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Summary

This research employs Mexico's state level data from 2001-2016 to examine the nexus between debt sustainability and regional economic growth. Following the ideas of Reinhart and Rogoff 2010 and Ilzetzki, et al 2019, the research seeks to establish the threshold between debt and regional growth. There is a need to understand whether increasing debt exerts benign effects on regional GDP growth in centralized fiscal systems prevalent in emerging countries and whether these effects differ by type of financing. The study employs the dynamic panel approach by Arellano and Bond (1991) to control for different types of endogeneity and the Seo and Shin (2016) kink model to estimate debt thresholds. The results point to a weak but positive association between debt and GDP growth, which differs by type of debt. Subnational debt thresholds of local governments locate at 67% as a share of guaranteed resources–lower than those reported at the national level. Employing debt as a share of GDP we find a much lower debt threshold (3.25%) which is explained by the fiscal interrelations architecture of federal systems with high local government dependence on federal transfers and subject to soft budget problems. The study finds economic growth is more sensitive to commercial bank debt and capital market debt than other types of debt.

Keywords: municipal debt, subnational capital markets, growth threshold, debt limits
JEL codes: H6, H63, H7

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1. Introduction

Credit risk analysts have warned that the extraordinary fiscal responses to the recession in developing countries induced by the coronavirus pandemic will send local and regional governments' debt to historic highs (Ejge and Franch, 2020). Subnational governments' debt will significantly increase with the subsequent debt burden in the forthcoming years. Central governments will struggle to provide stable sources of revenue posing a threat to the fiscal sustainability of local governments, which are, in many developing countries like Brazil and Mexico, highly centralized, dependent of federal transfers and face soft budget problems.

Some authors question whether such current and future debt increases at the local and national levels are sustainable and whether debt burdens can limit or instead boost regional economic growth (Quiroga and Smith 2019; Cabral et al., 2021; Allers and Natris, 2021). The soft budget constraint problem arises when local governments count on the help from central governments to bail them out in case of financial distress (Kornai, et al., 2003). Bailing out mechanisms include soft taxation, ad hoc subsidies and soft bank credits. Bethlendi et al. (2020) suggest to control the phenomenon of soft budgeting by reducing the amount of debt, but also by reducing expectations of bailing out and the reinforcement of market discipline through hard budget constrains (Smith et al., 2019).

The nexus between debt, debt sustainability and economic growth deserves closer examination at the local government levels, not just to assess the prospects of economic recovery, but also to determine the possible limits that exist with debt thresholds and the conditions imposed by federal fiscal governments interrelations. The literature on the debt growth nexus has been discussed extensively (see Blanchard 2019 for an exhaustive list), yet, there is little to no consensus on whether higher debt levels are good for economic growth or even what type of debt is best for growth. There is less evidence of the impact of subnational debt on economic growth and on whether a threshold exists for local governments in developing countries.

The debate on fiscal discipline, made popular by the controversial seminal contribution by Reinhart and Rogoff (2010), has found inconclusive evidence in favor of the debt-threshold hypothesis at the national level. Reinhart, Reinhart and Rogoff (2012) suggest

that highly indebted countries slow down economic growth when debt rises above 90% of GDP (Irons and Bivens, 2010), but this has been contended in detail for example by Herndon et al. (2014). Other influential authors have recently found opposing evidence suggesting that more debt is good for a country's growth in highly indebted developed economies (Blanchard, 2019).

The study of whether greater levels of subnational debt are sustainable as well as the effect of debt on regional economic growth is pertinent for developing countries. Even more so, the question affects these countries in the aftermath of the coronavirus economic crisis. Subnational debt of governments in Mexico has grown significantly to encourage economic recovery and economic growth since the crisis of 2009 has intensified after the pandemic. Some authors have noted that the financial pressure of these crises of 2009 and from 2020 with the pandemic has greatly affected the credit strength of local governments (Herrera, Brandaza and Ortiz, 2010). Other authors have looked for evidence on whether fiscal discipline has contributed to maintain subnational finances health or impacted the build-up of subnational debt in the long term (Smith, et al. 2019; Sönmez, 2013). While assessing long-term financial sustainability of local governments in highly centrally regulated countries, Bethlendi et al. (2020) noted consequences of soft budget problems in terms of debt sustainability. The literature is long and unconvincing as to what is the effectiveness of fiscal policy on growth (Horne, 1991; Blanchard, 1990; Paunovic, 2005, Talvi and Végh, 2000, Mendoza and Oviedo (2004).

As a result, the contribution of this study resides in transferring the debate on fiscal discipline and the debt-threshold hypothesis to the context of subnational governments—highly dependent and ridden by soft budget problems—in highly centralized fiscal regimes. The literature is specifically inconclusive on whether greater debt leads to greater growth or to the existence of a debt threshold in developed countries for growth to occur. Almost no studies investigate such threshold at the subnational or regional level and no studies distinguish the differential impact of the various types of debt on subnational growth. Easily accessible credit by commercial banks or governmental guarantees based on transfers may be easier for governments to allow for debt issuances. However, more difficult financing, such as bond markets or long-term debt issuances based on own source revenues for

repayment structures, can make subnational governments more fiscally sound, and thus have longer term impact on growth.

This research employs state data from Mexico for the period 2001-2016 to examine, first, the nexus between debt sustainability and regional economic growth, and second, to establish a threshold level between debt and regional growth following the ideas of Reinhart and Rogoff (2010) and Reinhart, Reinhart and Rogoff (2012). The Mexican constitution provides the golden fiscal rule that borrowing from federal and subnational governments can only finance public investment (Cabral et al., 2021). This rule, together with the prohibition of incurring liabilities with foreign entities, might encourage the sustainability of subnational debt. These rules however do not distinguish the convenience of each type of debt to encourage economic growth. This study investigates the individual effect of each type of debt on growth.

To test the impact of each type of debt on growth this study employs the dynamic panel approach by Arellano and Bond (1991) that allows to control for different types of endogeneity. Then, to estimate the threshold from which economic growth is affected by increasing levels of debt we employ Seo et al. (2016) dynamic panel approach with threshold effects. Similar to other studies and because of the asymmetry of growth patterns in developing countries:

> "we apply the regression kink model to the growth and debt problem made famous by Reinhart and Rogoff (2010). These authors argued that there is a nonlinear effect of aggregate debt on economic growth, specifically that as the ratio of debt to GDP increases above some threshold, aggregate economic growth will tend to slow. This can be formalized as a regression kink model, where GDP growth is the dependent variable and the debt/GDP ratio is the key regressor and threshold…" Hansen (2017).

There is a need to understand whether increasing debt may have benign effects on regional GDP growth and after which specific threshold level they could possibly surmount the recession caused by the recent COVID crisis. The results to our study point to a weak but

positive association between debt and GDP growth, which differs by type of debt. The threshold levels are also distinct depending on the nature of debt.

This paper is organized as follows. Section two presents a brief literature review on debt sustainability and growth. Section three presents the salient features of fiscal federalism in developing countries like Mexico, while section four shows the methods to be employed in this paper to test the effect of debt on growth as well as to estimate a threshold value after which regional growth can be affected. Section five presents the most relevant findings concerning the hypotheses raised by Reinhart and Roggoff (2010) and Blanchard (2019) and the effect of the fiscal environment on growth. Finally, section six discusses the main findings of the model and provides policy implications and recommendations.

2. Economic Growth and Public Debt

The question of fiscal sustainability of local governments to assess the impacts of debt on the local public finances and financial management has undergone close examination (Blanchard, 1990; Mendoza and Oviedo, 2009). Some studies find that Latin American countries approach a natural debt line, while others test whether governments can sustain high indebtedness trends, accounting for interest rates, growth rates, deficit levels and debt to GDP ratios (Paunovic, 2005; Croce and Juan-Ramón, 2003). Quiroga and Smith (2019) look for evidence on whether centralizing the control of subnational debt in Mexico supports the promotion of sustainable finances in municipal governments. The authors results point to a large continuing fiscal gap without the country seeking more autonomy in its fiscal decision making at the local level.

This line of research acknowledges that the relationship between subnational debt and economic growth closely links debt sustainability to the federal fiscal environment. A number of confounding factors including political budget cycles, devolution of authority and intergovernmental transfers, conditional and unconditional, play a major role. Mendoza and Rubio (2021) have found evidence in Mexico of a positive but weak effect of federal transfers on regional growth. These authors suggest that indebtedness, corruption, and lack of transparency could be root causes of the feeble pass-through from decentralization to regional growth.

Fiscal variables play a major role to explain economic growth. There is increasing literature investigating the nexus to government structure and debt issuances. Reinhart and Rogoff (2010) argue that the strength of the relationship between Gross Domestic Product (GDP) and debt/GDP ratio depends on the levels of indebtedness. While Reinhart and Rogoff find a weak nexus between GDP and debt at low levels of debt to GDP ratios, they report that such relationship strengthens with debt increases. High levels of debt negatively affect economic growth and debt thresholds are lower for developing countries. Reinhart, Rogoff & Savastano (2003) later introduced the concept of "debt intolerance," i.e., the pressure experienced by emerging market economies at different levels of indebtedness and find that, while advanced economies could tolerate high levels of debt before economic growth is compromised, emerging economies' debt thresholds are extremely low and largely dependent on the country's moratorium economic history. We believe this debt-growth nexus is deeply rooted on the fiscal equation of federal systems.

Decentralization processes in many emerging market economies during the past 20 years have strengthened the fiscal capacities of local governments. Sub-sovereign entities have now a better access to sophisticated and diversified debt markets to finance infrastructure and public investment projects (Kehew et al., 2005; Bethlendi et al., 2020). Bonds issued by sub-sovereign entities compete with traditional bank loans to finance local governments' infrastructure. The growing trend towards diversified sub-sovereign debt, banking, and capital markets is now a reality for these countries (Platz, 2009; Moldogaziev et al., 2018).

The debt threshold literature focuses mainly on highly indebted economies and looks to assess how much debt country governments can tolerate to promote economic growth. However, two decades ago, Giugale et al. (2000) argued that even with the significant increase in the levels of sub-sovereign indebtedness, the amount of subnational debt does not represent a threat to the macroeconomic environment of the country. In Mexico for instance, despite the steep hikes of subnational debt reported in the literature (Quiroga and Smith, 2019; Astudillo Moya et al., 2018), total subnational and subsovereign debt continues to be extremely small compared to national GDP and local GDP. The tendency of federal governments to maintain explicit and implicit agreements to absorb sub-sovereign debt can

lighten the financial pressure of local governments and explain the small GDP share of subnational debt. Several authors have warned about the negative consequences of such conduct of federal governments together with their propensity to bail out subnational finances which strengthens moral hazard incentives, fiscal irresponsibility, opacity and reveals soft budget problems (Hernández-Trillo, 2002; Quiroga and Smith, 2019; Mendoza-Velázquez, 2018).

Recent provocative advances in the study of the nexus between government debt and economic growth suggests on the contrary that more debt can actually encourage economic growth (Blanchard, 2019). These conclusions come from the study of highly indebted developed economies (i.e. Japan, Europe and the United States). Ilzetzki, Reinhart and Rogoff (2019) state in contrast that the periods in which government debt rises above 90% of GDP are associated with slowdowns and low economic growth. Quiroga and Smith (2019) highlight the role of institutions and also argues that the final result depends on the type of debt employed in the fiscal policy equation. Ter-Minassian (1997) note that for developing countries, with less evolved institutions, the question is not just what type of debt instruments to employ but more crucially when.

Blanchard's (2019) argues that governments can take out more debt because the social costs of more debt distribute over longer horizons. However, Blanchard does not indicate what type of debt, e.g., subnational, national, commercial banking, market based or government issued or other types, can promote economic growth. The conditions under which this is possible at the macroeconomic level is that the economic growth exceeds debt interest rates. Debt management becomes easier with stable interest rates, as debt as a share of GDP shrinks, with no need of new taxes are emitted.

Translating this fiscal ecosystem to local governments in emerging markets becomes an additional requirement for capital market investors to take into consideration, as well as the federal or central government's institutional and legal system, political context, its decision making, fiscal capacity, and transparency of the local governments, which may or may not be consistent with federal level institutions.

In this study we test two hypotheses. First, following the research of Blanchard (2019) we investigate whether more debt is associated with greater growth in local governments immersed in a federal system with high fiscal dependence and soft budget problems. Second, we test for threshold levels for different types of debt to evaluate whether a benign form of debt exists.

3. The Salient Features of Intergovernmental Fiscal Federalism in Mexico

A number of countries run a type of fiscal federalism where verticality, limited streams of local revenue and expenditure autonomy, and a high degree of subnational dependency on federal share transfers are salient features in developing economies. To lighten the burden of these pervasive salient features, intergovernmental fiscal systems undergo several discipline-enhancing fiscal reforms. Mexico for instance has introduced accounting and harmonizing fiscal laws since the beginning of the 2000s (Pérez-Benitez and Villarreal-Páez, 2018; Hernández-Trillo, 2018): the fiscal reform of 2003, the redesign of federal share transfers formulas in 2007 and the General Law of Government Accountability and Transparency in 2016 (LGCG). Finally in April 2016, the Mexican government enacted the Law of Financial Discipline to States and Municipalities (FD Law), which set limits to local public debt.

There are differences between these reforms. While the 2003 reform was comprehensive, composed of more than 300 fiscal arrangements favoring local governments, the Fiscal Coordination Law of 2007, in effect from 2008, focused in providing new rules to federal share conditional and unconditional arrangements (Mendoza and Rubio, 2021). To some analysts the reform of 2007 has reinforced the dependency of local governments to conditional transfers, while encouraging tax collection (Pérez-Benitez and Villareal-Paez, 2018). For others, fiscal reforms have been designed to strengthen intergovernmental relations of local governments in Mexico (Cabrero-Mendoza, 2013) and some recent studies provide encouraging evidence on the positive effect of these reforms on GDP from the 2003 (Mendoza and Rubio, 2021). However, these authors also warn that these reforms have encouraged the dependency on conditional and unconditional transfers while the effects on GDP remain elusive.

The fiscal reforms have taken place amid the increasing federal conditional and unconditional transfers to local governments. During the first decade of the 2000's, Mexico benefited from extraordinary revenue streams from steep hikes in oil prices. Local governments received both increasing flows of oil related share transfers and additional financial revenues from diverse financing sources (Mendoza and Rubio, 2021): credit banks, development banks and the stock market (subnational bond issues). While oil related inflows to local governments seem to have reinforced their dependency to the central government and constitute evidence for the soft budget problem (Hernández-Trillo et al., 2002), the availability of additional resources from a diverse pool of funding options has allowed subnational governments to withstand the financial stress to public finances in moments of crisis.

However, recent research prior to passing the FD Law in 2016 suggests that despite the increasing levels of subnational debt in Mexico, market debt has not been employed effectively or policy decisions have been made irrationally from a partisanship ideology to an urban planning perspective (Benton and Smith 2017; Smith and Benton 2017). Also, Mexico fits the highly centrally regulated fiscal model with limited autonomy over own revenues and a golden fiscal rule, which can help to promote fiscal and debt sustainability (Bethlendi et al., 2020). Centralization could give place to soft budget problems given the reputation of bailing out states due to a lack of fiscal discipline (Giugale et al., 2000; Hernández-Trillo et al., 2002; Cabral et al., 2021).

Several authors have warned about the existence of a soft budget problem in Mexico, arising from the willingness of the central government to bailout highly dependent subnational governments through conditional and extraordinary share transfers (Hernández-Trillo et al., 2002). A soft budget problem might translate into laziness of subnational governments to collect local fiscal revenue, into non-productive overspending, over indebtedness and into adverse effects to regional economic growth. Fiscally and solvency troubled subnational governments and a central government willing to bail out, conform fertile ground for a soft budget problem (Sato, 2007). In addition, the lack of strong incentives or provisions to stop overspending and over-indebtedness of local governments

encourage moral hazard, project investment inefficiency and ultimately adverse effects on economic growth.

However, in this paper we argue that not all types of debt exercise the same effect on growth. Various reasons can explain such differential effects of debt on growth: a) it can be the result of diverse effectiveness of financial management capacities of subnational governments; or b) the structure of debt arrangements, e.g., guaranteed by federal share transfers or by own-source revenue repayment structures; or c) the architecture and design of the fiscal federalism used to control the debt issues by the fiscal rules.

While the first of these possibilities has been addressed in previous work (Mendoza and Rubio, 2021), there is no research on the effects of differential debt on growth which leaves ample room to study and discuss the role of the fiscal environment to explain growth at the subnational level. Ter-Minassian (1997) noted that, for developing countries with less evolved institutions, an important question is the type of debt instruments employed to finance investments. For instance, subnational governments funding backed up with transfers may present as an effortless option for subnational governments, while bond markets or long-term debt issuances that require specialized skilled managers and the employment of own-source revenues might be harder to access. Bond and long-term debt own tax backed issuances could promote fiscally sound finances and possibly have longer-term impacts on growth.

Quiroga and Smith (2019) noted that the type of debt and the institutional fiscal environment in Mexico might indeed play a role in the explanation of subnational economic growth. However, the literature has not evolved to present a theory that provides a clear mechanics of the transmission channels over which subnational debt affects regional growth in developing countries described by these salient features: high verticality, scarce collection of tax revenue and strong dependency of federal transfers.

Additionally, local congresses allow subnational debt issuance in Mexico on the condition that local governments invest financial funds to develop infrastructure and require that debt does not exceed specific thresholds, to ensure the financial stability of public finances. The Mexican Constitution states that federal and subnational governments' borrowing can only finance public investments (Cabral et al., 2021). This is a golden fiscal

rule that seeks to ensure that debt encourages growth, along the prohibition to employ foreign debt to secure the stability of subnational finances.

Blanchard's (2019) argues that governments can take out more debt because the social costs of more debt distribute over longer horizons. However, no studies (to the author's knowledge) has examined the effect on growth of the different types of debt available to local governments in emerging markets operating in vertical fiscal federalisms, with limited collection of local revenue, limited expenditure autonomy, and a high degree of subnational dependency. We aim to provide some evidence in the search for those mechanisms. Specifically, on securitization of a particular loans may or may not affect the sustainability and growth at the local level.

4. Dynamic debt-growth nexus and debt thresholds

This section presents the methods employed in this study 1) to test the nexus between debt and economic growth, and 2) to determine a threshold level of debt. We test for threshold levels for different types of debt to investigate whether a benign form of debt exists. The fiscal discipline of subnational governments, the rational choice of debt and posterior impact on regional economic growth depend upon the democratic and federal system and on the strength of institutions, policy designs, legal and enforcing systems (Ter-Minassian, 1997; Quiroga and Smith, 2019). Recent research suggests that despite the increasing levels of subnational debt in Mexico, market debt has not been employed effectively or policy decisions have been made irrationally due to the political economy (Benton and Smith, 2017; Smith and Benton, 2017).

4.1 Dynamic Modeling of the Debt-Growth Nexus

There are two views about the effect of debt on economic growth at the subnational level. While Reinhart and Rogoff (2010) and Reinhart, Reinhart and Rogoff (2012) warn that over-indebtedness can negatively impact economic growth and debt levels below 90% of GDP do not have an impact on growth, Blanchard (2019) contends that more debt is actually associated with greater growth. We test the nature of the association between debt and economic growth for the case of local governments, immersed in a federal system with high

fiscal dependence, employing a dynamic panel approach that recognizes the possibility of debt affecting growth at different moments in time. The lack of consensus in the testing of this nexus is possibly because of the inability of methods to control for some forms of endogeneity, e.g., Krugman (2010) noted that low economic growth can lead to high levels of debt. Similar to other studies, this paper addresses endogeneity by employing GMM estimations with internal instruments. In particular, this study implements the Arellano-Bond (1991) dynamic panel data models to test the effect of debt on regional economic growth, accounting for specific sources of endogeneity: un-observed heterogeneity; simultaneity and dynamic endogeneity. Ignoring dynamic endogeneity can have severe consequences in terms of consistency. Dynamic modeling provides us with a robust method for identifying the causal effect of debt on economic growth. Schultz, Tan and Walsh (2010) show that the dynamic panel model by Arellano-Bond overcomes these problems by producing unbiased and consistent estimates, employing valid internal instruments during estimation.

Several works have previously employed the Arellano-Bond (1991) dynamic panel model with GMM to address unobserved heterogeneity, simultaneous, and dynamic endogeneity within the debt-growt nexus (Kumar and Woo, 2010; Presbitero, 2012; Kim, Ha and Kim, 2017). Besides addressing these types of endogeneity, the Arellano-Bond approach allows control for federal fiscal shifters. The GMM specification for dynamic panel datasets produces consistent parameter estimates in endogeneity and produces unbiased and consistent estimates Schultz, Tan and Walsh (2010).

We employ different versions of the Arellano-Bond model, each concerning the different types of debt: total debt, development bank debt, commercial bank debt, bond debt and trust fund debt. The estimations also distinguish between flow debt and cumulative debt, both as a share of GDP and guaranteed resources.

$$Growth_{i,t} = \sum_{j=1}^{k} \alpha_j Growth_{i,t-j} + \omega_1 Debt_{i,t} + \beta_1 CTrans_{i,t} + \beta_2 UTrans_{i,t} + \beta_3 Tax_{i,t} + \delta D_i + v_i + \varepsilon_{it} \qquad i=1,\ldots,N; \quad t=1,\ldots,Ti \qquad (1)$$

where $growth_{it}$ is GDP growth for state i in time t. The variable $Debt_{it}$ can take the ratio of cumulative debt to GDP during the period. The results also present a set of estimates with

debt flows as a share of GDP. To control for the fiscal system forces we include $CTransfers_{it}$ conditional transfers (aportaciones), $UTransfers_{it}$ Unconditional transfers (participaciones) and own-tax revenue (Tax_{it}). The models include a dummy variable to capture the impact of the 2009 crisis. Lagged dependent variables regressors correlate with unobserved panel level effects (v_i). Idiosyncratic errors ε_{it} are *i.i.d.* with variance σ^2_{ε}. Models assume that v_i and ε_{it} are orthogonal. The parameter α_1 measures the speed of adjustment or convergence of growth to a mean equilibrium. Arellano Bond estimator controls for endogeneity of lagged dependent variables and explanatory variables with the error term by differencing and removing fixed effects. Unlike OLS or fixed effects estimates, dynamic panel GMM estimators allow debt to relate to past performance and hence permits using some combination of variables from a states' history as valid instruments to account for simultaneity. These "internal" instruments for current realizations of debt comprise past values of debt and growth, eliminating the need of "external" instruments.

Economic growth dynamically depends on debt in all periods through past economic growth effects. Still, it is independent of past debt when growth is held fixed (Arellano, 2003). The parameters are identified assuming that debt is held fixed, i.e., debt is strictly exogenous relative to unobserved shift variables. Exogeneity allows us to use lagged values of corporate governance as instrumental variables in the Arellano-Bond framework. Lags of the economic growth, debt and federal fiscal variables are employed as instruments to remove fixed effects (Hansen, 1982). Large instrument collection can overfit endogenous variables and possibly invalidate GMM instruments. Our estimations ensure that instruments are below the number of units in the panel as an empirical rule of thumb. We employ the Sargan test to pin down overidentifying restrictions and ensure de validity of GMM estimators.

4.2 Debt threshold and growth

The nexus between debt and growth in this cross-regional panel study can be nonlinear, as explored with the dynamic panel approach above, but it could also reveal a specific type of threshold effect. Contrary to the findings by Reinhart and Rogoff (2010) and Reinhart, Reinhart and Rogoff (2012), and more in line with the arguments of Blanchard (2019), we expect that such threshold can signal the point after which regional economies should experience growth.

This study formalizes the modeling and estimation of a threshold effect employing the panel model with threshold effects by Seo and Shin (2016). This model allows for asymmetric effects depending on whether the threshold variable is above or below the unknown threshold. This approach overcomes the strict exogeneity assumption of covariates required by static models such as the one by Hansen (1999) which can be too restrictive. This dynamic modeling allows for lagged dependent variables and endogenous covariates via GMM estimation. Seo and Shin (2016) extend Hansen's model to the dynamic panel model with an endogenous threshold variable and a GMM estimator that reflects a kink restriction.

In this dynamic kink model, the regression is continuous but the slope has a discontinuity at a threshold point, hence a kink (Hansen, 2017). In contrast with regression discontinuity models that assume a known threshold, threshold regression models assume such the threshold parameter is unknown and must be estimated. Blanchard (2019) does not suggest the identification of a specific threshold or kink after which debt can encourage growth. However, we expect economic growth to quicken when the level of government debt relative to GDP exceeds a threshold level.

The dynamic threshold model is given by

$$y_{it} = x_{it}'\beta + (1, x_{it}')\delta 1\{q_{it} > \gamma\} + \mu_i + \varepsilon_{it}, \quad i = 1, \dots, n; \quad t = 1, \dots, T, \tag{2}$$

where y_{it} is the real GDP growth rate and x_{it} are covariates in state *i* for year *t*. The vector x_{it} may include lagged dependent variables and q_{it} is the threshold variable. First differences of (2) remove unobserved individual fixed effects μ_i and the estimation of the vector of unknown parameters $\theta = (\beta', \delta', \gamma')'$ through GMM. ε_{it} are zero mean idiosyncratic random disturbance. This model implies the presence of a discontinuity of the regression function capture by the term $(1, x_{it}')\delta$.

The first dynamic panel data model with debt threshold effects to explore the nexus between economic growth and debt-to-GDP ratio is as follows:

$$y_{it} = (\phi_1 y_{it-1} + \theta_{11} Debt_{it} + \theta_{21} P_{it} + \theta_{31} A_{it} + \theta_{41} Tax_{it}) 1_{\{q_{it} \le \gamma\}} \tag{3}$$

$$(\phi_2 y_{it-1} + \theta_{12} Debt_{it} + \theta_{22} P_{it} + \theta_{32} A_{it} + \theta_{42} Tax_{it}) 1_{\{q_{it} > \gamma\}} + \mu_i + \varepsilon_{it}$$

where $1_{\{q_{it} \leq \gamma\}}$ and $1_{\{q_{it} > \gamma\}}$ are an indicator function, q_{it} is the transition variable and γ the threshold parameter. In addition to examining different models by types of debt (total, government, bank and other) we control for the fiscal federal system by including *participaciones* (P_{it}, unconditional federal transfers), *aportaciones* (A_{it}, conditional federal transfers) and local tax revenue (Tax_{it}) in each regression. This model allows for asymmetric effects depending on whether the threshold variable is above or below the unknown threshold. This approach overcomes the strict exogeneity assumption of covariates required by static models such as the one by Hansen (1999) which can be too restrictive and allows for lagged dependent variables and endogenous covariates via GMM estimation.

Seo and Shin (2016) note however that the discontinuity shown in model (2) may mean a kink and not a sudden jump if $(1, x_{it}')\delta = \kappa(q_{it} - \gamma)$ for some κ. This equality holds when $x_{it} = \kappa q_{it}$ and the first element of $\delta = -\gamma\kappa$. With these restrictions model (2) becomes:

$$y_{it} = x_{it}'\beta + \kappa(q_{it} - \gamma)1\{q_{it} > \gamma\} + \mu_i + \varepsilon_{it}, \quad i = 1, \dots, n; \quad t = 1, \dots, T, \qquad (4)$$

This threshold dynamic data model by Seo and Shin (2016) captures the nonlinear asymmetric dynamics and cross-sectional heterogeneity simultaneously. The threshold variable as well as regressors are allowed to be endogenous. The estimation of the model can employ either first-differenced two-step least squares and first-differenced GMM. The former approach is useful when the threshold variable is strictly exogenous (Seo and Shin, 2016). The exogeneity assumption is tested employing the following t-statistic for the null that GMM estimate of the unknown threshold, $\hat{\gamma}_{GMM} = \hat{\gamma}_{2SLS}$. The asymptotic distribution of the t-statistic is the standard normal under the null hypothesis of strict exogeneity of the threshold variable, q_{it}.

5. Data Analysis and Estimation Results

In this section, we briefly describe the variables employed in the dynamic panel data regressions. We conform a balanced panel of annual data for the 32 federal states in Mexico from 2001 to 2016. Annual data on Gross Domestic Product (GDP) and indebtedness in Mexican Pesos (MXN) by type of loans come from the local finance database maintained by the National Institute of Geography and Statistics (INEGI). The Treasury Ministry provides

information on fiscal variables, e.g., federal conditional transfers, unconditional transfers and tax revenue in Pesos. In addition to employing the debt to GDP ratio as a measure of debt sustainability, we employ the ratio of debt to guaranteed resources (non-ear marked federal transfers plus own resources) from the Mexican Ministry of Finance. Rating agencies use this this variable of debt sustainability to assess state's capacity to *acquire* additional debt (Cabral et al., 2021).

Figure 1 presents the evolution of nominal debt issued by state governments for the period 2001-2016. In addition to the evident steep rise of total debt from 2010, when it grew from five billion Mexican Pesos to nearly 20 billion, we observe that commercial debt started to play a much more significant role, departing from almost no share, to more than 30% of total debt. While before 2009 capital markets debt-issues backed up with federal transfers was the main source of subnational debt (more than 80% in every year), after that date this type of debt represented somewhat above one third of total debt. Despite this, the share of bond financing issues still amounts to around one third of total debt and remains a very important financing source for state governments in Mexico.

Figure 2 presents the mean evolution of state debt as a share of GDP, a rapid accumulation from just 0.20% in 2001 to an average share of 4.10% in 2016, and from 29.3% as a share of guaranteed resources in 2001 to an average of 64.2% in 2016. The fiscal reforms in 1999 opened the possibility of indebtedness from 2001 (Giugale et al., 2000). Then, after 2008, the debt curve presents a higher gradient, possibly related to the impact of the Global financial crisis of 2008. This steep ascent of debt as a share of GDP and as a share of guaranteed resources is likely due to injections of liquidity by the federal government through development banks after the great crisis. Debt shares present a higher variability than GDP growth as shown in Table 1.[1] Figure 3 shows the ranking of states debt in 2016 both as a share of GDP and guaranteed resources.

Figure 4 reveals a highly nonlinear association between debt GDP ratio and economic growth. The overall mean distribution of data suggests that while the relation is negative at low levels, higher debt shares seem to encourage economic growth after a given threshold point of cumulative debt, when the effect begins to be positive. The positive association

[1] The appendix shows descriptive statistics employing the ratio of debt to guaranteed resources (non-ear marked federal transfers plus own resources) from the Mexican Ministry of Finance.

between debt and growth at the median level is not uniform, the nexus between debt and growth turns negative for states in the extreme quantiles of the distribution, for lowest and highest developed states. The ratio of debt to guaranteed resources reveals a similar pattern. However, in this case the effect of debt on growth, after a given breakpoint of guaranteed resources, becomes negative only for states with the lowest growth.

Figure 1. Evolution of state debt as a share of GDP and guaranteed resources.

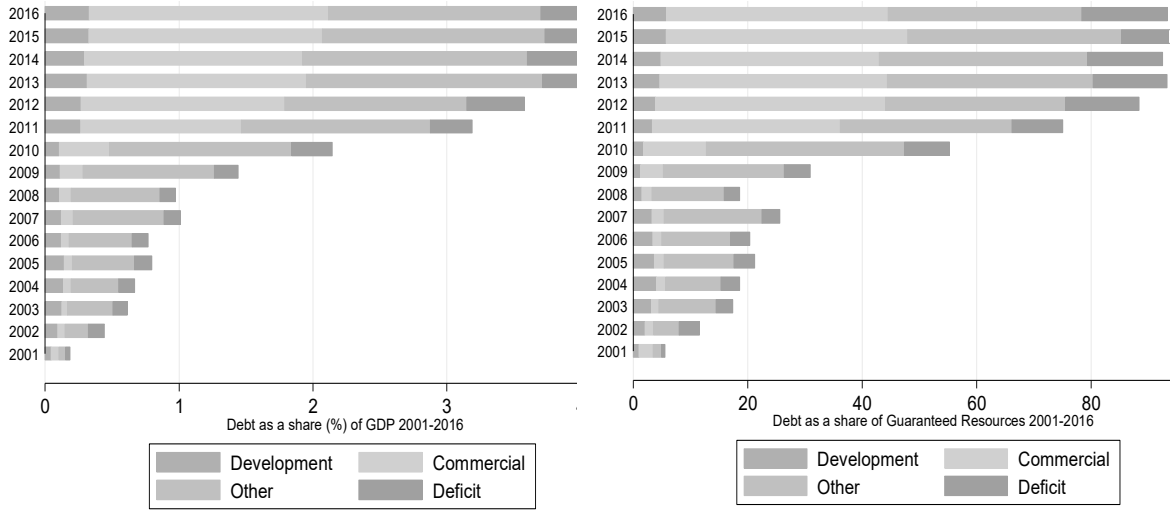


Figure 2. Cumulative debt as a share of GDP and guaranteed resources in 2016.

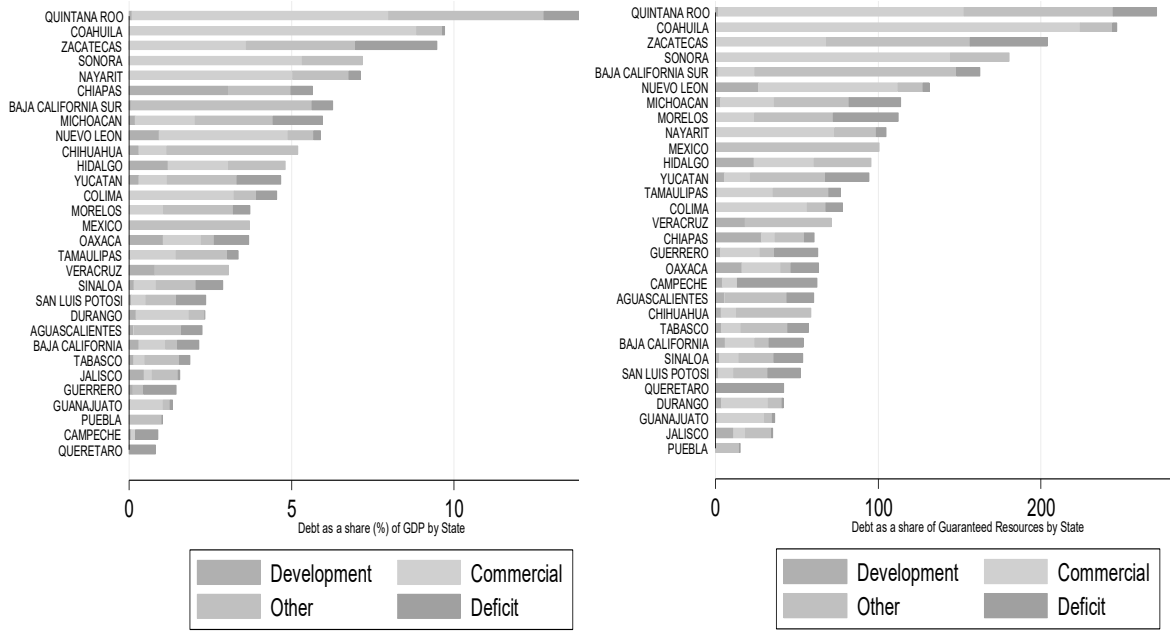
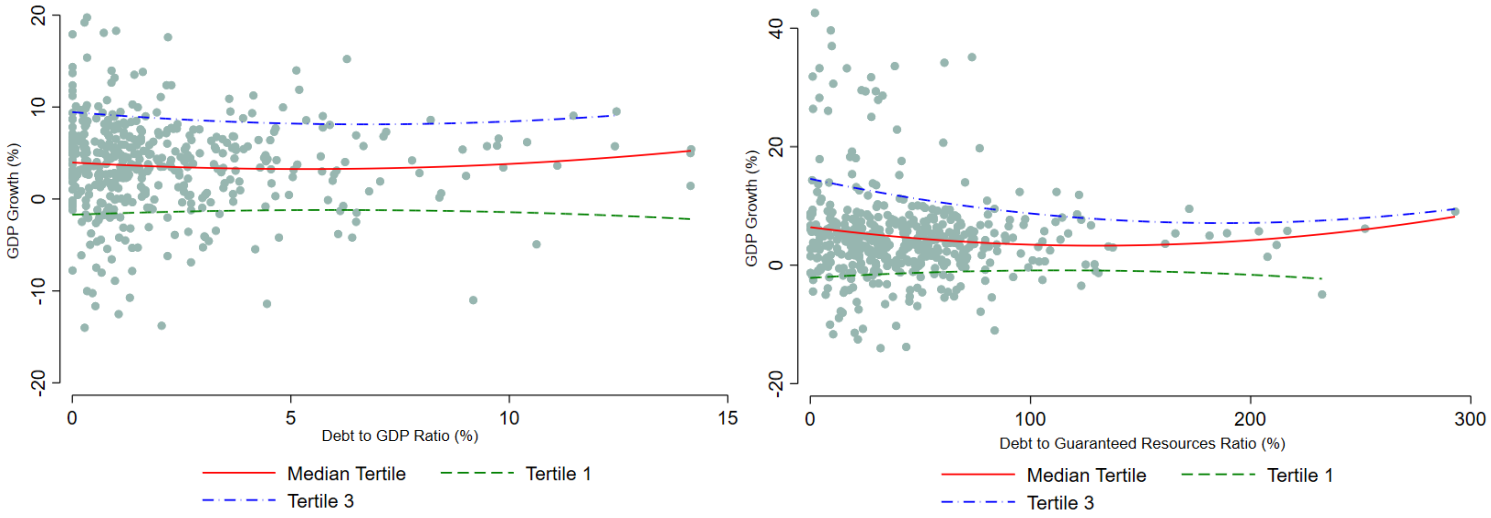


Figure 3. Debt to GDP and Debt to Guaranteed resources ratio to economic growth.



Mexican states with greater economic dynamism have higher average values but also higher volatility, which is detrimental to economic growth (see Table 1 and Table 1). Mean conditional transfers (*aportaciones*) are greater and slightly more volatile than non-conditional transfers (*partipaciones*) in per capita terms. Local revenues are not just small but also highly variable, confirming the high dependence of local governments. However, while the description the data between the groups of states is informative, it does not allow examining the dynamic behavior of the variables and fiscal interaction of the federal system. In the following sections, we report the estimates of dynamic panels to investigate the nexus between debt and GDP, as well as estimate a debt threshold.

5.1 Hypothesis 1. Greater subnational debt leads to more economic growth in countries with high verticality, dependence and weak tax revenues

The Mexican Constitution provides the golden fiscal rule in which federal and subnational governments can only borrow to finance public investment (Cabral et al. 2021). The first hypothesis of this study states that greater debt should lead to greater economic progress in highly centralized federal systems, with limited collection of tax revenue and high dependence on federal transfers. In particular, policy makers' optimizing objectives in local governments should comply with this golden rule and debt would tend to favor investment

and infrastructure projects that encourage local economic growth. Nonetheless, we believe that the quality of debt matters and exerts distinct effects on growth.

The Arellano-Bond estimates in Table 2 below show the effects by different types of debt (ω_1) on economic growth. The estimates show that total debt, bank debt, particularly development bank debt but also capital market debt, all have a very weak but significant positive effect on economic growth (see models 2 and 4). In contrast, employing the ratio of debt to GDP (see appendix A.2) we observe a positive effect of debt on GDP growth from commercial banks and total bank debt, but not development bank nor capital market debt..

Table 1. Descriptive Statistics debt-to-guaranteed resources ratio.

Variable		Mean	Std. Dev.	C. V.	Skewness	Kurtosis	Min.	Max.	Obs.
Financial	Overall	47.68	62.66	1.31	3.09	14.75	0.00	430.25	N = 491
	Between		34.30				11.79	149.36	n = 32
	Within		52.82				-101.68	328.58	T-bar = 15.34
Government	Overall	0.13	0.81	6.21	8.22	76.39	0.00	8.83	N = 491
	Between		0.45				0.00	2.32	n = 32
	Within		0.67				-2.19	6.64	T-bar = 15.34
Bank debt	Overall	19.18	45.74	2.38	5.03	33.94	0.00	422.65	N = 491
	Between		26.92				0.00	142.05	n = 32
	Within		37.33				-122.87	299.78	T-bar = 15.34
Development	Overall	3.20	7.40	2.32	3.59	17.63	0.00	53.02	N = 491
Bank	Between		5.64				0.00	23.23	n = 32
	Within		4.78				-19.56	32.99	T-bar = 15.34
Commercial	Overall	15.99	45.50	2.85	5.25	35.93	0.00	422.65	N = 491
Bank	Between		27.44				0.00	142.05	n = 32
	Within		36.65				-126.07	296.58	T-bar = 15.34
Other debt	Overall	20.75	27.47	1.32	3.03	19.45	0.00	270.70	N = 491
	Between		17.58				0.00	59.87	n = 32
	Within		21.48				-39.12	231.84	T-bar = 15.34

a. Guaranteed resources include non-ear marked federal transfers plus own resources.

An interesting feature of the Arellano-Bond model is the dynamic effect of debt on growth, for which the coefficient α_1 governs the speed of adjustment. The mean reversion of growth can help describe the extent of competition of local governments. A small α_1 as the one obtained from our estimations suggests that the economic growth of states possesses minimal persistence and low competition, while maintaining the fiscal environment constant. This parameter estimates are significant in all models when employing debt to guaranteed resources ratio (revenues plus non-ear-marked federal transfers) in table 2 but no significant speed of adjustment when employing debt to GDP (see Table A,2).

Table 2 Arellano-Bond Model (Debt as a share of Guaranteed Resources ratio).

Variables	GDP Growth Rate				
	(1)	(2)	(3)	(4)	(5)
Government Debt	0.0013				
	(0.0062)				
Comercial Bank Debt		0.0003***			
		(0.00003)			
Development Bank Debt			0.0010***		
			(0.0002)		
Capital Market Debt				0.0003**	
				(0.0001)	
Deficit					0.0001
					(0.0003)
$GDP\ Growth_{t-1}$	-0.1087***	-0.1112***	-0.1159***	-0.1025***	-0.1128***
	(0.0129)	(0.0113)	(0.0060)	(0.0099)	(0.0127)
Participaciones	-0.0810***	-0.0712***	-0.0820***	-0.0657***	-0.0729***
	(0.0128)	(0.0173)	(0.0081)	(0.0169)	(0.0098)
Local Revenue (Taxes)	0.0001	-0.0012	0.0004	0.00003	-0.00004
	(0.0013)	(0.0008)	(0.0008)	(0.0007)	(0.0005)
Aportaciones	-0.0923***	-0.0794***	-0.0881***	-0.0911***	-0.0901***
	(0.0065)	(0.0074)	(0.0037)	(0.0039)	(0.0045)
2009 Crisis Dummy	-0.0189***	-0.0257***	-0.0207***	-0.0225***	-0.0195***
	(0.0027)	(0.0041)	(0.0028)	(0.0039)	(0.0016)
_cons	-0.0962***	-0.0842***	-0.0949***	-0.0866***	-0.0894***
	(0.0155)	(0.0188)	(0.0101)	(0.0155)	(0.1122)
Arellano-Bond Test Statistic					
1st Order	-2.5329	-2.4869	-2.4641	-2.4796	-2.5155
	[0.0113] [a]	[0.0129] [a]	[0.0137] [a]	[0.0132] [a]	[0.0119] [a]
2nd Order	-0.7978	-0.42038	-0.5971	-0.5019	-0.8693
	[0.4250] [a]	[0.6742] [a]	[0.5504] [a]	[0.6157] [a]	[0.3847] [a]
Sargan Test	31.2149	30.3197	31.3019	29.5252	30.3089
	[1.0000] [b]	[1.0000] [b]	[1.0000] [b]	[1.0000] [b]	[1.0000] [b]
N	397	397	397	397	397

se in parentheses. Notes: *Aportaciones*, *Participaciones* and *Local Revenues* are per capita values in log form. Parameters estimated using an Arellano-Bond dynamic panel-data estimation and the command *xtabond* in Stata v.16. Notes: [a] Prob > z. [b] Prob > chi2. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

To capture the effect of the intergovernmental fiscal environment in Mexico, each model includes federal transfers and own-tax revenue. Interestingly, share transfers, e.g., the federal fiscal environment represented by unconditional and conditional transfers, adversely affects GDP growth. Interestingly, contrary to what is expected, own-tax revenue does not significantly relate to GDP growth. The shift dummy estimate that captures the change of deb gradient after the great crisis indicates a significant negative effect on average economic

growth after the great crisis. The size of this slope estimate is similar for both, i.e., employing debt to guaranteed resources ratio or debt to GDP ratio.

5.2 Hypothesis 2. More debt leads to greater GDP growth after a given debt threshold

Reinhart and Rogoff (2010) have argued that economic growth tends to slow down when the level of government debt as a share to GDP exceeds a given threshold. Using a long-span time series from 1792 to 2009 Hansen (2017) finds some evidence for the United States that high debt ratios, those above 44% of GDP, induce a moderate slowdown in expected GDP growth rates. In addition, some local congresses in Mexico require that subnational debt does not exceed specific thresholds to keep the financial stability of local governments. To consider the capacity of local governments to obtain increasing funding, as well as the particular federal fiscal set up in Mexico, we investigate the presence of a debt threshold employing the debt-to-guaranteed resources ratio. In our view, guaranteed resources are a better measure of the dimension of local governments and provide a much clearer picture of the sustainability of public finances (Cabral, et al., 2021). We test whether increasing levels of subnational debt as a ratio of guaranteed resources or GDP lead to more economic growth after an unknown threshold debt levels as suggested by Blanchard, et al. (2019).

We employ the balanced panel of the 29 states described above over the period 2001-2016 and work with a small sample of 416 observations. Table 3 presents the results of the asymmetric effects continuous threshold model (3) for low and high debt regimes employing different types of debt as threshold variables (models 1 to 6). The results confirm the existence of a threshold in a wide range between 0.1429% (deficit debt) and 67.93% (total debt), implying that between 55.42% and 97.92% of observations fall into the lower debt-to-guaranteed resource ratios regime, respectively.

In line with the claims of Reinhart and Rogoff (2010), when capital market and commercial bank debt are taken as threshold variables (models 3 4 and 5), local economies grow in lower debt regimes but then, after the estimated threshold is surpassed (14.91% and 2.45% respectively), growth negatively responds to increasing levels of debt. In turn, the results employing total bank debt and development bank debt as threshold variables suggest that before the threshold low debt regimes negatively relate to growth and higher debts surpassing the threshold relate to more growth, consistent with the arguments by Blanchard

(2019). The impact of federal transfers on growth is mixed depending on the regime and type of debt. With the exception of total bank debt, unconditional transfers (*participaciones*) exert a negative effect on growth in low-debt regimes, but a p slight positive effect on growth in high debt regimes. Likewise, conditional transfers (*aportaciones*) have some negative effect on growth in low debt regimes but a positive influence on growth in high debt regimes. With few exceptions, local revenue taxes have a negative effect on growth in either debt regime. However, when the threshold variable is debt to GDP we find that local revenues encourage growth in high debt regimes.

While the results of the continuous threshold model imply the presence of a discontinuity of the regression function, such discontinuity may not be a jump, but a kink instead. Table 4 presents the estimations of the kink model (4) by Seo and Shin (2016). In this regression kink model, the regression function is continuous but the slope has a discontinuity at a threshold point, hence the *kink* (Lien, Hu and Liu, 2017). The kink slopes and threshold parameters (γ) are statistically significant in most cases. Threshold levels change importantly and the kink slope are positive and negative depending on the type of debt. The impact of commercial debt on growth is positive, adding strong support to the arguments by Blanchard (2019) on the benign effect of debt on economic growth. The range of thresholds of debt-to-guaranteed resources ratio goes from 1.71 with commercial debt to 65.47% with total debt. Table A.3 in the appendix shows that this threshold reaches at most 3.25% of debt to GDP ratio. The fiscal environment measured by conditional and unconditional transfers discourages growth. However, this time there is a significant positive influence of own-tax revenue collection on GDP growth independent of the threshold variable.

5.3 Kink or continuous threshold regression models?

Because there is little guidance from economic theory on the choice between kinks and jump models we rely on robust inference on threshold and slope parameters of the model to decide the convenience of one of the models over another (Hidalgo, Lee and Seo, 2019). To enhance the robustness of our results we test now for the presence of threshold effects employing the testing procedure of Hansen (1996) with 1,000 bootstrap replications. The null hypothesis of

no unknown threshold effects is rejected in all the estimations as observed in the bootstrap p-value from non-standard limiting distribution in Tables 3, 4, A.3 and A.4.

Table 3. Continuous debt threshold model (debt to guaranteed resources).[a]

Variables	GDP Growth Rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Total Debt_b	-0.0008					
	(0.002)					
Total Debt_d	0.0006					
	(0.002)					
Bank Debt_b		-2.970*				
		(1.534)				
Bank Debt_d		2.970*				
		(1.535)				
Other Debt_b			0.025***			
			(0.009)			
Other Debt_d			-0.026***			
			(0.009)			
Development Bank_b				-3.738*		
				(1.924)		
Development Bank_d				3.737*		
				(1.924)		
Commercial Bank_b					0.685***	
					(0.135)	
Commercial Bank_d					-0.686***	
					(0.135)	
Deficit_b						-16.213
						(10.695)
Deficit_d						16.215
						(10.694)
Lagged GDP Growth_b	-0.317***	1.044	0.379	-0.633***	-0.557**	-0.809***
	(0.063)	(4.190)	(0.323)	(0.178)	(0.238)	(0.139)
Lagged GDP Growth_d	0.331*	-1.088	-0.572	0.379	0.619**	0.633***
	(0.169)	(4.327)	(0.356)	(0.235)	(0.268)	(0.182)
2009 Crisis Dummy_b	-0.051	0.000	0.043	-0.065**	-0.236	-0.059
	(0.035)	(0.479)	(0.153)	(0.027)	(0.228)	(0.227)
2009 Crisis Dummy_d	0.231**	-1.366***	-0.012	0.084	0.142	0.042
	(0.103)	(0.506)	(0.185)	(0.051)	(0.754)	(0.224)
Participaciones _b	-0.050	8.524***	-0.232	-0.282**	-0.625*	-0.496***
	(0.058)	(2.523)	(0.338)	(0.131)	(0.368)	(0.124)
Participaciones _d	0.144	-8.734***	-0.455	0.090	0.763**	0.328**
	(0.192)	(2.408)	(0.389)	(0.249)	(0.367)	(0.129)
Aportaciones_b	-0.331**	-9.415***	0.023	-0.069	0.148	0.085
	(0.146)	(2.664)	(0.122)	(0.081)	(0.142)	(0.069)
Aportaciones_d	0.360***	9.299***	-0.141	-0.033	-0.206	-0.204***
	(0.109)	(2.699)	(0.143)	(0.098)	(0.146)	(0.072)
Local Revenue (Taxes)_b	0.033	0.056	-0.003	0.023***	-0.036**	-0.0003
	(0.023)	(0.619)	(0.022)	(0.005)	(0.017)	(0.007)
Local Revenue (Taxes)_d	-0.054***	-0.042	0.009	-0.009	0.032*	0.006
	(0.019)	(0.619)	(0.026)	(0.009)	(0.017)	(0.008)
cons_d	0.074	-7.235*	-0.595	0.326	1.427**	0.405
	(0.245)	(3.957)	(0.495)	(0.253)	(0.672)	(0.252)
r	67.928**	1.467***	14.905***	0.419***	2.451***	0.143***
	(27.508)	(0.483)	(4.707)	(0.066)	(0.299)	(0.017)

N	29	29	29	29	29	29

Aportaciones, *Participaciones* y *Local Revenue* are percentages in log form. se in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4. Kink Debt Threshold Model with debt-to-guaranteed resources ratio.

Variables	GDP Growth Rate			
	(1)	(2)	(3)	(4)
Total debt	-0.0019***			
	(0.0004)			
Commercial		0.4856***		
		(0.0542)		
Other type			-0.1617	
			(0.1132)	
Dev. Bank				7.7388
				(12.9251)
$GDP\ Growth_{t-1}$	-0.1503***	-0.4424***	-0.1419***	-0.1080***
	(0.0133)	(0.0335)	(0.0187)	(0.0254)
2009 Crisis	0.0026	0.0000	0.0450***	0.0258***
Dummy	(0.0099)	(0.0096)	(0.0023)	(0.0050)
Participaciones	-0.0321	-0.0656*	0.0140*	0.0662**
	(0.0325)	(0.0338)	(0.0075)	(0.0335)
Aportaciones	-0.1168***	-0.1348***	-0.0921***	-0.1037***
	(0.0057)	(0.0111)	(0.0068)	(0.0072)
Local Revenue	-0.0034***	0.0069***	0.0008	0.0134***
(Taxes)	(0.0012)	(0.0019)	(0.0012)	(0.0009)
Kink Slope	0.0022***	-0.4844***	0.1619	-7.7356
	(0.0004)	(0.0543)	(0.1133)	(12.9251)
R	65.4722***	1.7116***	2.5346*	0.0419
	(5.9003)	(0.1370)	(1.0635)	(0.0718)
N	29	29	29	29

. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ a. Dynamic kink model with debt threshold, estimated from equation (2.b) in section 3.2. b. Standard error in parenthesis.

6. Discussion and conclusion

This study tests two hypotheses. First, driven by the opposing conclusions of Reinhart, Reinhart and Rogoff (2012) and Blanchard (2019) we investigate whether more debt associates with greater growth in local governments within a highly centralized federal system, which are prone to soft both problems and low own tax revenue. Second, we test for threshold levels for different types of debt to evaluate whether the financing source matters for local growth. Recent research suggests that despite the increasing levels of subnational debt in Mexico, debt has not been employed effectively to encourage growth and policy decisions have not been well designed to channel financial resources to ensure growth (Benton and Smith 2017; Smith and Benton 2017). Nonetheless, this study finds a significant

threshold level and evidence of a positive relation between debt-to-GDP and debt-to-guaranteed resources ratios on economic growth.

While studying national debt, Reinhart and Rogoff (2010) argue that levels of debt above a threshold of 90% associate with lower GDP growth rate. In this study, controlling for federal transfers, we find much lower subnational threshold levels at the regional level in a highly fiscally centralized country. Depending on the type of discontinuity assumed, the threshold for total debt lies at most at 3.52% of GDP, point after which greater debt would negatively affect economic growth. Such finding would help address the question of sustainability of the debt in subnational governments. Employing the ratio of debt to guaranteed resources (revenue plus non-earmarked federal transfers), which has been used in the literature to assess the capacity to acquire additional debt, this study confirms the positive association of debt with economic growth. We also find that the threshold for total debt lies at most at 65.47% of guaranteed resources. This finding would help address the question of sustainability of the debt in subnational governments.

Depending on the type of debt continuous threshold models suggest threshold points below 1% after which debt would encourage regional economic growth. Blanchard (2019) has recently suggested that more debt can be good for a country's growth. Such increase of debt is possible according to Blanchard because the social costs could extrapolate over longer time horizons. In this study we extend this possibility to identify the type of debt to which economic growth in the regions of federal systems respond more, namely commercial bank and development bank debt. Government debt usually comes with some guarantees, and together with the fiscal system environment at places seem to create the right incentives for a more effective use of funds to encourage growth. If such positive effect exists, it should not be taken as a 'carte-blanche' to encourage more debt. The results in our view indicate that the provisions and rules associated with commercial and development bank debt (fiscal, regulatory and normative) may instead be providing the right incentives to promote growth.

Controlling for the effect of debt, the kink model regression suggests that greater tax revenues relate to more economic growth. Our results seem to suggest a balance between sufficient tax collection to meet debt expenses while promoting growth. Fiscal authorities and local governments should ensure this is the case: i.e., public finances are able to meet

capital and interest payments of local debts while promoting growth (Smith et al, 2019). Development bank debt and commercial bank debt both show potential to encourage growth, more than other instruments.

Mexico fits the highly centrally regulated fiscal model with limited autonomy over own revenues and a golden fiscal rule, which can help promoting fiscal and debt sustainability (Bethlendi et al., 2020). However, this high centralization could give place to soft budget problems given documented evidence of direct and indirect bailing out of states in Mexico due to a lack of fiscal discipline (Giugale et al., 2000; Hernández-Trillo et al., 2002; Cabral et al., 2021). We believe an explanation for the negative impact of federal share transfers on growth might be found within the soft budget problem, which could distract federal resources to other non-productive activities or could increase financial management inefficiency (Mendoza and Rubio, 2019). According to the kink model, local revenue taxes and unconditional transfers (*participaciones*) have the potential to encourage growth, implying more commitment of local governments than when these are ear-marked resources (*aportaciones*).

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Appendix

Table A.1. Descriptive Statistics Debt-to-GDP ratio and fiscal variables.

Variable		Mean	Std. Dev.	C. V.	Skewness	Kurtosis	Min.	Max.	Obs.
GDP Growth	Overall	0.05	0.11	2.17	5.24	63.38	-0.49	1.46	N = 480
	Between		0.01				0.03	0.09	n = 32
	Within		0.11				-0.52	1.43	T = 15
Total Debt	Overall	2.11	2.42	1.15	2.24	8.94	0.00	14.16	N = 512
	Between		1.21				0.25	5.48	n = 32
	Within		2.07				-3.50	10.66	T = 16
Government Debt	Overall	0.01	0.09	7.68	9.33	90.26	0.00	0.91	N = 512
	Between		0.05				0.00	0.27	n = 32
	Within		0.07				-0.26	0.65	T = 16
Bank Debt	Overall	0.85	1.66	1.97	3.32	15.49	0.00	11.26	N = 512
	Between		0.88				0.00	3.95	n = 32
	Within		1.37				-3.15	8.11	T = 16
Development	Overall	0.18	0.47	2.61	4.27	24.63	0.00	3.53	N = 512
Bank Debt	Between		0.33				0.00	1.20	n = 32
	Within		0.31				-1.03	2.50	T = 16
Commercial	Overall	0.67	1.62	2.42	3.77	18.59	0.00	11.26	N = 512
Bank Debt	Between		0.88				0.00	3.95	n = 32
	Within		1.31				-3.32	7.94	T = 16
Other Debt	Overall	0.94	1.09	1.16	1.71	6.13	0.00	5.65	N = 512
	Between		0.70				0.00	2.80	n = 32
	Within		0.83				-1.48	4.38	T = 16
Participaciones	Overall	0.33	0.10	0.31	1.28	5.25	0.15	0.69	N = 512
	Between		0.09				0.22	0.64	n = 32
	Within		0.06				0.17	0.49	T = 16
Aportaciones	Overall	0.49	0.16	0.32	0.38	2.80	0.08	0.91	N = 512
	Between		0.10				0.22	0.70	n = 32
	Within		0.12				0.18	0.91	T = 16
Local Revenue	Overall	0.04	0.05	1.30	4.48	28.44	0.0003	0.41	N = 512
(Taxes)	Between		0.04				0.009	0.25	n = 32
	Within		0.02				-0.04	0.19	T = 16

Notes: *Participaciones* and *Aportaciones* per capita.

Table A.2. Arellano Bond Model Results (debt to GDP ratio)

Variables	GDP Growth Rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Total Debt	0.0042***					
	(0.0009)[d]					
Government debt		-0.0355				
		(0.0447)				
Bank debt			0.0071**			
			(0.0022)			
Dvlpmnt Bankdebt				0.0029		
				(0.0138)		
Commercial Debt					0.0073***	
					(0.0022)	
Other Debt						0.0062
						(0.0053)
GDP Growth$_{t-1}$	-0.0051	-0.0010	-0.0085	-0.0048	-0.0080	-0.0060

	(0.0127)	(0.0122)	(0.0141)	(0.0128)	(0.0121)	(0.0113)
Participaciones	-0.1300***	-0.121***	-0.131***	-0.121***	-0.130***	-0.124***
	(0.0106)	(0.0108)	(0.0083)	(0.0122)	(0.0076)	(0.0107)
Taxes[a]	-0.0022	-0.0017	-0.0019	-0.0009	-0.0022*	-0.0023
	(0.0012)	(0.0011)	(0.0015)	(0.0014)	(0.0010)	(0.0012)
Aportaciones	-0.0911***	-0.1030***	-0.0948***	-0.102***	-0.0980***	-0.0965***
	(0.0053)	(0.0054)	(0.0055)	(0.0060)	(0.0044)	(0.0075)
D_{2009}[b]	-0.0272***	-0.0163***	-0.0268***	-0.0193***	-0.0251***	-0.0227***
	(0.0036)	(0.0023)	(0.0037)	(0.0033)	(0.0031)	(0.0042)
Constant	-0.163***	-0.1570***	-0.164***	-0.151***	-0.166***	-0.162***
	(0.0128)	(0.0143)	(0.0089)	(0.0139)	(0.0105)	(0.0139)
Autocorrelation[c]						
1st Order	-2.9585	-3.0512	-3.005	-2.9905	-2.9920	-2.9916
	[0.0031][e]	[0.0023]	[0.0027]	[0.0028]	[0.0028]	[0.0028]
2nd Order	-0.5007	-0.6193	-0.4907	-0.7333	-0.4800	-0.5460
	[0.6166]	[0.5357]	[0.6237]	[0.4634]	[0.6312]	[0.5851]
Sargan Test	31.3924	31.4447	31.4234	31.2478	31.5594	31.4918
	[1.0000]	[1.0000]	[1.0000]	[1.0000]	[1.0000]	[1.0000]
N	416	416	416	416	416	416

Notes: [a] Prob > z. [b] Prob > chi2. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. a. Own-state-tax-revenues. b. Dummy variable with 1 for dates from 2009 and zero otherwise. c. *Arellano-Bond Test Statistic.* d. Standard errors in parentheses. e. Autocorrelation and *Sargan* tests show p-values in brackets. *Aportaciones*, *Participaciones* and *Local Revenues* per capita in logs. Parameters estimated using an Arellano-Bond dynamic panel-data estimation and the command *xtabond* in Stata v.16.

Table A. 3. Continuous debt threshold model, Debt to GDP.[a]

	GDP Growth Rate (GDP_t)				
Variable	(1)	(2)	(3)	(4)	(5)
Total Debt_b	-11.60***				
(θ_{11})	(2.153)[b]				
Total Debt_d	11.59***				
(θ_{12})	(2.157)				
Bank_b		5.832***			
(θ_{11})		(1.037)			
Bank_d		-5.804***			
(θ_{12})		(1.039)			
Other Debt_b			-0.226		
(θ_{11})			(0.161)		
Other Debt_d			0.0880		
(θ_{12})			(0.171)		
Devel. Bank_b[a]				14.25***	
(θ_{11})				(3.556)	
Devel. Bank_d				-14.48***	
(θ_{12})				(3.571)	
Comm. Bank_b					10.18***
(θ_{11})					(1.220)
Comm. Bank_d					-9.963***
(θ_{12})					(1.223)
GDP_{t-1}*_b*	-1.131**	-0.199***	-0.417***	-0.492***	-0.369***
	(0.357)	(0.0455)	(0.0349)	(0.0547)	(0.0352)
GDP_{t-1}*_d*	1.078**	-0.546*	-0.0332	0.485***	-0.229
	(0.350)	(0.262)	(0.0911)	(0.108)	(0.143)
D_{2009}*_b*	1.051	-0.181***	-0.0398	-0.0984	-0.0915
	(0.539)	(0.0330)	(0.0539)	(0.0702)	(0.0798)

D_{2009}_d	-1.112*	0.155	0.111	0.0297	0.0224
	(0.547)	(0.0834)	(0.0617)	(0.223)	(0.288)
Particip_b	1.406	-0.321*	-0.244	-0.206**	-0.379***
	(1.120)	(0.142)	(0.181)	(0.0756)	(0.0734)
Particip_d	-1.366	-0.287	0.715***	0.299	0.261
	(1.130)	(0.265)	(0.126)	(0.235)	(0.212)
Aportaciones_b	-0.680	-0.0734	-0.123*	-0.144**	0.0643
	(1.683)	(0.126)	(0.0547)	(0.0481)	(0.0567)
Aportaciones_d	0.571	-0.234	0.0986	0.0692	-0.379***
	(1.686)	(0.203)	(0.0560)	(0.0798)	(0.103)
Local Taxes_b	-0.602**	-0.0914**	-0.0006	0.0207***	-0.0154
	(0.217)	(0.0318)	(0.0044)	(0.00381)	(0.0126)
Local Taxes_d	0.602**	0.137***	0.0003	-0.0147	0.0711***
	(0.216)	(0.0364)	(0.0065)	(0.00769)	(0.0199)
cons_d	-0.318	0.399	0.967***	0.198	-0.213
	(0.447)	(0.348)	(0.145)	(0.440)	(0.417)
Threshold	0.364***	0.255*	0.978	0.0921	0.147
γ	(0.0307)	(0.109)	(0.806)	(0.0553)	(0.0765)

* p < 0.05, ** p < 0.01, *** p < 0.001 a. Dynamic panel data model with debt threshold effects, estimated from equation (3) in section 3.2 b. Standard error in parenthesis.

Table A.4. Kink Debt Threshold Model with Debt to GDP Ratio

Variables	GDP Growth Rate (GDP_t)				
	(1)	(2)	(3)	(4)	(5)
Total Debt	0.190***				
	(0.0127)				
Bank Debt		1.678***			
		(0.296)			
Other Debt			0.254***		
			(0.0425)		
Dev. Debt				-52.58	
				(727.5)	
Com. Debt					19.41*
					(8.948)
GDP_{t-1}	-0.178***	-0.258***	-0.0216	-0.454***	-0.291***
	(0.0238)	(0.0225)	(0.0176)	(0.0137)	(0.0211)
2009 Crisis	-0.0610***	-0.0856***	0.0660***	0.00468	-0.205***
	(0.0131)	(0.0208)	(0.00783)	(0.00980)	(0.0318)
Participationes	-0.109	-0.375***	-0.101**	-0.0251	-0.647***
	(0.0645)	(0.0160)	(0.0329)	(0.0428)	(0.0332)
Aportaciones	-0.217***	-0.263***	-0.131***	-0.312***	-0.161***
	(0.0170)	(0.0126)	(0.0123)	(0.0176)	(0.0191)
Taxes per Cap	0.0224***	0.0204***	0.00297	0.0334***	0.0167***
	(0.00191)	(0.00251)	(0.00193)	(0.00209)	(0.00248)
Kink Slope	-0.236***	-1.857***	-0.321***	53.42	-19.47*
	(0.0132)	(0.303)	(0.0364)	(727.5)	(8.957)
r	3.252***	0.534***	1.045***	0.00781	0.0490*
	(0.202)	(0.0732)	(0.134)	(0.106)	(0.0217)

. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ a. Dynamic kink model with debt threshold, estimated from equation (2.b) in section 3.2. b. Standard error in parenthesis.