Income-per-Capita$_{t-5}$	-1.567***	-2.689***	-2.114**	-9.165***
	(-5.32)	(-4.83)	(-3.14)	(-11.85)
N	1716	1716	1193	1716
R^2	0.390	0.337	0.179	

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12: Growth Models - Ten-Year
(Dep Var: Real GDP Growth-Per-Capita$_t$)

	(1)	(2)	(3)	(4)
Regression	OLS	FE	GMM	DPM
Debt/GDP$_{t-5}$ Hi	0.001	-0.008	0.005	-0.005
	(0.40)	(-1.88)	(0.56)	(-0.74)
Debt/GDP$_{t-5}$ Upmid	0.006	0.012**	0.033	0.019***
	(1.30)	(2.92)	(0.59)	(3.87)
Debt/GDP$_{t-5}$ Lowmid	0.000	0.013***	-0.027	0.004
	(0.07)	(4.26)	(-1.42)	(1.26)
Debt/GDP$_{t-5}$ Low	-0.001	0.005***	0.003	0.000
	(-1.41)	(4.47)	(0.99)	(0.16)
Δ Debt/GDP$_{t-5}$ Hi	-0.007	-0.022**	-0.011**	-0.021*
	(-0.89)	(-3.23)	(-2.69)	(-2.57)
Δ Debt/GDP$_{t-5}$ Upmid	-0.007	-0.007	0.003	0.009
	(-0.89)	(-0.94)	(0.12)	(1.34)
Δ Debt/GDP$_{t-5}$ Lowmid	-0.009*	0.001	-0.026	-0.011***
	(-2.25)	(0.33)	(-1.60)	(-3.54)
Δ Debt/GDP$_{t-5}$ Low	-0.006***	-0.001	-0.004**	-0.003***
	(-4.59)	(-0.47)	(-2.80)	(-3.98)
Upper-Mid Income Dummy$_t$	0.489	-0.615	-0.829	-0.911*
	(1.39)	(-1.74)	(-0.30)	(-2.32)
Low-Mid Income Dummy$_t$	0.628	-0.516	2.040	-0.677
	(1.85)	(-1.34)	(1.69)	(-1.46)
Low Income Dummy$_t$	0.266	-0.238	-0.011	-1.025*
	(0.64)	(-0.57)	(-0.01)	(-2.13)
Inflation Residuals$_{t-5}$	0.007***	0.005***	0.006	-0.003
	(5.42)	(4.87)	(1.29)	(-1.73)
Debt Forgive$_{t-5}$	-0.081	0.157	0.254	-0.122
	(-0.63)	(1.39)	(0.90)	(-0.98)
Real Growth$_{t-10}$	0.039**	-0.050***	0.074	-0.020*
	(2.84)	(-3.99)	(1.74)	(-2.25)
% Δ in Pop. 25-59 Y.O.$_t$	0.561***	0.287***	0.662***	0.176***
	(15.38)	(7.46)	(5.36)	(4.16)
EFW Chain Summary$_t$	0.698***	0.993***	0.633***	0.855***
	(14.14)	(16.03)	(3.98)	(8.22)
% Pop 15 Y.O. + Secondary Edu$_t$	0.035***	0.013	0.028*	0.013
	(8.77)	(1.46)	(2.23)	(0.98)
Log Income-per-Capita$_{t-5}$	-1.596***	-3.165***	-1.391**	-4.901***
	(-7.60)	(-8.89)	(-2.67)	(-12.62)
N	1716	1716	1193	1716
R^2	0.440	0.436	0.385	

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 13: Growth Models - Fifteen-Year
(Dep Var: Real GDP Growth-Per-Capita$_t$)

	(1)	(2)	(3)	(4)
Regression	OLS	FE	GMM	DPM
Debt/GDP$_{t-5}$ Hi	0.002	-0.006	0.001	0.003
	(0.61)	(-1.96)	(0.10)	(0.74)
Debt/GDP$_{t-5}$ Upmid	0.003	0.010**	0.106	0.022***
	(0.83)	(2.94)	(1.92)	(6.26)
Debt/GDP$_{t-5}$ Lowmid	0.001	0.012***	-0.033	-0.003
	(0.51)	(5.00)	(-1.40)	(-1.53)
Debt/GDP$_{t-5}$ Low	0.000	0.007***	0.002	0.002**
	(0.57)	(7.60)	(0.96)	(3.25)
Δ Debt/GDP$_{t-5}$ Hi	-0.010	-0.022***	-0.005	-0.018**
	(-1.43)	(-4.14)	(-0.88)	(-3.05)
Δ Debt/GDP$_{t-5}$ Upmid	-0.007	-0.005	0.048	-0.002
	(-0.99)	(-0.94)	(1.60)	(-0.38)
Δ Debt/GDP$_{t-5}$ Lowmid	-0.001	0.006*	-0.024	-0.011***
	(-0.16)	(2.52)	(-1.28)	(-4.87)
Δ Debt/GDP$_{t-5}$ Low	-0.002*	0.002**	-0.002	-0.000
	(-2.16)	(2.73)	(-1.11)	(-0.49)
Upper-Mid Income Dummy$_t$	0.673*	-0.447	-4.303	-1.069***
	(2.15)	(-1.63)	(-1.52)	(-3.81)
Low-Mid Income Dummy$_t$	0.682*	-0.429	2.323	-0.092
	(2.26)	(-1.44)	(1.72)	(-0.28)
Low Income Dummy$_t$	0.151	-0.341	-0.172	-0.919**
	(0.41)	(-1.05)	(-0.19)	(-2.67)
Inflation Residuals$_{t-5}$	0.008***	0.005***	0.008	-0.003
	(7.95)	(6.23)	(1.71)	(-1.83)
Debt Forgive$_{t-5}$	-0.011	0.189*	0.263	0.175*
	(-0.10)	(2.15)	(1.04)	(1.99)
Real Growth$_{t-10}$	0.052***	-0.028**	0.056	-0.006
	(4.27)	(-2.84)	(1.74)	(-0.89)
% Δ in Pop. 25-59 Y.O.$_t$	0.519***	0.272***	0.574***	0.187***
	(16.04)	(9.10)	(5.94)	(6.15)
EFW Chain Summary$_t$	0.597***	0.751***	0.571***	0.772***
	(13.64)	(15.56)	(3.78)	(10.39)
% Pop 15 Y.O. + Secondary Edu$_t$	0.036***	0.007	0.041**	-0.004
	(10.04)	(1.06)	(3.03)	(-0.39)
Log Income-per-Capita$_{t-5}$	-1.617***	-2.850***	-1.658**	-4.109***
	(-8.68)	(-10.31)	(-2.86)	(-14.81)
N	1716	1716	1193	1716
R^2	0.453	0.484	0.241	

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 14: 5 Yr MA Inflation & M1 Growth Rates over Benchmark Rate (Part A)

	I $\geq$ 20	M1g $\geq$ 20	I $\geq$ 50	M1g $\geq$ 50	I $\geq$ 100	M1g $\geq$ 100
High	0.00%	3.35%	0.00%	0.70%	0.00%	0.00%
Up-Mid	3.30%	10.32%	3.17%	3.50%	3.70%	3.70%
Low-Mid	48.35%	38.35%	55.56%	53.85%	50.00%	51.85%
Low	48.35%	47.98%	41.27%	41.96%	46.30%	44.44%
N	333	717	126	143	54	54

Note: The percentages are calculated by column from the number of countries in each benchmark group.

Table 15: 5 Yr MA Inflation & M1 Growth Rates over Benchmark Rate (Part B)

	N	I $\geq$ 20	M1g $\geq$ 20	I $\geq$ 50	M1g $\geq$ 50	I $\geq$ 100	M1g $\geq$ 100
High	251	0.00%	9.56%	0.00%	0.40%	0.00%	0.00%
Up-Mid	254	4.33%	29.13%	1.57%	1.97%	0.79%	0.79%
Low-Mid	647	24.88%	42.50%	10.82%	11.90%	4.17%	4.33%
Low	959	16.79%	35.87%	5.42%	6.26%	2.61%	2.50%

Note: The percentages are calculated by row from the number of countries in each WDI income class.

A Appendix

A.1 Data Restrictions, and the EFWI Variable

In relation to observation count varying between models: Growth in real GDP per-capita variable was not always congruent with data availability for money growth. Similarly, the exclusion of the percent population living in the tropics, percent population living within 100km of the coast, and air-distance to the three major world markets from the FE model increases the observations marginally above those included in OLS models; however, the difference in observations does not change the results by a qualitative, or statistically significant quantitative amount.

Several restrictions were placed on the data for this paper. (1) Observations for countries with less than 1 million population - This was done as smaller countries are likely to exhibit significantly different characteristics than larger countries, particularly in the lack of diversity among the sectors of their economy, and would be considered outliers in the data. Examples include Andorra, Luxembourg, Kuwait and The Bahamas[17]. (2) A requirement of at least four observations for all data that the moving-average transformation applies[18]. Since the moving average data-transformation calculation can be substantially different from the actual moving average depending on the true value of the missing observation. This is particularly true when there is a high degree of volatility in the values.

To control for institutions, data from the Economic Freedom of the World Index (Gwartney et al., 2012) were used, specifically the chain summary variable. For the Economic Freedom of the World Index chain summary variable provided in Gwartney et al. (2012), data was collected only in five-year increments from 1970 to 2000. However, from the year 2000 to 2009 (the end of the data used in this paper), the data was collected annually. As there is little variation in the chain summary over time where the data is present, linear-interpolation was used to fill in data for missing years between 1970 and 2000. Specifically, even weights were given to years that were missing data, and then were averaged between each nearest consecutive data point (five years) for a given country, (between years 1970 and 1975, as an example).

[17] At most, 69 observations were excluded in 1970, decreasing to 56 in 2009. It may be noted that if the population of a country increased above 1 million the country would enter the dataset used here by this criteria.

[18] Abbas et al. (2010), indicate that when their data source suggested an annual value very different from the values of the adjoining years, they insert missing values (96 times). There were three cases in which three missing values were inserted (the most consecutively inserted) and 20 cases where two missing values were inserted.

A.2 Data Sources

Table 16: Data Sources

M1 Growth Variables	World Development Indicators Dataset. Calculated using the Money (current LCU) variable (FM.LBL.MONY.CN).
Inflation Variables	From the World Development Indicators dataset. Particularly Inflation, GDP deflator (annual %) variable (NY.GDP.DEFL.KD.ZG).
Debt/GDP Variables	IMF Historical Public Debt Database, (v. Spetember 2012): PPPGDP-weighted, or medians.
Debt Forgiveness Variables	World Development Indicators Dataset. Data Transformed from Debt forgiveness grants (current US$) (DT.DOD.MDRI.CD) and Debt forgiveness or reduction (current US$) (DT.DFR.DPPG.CD) to a Dummy variable that is equal to one if either variable was non-zero, and equal to zero otherwise.
Income Per Capita	From the WDI dataset, GNI per capita, Atlas method (current US$) (NY.GNP.PCAP.CD).