INTERNATIONAL MONETARY FUND

State Capacity, Institutions and Growth: Taxing for Takeoff

Revisiting the Tax Tipping Point

Prepared by Matthieu Bellon and Ross Warwick

WP/25/203

2025
OCT

WORKING PAPER

 WP/25/203

IMF Working Paper
Fiscal Affairs Department

State Capacity, Institutions and Growth: Taxing for Takeoff—Revisiting the Tax Tipping Point
Prepared by Matthieu Bellon and Ross Warwick

Authorized for distribution by Katherine Baer
October 2025

ABSTRACT: Can simply exceeding a critical tax-to-GDP threshold bring about an accelerated trajectory of economic growth and development in a country? We conduct new event studies and exploit a richer dataset to revisit Gaspar, Jaramillo and Wingender's 2016 "tax tipping point" result. Both with their regression discontinuity approach and a dynamic difference-in-differences estimation, we find that cumulative growth over 10 years increases by 10 percentage points when a country's tax-to-GDP ratio increases above a 10 percent threshold. Further, we show that crossing the threshold coincides with the beginning of significant improvements in measures of a country's financial development, government effectiveness, legal framework, and governance. Event studies additionally reveal that only transformational episodes of tax increases above the threshold deliver these gains: episodic crossings that fail to bring tax revenues durably above the threshold and that don't coincide with improvements in financial development and government effectiveness yield fleeting gains. Our results suggest that a minimal tax capacity is necessary for growth but emphasize that only a sustained tax increase associated with other developmental progress is sufficient.

RECOMMENDED CITATION: Bellon, M., and Warwick, R. (2025). "State Capacity, Institutions and Growth: Taxing for Takeoff—Revisiting the Tax Tipping Point", IMF Working Paper.

JEL Classification Numbers:	H11, H26, O10, O43
Keywords:	Income per Capita; Taxation; Development; Multiple Equilibria; Event Study

Author's E-Mail Address:	mbellon@imf.org; rwarwick@imf.org

* We are indebted to Vitor Gaspar for inspiring the research question and invaluable discussions. We are grateful to Katherine Baer and Philippe Wingender for their guidance and constant advice. We thank Ruud de Mooij, Alexander Klemm, Shafik Hebous, and Fernanda Brollo for helpful comments and discussion. We are deeply grateful to Cindy Rojas Alvarado and Miyoko Asai for excellent research assistance.

WORKING PAPERS

State Capacity, Institutions, and Growth: Taxing for Takeoff

Revisiting the Tax Tipping Point

Prepared by Matthieu Bellon and Ross Warwick

Contents

Tables

I. Introduction

Economists have long argued that taxation underpins state formation and development. *The Crisis of the Tax State* (Schumpeter, 1918), advances that taxation is at the core of the origin and development of the modern state. Besley and Persson (2011, 2014) argue that fiscal capacity is one of three mutually reinforcing pillars of prosperity, together with legal capacity and collective capacity—the administrative ability to deliver public goods in health, education, infrastructure, security, etc. This implies a key role for taxation since a sustained boost in tax revenues makes it easier to finance legal institutions and public good provision—precisely enabling the virtuous cycle of development they describe.

Can simply exceeding a critical tax-to-GDP threshold bring about an accelerated trajectory of economic growth and development in a country? The causal effect of tax revenues on development is hard to identify as tax-to-GDP and measures of development—including GDP—are jointly determined. Gaspar, Jaramillo and Wingender (2016b)—hereafter GJW—and follow-up analyses (IMF 2023; World Bank 2024) seek to overcome this methodological challenge by focusing on local effects. These analyses uncover and exploit discontinuities in the data which allow them to argue for the existence of a tax tipping point and to quantify the growth consequences of increasing the tax ratio above this tipping point. Specifically, they find that countries with tax-to-GDP ratios that are slightly above a certain threshold enjoy faster economic growth relative to their peers that are slightly below the threshold. However, these empirical analyses rely primarily on cross-country variation and focus on effects on GDP, leaving several questions for future research. What are the broader development dynamics in episodes where a country crosses the tax-to-GDP threshold? Do all crossings unlock faster growth? Are additional improvements necessary, including improvements in other facets of institutional capacity?

We use event studies and a richer database to show that only transformational episodes where the tax-to-GDP ratio increases sustainably above a certain threshold deliver sizeable GDP growth gains. Our new dataset leverages WoRLD, a novel database of government revenue, which allows us to construct tax-to-GDP ratios for more countries (150 non-natural-resource-rich countries) and over a longer period, from 1965 to 2019. We also broaden the scope of the analysis by collecting institutional development indicators other than economic growth, including indicators of financial development, government effectiveness, governance, and legal institutions, as well as standard macro-fiscal variables (government expenditure, investment, debt). We re-estimate the location of the tax threshold using GJW's regression discontinuity approach based on Card, Mas and Rothstein (2008). We then conduct event studies leveraging recent advances in the difference-in-differences literature (Callaway and Sant'Anna, 2021). This allows us to exploit within-country variation and the quasi-experimental setting created by the tipping point discontinuity, in which we interpret crossing the threshold as a treatment effect, to advance beyond the empirical approach of GJW. We obtained three main results.

First, the existence of a tax tipping point is robust, and the large, estimated growth effect of crossing the tax threshold is consistent across techniques and datasets. We re-estimate the tax–to-GDP tipping point at 10 percent—almost three percentage points below GJW's estimate. This difference can be explained by revisions in the denominator of the tax ratio: nominal GDP series in many countries have been revised upwards since the publication of GJW, leading to a downward shift in many tax ratios, including the tax tipping point ratio. Remarkably, the approach in GJW, our re-estimated regression discontinuity results, and event studies of threshold crossings concur on the magnitude of the growth effect of raising the tax-to-GDP ratio above 10 percent: cumulative GDP growth over 10 years increases by around 10 percentage points. The event studies additionally allow us to strengthen the case for a tax tipping point by revealing that growth trends are not statistically different between countries that are about to cross the estimated tax threshold and those that stay below.

Second, we find that episodes where countries raise their tax-to-GDP ratios above the tax threshold are typically associated with transformational changes. Countries that are about to cross the tax threshold are broadly at a similar development stage compared to those that stay below. However, we show that increases in the tax ratio above the threshold coincide with significant improvements in several dimensions of institutional development. Various measures of financial development, an indicator of government effectiveness and, to some extent, measures of the legal framework and good governance, all start to rise in parallel with the revenue mobilization effort. Our event studies also show no differences in institutional development trends prior to the revenue mobilization effort, supporting the existence of a development trap below the tax tipping point. Countries stuck below the threshold are trapped in low-capacity, low-growth equilibria; those that cross it reach the institutional capacity to achieve sustained growth.

Third, we show that the growth benefits of crossing the tax threshold come from countries that raise their tax-to-GDP ratio sustainably and well above the threshold and where such increases are associated with improvements in financial development and government effectiveness. On average, countries crossing the tipping point undergo a sizeable increase in their tax ratios. However, not all countries that cross the tax threshold maintain their tax-to-GDP ratio above that level. We document that countries that see a fall back in their tax-to-GDP ratio experience short-lived and statistically insignificant increases in economic growth. For those countries that only experience a temporary revenue mobilization boost, we also observe that measures of financial development and government effectiveness do not improve. For the others, tax-to-GDP ratios continue to increase steadily above the threshold, by five percentage points after a dozen years. This remarkable revenue increase goes along with equally impressive improvements in financial development and government effectiveness. Overall, this suggests that a sustainable approach to revenue mobilization that is associated with other institutional progress is required to trigger economic growth acceleration.

Additional results suggest that investment and public goods are important channels fueling these growth surges. As may be expected given financial development and higher revenue, we find that total investment and government expenditure rise when the tax ratio crosses the threshold, alongside growing tax revenues. Together with the other finding about government effectiveness, this may suggest that the governments increase their contribution to growth by providing more and better public goods.

We build a transparent poverty trap model with a complementarity between taxation and institutional capacity that rationalizes our empirical findings. We assume that tax revenue is necessary to pay for investments in the stock of institutional capacity while increases in the tax-to-GDP ratio can only be achieved with enough institutional capacity. The model can produce two stable equilibriums, one with a low tax-to-GDP ratio, low institutional capacity, and therefore low production, and another one with higher levels along all dimensions. In this configuration, the model features a tipping point. A jump in the tax ratio can put a country that was stuck in the low-development equilibrium on a trajectory to the high-development equilibrium. Such a trajectory exhibits additional increases in the tax ratio and improvements in public investment and institutional capacity that resemble those documented empirically. In contrast, slightly smaller initial jumps in the tax ratio and those that are not associated with improvements in institutional capacity put countries on a path that brings them back to the low-development equilibrium, consistently with our findings.

Our findings link to a long-standing theoretical literature on the positive influence of the tax system on the economy. Barro (1990) argues that channeling tax revenue into public goods and infrastructure can raise overall productivity. In endogenous-growth settings, Barro and Sala-i-Martin (1992) show that a carefully designed tax structure can limit distortionary costs and even lift the GDP growth rate. These papers complement the literature stressing the interrelated nature of facets of state capacity, including the role for tax-raising in fostering economic development.

We additionally contribute to the poverty trap literature (Azariadis and Stachurski, 2005) and more recent work on the existence of multiple equilibria with respect to taxation and socio-economic development. Traxler (2010) builds a model showing that a shift in social norms can push a country out of a low tax compliance equilibrium into a high tax compliance equilibrium. Cantoni et al. (2024) assemble data on early-modern Holy Roman Empire and show how quasi-random tax reforms reaped higher revenues, financed larger militaries and forged stronger dynastic marriages—outcomes that let their states survive, enlarge and become more cohesive. Bergeron et al (2024) use randomized experiments in the Democratic Republic of the Congo to show that improvements in tax administration and tax policy design can together trigger a jump to a new equilibrium with higher tax rates and tax compliance. The findings echo the tax tipping point logic: once fiscal capacity jumps beyond a critical level, it enables the resources and institutional momentum that can propel durable socio-economic development.

Finally, our paper can also be linked to the literature on growth accelerations. We estimate that crossing the tax-to-GDP threshold lifts annual growth by about 1 percentage point a year over a decade on average. When focusing on episodes where countries raised their tax-to-GDP ratio sustainably above the threshold, the growth acceleration reaches 2 percentage points — a value close to the most dramatic surges documented in other work, where growth jumped by up to 2.5 points annually for eight years (Hausmann et al., 2005). Hence, this constitutes a major, sustained growth impulse, adding to other factors that repeatedly accompany acceleration episodes, including stronger investment and trade, political-regime shifts, economic reforms, and a more equitable income distribution (Hausmann et al., 2005; Berg et al., 2012).

The rest of the paper is organized as follows. Section II describes the data and its sources and discusses the relationship between taxation and various indicators of development. Section III explains our empirical approaches. Section IV presents our empirical results. Section V presents a model to rationalize our empirical findings. Section VI concludes.

II. Taxation in the WoRLD and Development

1. Data

Tax Revenue

A large historical tax-to-GDP series is the crucial dataset underlying our analysis. We combine five data sources to create an unbalanced historical tax-to-GDP series. Table 1 provides an overview of these datasets and their time and country coverage. Three data series are drawn from IMF sources: the World Revenue Longitudinal Database (WoRLD[1]), the World Economic Outlook (WEO) from October 2024, and the Historical Government Finance Statistics 1986 dataset. OECD data covers only member countries and is collected from member submissions. The UNU-WIDER Government Revenue Dataset (GRD, previously managed by the International Centre for Tax and Development) compiles revenue data from various secondary sources (including national sources, WEO and OECD data).

Our preferred measure of tax-to-GDP excludes social security contributions (SSCs). This is consistent with the IMF's Government Finance Statistics Manual 2014. SSCs are generally reported separately in our source datasets where available. Thus, we utilize measures of tax revenues exclusively of SSCs, or manually exclude SSCs from total tax revenues as required (SSCs are counted in total tax revenues in OECD data). Where both are available, we take measures of tax revenue at the general government level, as opposed to central government only.

Table 1. Data Sources for Historical Tax Revenue Series

Dataset	Source	Years	Countries	Observations
1. WoRLD	IMF surveillance	1980-2022	193	5392
2. OECD	Member submissions	1965-2022	36	1719
3. WEO	IMF surveillance	1962-2023	196	5408
4. GRD	Various secondary sources	1980-2022	193	6650
5. GFS 1986	IMF surveillance	1970-2002	157	2967

Note: Authors' construction.

We combine these five source datasets to construct a single data series covering the most years and countries possible. According to availability, we utilize the five data series in the following preference order: (1) WoRLD; (2) OECD; (3) WEO; (4) GRD; (5) GFS 1986. Splicing is used to combine data from different sources. This is necessary to avoid spurious structural breaks in the data arising when joining data from different sources. Specifically, when combining overlapping data series, we use observed growth rates to cast backwards or forwards tax revenue from the preferred data source. In select cases, when there is a data gap of less than five years, we use linear interpolation to fill gaps in the panel dataset. All the constructed series are

[1] For more information, see: https://www.imf.org/en/Topics/fiscal-policies/world-revenue-longitudinal-database. WoRLD is the complete successor to Mansour (2014, 2015) used in GJW.

reviewed ex-post and anomalous cases studied. In select cases where tax revenue changes abruptly without an identifiable explanation, ad-hoc revisions to the process are applied, such as changing the preferred underlying data series.[2]

We exclude countries with significant natural resource rents from our sample, as natural resources alter the relationship between taxes and state capacity. We drop countries identified as resource-rich in WoRLD or that have natural resource rents exceeding 30 percent of GDP (as measured in the World Development Indicators) on average.[3]

The constructed tax-to-GDP series used in our analysis covers 150 countries over the period 1965-2019.[4] It is an unbalanced panel, with an average of just under 42 observations per country. Table 2 provides an overview of the data series over time. Country coverage improves over time, and in recent years WoRLD provides near-complete global coverage. In earlier years, WoRLD was not available and thus other data sources provide the base for our series. In such cases, splicing helps to populate most of our observations. Interpolation accounts for a small share of observations throughout the dataset. Table A1 in the Appendix shows that our series is highly correlated with each underlying dataset, with a pairwise correlation coefficient of at least 0.98 with respect to each source dataset except GFS 1986. The correlation coefficient with respect to the series of GJW is 0.96. These strong coefficients hold even when restricting the comparison to spliced data, with the correlation with the series of GJW at 0.95 among these observations.

Table 2. Summary of Constructed Historical Tax Revenue Series

Years	Countries	Observations	WoRLD (%)	Spliced (%)	Interpolated (%)
Overall	150	6273	61.0	37.4	0.4
1965-1975	75	391	0.0	97.4	0.3
1975-1985	108	927	8.2	90.7	1.3
1985-1995	142	1230	33.7	64.6	0.8
1995-2005	150	1475	77.8	20.3	0.2
2005-2015	150	1500	96.5	2.1	0.0
2015-2019	150	750	98.7	0.0	0.0

Note: Authors' construction.

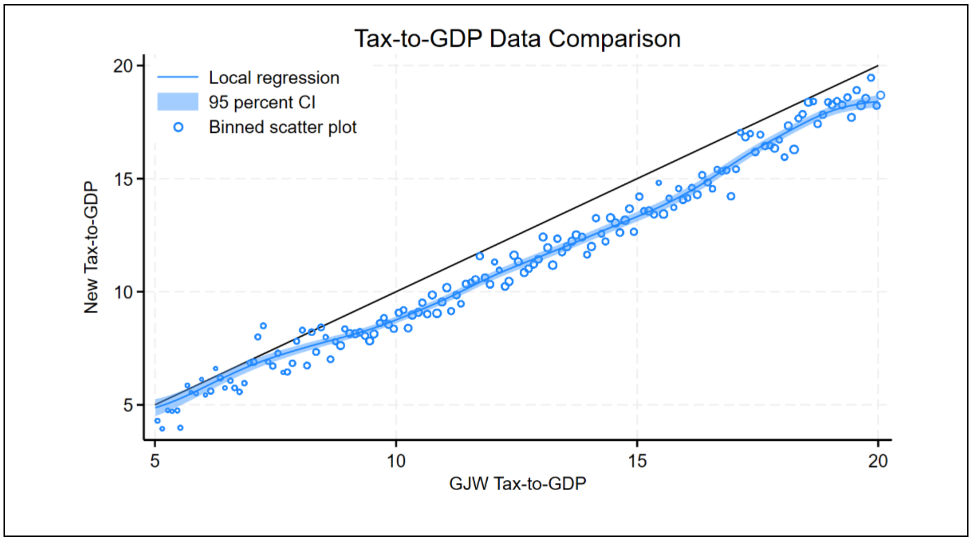
Tax-to-GDP ratios are on average substantially lower in our data than in the series used by GJW, primarily because of revisions to historical nominal GDP data. As explained in Appendix 3, these were widespread in recent years as many countries (especially developing countries) implemented updated national accounting standards and practices. They disproportionately led to upwards revisions to historical nominal GDP estimates. With historical nominal tax revenue data largely unchanged, one result of these GDP revisions is that tax-to-GDP figures are mechanically revised downwards—sometimes substantially. Figure 1 illustrates this pattern, highlighting that the new tax series is systematically lower than in GJW, with this gap being clearest for cases where tax-to-GDP in GJW was in the range of 10 to 18 percent.

[2] All code for dataset construction will be made available upon request.

[3] We also drop Zimbabwe on account of its hyperinflation episode which distorts macroeconomic aggregates.

[4] 2019 is the last year of data in the Penn World Tables.

Figure 1. Comparison of Tax-to-GDP in GJW and New Data Series



Note: Figure plots tax-to-GDP as measured in Gaspar, Jaramillo and Wingender (2016b) against the series constructed in this paper for a comparable sample of countries and years. Dots show binned data in bins 0.1 wide. Straight line is a 45-degree line; the other line plots a Gaussian kernel function with 95 percent confidence intervals.

Development Indicators

Real GDP per capita is our first development outcome. We source this from the Penn World Tables (PWT version 10.01 (Feenstra, Inklaar and Timmer, 2015)) data on real GDP (at constant 2017 national prices in 2017 USD) and population and measure cumulative real GDP growth per capita over different time horizons in our empirical analysis.

To investigate the role of other facets of economic and institutional development, we collect a series of additional indicators, prioritizing those with the best time and country coverage. The new indicators cover four distinct areas: financial development, government efficiency, the rule of law, and good governance. We consider each of these to be development outcomes of interest in themselves, but also measures of national institutional capacity, which our theoretical underpinning posits as fundamental for stable economic development. A description of each indicator is provided below. Summary statistics are reported in Table A.2 in the appendix.

Financial Development. To measure financial development, we rely on the widely used financial development indexes (FDI) developed in Svirydzenka (2016), which are the most comprehensive and have among the best country and time coverage. For conciseness, we focus on the two main sub-indexes, which measure the development of financial institutions (FDI-FI) and financial markets (FDI-FM), as well as the Financial Development Index (FDI-FD) that aggregates the two sub-indexes. Each of these indexes are based on precise measures of financial depth, access, and efficiency. An increase in any of these indexes indicates an increase in financial activity and assets as a share of GDP, a larger number of firms and households formally engaged in financial activities, and greater efficiency in financial activities. The indexes cover 149 countries (all countries in our dataset except for the Republic of Montenegro) from 1980 to 2019 and we standardize them to have mean zero and a standard deviation equal to one. For robustness checks, we also consider the standardized series "Private credit by deposit money banks to GDP (%)" from the World Bank's Global Financial Development

Database (Cihák et al., 2012). While private credit is an input used to construct the FDI-FI index, we consider this series in isolation because it covers all years back to 1965 and all countries.

Government Effectiveness. We draw from the World Bank's World Governance Indicators, henceforth the WGI (Kaufman and Kraay, 2024) and use the Government Effectiveness index capturing "perceptions and views of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies". As for other WGI indicators, the index is constructed by combining about 50 individual indicators measuring aspects of governance that capture perceptions and views of the quality of governance reported by experts and survey respondents worldwide.[5] The index is normalized to have mean zero and a standard deviation of one. It covers all the countries in our sample from 1996.[6]

Legal Structure and Rule of Law. We focus on the Fraser Institute's index of Legal Structure and Security of Property Rights (Gwartney, Lawson, and Murphy, 2024). The index aggregates five indicators that range from 0-10, where 0 corresponds to (i) "no judicial independence", (ii) "no trusted legal framework exists", (iii) "no protection of intellectual property", (iv) "military interference in rule of law", and (v) "no integrity of the legal system". Each of these five indicators draws from multiple sources, including surveys and expert assessments. The final indicator value is the average of whichever sources are available, and the data are chain-linked to ensure consistency over time.[7] The index is then standardized and covers 138 countries from 1970 to 2019.[8]

Governance. We consider two independently constructed indicators that decrease with the level of corruption, both with wide but not fully overlapping coverage. The Sherppa Ghent University's Bayesian Corruption Indicator (BCI) covers 147 countries from 1984 (Standaert 2015).[9] It is a composite index of the perceived overall level of corruption, with corruption referred to as the "abuse of public power for private gain" and combining the information of 20 different surveys. We standardize it like for other indicators. Alternatively, the Varieties of Democracy (V-Dem) Institute's Public Sector Corruption Index (PSCI) covers fewer countries (139), but it spans the entire time period of our sample (Pemstein et al. 2023).[10] It aggregates two indicators, bribery and embezzlement, across the executive, legislative and judicial branches of government, covering both high and low levels of the public sector. We use its log transformation and standardize it to have mean zero and a standard deviation of one.

Public Finance and Investment

We examine four other public finance variables in addition to tax revenue. We collect government expenditure, primary balance, and gross debt, all in percent of GDP, from the Public Finances in Modern History database (initially developed in Mauro et al. 2015 and maintained up to date by the IMF). We supplement these with general government and total investment (gross fixed capital formation), the latter

[5] The WGI rely on a diverse set of data sources, including several global and regional surveys of households and firms, as well as expert assessments produced by organizations in the public, private, and NGO sectors.

[6] WGI data is available in 1996,1998, 2000 and annually from 2002 onwards. We linearly interpolate the data in 1997, 1999, and 2001.

[7] For example, the WGI "rule of law" index is one of the input indexes used to assess whether "no trusted legal framework exists".

[8] The 12 countries not covered are Antigua and Barbuda, Aruba, Dominica, Grenada, Hong Kong SAR, Macao SAR, Maldives, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, São Tomé and Príncipe, and Uzbekistan.

[9] The three missing countries are Aruba, Hong Kong SAR, and Macao SAR.

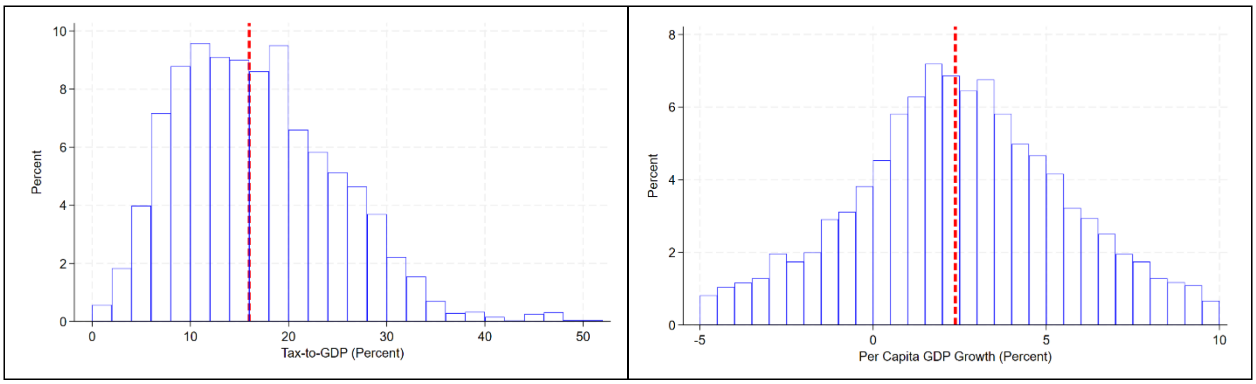
[10] Missing countries are Antigua and Barbuda, Aruba, The Bahamas, Belize, Dominica, Grenada, Hong Kong SAR, Macao SAR, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines.

including the private sector's contribution to investment. Both variables are in percent of GDP and from the IMF Investment and Capital Stock Dataset (IMF 2021).

2. Stylized Facts

Figure 2 (left panel) shows the distribution of tax-to-GDP in our full dataset. The median value is 16 percent across all years; the 25th and 75th percentiles are 10.6 and 22.1 percent, respectively. The right panel shows the distribution of annual per capita real GDP growth, which displays a wide dispersion. The median value is 2.4 percent, with the mean at 2.2 percent.

Figure 2. Distributions of Tax-to-GDP and Annual GDP Per Capita Growth



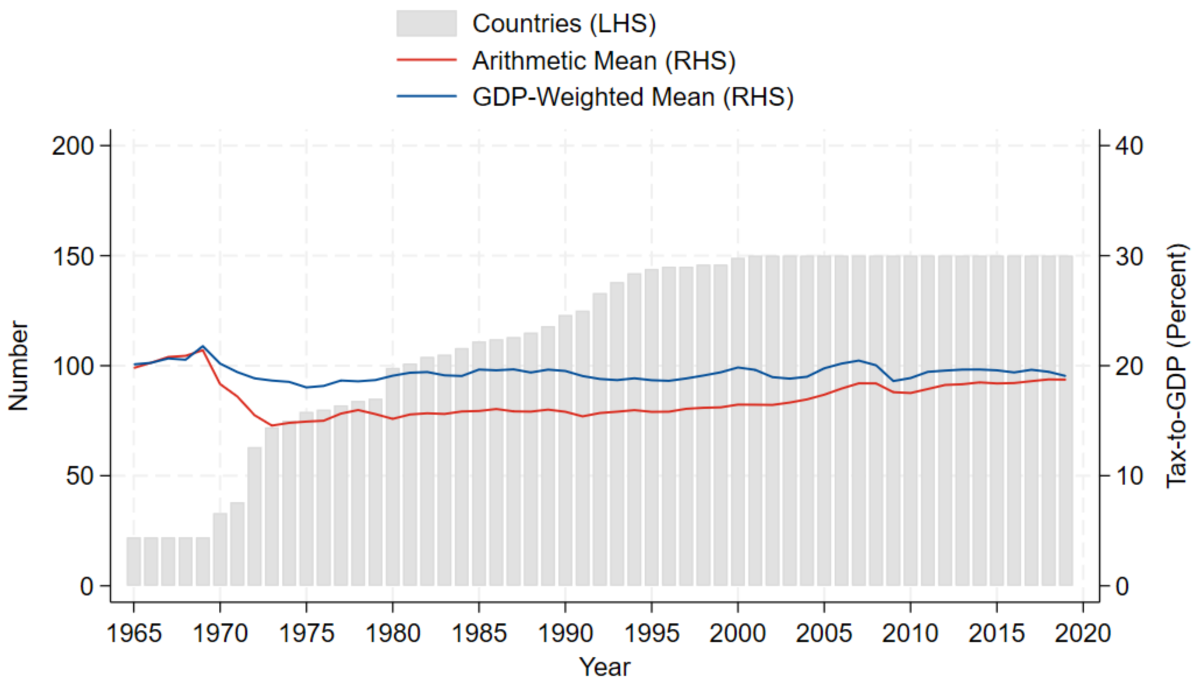
Note: Left figure shows the full distribution of country-year observations of tax-to-GDP in our constructed tax series. The figure on the right shows the distribution of real annual GDP per capita growth in our sample, excluding outliers at approximately the 5th and 95th percentiles. Dashed lines indicate median values. See text for data details.

Average tax revenues as a share of GDP have increased slowly over time in our sample. Figure 3 shows that since 1980, when about 100 countries are covered, the average tax-to-GDP ratio increased from around 15 percent to nearly 19 percent. However, global tax revenues—as indicated by the GDP-weighted series—remained flat. This implies that increases in tax-to-GDP are concentrated in smaller economies, on average.

Real incomes per capita are strongly positively correlated with tax-to-GDP. Using the most recent observation available for each country, the linear association in Figure 4 shows that, in the cross-section, a 10-percentage point increase in the tax-to-GDP ratio is associated with more than a doubling of real income per capita.

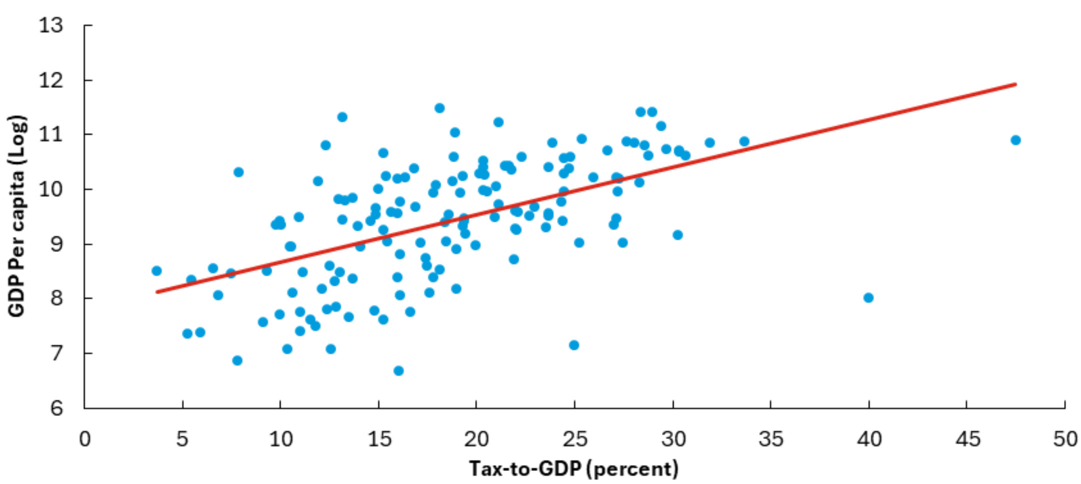
This correlation extends to other measures of economic and institutional development as well (Figure 5). The four panels shown cover legal structure and property rights, government effectiveness, financial development, and corruption. In all cases, higher tax revenues are associated with better development outcomes. While these associations cannot be interpreted as causal, they do motivate an investigation of the role of tax capacity and revenue mobilization in broad economic development.

Figure 3. Average Tax-to-GDP Over Time



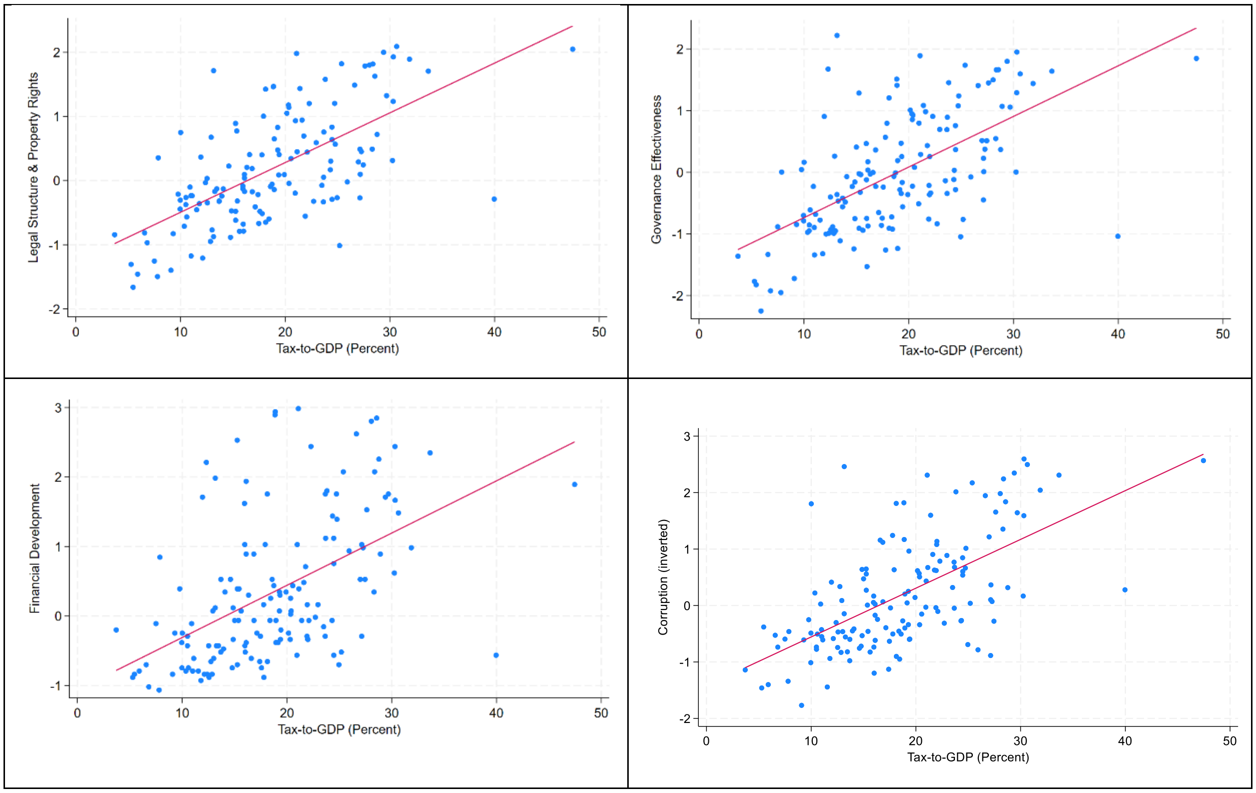
Note: Authors' construction. LHS: Left-Hand Side. RHS: Right-Hand Side.

Figure 4. Correlation between Tax-to-GDP and GDP Per Capita



Note: Figure shows one observation per country, using the latest year available for each country. Red series shows a linear fit of the data. See text for data sources and definitions.

Figure 5. Correlation between Tax-to-GDP and Other Institutional Development Indicators



Note: Figures show one observation per country, using the latest year available for each country. Red series shows a linear fit of the data. All y-axis variables are standardized to have mean zero and standard deviation one. See text for data sources and definitions.

III. Empirical Approach

1. Searching for a Tax Tipping Point

To search for a tipping point in the relationship between tax-to-GDP and economic growth, we utilize the regression discontinuity methodology of GJW with our newly constructed tax dataset. This methodology in turn draws on Card, Mas and Rothstein (2008), who argue that multiple equilibria can arise in settings where feedback loops occur and propose an approach for identifying thresholds where small changes in initial conditions give rise to large changes in outcomes. In our context, this involves searching for levels of tax-to-GDP around which we observe sharp changes in subsequent GDP growth rates.

The search for a tipping point involves two steps. We describe the methodology briefly here; a more complete econometric treatment can be found in the original paper.

In the first step, we search for a candidate tipping point. To do this, we model subsequent cumulative per capita GDP growth rates as a function of the tax-to-GDP level, allowing this relationship to vary discontinuously at an unknown tipping point, or threshold value. In the second step, we utilize the candidate tipping point to estimate the association of crossing the threshold with subsequent economic growth, taking the threshold value estimated from the first step as known.[11]

Our benchmark model relates cumulative real GDP per capita growth $\Delta GDPPC_{c,t+j}$ in country c, year t, j years ahead to some function of the tax-to-GDP level $tax_{c,t}$, allowing this to vary discontinuously at the unique and unknown threshold value γ, allowing for covariates X_{ct} and year fixed effects δ_t:

$$\Delta GDPPC_{c,t+j} = \begin{cases} \alpha_l + f_l(tax_{ct} - \gamma) + X_{ct}\rho + \delta_t + \varepsilon_{ct}, & \text{if } tax_{ct} \leq \gamma \\ \alpha_r + f_r(tax_{ct} - \gamma) + X_{ct}\rho + \delta_t + \varepsilon_{ct}, & \text{if } tax_{ct} > \gamma \end{cases} \quad (1)$$

The approach searches for a structural break in the relationship between taxes and subsequent growth and focuses on the local effect of small changes in tax revenues around this structural break. We allow for a growth discontinuity around a specific level of tax revenues, with countries falling to the right of a given threshold value akin to treated observations in a standard regression discontinuity setup. Flexible functions $f_l(.)$ and $f_r(.)$ describe the relation between taxes and growth on either side of this threshold.

To search for a tipping point, in practice we utilize a parsimonious model of the following form for country c, year t, and time horizon j:

$$\Delta GDPPC_{c,t+j} = \alpha + \beta D_{ct} + \varepsilon_{ct} \quad (2)$$

ε_{ct} is an error term, and $D_{ct} \equiv \mathbf{1}(tax_{ct} > \gamma)$ is an indicator function for whether country c's tax-to-GDP ratio in year t exceeds some fixed but unknown threshold γ. Potentially, a full set of covariates and country and year fixed effects could be used in this step. However, GJW argue that this reduces statistical power, rendering the full model incapable of identifying the tipping point. We follow GJW and Card, Mas and Rothstein (2008) and ignore covariates and fixed effects and approximate $f(tax_{ct} - \gamma)$ by a constant function. The second step provides ex-post validation of the relevance of the estimated tipping point.

We perform a grid search over many potential threshold values, selecting the value γ that maximizes the R-squared of the estimated model as the candidate tipping point. We restrict this grid search procedure to values of tax-to-GDP between 5 and 30 percent and drop observations for which tax-to-GDP is either below 5 percent or above 40 percent. We search for the value $\hat{\gamma}$ that maximizes the R-squared of Equation (2). We use the approach outlined in Hansen (1999) to test for the existence of a tax tipping point in a setting that accounts for the non-standard properties of the threshold estimate $\hat{\gamma}$.

Taking the value of γ as if it were known based on the estimates in the first step, we then estimate the effect of crossing the tipping point on cumulative GDP growth. This amounts to estimating:

$$\Delta GDPPC_{c,t+j} = \alpha + \beta D_{c,t} + f(tax_{ct} - \gamma) + X_{ct}\rho + \varepsilon_{c,t} \quad (2')$$

where $f(.) \equiv f_r(.) + D_{c,t} f_l(.)$ is the sum of two flexible functions capturing the relation of GDP growth with the tax ratio on both sides of the tax threshold. In this step, we do include controls and fixed effects X_{ct}.

[11] See Hansen (2000) for a discussion of the properties of this two-step estimation approach.

The coefficient estimate $\widehat{\beta}$ indicates the additional economic growth in countries above the tipping point, compared to those just below. The procedure is performed for different economic growth horizons (3, 5, 7 and 10 years). We perform several tests of the robustness of estimated growth effects, including the use of different covariates, different functional forms to describe the global relationship between growth and taxes, and placebo tests using arbitrary threshold values above and below our estimated tipping point.

This approach differs from a standard regression discontinuity design. For one, the rule that determines "treatment"—i.e. the location of the tax tipping point—is determined by the data in the first step. The interpretation of "treatment" is also complicated by the fact that tax-to-GDP is endogenous with respect to GDP (and thus GDP growth). However, by focusing on local effects—that is, changes in outcomes associated with small changes in tax revenues—this concern is considerably reduced. A causal interpretation hinges on observations on either side of the estimated threshold being otherwise comparable, with treatment determined by one of various sources of exogenous variation in realized tax revenues. While we must recognize that third factors may drive changes in both tax-to-GDP and other development outcomes in general, this is less likely to be relevant to discontinuous changes around specific tax thresholds. Moreover, the dynamic approach implemented in the event studies described below allows us to control for country-specific growth trajectories and ensure that differential trends among "treatment" and "control" observations in advance of the tipping point do not drive our results.

2. Event Study

We complement the two-step procedure described above by using an event study approach to study the dynamics of countries that cross the estimated tax threshold. Taking the existence of a tax tipping point as given, we examine the dynamics of outcomes around the time when a country raises their tax-to-GDP ratio above the threshold. For conciseness, we focus on the threshold of 10.35 percent that we estimate for the 10-year growth horizon.

**The event study is implemented using a Difference-in-Differences approach, using crossings of the tipping point as `treatment'.** We compare outcomes in countries that have been `treated' with those in 'untreated' countries, where we define `treatment' as having crossed the tax tipping point. The comparison is between `treated' and `untreated' countries and importantly within `countries' as outcomes are compared before and after crossing the tipping point (`treatment').

We estimate a dynamic Difference-in-Differences (DiD) model for several outcomes y_{ct} (log GDP per capita, the tax ratio, and the various development indexes) as reflected in the following equation:

$$y_{c,t} = \alpha_c + \delta_t + \sum_{k=-11}^{15} \beta_k \mathbf{1}\{t_{crossing,c} + k = t\} + \epsilon_{c,t} \qquad (3)$$

where α_c is a country fixed effect, δ_t is a year fixed effect, $\mathbf{1}\{t_{crossing,i} + k = t\}$ is a dummy variable equal to 1 for the year that is k years after country c crosses the tax-ratio threshold when k is positive, or $|-k|$ years before the country c crosses the threshold when k is negative. The latter variable is akin to a treatment indicator allowing the treatment effect to vary with treatment duration. Robust and asymptotic standard errors are estimated, which are obtained using Influence Functions.[12]

The coefficients β_k capture the dynamic impact of treatment (crossing the threshold), in each of the 11 years preceding the crossing (when k is negative), in the year of the crossing (when k is zero), and in each of the following 15 years (when k is positive). The inclusion of country fixed effects implies that we focus on relative changes compared to a base year, which we choose to be the year preceding threshold crossing. Hence, we normalize the coefficients and impose that $\beta_{-1} = 0$.

All β_k coefficients are estimated using the estimator developed in Callaway and Sant'Anna (2021). The literature has shown that traditional two-way fixed effects estimators (TWFE) can perform poorly in dynamic DiD setups with multiple time periods and variation in treatment timing like in equation (3). TWFE regressions make "clean" comparisons between treated and not-yet-treated units, as well as "forbidden" comparisons between units that are both already-treated. When treatment effects are heterogeneous, these "forbidden" comparisons can lead to severe drawbacks. For example, TWFE coefficients may take the opposite sign of all individual-level treatment effects due to "negative weighting". The estimator proposed in Callaway and Sant'Anna (2021) addresses these issues by (i) estimating "clean" comparisons between the countries treated from $t_{crossing,c}$ to $t_{crossing,c} + k$ and the countries not yet treated over that same period, and (ii) using appropriate weights to aggregate these comparisons across $t_{crossing}$ into estimators of the treatment effects by length of exposure ($\hat{\beta}_k$).

In our setting, the dynamic DiD framework is additionally complicated because some countries exit out of treatment, meaning that some countries experience a decline in the tax ratio to levels below the threshold. Overall, the broad trend is that the share of countries above the threshold increases over time (see Figure A3 in the Appendix). Only two countries that are above the threshold at the beginning of the sample end up below the threshold.[13] Furthermore, many countries that start below the threshold and end up above experience more than one threshold crossing as their tax ratio fluctuates around the threshold before ending above (See Table A3 in Appendix).

To address this issue, we focus on countries' first observed crossing of the tax-to-GDP threshold from below ("first crossing"). In other words, we consider a country to be "treated" in the first year when we observe the tax ratio increasing to exceed the threshold and in all the subsequent years. Applying the Callaway and Sant'Anna (2021) estimator means that we exclude from the estimation the 82 countries that are above the tax ratio threshold throughout the estimation period. For the control group, we use the 2,901 observations both from countries that are always below the threshold (never treated) and from the not-yet treated countries.[14]

[12] Loosely speaking, an influence function quantifies how a statistic changes once a small amount of data mass is added at a certain point in the probability distribution on which the statistic is based. It has been shown that, asymptotically, the sampling variance of a statistic is equal to the sampling variance of the mean of its influence function (Hampel 1974, Deville 1999).

[13] These two countries are Central African Republic and Sudan. To be precise, for these two countries, the first tax-ratio we observe is above the threshold and the last tax-ratio we observe is below the threshold.

[14] Six countries have a tax-to-GDP ratio that is below the [10.35] percent tax-to-GDP threshold throughout the sample period: Bangladesh, Comoros, Guinea-Bissau, Haiti, Myanmar, and Nigeria.

In a robustness check, we work on a trimmed sample that excludes the initial and final years corresponding to a decline in the tax ratio below the threshold. To be precise, for countries that start above the threshold, fall below, and rise above, we exclude all the observations *before* the first year in which the tax ratio is below the threshold (88 observations). For countries that rise above the threshold but end up below the threshold, we exclude all observations *after* the last year in which the tax ratio is above the threshold (97 observations). We drop these observations to reduce the number of observations with taxes below the threshold in the treated groups and observations with taxes above the threshold in the control group. As a result, while we initially have 2,901 observations corresponding to countries that are below the threshold at least once, the event study on this trimmed sample is performed on 2,710 observations.

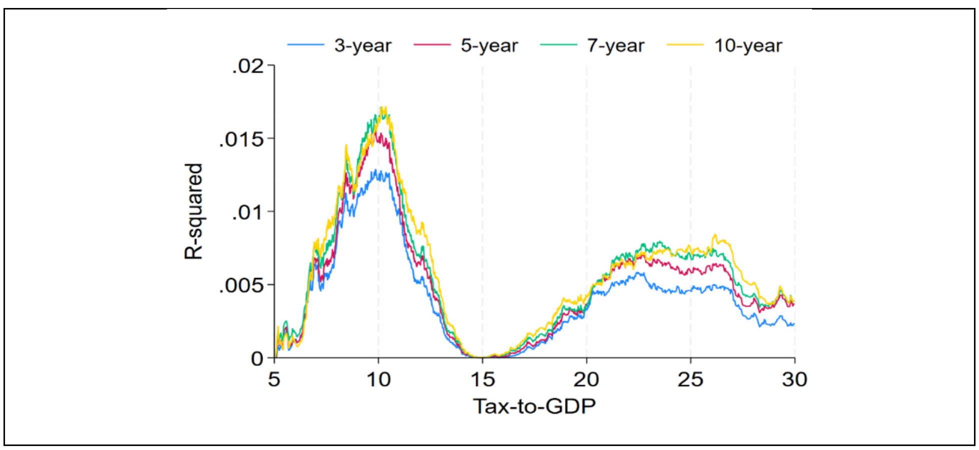
IV. Empirical Results

1. Identifying a Tax Tipping Point

Locating a Potential Tax Tipping Point

Figure 6 shows the results of the grid search procedure implemented by estimating Equation (2). It plots the estimated R-squared over many possible threshold values and over four different time horizons for economic growth. The four time horizons utilized show quantitatively and qualitatively similar patterns, with a clear peak in the R-squared at a tax ratio of roughly 10 percent of GDP.

Figure 6. Grid Search for Tax Tipping Point Candidates



Note: Figure shows the R-squared from estimating Equation (1) when setting the threshold at different values up to 30 percent of GDP. The series are obtained using different growth horizons (3, 5, 7, and 10 years) as the dependent variable.

The estimated tax tipping point thresholds are highly statistically significant. Table 3 reports p-values for the null hypothesis that there is no tax tipping point, using the procedure described by Hansen (1999). Across all four growth horizons, p-values indicate strong statistical significance, consistent with the graphical evidence in Figure 7. Further, in Table 4, the estimated threshold values are shown with corresponding confidence intervals at the 95 and 99 percent confidence levels, again using the bootstrap procedure described in Hansen (1999). In each case, the tipping point is tightly estimated.

Table 3. Tests for Statistical Significance of Tax Tipping Point

		3-year	5-year	7-year	10-year
p-value		0.00	0.00	0.00	0.00
F_1 Statistic		69.23	82.09	84.97	77.58
Critical values:	0.10	2.79	2.61	2.91	3.01
	0.05	3.95	3.73	3.88	4.23
	0.01	6.62	6.24	8.04	7.23

Note: Table shows test statistics for the null hypothesis of no tipping point in tax-to-GDP. Critical values and p-values obtained by bootstrapping individual test statistics 1000 times. See Hansen (1999) and GJW for more details.

Table 4. Estimated Tax Tipping Points

	Cumulative GDP per-capita growth			
	3-year	**5-year**	**7-year**	**10-year**
Tax-to-GDP threshold	9.87	9.85	10.12	10.35
Confidence intervals:				
95% no-rejection region	[9.50; 10.56]	[9.70; 10.26]	[9.78; 10.55]	[9.94; 10.56]
99% no-rejection region	[9.26; 10.68]	[9.47; 10.56]	[9.45; 10.56]	[9.78; 10.68]

Note: Table presents estimates for the tax tipping point based on Equation (1). Confidence intervals are obtained by the "no-rejection region" method. See Hansen (1999) and GJW for more details.

These estimated threshold values are considerably below those found in GJW, which were in the range 12.4-12.9 percent. This difference is not primarily driven by changes in the sample of countries or years included in the new dataset. Figure A1 in the Appendix shows results from the grid search procedure when restricting the sample of the new dataset to be comparable with that of GJW.[15] This yields similar results to Figure 6, with the threshold value estimated to fall within the range of 10.2 to 10.6 percent.

Our conjecture is that the significant revisions to historical tax-to-GDP data are behind this change in results. This is supported by the fact that the grid search produces R-squared profiles with the same shape as in GJW, but with the curve shifted to the left towards lower tax-to-GDP values. This parallels the lower tax-to-GDP figures in general, with the downward revisions most common and uniformly downwards for countries with lower tax-to-GDP ratios in the first place.

To further assess the robustness of the existence and location of the tax tipping point, we additionally apply a machine learning technique (see Appendix Section 4). We use a Causal Random Forest approach which looks for a structural break in the relationship between growth and the tax-to-GDP ratio. Bootstrapping techniques allow us to create a distribution of tax tipping point estimates. Our results confirm the presence of a tipping point at about the same level, although this alternative approach yields much less precise estimates primarily distributed in a range of 10 to 15 percent of GDP.

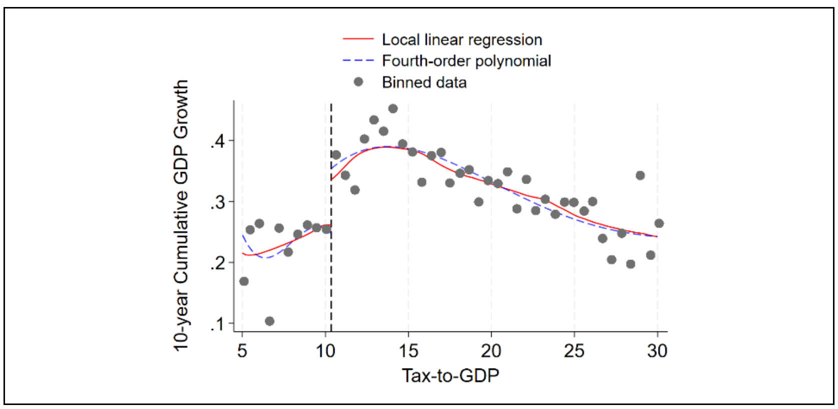
Economic Growth and the Tax Tipping Point

[15] The sample in this case lacks four countries included by GJW: three that are now considered resource-rich and one (Zimbabwe) whose hyperinflation episode distorts macroeconomic data considerably.

Figure 7 presents results from the second step, illustrating the cumulative growth effect from crossing the tipping point. The left panel uses the estimated tipping point based on 10-year cumulative growth (10.35 percent) and plots the distribution of observed growth outcomes for observations on either side of this threshold. There is a visually clear discontinuity at this level: countries above this tax-to-GDP level see significantly higher cumulative per capita GDP growth in the subsequent decade. The size of the discontinuity—the additional cumulative GDP growth from crossing the tipping point—is estimated at 10.7 percent when the fourth order polynomial function is used to estimate the global relationship between tax ratios and subsequent growth (or 7.5 percent when local linear regression is used).[16]

Figure A2 in the Appendix plots the equivalent results for cumulative growth at different horizons. For countries above the tax tipping point, the effect on growth accumulates over time, including beyond the 10-year horizon for which main results are reported. There is suggestive but statistically insignificant evidence that countries above the tipping point also exhibit faster growth at shorter horizons.

Figure 7. Growth Effect from Crossing the Tipping Point



Note: Figure shows a scatter plot of average 10-year per capita GDP growth in 0.5 percentage point bins of tax-to-GDP. The solid line is a local linear regression separately fit on either side of the tipping point using an Epanechnikov kernel and a bandwidth of 1.72, selected by common mean squared error minimization. The dashed series is a global fourth order polynomial estimated on either side of the tipping point.

Table 5 shows regression discontinuity design results for the growth effect of the tax-to-GDP threshold. The estimated growth effect is consistent and statistically significant after controlling for year fixed effects, the level of GDP and capital stock per capita (in logs), and trade openness. The addition of a human capital index reduces coefficient sizes slightly but also shrinks the sample somewhat due to missing data, and thus coefficients are not fully comparable. Note that we do not include country fixed effects at this stage on the grounds that this analysis is largely cross-sectional, and within-country variation will be better integrated and exploited in the event study analysis that follows. These results are in the same range as those in GJW, who estimated a 12.4 percent gain over 10 years in their basic specification, and 7.5 percent in their preferred specification.

[16] The bandwidth for local linear regression is selected by common mean squared error minimization, yielding a bandwidth of 1.72.

Table 5. Growth Regressions from Crossing the Tipping Point

Dependent variable: 10-year cumulative GDP per capita growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Tax-to-GDP threshold	0.107*	0.113**	0.103**	0.104**	0.103**	0.075	0.074
	0.0559	0.0522	0.0504	0.0506	0.0503	0.0484	0.0494
Log(GDP per capita)			-0.0316*	-0.0378*	-0.0263	-0.0819***	-0.0503
			0.0186	0.0197	0.0466	0.0305	0.0504
Trade openness				0.000297			0.000698**
				0.00031			0.00031
Log(Capital per capita)					-0.00377		-0.0442
					0.0365		0.0364
Human Capital						0.154***	0.170***
						0.0562	0.0563
Year FE	N	Y	Y	Y	Y	Y	Y
Observations	4470	4470	4470	4470	4447	3926	3903
R-squared	0.04	0.1	0.107	0.109	0.103	0.15	0.157

Note: Table shows regression results where the outcome variable is forward-looking 10-year cumulative GDP per capita growth, with the base year set to 1. Tax-to-GDP threshold is an indicator variable equal to one if the tax-to-GDP ratio exceeds 10.35 percent. GDP per capita and capital stock per capita are at constant national prices expressed in thousands of 2017 US$. Trade openness is the sum of merchandise imports and exports as a share of GDP. The human capital index is based on average years of schooling and assumed returns to education. All covariates are sourced from PWT 10.01. See text for further data details. Coefficients from a fourth-order polynomial in tax-to-GDP fully interacted with the tax-to-GDP threshold and year fixed effects not shown. Standard errors clustered at the country level in parentheses. * means p<10%, ** p<5%, *** p<1%.

We conduct several other robustness checks on the main results reported here relating to 10-year growth horizons. First, we test for continuity in the density of tax-to-GDP around the tipping point, using the non-randomized approximate sign test (Bugni and Canay, 2020). We cannot reject the null hypothesis of continuous density (p-value of 0.22). Second, we present estimated regression discontinuity coefficients from specification (1) in Table 5 using alternative orders of the polynomial estimating the relationship between taxes and GDP (Table A4). More parsimonious choices of the polynomial yield larger point estimates, while higher order polynomials reduce coefficient sizes. However, in no case can we reject the null that the regression coefficient under an alternative polynomial is different to that under the fourth-order polynomial used in our main results. Finally, we conduct placebo regressions where we arbitrarily vary the threshold value at increments of 0.5 below and above the estimated tipping point of 10.35 (Table A5). At no other threshold value do we find statistically significant evidence of a growth impact. Collectively, these tests offer compelling evidence of the robustness of the growth discontinuity at the tax tipping point.

2. Dynamics Around the Tax Tipping Point

Confirming the Relevance of the Tax Tipping Point with an Event Study Approach

We now focus our attention on the dynamics of development indicators around the time when countries cross the tax tipping point by estimating equation (3). Our baseline specification relies on the threshold estimated for the 10-year horizon.

The event study estimates confirm the regression discontinuity results and the relevance of a tax tipping point. Panel a) in Figure 8 plots the dynamics of log GDP per capita before and after raising tax-to-GDP above the threshold for the first time. Trends prior to crossing the tipping point countries in `treated' countries are not significantly different from trends in `untreated' and `not yet treated' countries with tax ratios below the threshold. This supports the interpretation of crossing the threshold as a quasi-experimental treatment.

In the years following the tax threshold crossing, countries see a significant increase in GDP per capita relative to those that remain below the threshold, especially from one to eleven years after. Beyond eleven years, imprecision leads to insignificant results, but the estimated effects continue to grow. In other words, the event studies confirm faster growth above the tax threshold. Further, the estimates imply an added 10 percentage points growth rate per decade, a magnitude that is consistent with the regression discontinuity findings.

The event study estimates for the tax-to-GDP ratio show that crossing the threshold is typically the outcome of a large change in tax mobilization. The estimates shown in Panel b) in Figure 8 reveal no signs of pre-trends before the threshold is crossed. The increase in the tax ratio observed in the 3-year window around the crossing (from year -2 to year 1) is abrupt and substantial, as the ratio is estimated to increase by almost 3 percentage points. For the next 15 years after, the tax ratio fluctuates around the level reached on the year of the threshold crossing and does not exhibit a clear trend.

Table 6. Tax-to-GDP ratios around the First Threshold Crossing

	Mean	SD	First quantile	Median	Third quantile
Three years prior	8.01	2.11	7.3	8.75	9.47
Two years prior	8.49	1.85	8.24	9.24	9.51
One year prior	9.35	0.94	9.03	9.68	9.99
Threshold crossing year	11.16	1.04	10.57	10.85	11.32
One year after	11.43	1.86	10.33	11.08	11.97
Two years after	10.96	1.48	9.73	11.09	11.96
Three years after	11.02	1.6	9.89	11.17	11.99

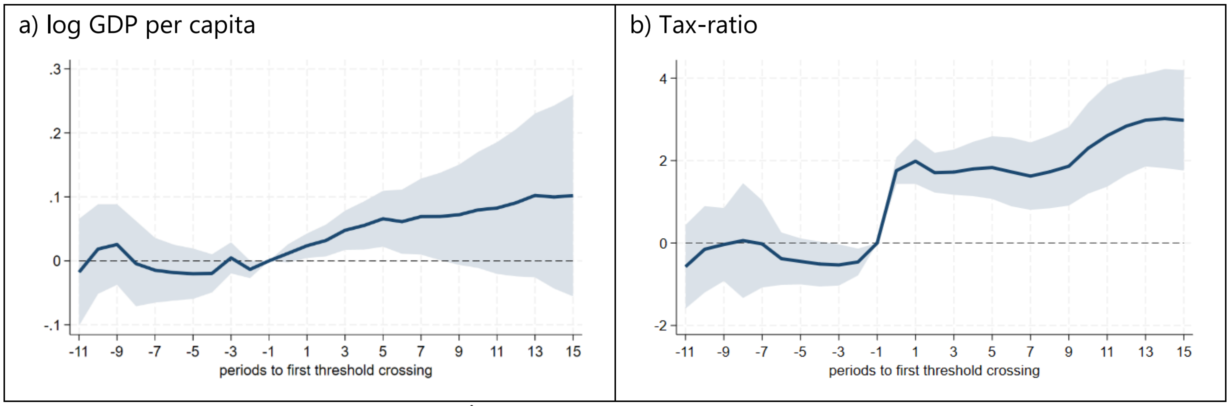
Note: Summary statistics for the 43 countries for which we observe tax-to-GDP ratios in a 7-year window around the year when they exceed the tax threshold for the first time. The list includes Argentina, The Bahamas, Bhutan, Burkina Faso, Burundi, Cambodia, Chad, Colombia, Ecuador, El Salvador, Ethiopia, The Gambia, Ghana, Guatemala, Guinea, Honduras, Indonesia, Kenya, South Korea, Lao People's Democratic Republic, Lebanon, Madagascar, Malawi, The Maldives, Mali, Mexico, Nepal, Nicaragua, Niger, Paraguay, Peru, The Philippines, Rwanda, Sierra Leone, Spain, Sudan, Suriname, São Tomé and Príncipe, Tanzania, Togo, Turkey, Uganda, and Vietnam.

To make the magnitude of the increase in the tax ratios around the tipping point more concrete, we provide descriptive statistics in Table 6. We focus on the 43 countries for which we observe tax ratios continuously from 3 years before crossing the threshold to 3 years after the crossing.[17] This focus allows us to ensure that changes in the average tax-to-GDP ratio are not driven by a change in the composition of countries included in annual averages. Table 6 shows that the average tax ratio increased from 8 percent to 11 percent over the three years leading to the year of the 10.35 precent threshold crossing. When looking at the median

[17] In our sample, we observe tax ratios that increase to cross the threshold in 62 distinct countries.

instead of the average, the magnitude of the change is reduced but remains large at 2 percentage points. Among the 43 countries, a sizeable share nevertheless experiences a decline in the tax ratio after crossing the tax threshold. Already in the year after crossing the threshold, a quarter (about ten countries) have tax ratios that fall back below the threshold, indicating that some crossings are short-lived.

Figure 8. Dynamic Effects of Crossing the Tax-Ratio Threshold from Below: Event Study Graphs



Notes: The graphs show the coefficient estimates $\hat{\beta}_k$ from equation (3) and the associated 90 percent confidence interval. The coefficients β_k capture the effects of having crossed the 10.35 percent tax ratio threshold either $-\kappa$ years ago for $\kappa < 0$, or κ years after for $\kappa > 0$. The outcome variable is log GDP per capita in panel a) and the tax-to-GDP ratio in panel b). Robust and asymptotic standard errors are estimated, which are obtained using Influence Functions.

The event study results for log GDP per capita and for the tax-to-GDP ratio are robust to several checks. First, we use an alternative implementation of the Callaway and Sant'Anna (2021) estimator where we only use the countries that are always below the tax ratio threshold as the control group (Figure A4 Panel a and b in the Appendix). This alternative leaves us with fewer observations and the confidence intervals widen somewhat. However, the results are broadly the same and remain significant at the 90 percent level, except for horizons beyond 5 years for GDP. Second, we estimate standard errors using a multiplicative wild bootstrap procedure (Figure A4 Panel c and d in the Appendix). This leads to narrower confidence intervals compared to our baseline approach. Third, we use the lower 3-year horizon threshold estimate of 9.87 percent tax-to-GDP threshold and find that results are essentially unchanged (Figure A4 Panel e and f in the Appendix). Fourth, we alternatively define treatment as the last observed crossing of the tax-to-GDP threshold (Figure A4 Panel g and h). Again, the results are broadly the same. However, the absence of pre-trends in log GDP per capita is less clear: this likely captures the effect of previous threshold crossing in the countries where the tax ratio fluctuates around the threshold before their last crossing. This supports our baseline approach focusing on the first threshold crossing. Finally, we replicate all the above event studies using the alternative trimmed sample where we exclude the years with a tax ratio above the threshold before the first observed crossing and the years below the threshold after the last observed crossing (Figure A5 in the Appendix). Our findings are almost identical, except for the timing of the tax ratio increase which seems to begin a year earlier.

Dynamics of Other Development Indicators Around the Tax Tipping Point

We next consider how other dimensions of institutional development evolve around crossings of the tax-to-GDP threshold. On the one hand, prior progress along other dimensions of development could potentially be necessary for countries raising their tax ratio above the threshold to experience accelerated GDP growth. On the other hand, it could be the case that crossing the tax tipping point accelerates development along multiple dimensions. Both cases are not necessarily exclusive and, for both, development along these other dimensions might be the one of the mechanisms via which higher tax ratios deliver faster economic growth.

We first examine institutional development indicators, comparing countries in the years that are at least a decade away from the tipping point, and those that will cross the tax threshold in 10 years or less. Figure A8 in the appendix shows that all indicators (the financial development index, the government effectiveness index, the legal framework index, and the corruption index) largely overlap. This suggests that the beneficial effects of crossing the tipping point may not be predicated on having a certain initial level of development along these dimensions. We then investigate the potential role of dynamics by applying the event study approach reflected in equation (3) to these development indicators.

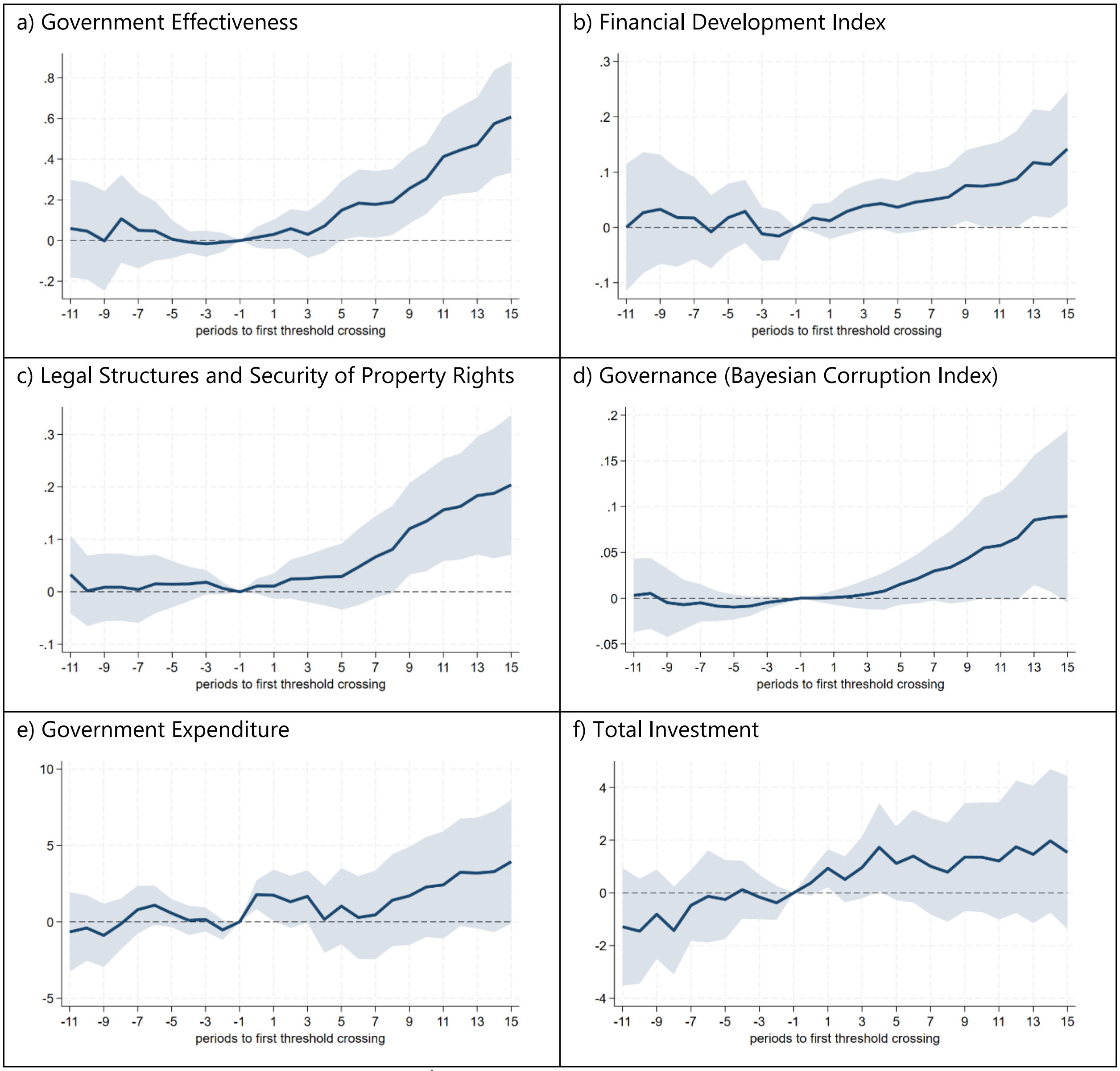
Overall, we find no significant differences in pre-trends in institutional development indicators prior to reaching the tipping point. However, our estimates show improvements in institutional development indicators that begin at about the time when the tax ratio starts to exceed this threshold. We replicate the analysis twice, on the full and the trimmed sample and obtain very similar results. We present the results obtained on the full sample in the main text and report the other results in the appendix (Figure A7).

First, we find that government effectiveness also improves when crossing the tax ratio threshold. The results of the event study show the absence of a pre-trend and a significant and continuous improvement of the government effectiveness indicator after the tax ratio rises above the threshold (Panel b in Figure 9). The magnitude of the improvement is large and, therefore, highly significant despite a small sample size (due to many missing observations). After ten years, it is equal to 30 percent standard deviation of the indicator. Again, such 10-year improvements are rare as they occur in less than 20 percent of the available observations.

Second, focusing on financial development, we find that it starts to accelerate when the tax ratio rises above the threshold. The estimated dynamics shown in Panel “a” in Figure 9 suggest that there is no significant difference in the 11 years prior to crossing the threshold. However, there is a clear and steady increase in the financial development index around the time of the threshold crossing, indicating that the already documented acceleration in GDP growth is tightly associated with financial development. Furthermore, the magnitude of the estimated improvement after ten years is large and statistically significant at almost 10 percent of the standard deviation of the index.

The finding that financial development accelerates after crossing the tax-to-GDP threshold is robust to the use of alternative indicators. We examine the narrower concept of private credit by depositing money banks to GDP because it has better time coverage. The results are similar but clearer, with no pre-trends and significant improvement post-crossing (Figure A panel a in the Appendix). Further, our baseline index allows us to distinguish between the development of financial institutions and the development of financial markets. Results in Figure A6 panel c and d in the Appendix suggest that overall financial development comes mostly from improvements in financial institutions and less so from improvements in financial markets.

Figure 9. Dynamic Effects of Crossing the Tax-Ratio Threshold from Below: Event Study Graphs



Notes: The graphs show the coefficient estimates $\hat{\beta}_k$ from equation (3) and the associated 90 percent confidence interval. The coefficients β_k capture the effects of having crossed the 10.35 percent tax ratio threshold either $-\kappa$ years ago for $\kappa < 0$, or κ years after for $\kappa > 0$. The outcome variable is the Financial Development Indicator in panel a), the Government Effectiveness Indicator in panel b), the Legal Structures and Security of Property Rights in panel c), and the Bayesian Corruption Index in panel d). See Section II.1 and Table A2 for details. Robust and asymptotic standard errors are estimated using Influence Functions.

Third, we examine legal structures and the security of property rights (Panel c in Figure 9) where evidence is more mixed. Again, there are no significant differences between countries whose tax ratios will cross the threshold and those in the control group before the threshold crossing. Although insignificant, the estimates nevertheless point to some slow improvement prior to the crossing. After the tax ratio crosses the threshold, progress along this dimension is initially slow and only accelerates significantly after ten years. By then, the magnitude of the added increase is equal to 15 percent of the standard deviation of the indicator.

Fourth, we find some suggestive but mostly statistically insignificant evidence that crossing the tax threshold leads to improved governance. Both the estimated effects on the Bayesian Corruption Index (Panel d in Figure 9) and the alternative Public Sector Corruption Index (Figure A6 panel b) strongly suggest the absence of any pre-trends prior to crossing the threshold. Thereafter, estimates for both indicators suggest a continuous decline in corruption, but the improvement in governance is often insignificant. This may be because the improvement after ten years is small, equal to 5 percent of the standard deviation of the Bayesian Corruption Index.

Finally, we find that higher taxes and the development of institutions impact other macro-economic variables. Higher government revenue immediately translates into higher spending (Panel e in Figure 9). Government expenditure increases by 2 percent of GDP for at least a decade. However, higher revenue and higher spending broadly offset each over and we don't find any significant change in the primary balance nor in the debt-to-GDP ratio (Figure A6 panel e) and f) in the appendix). Noisy estimates also suggest that total investment increases, with at least a significant increase of 1 percent of GDP the year after the crossing the threshold, and further insignificant increases to 2 percent in the years that follow.

Lessons from Sustainable Increases in the Tax-to-GDP Ratio

We now distinguish between short-lived and sustained increases of the tax ratio above the threshold. While our results support a significant average effect from raising the tax-to-GDP ratio above the tipping point, they also point to heterogeneous outcomes.

Some countries experience short-lived tipping point crossings: their tax-to-GDP ratio rises above the threshold momentarily before falling back below it. In Table 7 we split in half the sample of countries for which we observe the tax ratio continuously for 7 years around the tipping point (the sample underlying Table 7). The first sub-sample consists of countries with short-lived crossings, meaning countries for which the tax ratio is above the threshold less than 75 percent of the time in the 15 years after crossing the threshold. The second sub-sample consists of the other half of countries that maintained the tax ratio above the threshold more sustainably. Table 7 shows that countries have similar tax ratios on average initially and until they cross the threshold. However, countries with a short-lived crossing see their tax ratio falling back below the threshold two years after the initial crossing on average.

Table 7. Tax-to-GDP Ratios around the First Threshold Crossing

	21 countries with short-lived crossings				22 countries with sustained crossings			
	Mean	SD	First quantile	Third quantile	Mean	SD	First quantile	Third quantile
Three years prior	7.93	2.25	4.9	10.05	8.08	2.02	6.22	9.76
Two years prior	8.31	2.22	6.67	9.79	8.67	1.45	6.65	9.85
One year prior	9.3	0.94	7.97	10.05	9.39	0.96	7.61	10.08
Threshold crossing year	10.98	0.85	10.38	11.88	11.33	1.18	10.63	12.19
One year after	11.02	2.48	9.45	11.84	11.81	0.85	10.86	12.92
Two years after	10.27	1.58	8.89	11.96	11.62	1.03	10.34	12.78
Three years after	10.08	1.25	8.58	11.6	11.92	1.38	10.66	12.85

Note: The table focuses on the 43 countries for which we observe tax-to-GDP ratios in a 7-year window around the year when they exceed the tax threshold for the first time. The left panel shows summary statistics for the subset of 21 countries for which the tax ratios are above the threshold less than 75% of the times in the 15 years after crossing the threshold. The right panel shows summary statistics for the subset of 22 countries for which the tax ratios are above the threshold more than 75% of the times in the 15 years after crossing the threshold.

We contrast the experience of countries that succeeded in raising the tax-to-GDP ratio sustainably and those that did not. To do so, we split our sample using the same rule as in Table 7, separating countries depending on whether their tax ratio stays more or less than 75 percent of the time above the threshold in the 15 years after crossing the tax tipping point. Interestingly, the two groups are extremely similar along many other dimensions in the year that precedes their crossing of the tax threshold: they have distributions of values for our four development indicators that are very close across the two groups, with the possible exception of legal structure (Figure A9 in the appendix). This supports an interpretation that any difference in development trajectories across the two groups is closely linked to the nature of tax developments.

Hence, we implement our event study estimation on each sub-sample separately.[18]

We find that the growth benefits of crossing the tipping point are short-lived and insignificant if the tax ratio is above the threshold only briefly. Figure 10 shows the dynamics of the tax ratio, GDP per capita, and the institutional development indicators for each sub-sample. By construction, we see that tax ratios in the group with short-lived crossings return to their initial levels, and that this occurs only a few years after crossing the threshold (left-hand side of panel a) in Figure 10). For these countries with a short-lived crossing, GDP per capita initially increases slightly but insignificantly initially and stays mostly at the same level in the 15 years after the crossing (left-hand side of panel b) in Figure 10). By contrast, the countries that maintained their tax

[18] Note that we include the group of countries that never cross the threshold in both subsamples as controls.

ratios more sustainably above the threshold experience a steady increase in that ratio beyond the initial increase, by up to 5 percent of GDP after 12 years. In parallel, economic growth accelerates and GDP per capita increases continuously and significantly, with annual growth higher by almost 2 percentage points for 10 years compared with the control group. In all our outcome variables, there are no pre-trends.

While sustainable crossings are associated with significant and substantial improvements in financial development and government effectiveness, short-lived crossings are characterized by the absence of any improvement along these two dimensions (panels c and d in Figure 10). The estimation results also show that the timing of these improvements tightly coincides with the increase in the tax ratios in the case when they increase sustainably. In contrast, evidence for the other two development indicators is more mixed, like in the general case. Panel e) in Figure 10 shows that the legal framework seems to increase in both sub-samples although the increases are only significant a decade after the crossing of the threshold. Panel f) in Figure 10 shows a decline in corruption, although small and insignificant, in both sub-samples. Overall, this shows that sustainable and successful crossing of the tax threshold are tightly associated with improvements in financial development and government effectiveness and less clearly so with improvements along other dimensions of institutional development.

Finally, we also see substantial differences in investment across groups. Especially when examining government investment, we find a large and sustainable increase in the first four years following a sustained crossing of the tax threshold, with a peak that reaches almost 2 percent of GDP (Figure 10 panel h). This increase is particularly large in light of the sample average public investment of 4.6 percent. By contrast there is no significant change before and after crossing the tax threshold when that crossing is short-lived.

These heterogeneous results invite a deeper understanding of the reform processes that bring about sustained increases in tax capacity. This is largely beyond the scope of this paper but Gaspar, Jaramillo and Wingender's (2016a) companion paper identified constitutive institutions, inclusive politics, and credible leadership as crucial political ingredients through the lens of four case studies where tax capacity increased substantially. Future research could explore the respective roles of political systems and transitions, existing institutional competencies, and external support, for example. Similarly, the design of tax policies and composition of revenues may be relevant for the growth impacts and sustainability of reforms (Arnold et al., 2011; Acosta-Ormaechea and Moruzomi, 2021) but incomplete historical revenue composition data hinders an investigation of this margin with the data used in this paper.

Figure 10. Dynamic Effects of Crossing the Tax-Ratio Threshold from Below: Event Study Graphs

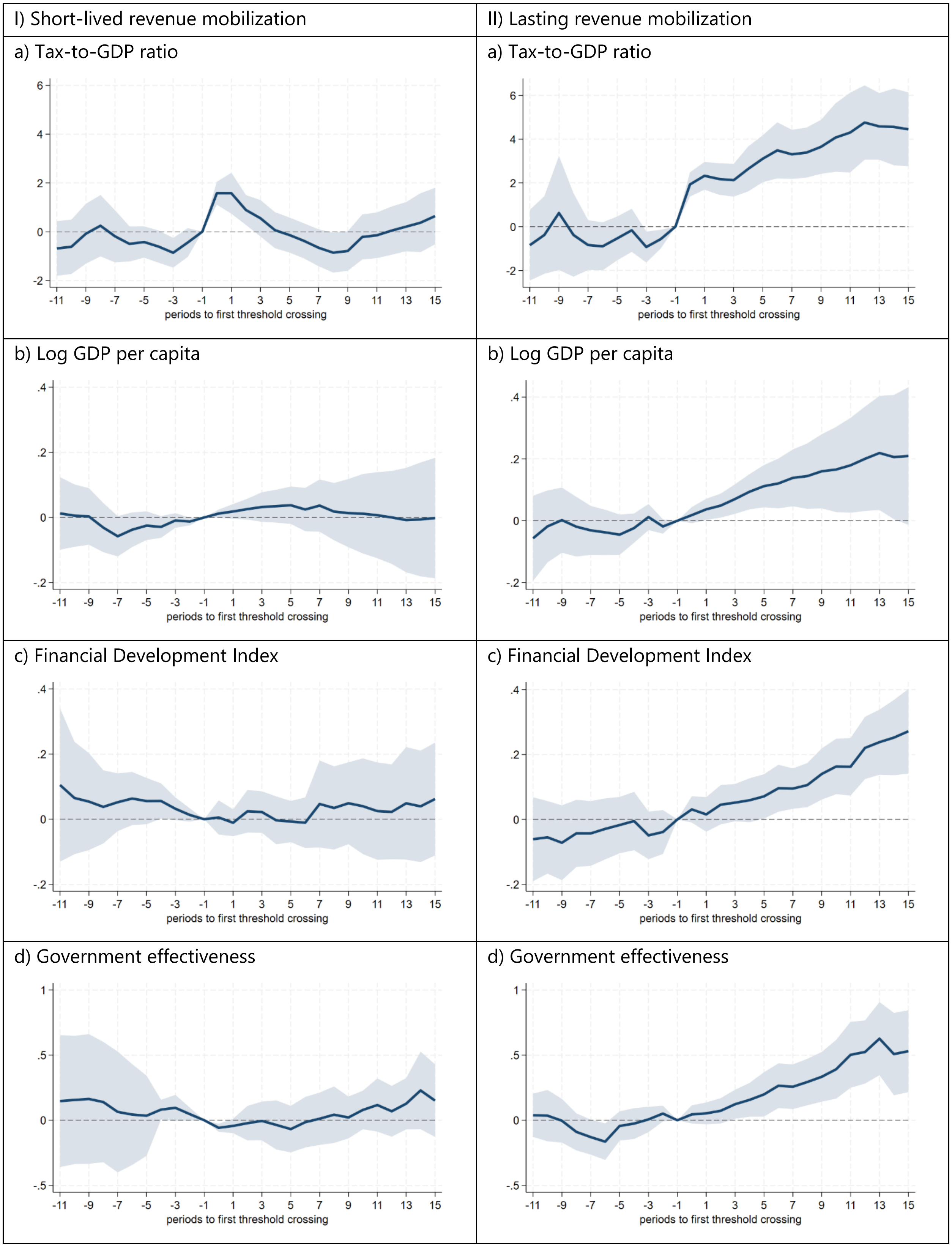
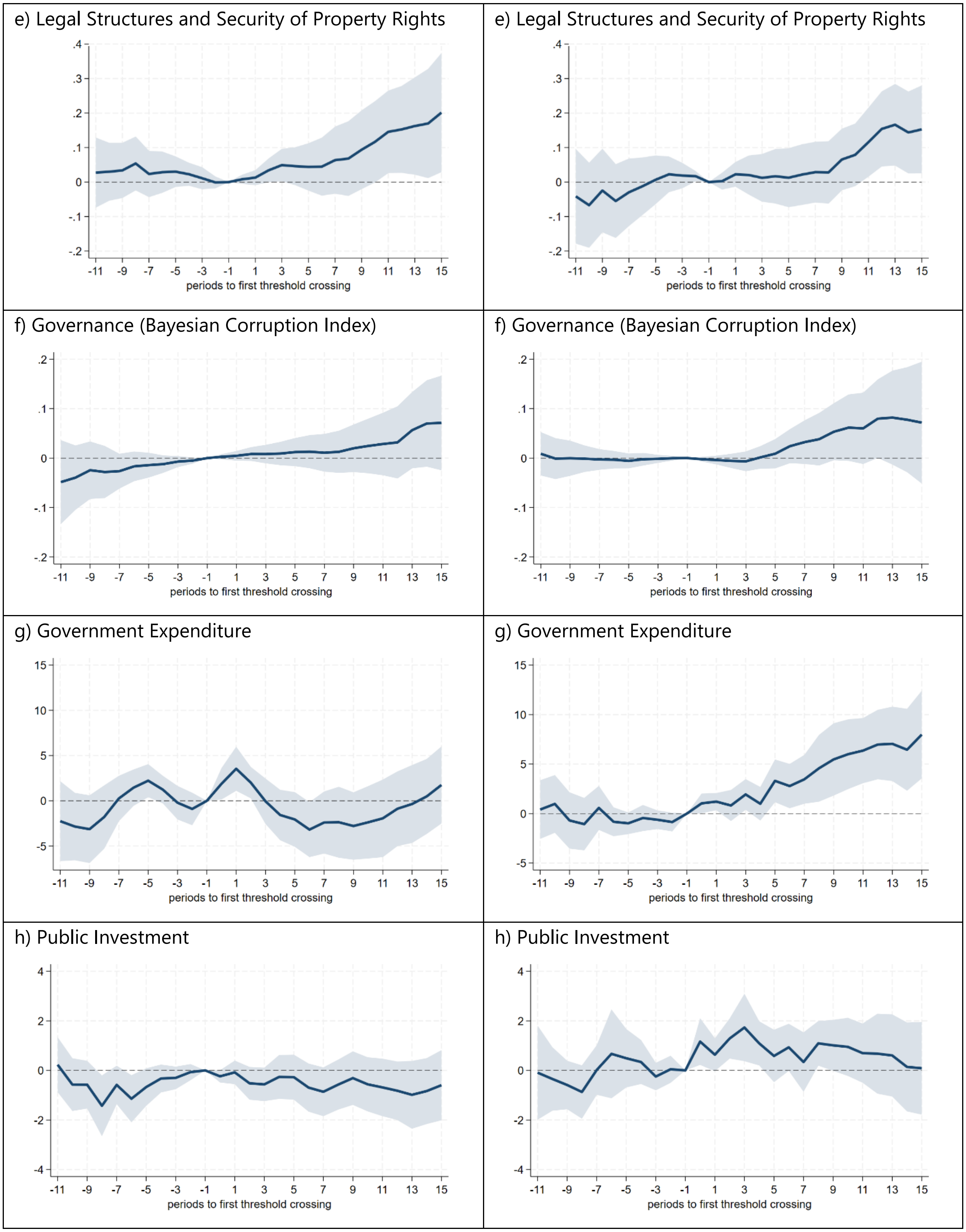


Figure 10 Continue



Notes: The graphs show the coefficient estimates from equation (3) and the associated 90 percent confidence interval. The coefficients capture the effects of having crossed the 10.35 percent tax ratio threshold either $-\kappa$ years ago for $\kappa < 0$, or κ years after for $\kappa > 0$. Graphs are the left-hand (right-hand) side are estimated using the sub-sample of countries for which the tax ratios are above the threshold less (more) than 75% of the times in the 15 years after crossing the threshold. The outcome variable is the tax-to-GDP ratio in panels a), log GDP per capita in panels b), the Financial Development Indicator in panels c), the Government Effectiveness Indicator in panel d), the Legal Structures and Security of Property Rights in panel e), and the Bayesian Corruption Index in panel f). See Section II.1 and Table A2 for details. Robust and asymptotic standard errors are estimated using Influence Functions.

V. Theoretical Interpretation of Findings

1. Model Setup

We rationalize our empirical findings with a simple dynamic model of development. The model features multiple equilibria, including a low-development trap, inspired by the literature on poverty traps (Azariadis and Stachurski, 2005). It also features complementarity between fiscal capacity and other elements of institutional capacity, in the spirit of Besley and Persson (2014). We assume that fiscal capacity is captured by the tax-to-GDP ratio and denote this ratio with the variable s. We bundle other dimensions of institutional capacity in a stock variable Z. This variable can be interpreted as measuring the strength of Besley and Persson's other two pillars of prosperity, namely legal capacity and collective capacity, and more generally reflects the public goods (tangible and intangible) that support economic activity.

We take a long view and assume that production is essentially a function of institutional capacity. Specifically, we assume that production is given by a function F(AL,K,Z) that has three inputs: the stock of productive institutional capacity, the stock of private capital K, and labor L which is augmented with exogenous technological productivity A. We assume that the function is homogeneous of degree 1. We further assume that the stock of capital per effective worker is entirely determined by institutional capacity, meaning that there is a function $k(.)$ such that $\frac{K}{AL} = k\left(\frac{Z}{AL}\right)$. Therefore, output per capita is given by a function $f(z) = \frac{F(AL,K,Z)}{AL} = F(1, k(z), z)$ where the lower-case variable z is the stock of institutional capacity per worker, adjusted for productivity. The function is assumed to be monotonically increasing.

We assume that institutional capacity can accumulate over time, and that such accumulation is facilitated by government investments. The government can use a fraction $(1-g)$ of its total revenue $s * f(z)$ to invest in productive institutional capacity. In practice, this investment can take the form of infrastructure building (e.g., roads, schools, hospitals, etc.), expenditure that contributes to law enforcement and national security, as well as spending towards improving the quality of the legal and regulatory framework. An exogenous fraction δ_z of the stock of institutional capacity depreciates per unit of time, reflecting physical wear and tear as well as bureaucratic drift. Hence, the law of motion for institutional capacity follows the following equation, where $\dot{z}$ is the derivative of z with respect to time and ϵ_z is a term that is mean-zero and captures shocks, such as discretionary reforms or sudden political regime changes.

$$\dot{z} = s * f(z)(1-g) - \delta_z z + \epsilon_z \qquad (4)$$

Absent any discretionary reform, we assume that changes in the tax ratio are the result of a race between competing pressures. We denote the change in the tax ratio per unit of time as $\dot{s}$ (the derivative of s). On the one hand, the tax ratio decreases every period at a rate δ_s, because taxpayers find new loopholes and new (legal and illegal) ways to avoid paying taxes and governments face pressure to introduce tax concessions to support different economic and social causes. On the other hand, the government can foster compliance by building trust about the use of government revenue ("tax morale") and with better tax administration, although its ability to effectively do so depends on institutional capacity, as reflected by an increasing function $h(z)$. Hence, the law of motion for the tax ratio follows the following equation, where ϵ_s is again a term that is mean-zero and captures shocks, such as discretionary reforms.

$$\dot{s} = h(z) - \delta_s s + \epsilon_s \qquad (5)$$

2. Dynamic Results

The dynamic solutions that satisfy the two laws of motion are best described with a phase diagram in the (z, s) space. In this space, the curve defined by $\dot{z} = 0$ and $\epsilon_z = 0$, or equivalently defined by $s = \frac{\delta_z z}{f(z)(1-g)}$, indicates the values of (z, s) such that z is stable (in blue in Figure 11). Institutional capacity increases in the area above this curve where $s > \frac{\delta_z z}{f(z)(1-g)}$ as this implies $\dot{z} > 0$. It decreases in the area below. In words, institutional capacity increases when a high enough tax ratio ensures that investment in such capacity exceeds exogenous capacity depreciation. Similarly, the curve defined by $\dot{s} = 0$ and $\epsilon_s = 0$, or equivalently by $s = \frac{h(z)}{\delta_s}$, indicates the values of (z, s) such that s is stable (in red in Figure X). And the tax ratio increases in the area below this curve where $s < \frac{h(z)}{\delta_s}$ as this implies $\dot{s} > 0$. Intuitively, the tax ratio increases if the economy starts from a low tax ratio such that the effect of tax erosion is small and is more than compensated by the revenue the government can mobilize thanks to existing institutional capacity.

We interpret the literature and our empirical findings as indicating that there are two stable equilibriums, one characterized by low development and a low tax ratio, and another characterized by the opposite, as described in Figure 11. In general, the phase diagram implied by the above two laws of motions can take different forms depending on the shape of the $f(z)$ and $h(z)$ functions. We consider the case with two attractors (stable equilibriums at points A and C) and one unstable saddle path equilibrium (point D).

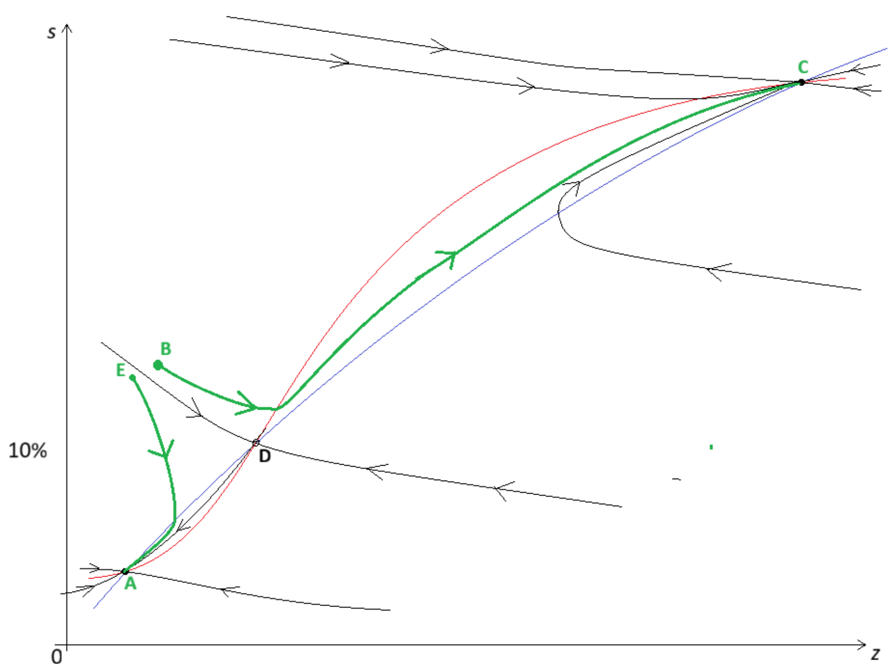
The model dynamics can rationalize the different trajectories empirically observed after crossing the tipping point. At equilibrium in the model, countries that are below the tipping point are at the low-z low-s equilibrium in point A in Figure 11. Following a shock (ϵ_z, ϵ_s), they can experience an increase in the tax ratio that brings them above the threshold. Two types of trajectories ensue: countries can land above the saddle path as in point B if the shock is positive enough along the two dimensions, or below as in point E. From point B, the laws of motion imply that the country will move to a new high-z high-s equilibrium (along the thick green curve to point C), accumulating more institutional capacity along the way, and possibly experiencing further increases in the tax-to-GDP ratio as greater capacity allows the government to mobilize more revenue. Further, the increase in institutional capacity leads to an increase in production (above and beyond what would be implied by exogenous population and productivity growth). From point E, the laws of motion imply that the tax ratio gradually converges back to the low-z low-s equilibrium in point A, as there is not enough accumulation of institutional capacity to sustain higher tax collection.

The B-to-C trajectory is fully consistent with the crossings documented for the countries that raised the tax ratio sustainably above 10 percent of GDP: in this case, the previous section showed an increase in investment as well as a steady improvement in various measures of institutional capacity, along with a continued increase in revenue. The E-to-A trajectory is consistent with the other empirical case, where short-lived crossings of the tipping point are associated with insignificant changes in various measures of institutional capacity.

Our model suggests that the keys to successful crossings are either a tax increase that is sufficiently above the threshold, or an increase in the tax ratio paired with a simulatenous improvement in institutional capacity. Either combination can move a country above the saddle path and on a trajectory to the high-z high-s equilibrium. Empirically, we see that the sustained crossings that deliver accelerated growth start with a slightly larger increase in the tax ratio on average and are associated with an improvement in public investment and several measures of institutional capacity.

While our analysis focuses on increases in the tax-to-GDP ratio, the transition to the high-z high-s equilibrium could theoretically be initiated by any combination of shocks (ϵ_z, ϵ_s) that brings the economy above the saddle path. Because the saddle path is downard slopping, this could be achieved with a large positive shock to the stock of institutional capacity ϵ_z and with a smaller role for ϵ_s. In practice, it might be harder and less likely to see large and rapid improvements in institutional capacity compared to large positive shocks to the tax-to-GDP ratio, as the levers of tax policy arguably provide more scope for discretionary reforms than for institutional capacity. But our analysis focuses on the tax ratio and cannot rule out the relevance of large shocks to institutional capacity. We leave research on such shocks for future work.

Figure 11. Dynamic Changes in the Tax-to-GDP ratio and Institutional Capacity in Theory



Notes: This is the phase diagram of the tax-to-GDP ratio s and institutional capacity z implied by equations (4)-(5). Point A and point C are two attractors (stable equilibriums) while point D is an unstable saddle path equilibrium. The thick green trajectory going from point B to point C illustrates the dynamics of a country that crosses the 10% tax threshold sustainably while the other thick green trajectory going from E to A illustrates the dynamics of a short-lived crossing of the threshold.

VI. Conclusion

This paper corroborates earlier research finding that there is a minimum level of tax-to-GDP above which economic growth accelerates. Assembling a historical tax series covering 150 countries from 1965 to 2019 and applying the two-step approach applied by GJW, we find a robust tax tipping point of around 10 percent of GDP. This figure is nearly three percentage points lower than in GJW, with this change primarily driven by considerable and widespread upwards revisions to historical nominal GDP series, implying lower tax-to-GDP ratios.

Durable crossings of the tax threshold are associated with an increase in per capita GDP of about 20 percentage points over a dozen years. With short-lived crossings seeing no subsequent growth benefits, sustained crossers drive an average growth gain of 10 percentage points over 10 years when considering the full sample of tipping point crossings. The magnitude of the growth effect is both statistically and economically significant, as estimated using both a regression discontinuity approach and a dynamic difference-in-difference method. The latter approach also shows no significant differences in growth trends prior to countries crossing the tipping point compared to countries that remain below the tipping point.

Additionally, we document that durable crossings of the tax threshold are associated with substantial improvements across several other dimensions of economic and institutional development, including financial development, government effectiveness, government investment, and legal institutions. As with economic growth, the gains that we find on these outcomes in the overall sample are concentrated in countries that maintain their tax ratios at an increased level above the tipping point.

The contrasted trajectories of countries with sustainable versus short-lived tax increases suggest that the tax tipping point might be best reinterpreted as a minimum tax threshold for accelerated growth. It is not that case that a single year of tax revenue mobilization above a critical threshold yields economic development gains in subsequent years. Instead, crossing this threshold can mark the start of a marked upturn in economic fortunes if increases in tax revenues are sustained and paired with complementary investments and improvements in public goods and institutional capacities.

Our findings provide evidence for a minimum level of tax capacity necessary for economic development and can be rationalized with a simple theoretical model. A critical threshold of tax revenue enables a minimum level of state capacity and public goods that support economic development. Crossing the threshold yields a fiscal double dividend for the state as its revenue increases both because of the higher tax-to-GDP ratio and because of a larger tax base. Greater fiscal capacity provides financing for the other fundamental “pillars of prosperity”. Countries stuck below the threshold remain trapped in a low-tax and low-capacity equilibrium; those that cross it take the first decisive step toward durable development.

But our findings also imply that a holistic approach to revenue mobilization is needed, advocating for tax-to-GDP ratios durably above the tipping point and accompanied by institutional reforms. Finding the optimal level of taxes is beyond the scope of this paper and depends on many factors, notably including national economic conditions and citizens’ preferences. However, the dynamics of development indicators around the tipping point suggest that accelerated socio-economic growth only materializes for transformational changes in revenue mobilization—that is for large and sustained increases in tax revenues above the tax tipping point that are accompanied with institutional development along other dimensions.

References

Acosta-Ormaechea, S. and Moruzomi, A. (2021). The value-added tax and growth: design matters. *International Tax and Public Finance*. Volume 28, pages 1211–1241.

Arnold, J. M., Brys, B., Heady, C., Johansson, Å., Schwellnus, C., & Vartia, L. (2011). Tax policy for economic recovery and growth. *Economic Journal*, 121, F59–F80.

Azariadis, C. and Stachurski, J., 2005. Poverty traps. *Handbook of economic growth*, *1*, pp.295-384.

Barro, R. J., 1990, "Government spending in a simple model of endogenous growth", Journal of Political Economy, 98, 103-125.

Barro, R. J. and X. Sala-i-Martin, 1992, "Public finance models of economic growth", Review of Economic Studies, 59, 645-661.

Benitez, J. C., M. Mansour, M. Pecho & C. Vellutini. *Building Tax Capacity in Developing Countries.* IMF Staff Discussion Note SDN/2023/006, September 2023, International Monetary Fund, Washington DC.

Berg, A., Ostry, J. D., & Zettelmeyer, J. (2012). "What makes growth sustained?", Journal of Development Economics, 98(2), 149-166.

Bergeron, A., Tourek, G., & Weigel, J. L. (2024). The State Capacity Ceiling on Tax Rates: Evidence from Randomized Tax Abatements in the DRC. Econometrica, 92(4), 1163-1193. https://doi.org/10.3982/ECTA19959

Besley, T. and T. Persson, 2011, Pillars of Prosperity: The Political Economics of Development Clusters. Princeton: Princeton University Press.

Besley, T. and T. Persson, 2014, "The Causes and Consequences of Development Clusters: State Capacity, Peace and Income", Annual Review of Economics, 6:927-49.

Bugni, F. A., & Canay, I. A. (2021). Testing continuity of a density via g-order statistics in the regression discontinuity design. *Journal of Econometrics*, *221*(1), 138-159.

Callaway, B. and Sant'Anna, 2021, P. H. Difference-in-differences with multiple time periods. Journal of Econometrics, 225(2):200–230.

Cantoni, D., Mohr, C. and Weigand, M., 2024. The Rise of Fiscal Capacity: Administration and State Consolidation in the Holy Roman Empire. *Econometrica*, *92*(5), pp.1439-1472.

Card, D., Mas, A., & Rothstein, J. (2008). Tipping and the Dynamics of Segregation. *The Quarterly Journal of Economics*, *123*(1), 177-218.

Choudhary, R., F. U. Ruch & E. Skrok. *Taxing for Growth: Revisiting the 15 Percent Threshold.* World Bank Policy Research Working Paper No. 10943, 10 July 2024, Washington DC

Dahlberg, Stefan, Aksel Sundström, Sören Holmberg, Bo Rothstein, Natalia Alvarado Pachon, Cem Mert Dalli, Rafael Lopez Valverde, Victor Saidi Phiri & Lauren Gerber. 2025. The Quality of Government Basic Dataset, Version Jan25. University of Gothenburg: The Quality of Government Institute, https://www.gu.se/en/quality-government doi:10.18157/qogbasjan25

Deville, Jean-Claude. 1999. “Variance estimation for complex statistics and estimators: Linearization and residual techniques.” Survey Methodology 25:193–203

Feenstra, R., Inklaar, R. and Timmer, M. (2015), "The Next Generation of the Penn World Table." *American Economic Review*, *105*(10), 3150-3182.

Gaspar, V., Jaramillo, L., & Wingender, P. (2016a). Political Institutions, State Building and Tax Capacity: Crossing the Tipping Point. IMF Working Paper, WP/16/233.

Gaspar, V., Jaramillo, L., & Wingender, P. (2016b). Tax Capacity and Growth: Is there a Tipping Point? IMF Working Papers, WP/16/234.

Government Finance Statistics Manual (GFSM). 1986. “Government Finance Statistics Manual 1986.” A Manual on Government Finance Statistics—1986

Government Finance Statistics Manual (GFSM). 2014. “Government Finance Statistics Manual 2014.” https://www.imf.org/external/pubs/ft/gfs/manual/2014/gfsfinal.pdf.

Hampel, F.R., 1974. The influence curve and its role in robust estimation. Journal of the American Statistical Association, 69(346), pp.383-393.

Hansen, B. E. (1999). Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of econometrics*, *93*(2), 345-368.

Hansen, B. E. (2000). Sample splitting and threshold estimation. *Econometrica*, *68*(3), 575-603.

Hausmann, R., Pritchett, L., & Rodrik, D. (2005), “Growth accelerations”, Journal of Economic Growth, 10(4), 303-329.

International Monetary Fund. 2021. Investment And Capital Stock Dataset (ICSD) 2021: Manual & FAQ - Estimating Public, Private, And PPP Capital Stocks. Washington, DC. https://infrastructuregovern.imf.org/content/dam/PIMA/Knowledge-Hub/dataset/InvestmentandCapitalStockDatabaseUserManualandFAQ_May2021.pdf

International Monetary Fund. 2024. World Economic Outlook: Policy Pivot, Rising Threats. Washington, DC. October

James Gwartney, Robert Lawson, and Ryan Murphy (2024). *Economic Freedom Dataset*, published in Economic Freedom of the World: 2024 Annual Report. Fraser Institute.

James Gwartney, Robert Lawson, and Ryan Murphy (2024). *Economic Freedom of the World: 2024 Annual Report*. Fraser Institute

Kaufmann, Daniel; Kraay, Aart. 2024. The Worldwide Governance Indicators: Methodology and 2024 Update. Policy Research Working Paper; 10952. © World Bank. http://hdl.handle.net/10986/42373

Mansour, M. 2014. “A Tax Revenue Dataset for Sub-Saharan Africa: 1980–2010.” Revue d’économie du développement 22 (3): 99–128.

Mario Mansour, 2015. "Tax Policy in MENA Countries: Looking Back and Forward," IMF Working Papers 2015/098, International Monetary Fund.

Mansour, Mario, Marijn Verhoeven, Fayçal Sawadogo, and Benedict Chu Sheen Tan. 2025. “Methodology and Overview of the IMF’s World Revenue Longitudinal Database.” IMF Technical Notes and Manuals 2025/04. International Monetary Fund, Washington, DC.

Mauro, P., Romeu, R., Binder, A. and Zaman, A., 2015. “A modern history of fiscal prudence and profligacy”. Journal of Monetary Economics, 76, pp.55-70.

Martin Cihák, Asli Demirgüç-Kunt, Erik Feyen, and Ross Levine. 2012. *Benchmarking Financial Systems around the World.* Policy Research Working Paper 6175, World Bank, Washington, DC.

OECD (2023), Revenue Statistics 2023: Tax Revenue Buoyancy in OECD Countries, OECD Publishing, Paris, https://doi.org/10.1787/9d0453d5-en.

Pemstein, D., Marquardt, K. L., Tzelgov, E., Wang, Y.-t., Medzihorsky, J., Krusell, J., Miri, F., & von Römer, J. (2023). *The v-dem measurement model: Latent variable analysis for crossnational and cross-temporal expert-coded data*. Varieties of Democracy Institute Working Paper, 21 (8th Ed)

Schumpeter, J.S., 1918, Die Krisis des Steuerstaats, Zeitfragen aus dem Gebiete der Soziologie, 4, Graz and Leipzig: Leuschner & Lubensky, pp. 3-74 also available as chapter 1, The Crisis of the Tax State, in Richard Swedberg (ed.), 1991, The Economics and Sociology of Capitalism / Joseph A Schumpeter, Princeton: Princeton University Press.

Seidel, A., and M. Thum, 2015, “Tax Evasion, Corruption and Market Entry”, Scottish Journal of Political Economy, doi: 10.1111/sjpe.12100

Standaert, S. (2015). *Divining the level of corruption: A Bayesian state-space approach*. Journal of Comparative Economics, 43 (3), 782–803. https://doi.org/10.1016/j.jce.2014.05.007

Svirydzenka, K., 2016. *Introducing a new broad-based index of financial development*. International Monetary Fund Working Paper 16/5

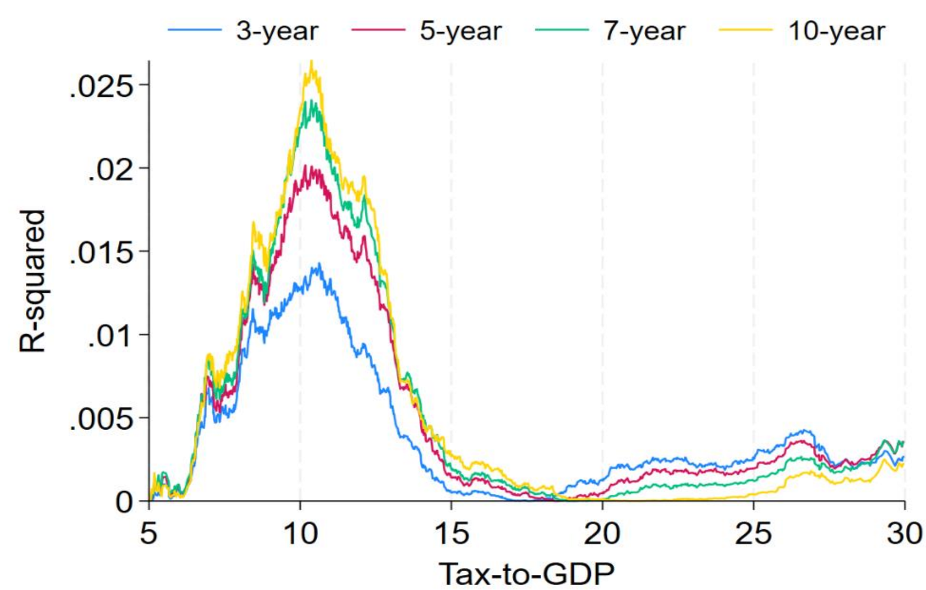
Traxler, C., 2010, “Social Norms and Conditional Cooperative Taxpayers”, *European Journal of Political Economy*, 26 (2010) 89–103.

UNU-WIDER Government Revenue Dataset. Version 2023. https://doi.org/10.35188/UNU-WIDER/GRD-2023.

Appendix

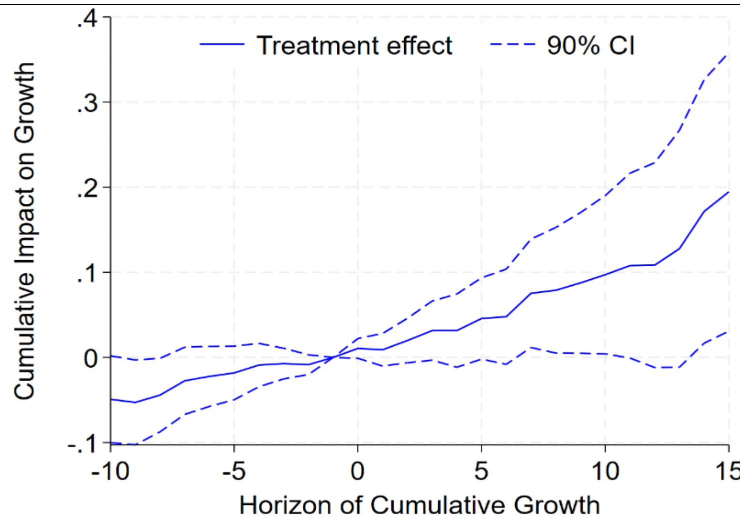
1. Additional Figures

Figure A1. Grid Search for Tipping Point on GJW Sample



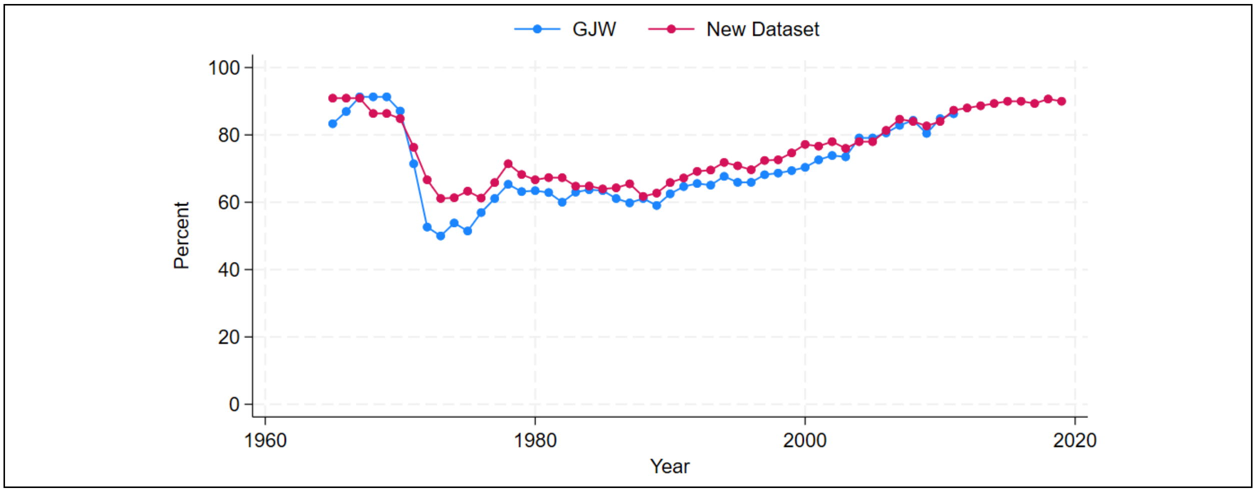
Note: Figure shows the R-squared from estimating Equation (1) when setting the threshold at different values up to 30 percent of GDP. The series are obtained using different growth horizons (3, 5, 7, and 10 years) as the dependent variable. The sample of countries and years here is restricted to those used by GJW, but using the newly constructed tax series of this paper.

Figure A2. The Growth Effect of the Tipping Point at Different Time Horizons



Note: Figure shows regression coefficients for $\hat{\beta}$ with 90 percent confidence intervals from estimating equation (1') over different time horizons *j*.

Figure A3. Countries With Tax-to-GDP Above Estimated Tipping Points



Source: GJW series uses the tax series constructed by Gaspar, Jaramillo and Wingender (2016b) and the tipping point they estimated over a 10-year growth horizon (12.88). New Dataset series uses the tax series constructed in this paper and a threshold of 10.35 based on our 10-year growth horizon estimates. See text for details.

Figure A4. Dynamic Effects of Crossing the Tax-Ratio Threshold: Trimmed Sample

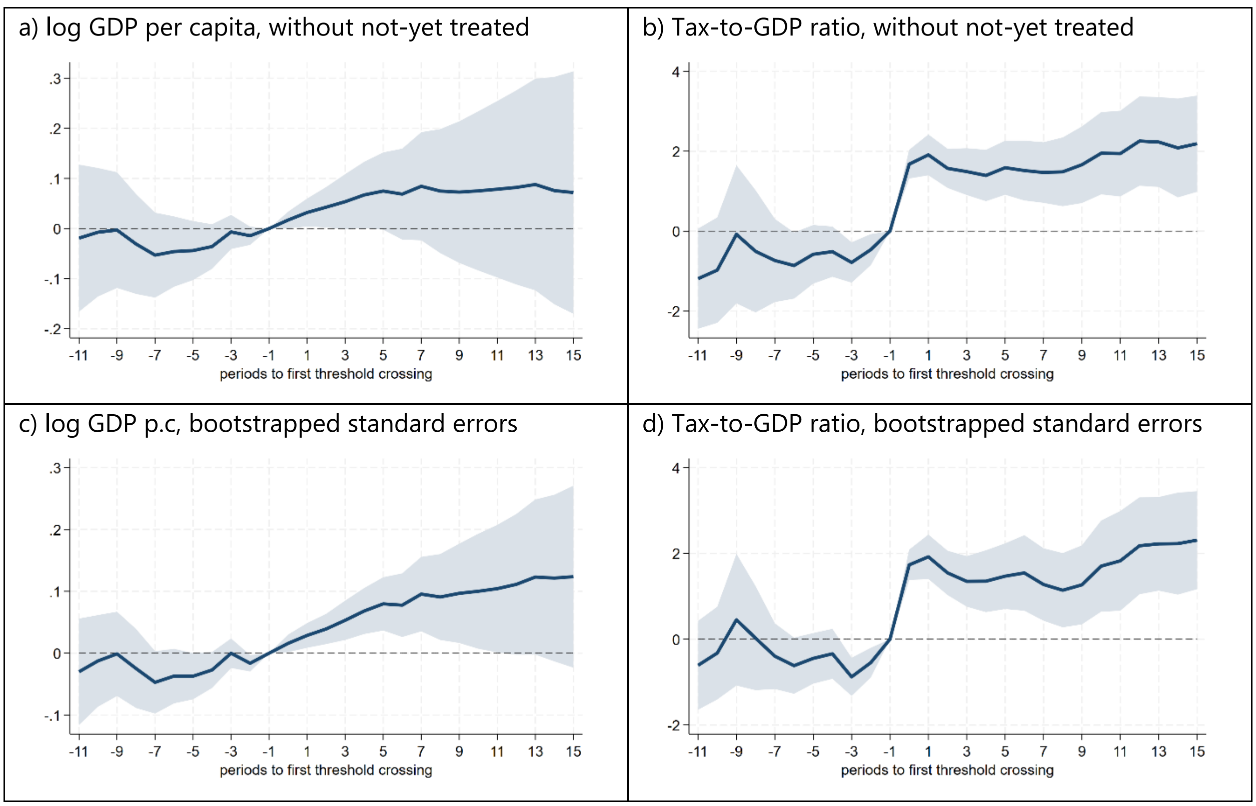
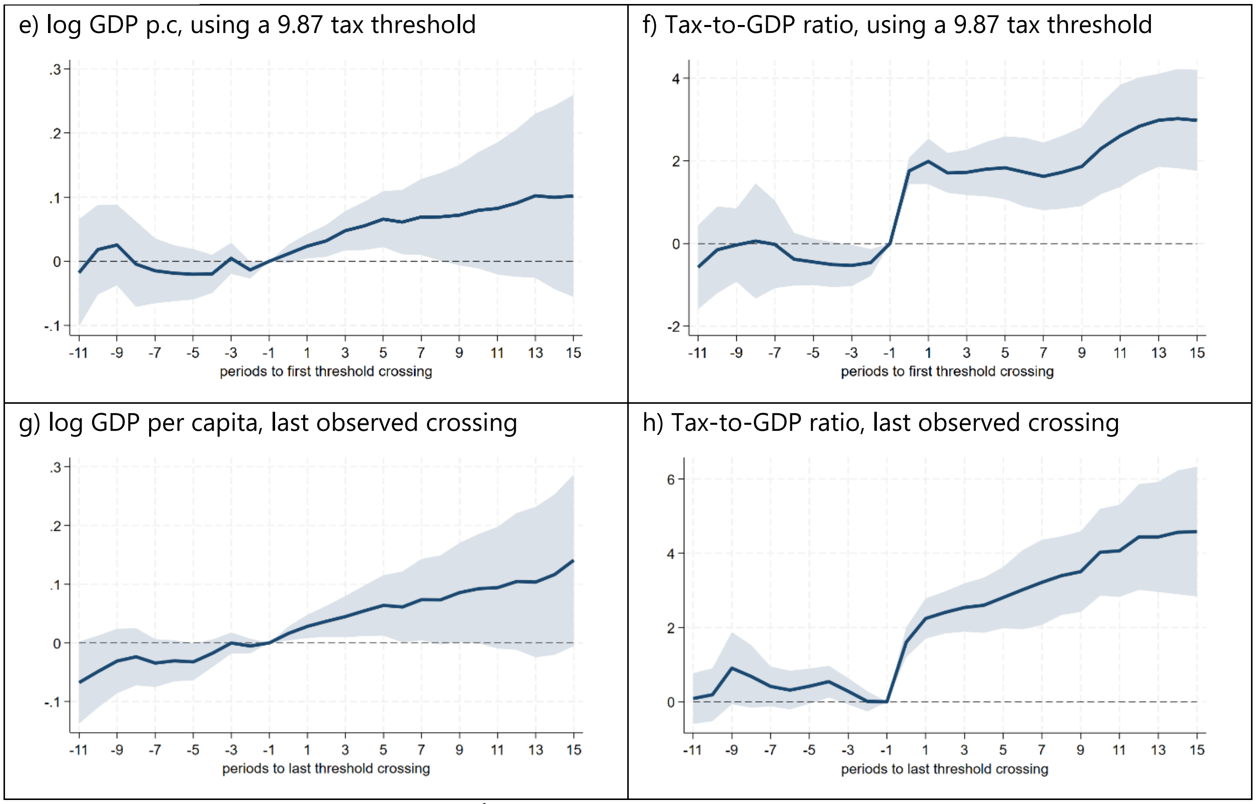


Figure A4 continue



Notes: The graphs show the coefficient estimates $\hat{\beta}_k$ from equation (3) and the 90 percent confidence interval, this time implemented on the trimmed sample (see section III.2 for details). In the first row, the control group only includes the countries that are below the tax threshold throughout the sample; in the second row, standard errors are estimated using a multiplicative WildBootstrap procedure; in the third row, we use a tax-ratio threshold of 9.87 percent; in the last row, treatment is defined as the last observed threshold crossing. Unless otherwise specified, robust and asymptotic standard errors are estimated using Influence Functions.

Figure A5. Dynamic Effects of Crossing the Tax-Ratio Threshold: Event Study Robustness Checks

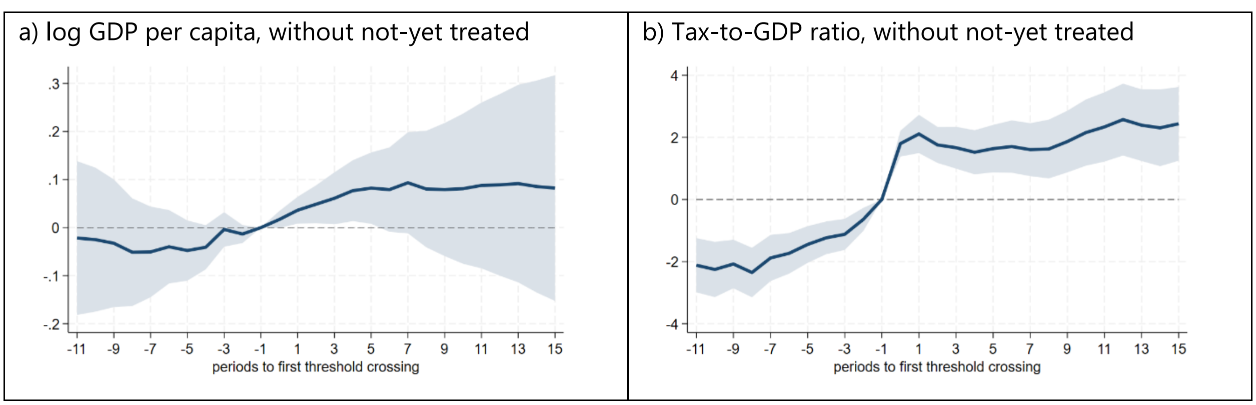
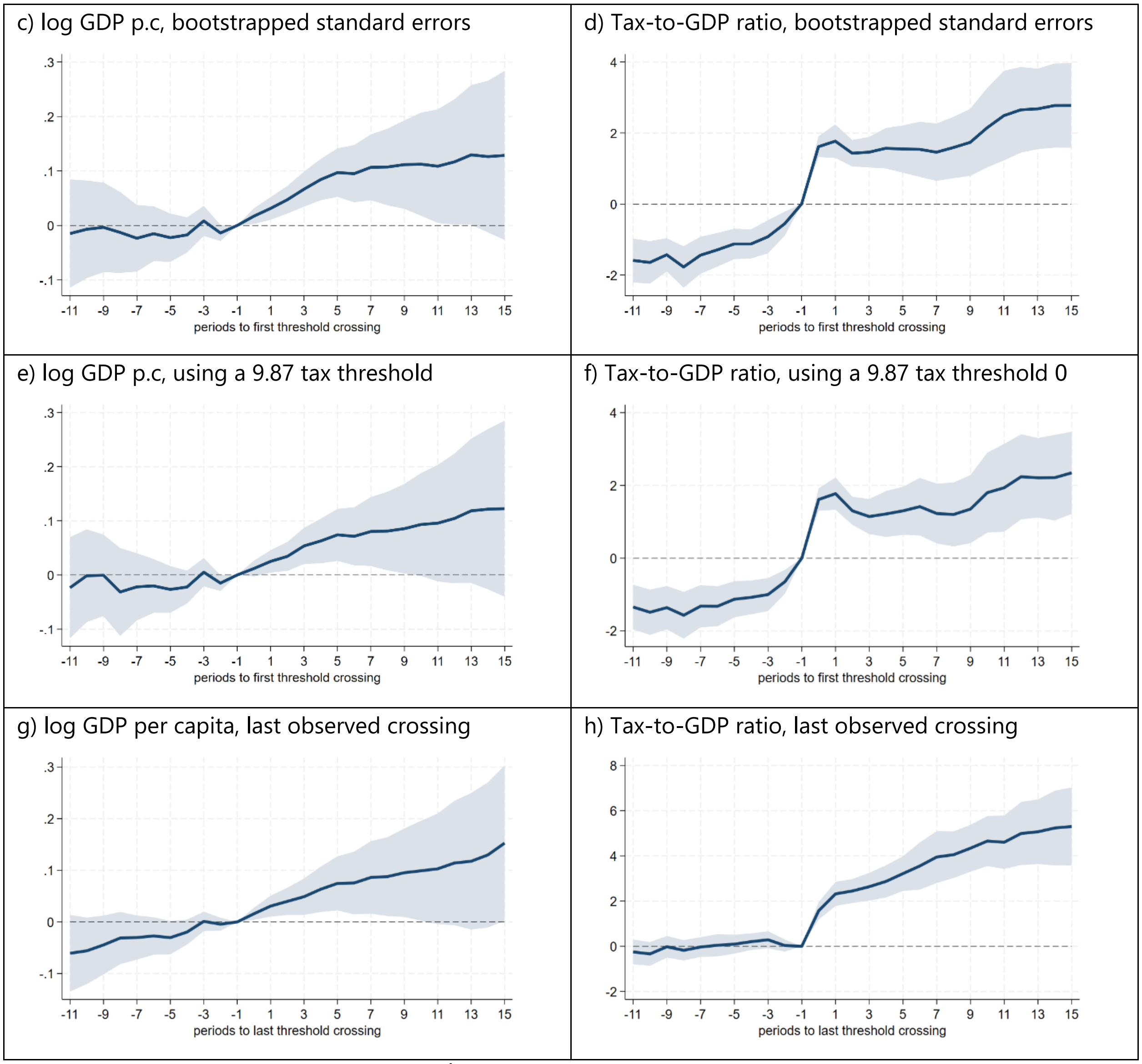
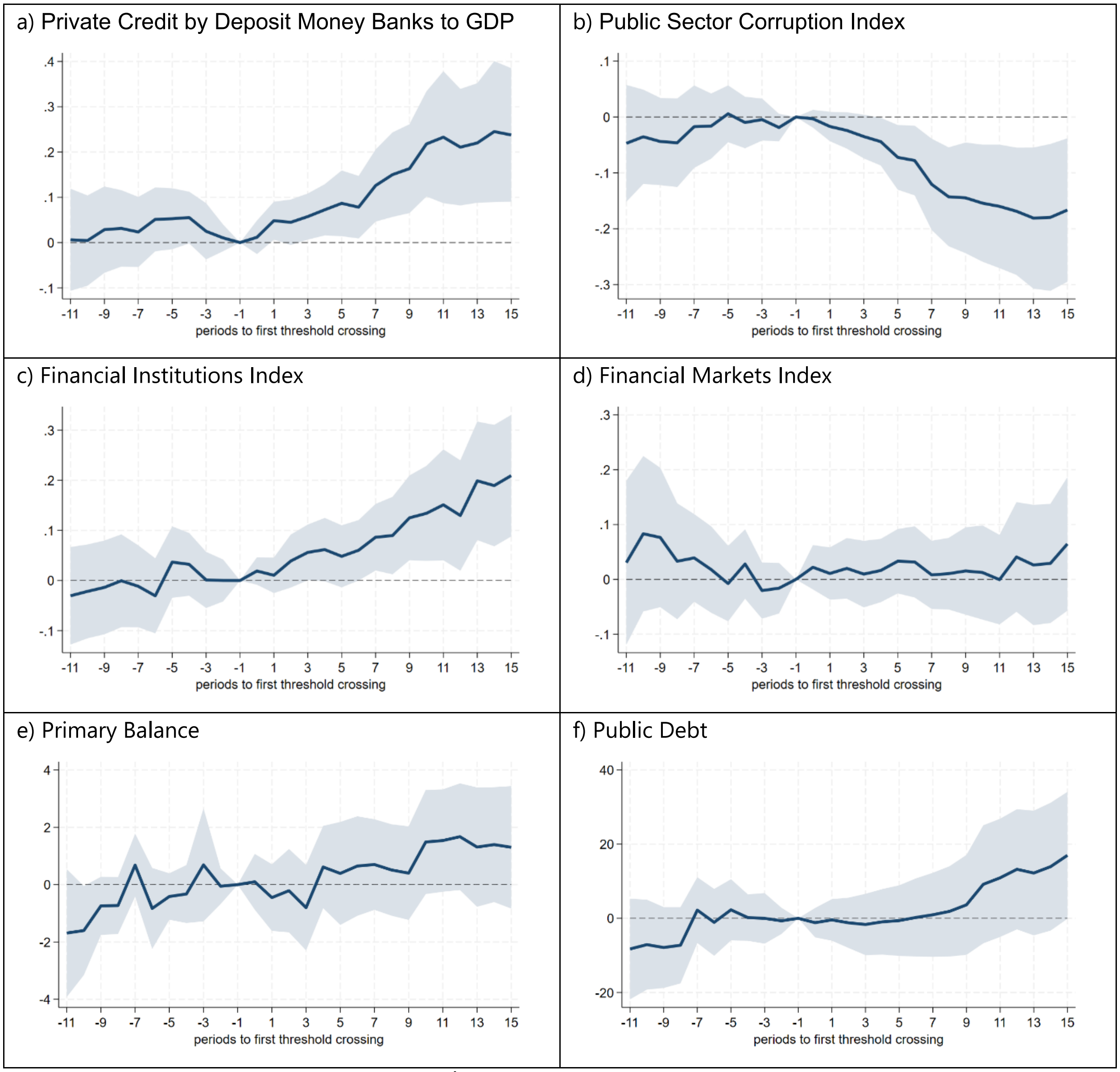


Figure A5 continue



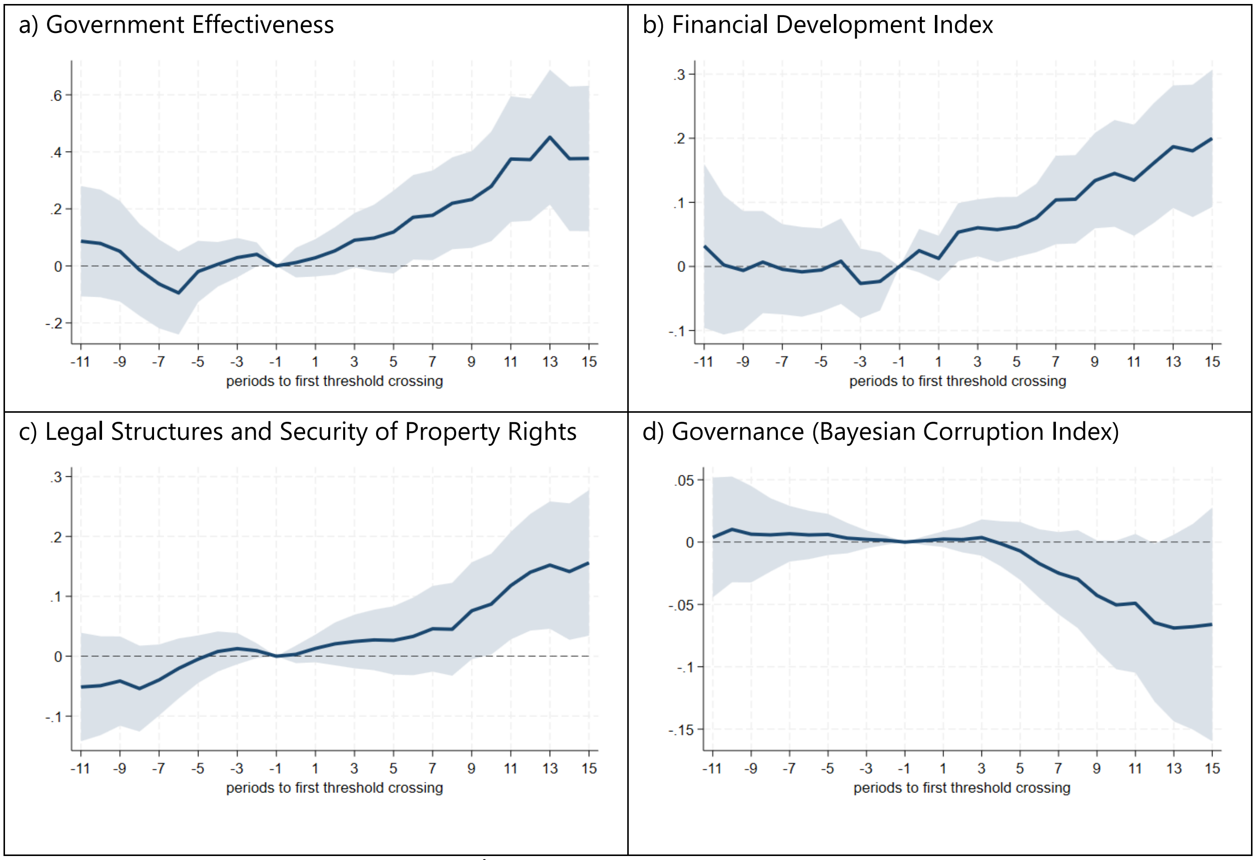
Notes: The graphs show the coefficient estimates $\hat{\beta}_k$ from equation (3) and the 90 percent confidence interval. In the first row, the control group only includes the countries that are below the tax threshold throughout the sample; in the second row, standard errors are estimated using a multiplicative WildBootstrap procedure; in the third row, we use a tax-ratio threshold of 9.87 percent; in the last row, treatment is defined as the last observed threshold crossing. Unless otherwise specified, robust and asymptotic standard errors are estimated using Influence Functions.

Figure A6. Development Indicators Around the Tipping Point: Additional Indicators



Notes: The graphs show the coefficient estimates $\hat{\beta}_k$ from equation (3) and the associated 90 percent confidence interval. The coefficients β_k capture the effects of having crossed the 10.35 percent tax ratio threshold either $-\kappa$ years ago for $\kappa < 0$, or κ years after for $\kappa > 0$. See Section II.1 and Table A2 for details about the outcome variables. Robust and asymptotic standard errors are estimated using Influence Functions.

Figure A7. Development Indicators Around the Tipping Point: Trimmed Sample Event Study Graphs



Notes: The graphs show the coefficient estimates $\hat{\beta}_k$ from equation (3) and the associated 90 percent confidence interval. The coefficients β_k capture the effects of having crossed the 10.35 percent tax ratio threshold either $-\kappa$ years ago for $\kappa < 0$, or κ years after for $\kappa > 0$. The outcome variable is the Financial Development Indicator in panel a), the Government Effectiveness Indicator in panel b), the Legal Structures and Security of Property Rights in panel c), and the Bayesian Corruption Index in panel d). See Section II.1 and Table A2 for details. Robust and asymptotic standard errors are estimated using Influence Functions.

Figure A8. Development Indicators Long Before the Tipping Point and In the Decade Before.

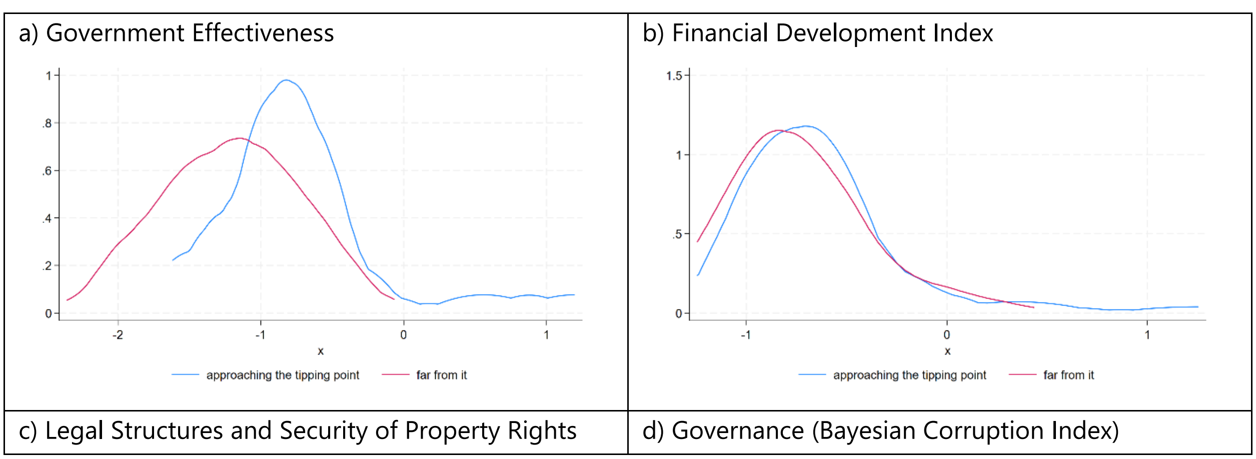
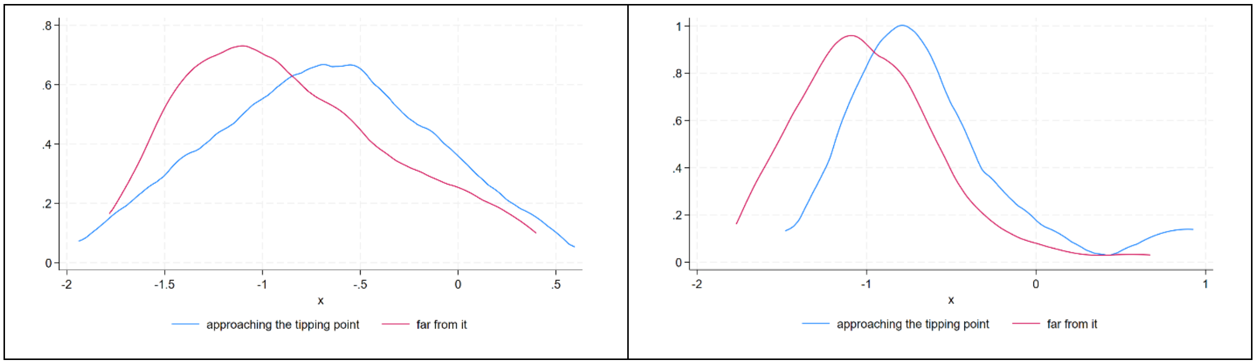
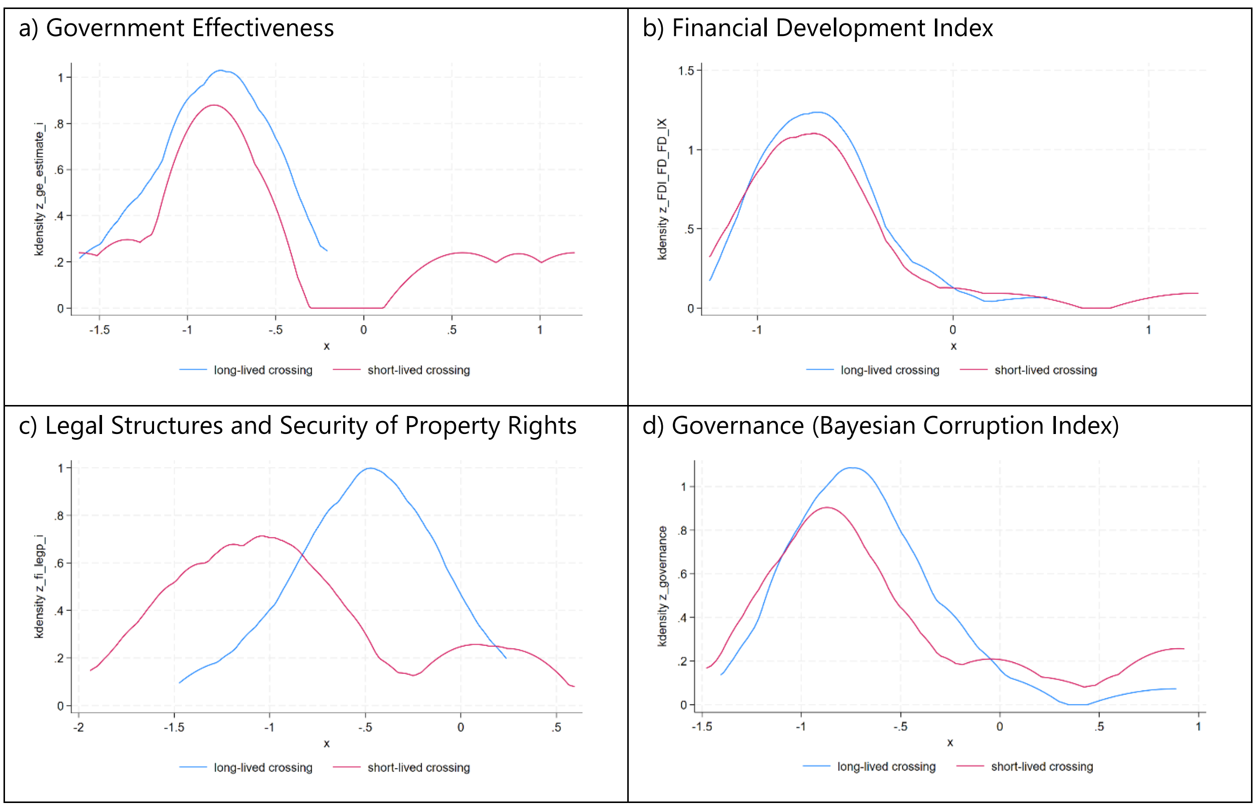


Figure A8 continue



Notes: The graphs show the distribution of development indicators for two subsamples of the event study, distinguishing between countries in the years that are at least a decade away from the tipping point (countries "far from it"), and those that will cross the tax threshold in 10 years or less (countries "approaching the tipping point").

Figure A9. Development Indicators Long Before the Tipping Point and In the Decade Before.



Notes: The graphs show the distribution of development indicators in the year before crossing the tipping point, distinguishing between the sub-sample of countries for which the tax ratios are above the threshold less than 75% of the times in the 15 years after crossing the threshold ("short-lived crossing") and the rest ("long-lived crossing").

2. Additional Tables

Table A1. Pairwise Correlations Between Different Tax Series

ALL DATA	New Series	GJW	WoRLD	OECD	WEO	GRD	GFS
New Series	1.0000						
GJW	0.9584	1.0000					
WoRLD	0.9966	0.9601	1.0000				
OECD	0.9888	0.9927	0.9781	1.0000			
WEO	0.9816	0.9501	0.9849	0.9638	1.0000		
GRD	0.9861	0.9671	0.9836	0.9966	0.9782	1.0000	
GFS	0.8502	0.9068	0.9032	0.9830	0.8722	0.8750	1.0000
SPLICED DATA	New Series	GJW	WoRLD	OECD	WEO	GRD	GFS
New series	1.0000	0.9455	1.0000	0.9828	0.9839	0.9789	0.7956

Note: Authors' construction. Correlation coefficients use all observations available in each pairwise case.

Table A2. Summary Statistics - Table of Raw Indicators

	Years	Countries	Obs.	Interpolated (%)	Scale	Avg.	SD
Financial Development							
Financial Development Index (FDI-FD)	1980-2019	149	5452	0.0	0 - 1	0.3	0.2
Financial Institutions Index (FDI-FI)	1980-2019	149	5452	0.0	0 - 1	0.4	0.2
Financial Markets Index (FDI-FM)	1980-2019	149	5452	0.0	0 - 1	0.2	0.2
Private credit by deposit money banks to GDP (%)	1965-2019	149	5878	0.8	0 - 100	42.4	35.9
Government effectiveness							
Government Effectiveness Index[1][19]	1996-2019	149	3538	12	-2.5 – 2.5	0.1	1.0
Legal Structure and Rule of Law							

[19] [1] Estimate of governance in standard normal units ranging from approximately -2.5 (weak) to 2.5 (strong) governance performance. The units of the estimates of governance are those of a standard normal distribution. This means that roughly 99 percent of estimates will fall within the range -2.5 to 2.5. It is however possible to see more extreme values in rare cases. Looking across all six aggregate indicators for all 25 years covered in the WGI, just 77 out of 30,974, or 0.2 percent of observations, fall outside this range (Kaufman and Kraay 2024).

Table A2 continue

Legal Structure and Security of Property Rights	1970-2019	138	5589	41.9	0 - 10	5.2	1.9
Governance*							
Bayesian Corruption Indicator (BCI)	1984-2019	146	4562	0.0	0 - 100	45.6	18.7
Public Sector Corruption Index	1965-2019	139	5846	0.0	0 - 1	0.4	0.3
Public Finance and Investment							
Total Investment	1965-2019	149	6110	0.0		18.7	8.7
Public Investment	1965-2019	149	6110	0.0		4.6	3.6
Government expenditure	1965-2019	149	4662	0.0		29.5	12.7
Primary Balance	1965-2019	149	4597	0.0		-0.01	3.74
Government Debt	1965-2019	149	4593	0.0		53.1	35.6

Note: Summary statistics for the effective sample of countries with available tax-to-GDP data (6273 observations). * In the analysis we multiply these indicators by -1 to reflect better governance before standardizing them.

Table A3. Years in which Countries Crossed the Tax-to-GDP Threshold of 10.35 Percent of GDP from Below

Country	Years of 10.35 percent threshold crossing from below			
Albania	1998			
Antigua and Barbuda				
Argentina	1992			
Armenia				
Aruba				
Australia				
Austria				
Bahamas, The	2000	2006		
Bangladesh				
Barbados				
Belarus				
Belgium				
Belize				
Benin	1981	2007	2019	
Bhutan	2000	2002	2009	
Bolivia	1986	1992		
Bosnia and Herzegovina				
Botswana				
Brazil				
Bulgaria				
Burkina Faso	1997	2004		
Burundi	1978	1991		
Cabo Verde				
Cambodia	2014			
Cameroon	1980	2000	2006	2011
Canada				
Central African Republic	1990			

Table A3 continue

Chad	2007	2010			
Chile					
China	1997				
Colombia	1991				
Comoros					
Costa Rica					
Croatia					
Cyprus					
Czech Republic					
Côte d'Ivoire	1994	2002	2006	2012	
Denmark					
Djibouti					
Dominica					
Dominican Republic	1974	1992	1997		
Ecuador	2001	2005			
Egypt					
El Salvador	1984	1994	1999		
Estonia					
Eswatini					
Ethiopia	2001	2010			
Fiji					
Finland					
France					
Gambia, The	1987	2014	2019		
Georgia	1997				
Germany					
Ghana	2011				
Greece					
Grenada					
Guatemala	1977	1999	2002	2011	
Guinea	1987	1989	2011		
Guinea-Bissau					
Guyana					
Haiti					
Honduras	1991				
Hong Kong SAR	1990	2003			
Hungary					
Iceland					
India	1976	1978			
Indonesia	1979	1985	1990	2001	2010
Ireland					
Israel					
Italy					
Jamaica					
Japan					
Jordan	1975				
Kazakhstan					
Kenya	1994				
Korea	1975				

Table A3 continue

Kyrgyz Republic					
Lao P.D.R.	2000	2007			
Latvia					
Lebanon	1991	1994			
Lesotho	1973	1977			
Lithuania					
Luxembourg					
Macao SAR					
Madagascar	1975	1999	2004	2007	2017
Malawi	2008				
Malaysia					
Maldives	1987	2004	2011		
Mali	1998				
Malta					
Mauritius					
Mexico	1979	2013			
Moldova					
Mongolia					
Montenegro, Rep. of					
Morocco					
Mozambique	1982	1988	2007		
Myanmar					
Namibia					
Nepal	2009				
Netherlands					
New Zealand					
Nicaragua	1997				
Niger	2013	2018			
Nigeria					
North Macedonia					
Norway					
Pakistan	2018				
Panama	1974	1977	1990	2012	
Paraguay	1978	1995			
Peru	1990				
Philippines	1975	1980	1987	1989	
Poland					
Portugal					
Romania					
Russia					
Rwanda	2006				
Senegal					
Serbia					
Seychelles					
Sierra Leone	1978	2016			
Singapore					
Slovak Republic					
Slovenia					
South Africa					

Table A3 continue

Spain	1973	1978	
Sri Lanka	1972	2015	
St. Kitts and Nevis			
St. Lucia			
St. Vincent and the Grenadines			
Sudan	1991		
Suriname	1995		
Sweden			
Switzerland			
São Tomé and Príncipe	2001		
Tajikistan	1996		
Tanzania	1991	2007	
Thailand			
Togo	2006	2011	
Trinidad and Tobago			
Tunisia			
Türkiye	1977	1981	1990
Uganda	2016		
Ukraine			
United Kingdom			
United States			
Uruguay	1976		
Uzbekistan			
Vietnam	1993	2000	
Zambia			

Table A4. Regression Discontinuity Results with Alternative Polynomials

Order of polynomial	2	3	4	5	6	7	8
Coefficient	0.132**	0.127**	0.107*	0.091*	0.075	0.078	0.075
	0.054	0.059	0.056	0.055	0.056	0.058	0.059

Note: Table shows results from specification (1) in Table 5 with alternative orders of the polynomial, with the order indicated in the column header. See Table 5 notes and text for details. * means p<10%, ** p<5%, *** p<1%.

Table A5. Regression Discontinuity Results with Alternative Threshold Values

Threshold	-2.0	-1.5	-1.0	-0.5	Main	0.5	1.0	1.5	2.0
Coefficient	-0.015	-0.447	0.092	0.117	0.107*	0.046	0.046	0.078	0.192
	0.215	0.363	0.189	0.087	0.056	0.059	0.085	0.100	0.134

Note: Table shows results from specification (1) in Table 5 with alternative threshold values, with deviation in the threshold value from that in Table 5 ("Main") indicated in the column header. See Table 5 notes and text for details. * means p<10%, ** p<5%, *** p<1%

3. Nominal GDP Revisions and Tax-to-GDP Ratios

Historical GDP series may be revised over time considering newly available or incorporated data, as well as changes in methodological approaches. Incorporating more complete and accurate data, which often becomes available with a lag, can materially change estimates. For instance, annual surveys may be refined or administrative records like tax data may become accessible. Methodological changes can also alter GDP estimates over time, including due to changes in the base year, or more systematic changes in national accounting practices. The 2008 System of National Accounts (SNA) introduced several such changes, including a broader definition of financial services and a new treatment for the classification of research and development.

GDP estimates were revised for many countries in the last decade, and in most cases, revisions increased GDP estimates. This can be illustrated by comparing nominal GDP recorded (in local currency) in different vintages of the World Economic Outlook (WEO). Among 180 countries[20], 2010 GDP recorded in the April 2025 WEO was 1.4 percent higher than in the April 2016 WEO at the median, and 8.3 percent higher at the mean.

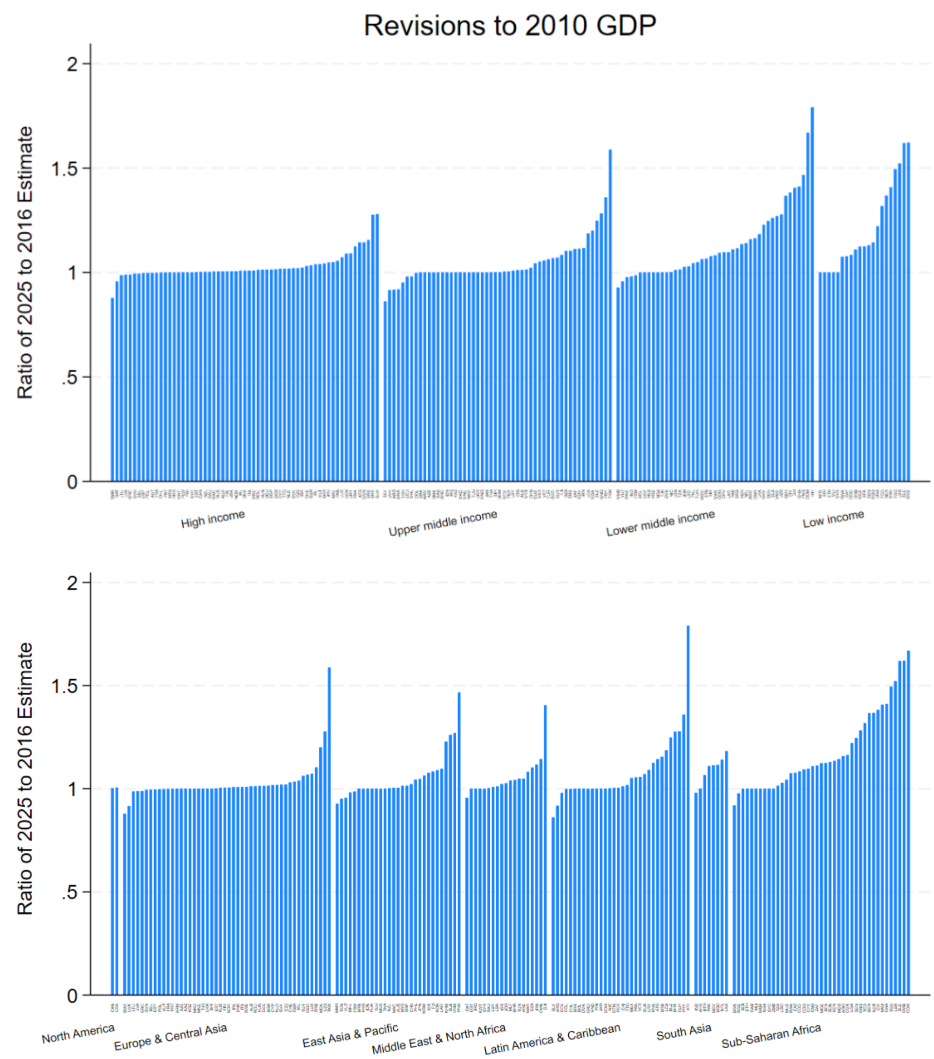
The extent of revisions diverges significantly across income levels and regions. Figure A6 below shows that revisions are both more common, larger, and more uniformly upwards among low- and lower middle-income countries, with many cases of upwards revisions of 30 percent of more in each of these groups. Regionally, upwards GDP revisions have the largest effect in sub-Saharan Africa, where most countries' 2010 GDP estimates increased in the last decade. However, upwards revisions also occurred in many countries in the rest of the world, too.

These upwards revisions of GDP in many African countries in particular have been the subject of some discussion.[21] They are attributed to improvements in the recording of economic activity, including the implementation of the latest standards and the rebasing of GDP, sometimes after long gaps.

[20] This sample includes countries with non-missing observations in both years and excludes countries that underwent currency redenomination in the intervening years.

[21] See, for example, the following blog from The World Bank: WDI - Many African economies are larger than previously estimated.

Figure A10. Ratio of 2010 Nominal GDP in April 2025 and April 2016 WEO, by Country

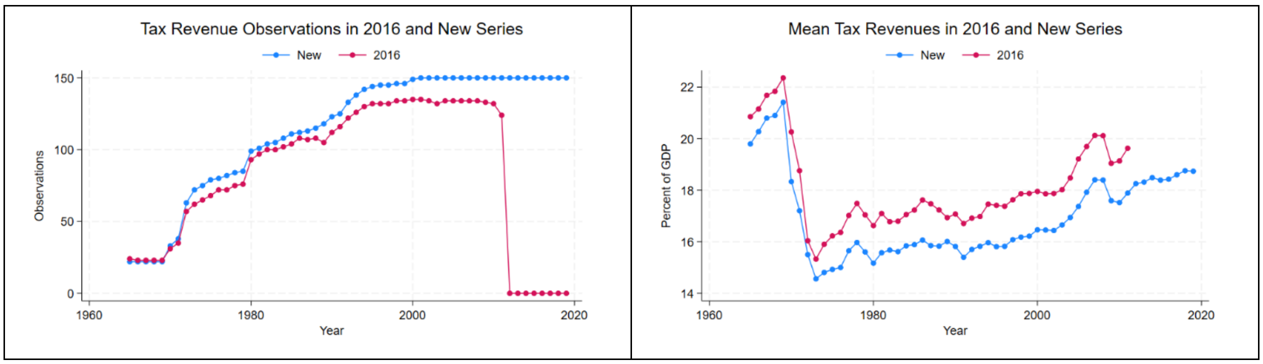


Note: Authors' construction based on IMF World Economic Outlooks editions April 2016 and April 2025.

GDP revisions substantially reduce estimated tax-to-GDP in historical data compared to that used in GJW. Taking 2010 as an example year, tax-to-GDP in the new series is 9.9 percent for Togo, compared to 15.7 percent in GJW, reflecting an upwards revision to nominal GDP of 50 percent. For Djibouti (GDP revised upwards more than 40 percent) it decreases from 20.2 percent to 14.8 percent, and for Uzbekistan (28 percent upwards revision) from 20.6 percent to 16.1 percent.

This phenomenon is the primary driver of the difference in tax-to-GDP as measured in our series compared to that used in GJW. Overall, average tax-to-GDP is just over 1 percentage point (pp) lower in the new series (Figure A11). Restricting the comparison to the same countries and years across datasets yields an average difference of 1.25pp. Hence, the difference is not attributable to different samples.

Figure A11. Comparison of New Tax Series to GJW 2016



Note: Authors' construction. Mean Tax Revenues panel is not restricted to the same countries as in GJW but such a restriction yields very similar results.

4. Causal Forest as a Robustness Check for the Grid Search Tipping Point[22]

As a robustness check for the grid-search – R-squared maximization specification, we used a simple Causal Random Forest without covariates to estimate heterogeneous effects of taxation on economic growth. This specification was chosen to maintain consistency with the simplicity of the main grid search procedure, which also does not include additional controls. The treatment variable is the tax-to-GDP ratio, a continuous variable measured in the initial year of the forward growth window, and the outcome variable is future GDP per capita growth, calculated over 3, 5, 7, 10, and 15-year horizons.

Causal forests are a causal inference learning method that are an extension of Random Forests. In random forests, the data is repeatedly split to minimize prediction error of an outcome variable. Causal forests are built similarly, except that instead of minimizing prediction error, data is split to maximize the difference across splits in the relationship between an outcome variable and a treatment variable. This is intended to uncover how treatment effects vary across a sample, enabling the estimation of heterogeneous treatment effects rather than average effects alone.

Using panel data sorted by country and year, we applied the causal forest algorithm to estimate Conditional Average Treatment Effects (CATEs). In this simplified setup without covariates, the algorithm captures

[22] This section was prepared by Cindy Rojas Alvarado.

unconditional heterogeneity. It approximates variation in treatment effects, but this heterogeneity reflects only random sampling variation, instead of differences explained by observed characteristics.
To detect the tipping point we applied LOESS smoothing (Locally Estimated Scatterplot Smoothing) to the scatterplot of estimated treatment effects versus the tax-to-GDP ratio. LOESS is a nonparametric technique that fits simple models to localized subsets of the data to capture flexible, nonlinear relationships. The tipping point is identified as the value of tax-to-GDP at which the smoothed curve shows a clear change in trend, marking where the marginal effect of taxation begins to shift meaningfully.

To evaluate the stability of this estimate, we implemented a nonparametric bootstrap procedure, resampling the data with replacement and re-running the full causal forest and LOESS estimation for each draw. The tipping point was re-estimated in each iteration, yielding an empirical distribution of tipping points from which we computed confidence intervals. The bootstrap distributions are shown in Figures A7 for each growth horizon. These results confirm that the tipping points are not artifacts of sampling noise and provide evidence of non-linear effects in the taxation-growth relationship.

Overall, this simple, non-parametric robustness check complements our main findings and shows that—even in a model-free setting—there is a statistically detectable inflection point in the effect of taxation on economic growth.

Table A6. Tipping Point - Bootstrap Point Estimates and Confidence Intervals

Horizon	Tipping point	CI Lower	CI Upper
3	13.3	7.3	18.6
5	14.3	7.3	19.0
7	14.6	7.4	18.3
10	13.8	6.9	18.9

Figure.A12. Distribution of Bootstrapped Tipping Point Estimates over Different Time Horizons

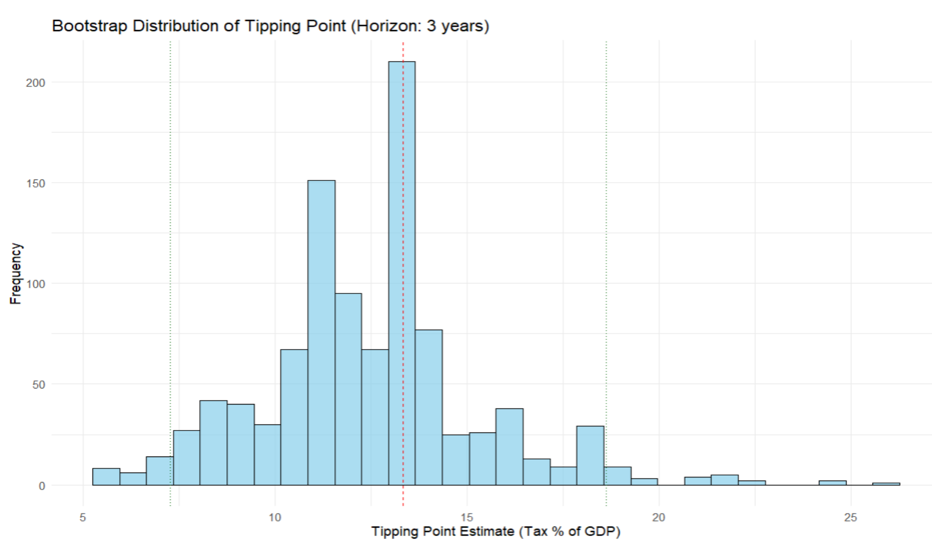
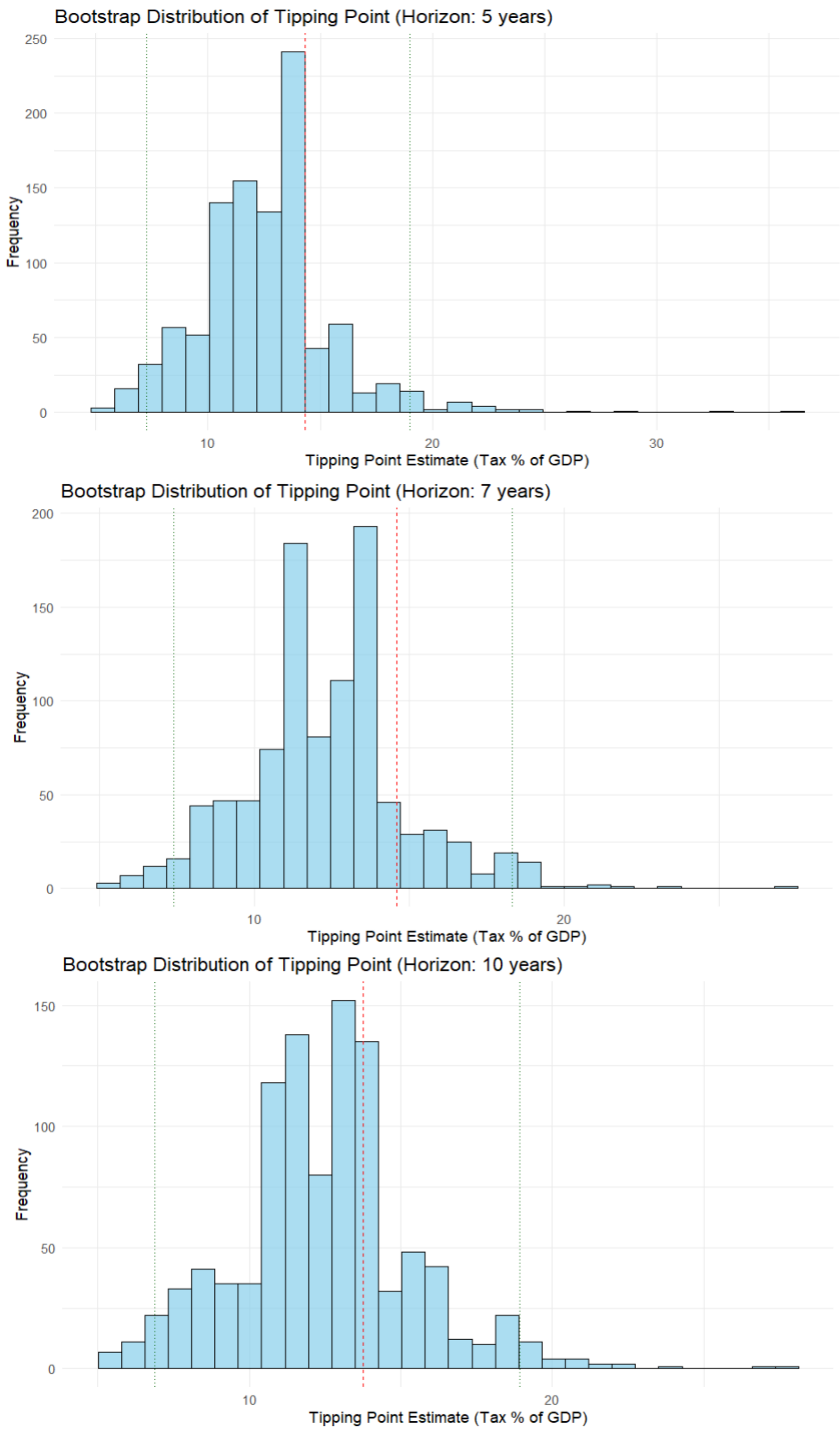


Figure A12 continue



Note: Each panel displays the bootstrap distribution of the estimated tipping point over different time horizons: 3, 5, 7, and 10 years. The red dashed line marks the tipping point estimate from the original (non-bootstrapped) sample. Distributions are based on 1,000 bootstrap replications using LOESS-smoothed treatment effects from causal forest models. The green vertical lines indicate the 2.5th and 97.5th percentiles, forming a 95% confidence interval around the tipping point estimate.

PUBLICATIONS

State Capacity, Growth and Institutions: Taxing for Takeoff

Working Paper No. WP/2025/203