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journal homepage: www.elsevier.com/locate/jmacroThe effect of public debt on growth in multiple regimes[☆]Andros Kourtellos^{a,*}, Thanasis Stengos^b, Chih Ming Tan^c^a Department of Economics, University of Cyprus, P.O. Box 537, CY 1678 Nicosia, Cyprus^b Department of Economics, University of Guelph, Guelph, Ontario N1G 2W1, Canada^c Department of Economics, College of Business and Public Administration, University of North Dakota, Gamble Hall Room 290, 293 Centennial Drive Stop 8369, Grand Forks, ND 58202-8369, United States

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ABSTRACT

We employ a structural threshold regression methodology to investigate the heterogeneous effects of debt on growth using public debt as a threshold variable as well as several other plausible variables. Our methodology allows us to address parameter heterogeneity that characterizes cross-country growth data and at the same time account for endogeneity. We find strong evidence for threshold effects based on democracy, which implies that higher public debt results in lower growth for countries in the Low-Democracy regime. Our results are consistent with the presence of parameter heterogeneity in the cross-country growth process due to fundamental determinants of economic growth proposed by the new growth theories.

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1. Introduction

There is a growing concern that current debt trajectories in several economies around the world are not sustainable implying risks to long-term growth and stability. For example, at the end of 2011, Japan's debt-to-GDP of 233% was the highest debt-to-GDP ratio among the world's developed countries. The US debt-to-GDP ratio reached 102% after the government's debt ceiling was lifted, and in Europe, the prime example is Greece with a 165.3% debt-to-GDP ratio. The outlook for a number of countries does not look any better under existing fiscal policies. As argued by [Cecchetti et al. \(2011a\)](#) projections of debt-to-GDP ratios look even worse, especially when one takes into account expected future age-related spending.

All this evidence has created an urgent need for policymakers in governments, central banks, and international policy organizations to understand the effects of public debt on economic growth. The fear that investors may interpret the high debt-to-GDP ratios as the result of time inconsistent or inflationary policies has led countries to implement immediate and severe austerity measures on their citizens and adopt fiscal discipline in order to restore their credibility irrespective of the costs in terms of high unemployment, deflation, and the possibility of depression. But is this fear justified for all countries?

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In fact, the concerns over the sustainability of public debt levels are grounded in both theory and empirics; see for example [Panizza and Presbitero \(2013\)](#) for a comprehensive survey of the existing literature.¹ The theoretical literature has distinguished between the positive short-run effects of accumulating public debt in order to enact counter-cyclical policies and potential negative long-run growth effects from high levels of debt. For example, [Elmendorf and Mankiw \(1999\)](#) emphasize the potential crowding out effect of higher public debt on private investment although their back-of-the-envelope calculations suggest that the growth effects from crowding out may be modest.

A key focus of the current literature on the effects of public debt on economic performance has been the attempt to identify nonlinear and in particular threshold effects. The idea is that debt levels that are above a particular threshold value may have different implications for growth compared to more moderate levels of debt. There exists theoretical work that suggests that the effect of public debt on growth may, in fact, be nonlinear so that there may exist an optimal level of public debt; see [Checherita-Westphal et al. \(2012\)](#) and [Ghosh et al. \(2013\)](#). Using data for OECD countries, [Greiner \(2011\)](#) finds that the optimal level of public debt ranges between 43% and 63% of GDP.

In terms of the empirical literature, a recent prominent study by [Reinhart and Rogoff \(2010\)](#) found that there is generally a weak relationship between government debt and economic growth for countries with debt below 90% of GDP. However, for countries with debt-to-GDP over 90%, debt can have adverse consequences on growth. Other studies have attempted to provide a formal test for the 90% threshold value of [Reinhart and Rogoff \(2010\)](#). For example, [Cecchetti et al. \(2011b\)](#) and [Cecchetti et al. \(2010\)](#) employ the threshold regression of [Hansen \(2000\)](#) to estimate public debt thresholds. [Cecchetti et al. \(2011b\)](#) study the effects of public debt on growth using a new dataset on debt levels in 18 OECD countries from 1980 to 2010. Using threshold regression, they find that government debt is bad for growth when it is above the threshold value of 85% of GDP. [Cecchetti et al. \(2010\)](#) using threshold regression methods on data for a larger set of countries for 1980–2008 find that a threshold of 77% public debt-to-GDP ratio is the critical level after which debt becomes damaging to growth. Relatedly, [Minea and Parent \(2012\)](#) employ the panel smooth threshold regression model of [González et al. \(2005\)](#) who find that there is a negative effect of public debt on growth when the level of debt is between 90% and 115% of GDP.

Current work suffers from a number of conceptual and methodological issues. An important limitation of the recent work has been the failure to adequately account for heterogeneity in the effect of debt on growth, which may arise due to alternative growth theories. Specifically, researchers have been searching for threshold effects of public debt on growth when debt is above or below a particular public debt threshold value. The alternative that has been considered is simply that there is no nonlinearity in the effect of public debt on growth. However, these studies do not investigate other possible threshold variables beyond the debt-to-GDP ratio. But, why would we believe a priori that the effect of public debt on growth is characterized only by excessive levels of debt?

This paper is designed to elucidate our understanding by providing answers to the above questions using an econometric methodology that allows us to deal with parameter heterogeneity more generally. Parameter heterogeneity refers to the idea that the data generating process that describes the cross-country growth process is not common for all observations. For example, theory suggests that other factors besides just the debt-to-GDP ratio; e.g., a country's trade openness or institutional quality, are plausible sources of convergence clubs and therefore can be used as threshold variables to sort countries into multiple growth regimes in which countries obey the same growth model.

One approach that deals with the problem of parameter heterogeneity is to use threshold regression (TR) or sample splitting models. In a seminal paper, [Durlauf and Johnson \(1995\)](#) employed a sample splitting (specifically, a regression tree) approach to uncover multiple growth regimes in the data. Following a similar strategy [Papageorgiou \(2002\)](#) organized countries into multiple growth regimes using the trade share and [an \(2010\)](#) classified countries into development clubs using the average expropriation risk.² A key goal of this paper therefore is to evaluate the strongest evidence for a particular factor (be it the debt-to-GDP ratio, institutions, etc.) out of a large set of plausible candidates, in the context of threshold regression models, as being the most plausible threshold variable to characterize the heterogeneous effects of public debt on growth and thereby, consequently, organizing countries into multiple growth regimes.

One difficulty with the recent work on the effects of public debt on growth is that they largely ignore the problem of endogeneity in the threshold variable. This is important because, as [Kourtellos et al. \(2013\)](#) argue, if the threshold variable is endogenous, the above approaches will yield inconsistent parameter estimates for the regime-specific partial effects. In fact, there is strong evidence that variables such as public debt, trade, and institutions are endogenous; see [Panizza et al. \(2012\)](#); [Frankel and Romer \(1999\)](#) and [Acemoglu et al. \(2001\)](#), respectively. In this paper, we therefore model parameter heterogeneity using the structural threshold regression (STR) model, which was proposed by [Kourtellos et al. \(2013\)](#). Threshold regression models classify observations into stochastic processes depending on whether the observed value of a threshold variable is above (or below) a threshold value. A key feature of STR is that it allows for the endogeneity of the threshold variable as well as for the endogeneity of regressors. Our analysis augments the Solow growth model with the debt-to-GDP ratio and investigates the possibility of multiple growth regimes in the data using a comprehensive set of growth determinants as threshold variables including among others the debt-to-GDP ratio, institutions, ethnic fractionalization, and trade openness.

In terms of our findings, we find strong evidence for threshold effects based on democracy, as a proxy for institutional quality, in the effect of debt on growth. More precisely, our findings show that there exists a critical level of democracy under

¹ The literature review portions of this paper draw heavily from their work.

² An alternative approach employs semiparametric models based on nonparametric smooth functions to identify general nonlinear growth patterns. Notable examples include [Durlauf et al. \(2001\)](#) and [Mamuneas et al. \(2006\)](#).

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