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How does government size affect economic growth? New results from a historical dataset*

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Abstract

This paper contributes to the still unresolved issue of the growth impact of government size by analysing a historical panel data set of 17 developed countries that ranges from 1880 to 2016. The unique feature of the long-time dimension allows for conducting a kind of natural experiment. Government size is closely related to economic-policy paradigms. The time span covers different economic policy paradigms, in particular, 'laissez-faire' before World War II and Keynesian economic policy after World War II. Before WW II government size is small, after WW II it is (has grown) big. Furthermore, this paper contributes to filling a gap in the literature by testing the non-linear hypothesis (Armey curve). We take particular attention to a key shortcoming of panel-data analysis – parameter or individual heterogeneity. Overall, this analysis suggests a systematic positive, albeit quite small, linear relationship of government size with economic growth. As a consequence, rather than concentrating their attention to the sheer size of government, policy makers are advised caring for an efficiently run and high-quality government sector as a prerequisite for a steady growth path.

Key words: government size, economic growth, Armey curve, historical data, robustness analysis

JEL Classification: H50, E62, C23

1. Introduction

One of the most contentious issues in economics is the question whether 'big' government is good or bad for economic growth. However, the empirical evidence has been inconclusive so far (Colombier 2015; Churchill et al. 2017; Braendle 2020). A pertinent question is whether a tipping point for government size exists. A second related question is how to measure government size. Different measures of government size are used in the literature (Vedder and Gallaway 1998; Nijkamp and Poot 2004; Gemmell and Au 2013; Colombier 2015; Churchill et al 2017; Hajamini and Falahi 2018). These include the ratios of general-, central- and sub-national government expenditure; tax revenues, government consumption, government consumption and transfers, and public investments to GDP.

So far, the literature has focused on the post-WW II period to analyse the growth of government size. In contrast, this paper gains new insights in this issue by applying, to the best of the authors' knowledge, for the first time a longitudinal dataset that ranges from 1880 to 2016 and consists of 17 OECD countries. Thus, in contrast to the literature, which is based on datasets with a ratio of the time to the individual dimension (T/N) that ranges approximately between 0.3 and 2, the ratio of this study's dataset corresponds to 7.8 (Churchill et al. 2017). The time dimension enables us to cover different economic-policy paradigms regarding the role of government in the economy in our analysis. Laissez-faire economic policy until the Great Depression, Keynesian revolution after World War II (WW II) until the end of the 1970-ties, neoliberal economic policy (Washington Consensus) till the Global Financial Crises (GFC) and a re-evaluation of the role of government in the aftermath and the COVID-19 pandemic. Overall, we can observe 'smaller' governments before WW II and 'bigger' governments after WW II. The time dimension is a statistically significant factor for the empirical evidence on the relationship between government size and economic growth (Churchill et al. 2017).

Endogenous growth theory predicts an inversely U-shaped functional relationship between government size and economic growth (Barro 1990; Barro and Sala-i-Martin 1995). This

relationship is sometimes called the Armey curve (Armey 1995). Endogenous growth theory shows that the optimal level of government size is reached where the adverse impact of marginal taxation (financing government activity) on economic growth is offset by the increase of the social marginal productivity of private capital through the marginal increase of the public-input-to-GDP ratio. In this steady-state equilibrium the absolute value of the marginal taxation impact on economic growth corresponds to the marginal productivity of the public input. Beyond this level, government activity is supposed to be growth-hindering because the adverse impact of taxation dominates. With an increasing public-input-to-GDP ratio the marginal productivity of capital approaches asymptotically zero. The presumption of the endogenous growth model is that productive public inputs such as education, public infrastructure or government financed research and development raise private capital productivity because they are non-rival at the factor level (see Barro and Sala-i-Martin 1995, 152-158; Colombier and Pickhardt 2002, 22-25). These are factor-augmenting public inputs. Bigger government implies higher tax rates so that the dampening growth effects of distortionary taxation on the savings-investment and labour-leisure-time decision of private households dominates the beneficial impact of the public input. The marginal social costs of taxation exceed the marginal social productivity of the factor-augmenting public input in the endogenous growth model.

Furthermore, since Buchanan and Wagner (1977) new political economists have argued that government actors (politicians, bureaucrats) in democracies are incentivised to inefficiently oversize the government, e.g. due to political business cycles or rent-seeking activities.[1] Thus, according to New Political Economy democratic governments have a deficit bias. For example, politicians may be tempted to conduct a pro-cyclically fiscal policy stance in booming times, over-expand fiscal stabilization programmes to serve their constituencies or enact oversized social transfers to enhance their chances to become re-elected. This behaviour enhances the risk

[1] For a survey on the 'deficit bias' see Alesina and Passalqua (2015).

of crowding-out effects. However, new empirical evidence on fiscal policy in the aftermath of the GFC runs counter to the new-political-economy arguments. This evidence shows that expansionary fiscal policy can exert beneficial effects on economic growth (Aghion and Marinescu 2007; Jordà and Taylor 2016; Fatàs and Summers 2018; Gechert et al. 2019). The literature provides the following reasons for a longer-run effect of fiscal policy. First, recessions have regularly persistent effects (Cerra and Saxena 2008). Second, fiscal policy reduces the growing uncertainty in recessions by smoothing the business cycle (Aghion and Marinescu 2007). Third, market failures in the capital and labour market caused by behavioural biases and information asymmetries such as credit constraints and hysteresis are common (Blanchard and Summers 1987; Greenwald and Stiglitz 1993: Akerlof 2007). Fourth, fairness concerns of employees matter (Bhaskar 1990). Ultimately, long-run fiscal multipliers increase if monetary policy has reached the zero-lower bound of nominal interest rates (De Long and Summers 2012; Gechert 2015; Fatàs and Summers 2018).

Recent surveys on the impact of government size come to inconsistent results regarding the overall empirical evidence on the growth effects of government size. While the survey by Gemmell and Au (2013) draws the conclusion that the positive impact of productive public inputs and the distortionary tax effect cancel each other out, the survey by Bergh and Henrekson (2011) and a meta-analysis by Churchill et al. (2017) suggest a systematic negative correlation between government size and economic growth for developed countries. However, the latter outcome rests on a number of qualifications. First, Bergh and Henrekson (2011) maintain that a consensus had been reached for developed country. However, the 'consensus hypothesis' is based on a very small sample of seven studies where only five lend support to this thesis. Colombier (2015) shows that the survey by Bergh and Henreksson (2011) suffers from a paper-selection bias. Second, the studies in Bergh and Henrekson (2011) are also covered by the meta-analysis of Churchill et al. (2017) that include 29 studies for developed countries. Six out of 23 studies surveyed by Gemmell and Au (2013) overlap with Churchill et al. (2017). While

Gemmel and Au (2013) focus on the tax side of the public budget, Churchill et al. (2017) analyse the growth effects of general government expenditure and government consumption as a ratio of GDP. Third, many studies suffer from an endogeneity bias as they do not take into account of reversed causality (see Churchill et al. 2017, 160-161). In the long run, Wagner's law, Baumol's cost disease or long-run effects of fiscal policy are reasons for the endogeneity of government expenditure (e. g. Wu et al. 2010). In instrumented-variable (IV) regressions the general-government-expenditure-to-GDP ratio is on average statistically positive significant (e. g. Colombier 2009). Wu et al. (2010) who conduct a Granger causality analysis for a panel of 182 countries from 1950 to 2004 come to the same conclusion and provide evidence for a statistically positive bi-directional causation. Nonetheless, one should be cautious with regard to IV approaches as instruments might be weak. Moreover, cross-country studies that drive the result of a statistically negative correlation suffer from a further source of endogeneity bias – omitted variables (see Churchill et al. 2017, 160-161). Cross-country studies usually do not take country fixed effects into account that control for unobservable or unmeasurable factors such as the rule of law. Gemmell and Au (2013, 112) argue that cross-country studies are of 'little assistance', in particular, as the crucial question of the growth effects of government size *within* a country is not dealt with. As a result, panel-data methods have prevailed over cross-country studies as the standard approach. Fourth, panel-data studies that average data by five or more years do not find systematic growth effects of the general-government-expenditure-to-GDP ratio (see Churchill et al. 2017, 160). This indicates that government size does not affect growth in the long term. Fifth, a publication selection bias might exist as studies published in high-ranking journals report a statistically significant higher number of non-significant results than lower-ranking journals (see Churchill et al. 2017, 162). Finally, the studies analysed by Churchill et al. (2017, 155 and 163) do not test for non-linear effects and concentrate on linear effects. This points to a lack of evidence concerning the non-linearity hypothesis recently ascertained by some authors (see Christie 2014, 184; Hajamini and Falahi 2018, 2). The few

studies that analysis non-linear effects of government expenditure on GDP in developed economies find evidence for an optimal government size. This implies having a tipping point of government activity as predicted by endogenous growth theory. However, since measures for government size vary across these studies, the comparability of this literature is limited. While Vedder and Gallaway (1998) and Christie (2014) use general government expenditure, Asimakopoulos and Karavias (2016) and Hajamini and Falahi (2018) apply government consumption as a measure of government size. Vedder and Gallawy (1998) supplement their analysis with central government expenditure as a meausure for government size. Hajamini and Falahi (2018) add expenditure other than government consumption and public investments as measures for government size. Moreover, this literature applies different methods to test the non-linearity hypothesis.

In addition, it is a worthwhile to account for another strand of growth empirics. This strand tackles the shortcoming that growth theory cannot provide the empirical researcher with a unanimous set of growth determinants, called "opend endedness" (Temple 1999). These studies aim at carving out determinants that are related robustly to economic growth by the application of methods that care for model uncertainty such as Leamer's (1985) extreme bound analysis. For example, Sturm and de Haan (2005) present a comprehensive analysis that cares for robustness of estimates against model uncertainty, parameter heterogeneity and outlying observations. They do not find any evidence for a robust correlation between government activity and growth. Public investment and public consumption serve as measures of government activity.

This paper contributes to the literature by following the call issued by Churchill et al (2017, 164) to improve the identification strategy on the growth effects of government size. Thus, we care for individual heterogeneity that is a key shortcoming of standard panel-data estimation methods (Temple 1999). Given the sample at hand, we carry out a natural experiment of the growth effect for small and big government by splitting the sample. We apply a standard

estimation approach in this field that is based on endogenous growth theory, a two-way fixed effects model (see Churchill et al 2017, 145). We use a specific to general approach to test for the sensitivity of our results. Typical controls that are shown to be robustly correlated with growth by the growth-empirics literature are included in our regressions (Sturm and De Haan 2005). Given the lack of evidence with respect to non-linear effects of government expenditure, we test also the non-linear hypothesis. To deal with reversed causality and avoid the notorious problem of invalid instruments, a simple approach proposed by Woo and Kumar (2015) is applied.

Given the limited data availability, we resort to the GDP ratio of central government expenditure as a measure of government in the full sample. This implies the hypothesis that the growth-relevant variation of government size takes mainly place at the central government level. We think that this is a plausible assumption because central government bears the main responsibility for the biggest observed peace-time-government expansion in the period from the midst of the 1950-ties to the midst of the 1980-ties after WW II. This development can be explained by discretionary fiscal policy, the build-up of comprehensive social security systems, which serves as the same time as a huge automatic stabiliser, and the increase in defense spending in the cold war. We provide empirical evidence on the relationship between central- and general government expenditure that lends support to our hypothesis. Moreover, we carry out robustness tests with the ratio of general government expenditure to GDP for the period from 1960 to 2016.

Our regression analysis shows that the ratio of central government expenditure to GDP has not been harmful for growth across the board in developed countries independently from the time period chosen (1880-2016, pre- and post-WW-II period). For the time period from 1960 to 2016 we find a slight positive correlation between government size and growth. This result comes up independently from the fact if we apply general- or central government expenditure

as a measure of government size. In contrast to the literature our results do not suggest a non-linear relationship.

This paper is organised as follows. In the following section the data and the estimation strategy are outlined. This is followed by a discussion of central government expenditure as a measure of government size. Section four, presents the results of the empirical analysis. Finally, conclusions are drawn in section five.

2. Data and estimation strategy

Data for central government expenditure and macroeconomic variables originate from the historical dataset by Jordá et al. (2017) that covers the period from 1870 to 2016. We supplement this dataset by IMF data on government expenditure from 1880 to 2016 and OECD National Accounts data on general government expenditure that range from 1960 to 2016 (Mauro et al. 2015). Central government expenditure covers the period from 1880 to 2016 in our estimations. We use a standard approach to test for the impact of government expenditure on economic growth that is based on endogenous growth theory (see Churchill et al. 2017, 145). We apply a two-way fixed effect within estimator and use Driscoll-Kray-covariance estimator that is robust to heteroscedasticity, serial and spatial correlation (Driscoll and Kray 1998). The regression model is as follows:

$$\Delta y_{i,t:t-j} = \alpha y_{i,t-1:t-(j+1)} + \beta g_{i,t-5:t-(j+5)} + \gamma_n X_{n,i,t:t-j} + d_t + tr_i + \mu_i + \pi_t + e_{it} \quad (1)$$

With: t:= year t, t= 1880,…,2016; i:= country i, i = 1,...,17; j:= calculation of j-year moving averages; n:= co-variate n, n = 1,…,8.

We carry out estimations with 5-year moving averages of the continuous variables y, g and X (j=5). Apart from the inflation rate and the long-term interest rate, each continuous variable enters equation (1) in natural logarithms. The regressand $\Delta y_{i,t:t+j}$ corresponds to the growth rate of real GDP per capita in country i and year t, $y_{i,t-1:t-(j+1)}$ represents real GDP per capita of country i in year t-1. Coefficient α is a proxy for conditional convergence. Churchill et al. (2017, 160) give evidence that studies that include conditional convergence or population size

tend to find more adverse effect of government size. To err on the side of caution, we consider both. Population growth, is taken into account by the dependent variable because the latter is expressed in terms of population size. However, to avoid double entries, we do not include population growth as a regressor variable. The influence of the government-expenditure-to-GDP ratio, $g_{i,t-5:t-(j+5)}$, in country i and year t-5 on subsequent growth is captured by coefficient β. Thereby, we follow a proposal by Wu and Koomar (2015) to deal with reversed causality. Therefore, we can abstain from using possibly weak instruments (see Churchill et al 2017, 164). We apply a common set of control variables represented by matrix X (see Churchill et al. 2017, 145-146). Thus, we include the ratio of investments to GDP supplemented by further possible determinants of economic growth. These are the openness of an economy and the real exchange rate to the US-$. As is standard, openness is measured by the sum of the import-and-export-ratio-to GDP. Strong evidence for a growth-relevant impact of these variables is given (Sturm and de Haan 2005; Rodrik 2008; Colombier 2015). Monetary policy might have long-term impacts so that we include monetary indicators, i.e. the inflation rate and an interest rate, in equation (1) (Akerlof 2007). Although monetary policy steers short-term interest rates, we include the inflation-adjusted long-term interest rates for the following reasons. First, in our sample short- and long-term interest rates show a strong correlation of 97% (Pearson's correlation coefficient). This result supports the Keynesian view that the interest rate is determined in the money market (Bofinger 2020). Second, the long-term interest rate represents the yield of 10-year government bonds. This variable measures possible crowding out effects of private investments by credit-financed government expenditure and/ or restrictive monetary policy. Furthermore, deflation or high inflation indicate times of economic instability that can be growth-dampening. The dummy and deterministic variables $d_t, tr_i, \mu_i,$ and π_t respectively stand for years of financial crises, a country-specific trend, country- and time fixed effects respectively. The fixed effects capture unobserved heterogeneity across countries and over time. Time fixed effect catch common shocks that hit countries symmetrically such as

worldwide recessions, financial crises, oil-price schocks or pandemics (e.g. COVID-19) (Colombier and Breuer 2020). Country-specific trends allow for time-specific heterogeneity across countries. They reflect idiosyncratic shocks in certain countries that are time-varying, e.g. shocks that exert an asymmetric impact on the individual economies.

Following the overwhelming majority of the literature we, first, estimate a model with a linear specification of the growth impact of government size. In a second step, we use a standard method to test the hypothesis of endogenous growth theory, the Armey curve, by adding a quadratic term for government expenditure in equation (1) (Vedder and Gallaway 1998; Colombier and Breuer 2020). In both cases, we adopt a specific to general approach. The idea is to show how a successive refinement in identifying the growth impact of government size affects the results. This means that the individual heterogeneity gains step-wisely more weight in the regressions so that the panel is increasingly structured. In a first step, we run a baseline model with two-way fixed effects including a convergence term and government size. To improve our identification strategy for unobserved heterogeneity across countries we add country-specific trends and a dummy variable for financial crises ("baseline plus"). Finally, further controls that are viewed as main growth determinants make up the extended model specification. We further fine-grain our analysis with respect to individual heterogeneity by a test on the stability of the government-expenditure coefficients across countries – the so-called 'poolability' restriction. All estimations are carried out for the full sample and the sample split between the pre-WW-II- and post-WW-II period. This procedure is based on the hypothesis that overall government size has been relatively small up to WW II, has grown bigger after WW II up to the midst of the 1980-ties and has remained more or less stable afterwards. In the following section, we provide evidence for this hypothesis.

3. Central government expenditure as a measure for government size

As outlined in the introduction, the extended time dimension enables us to explore the impact of government size in different periods that reflect different economic-policy paradigms

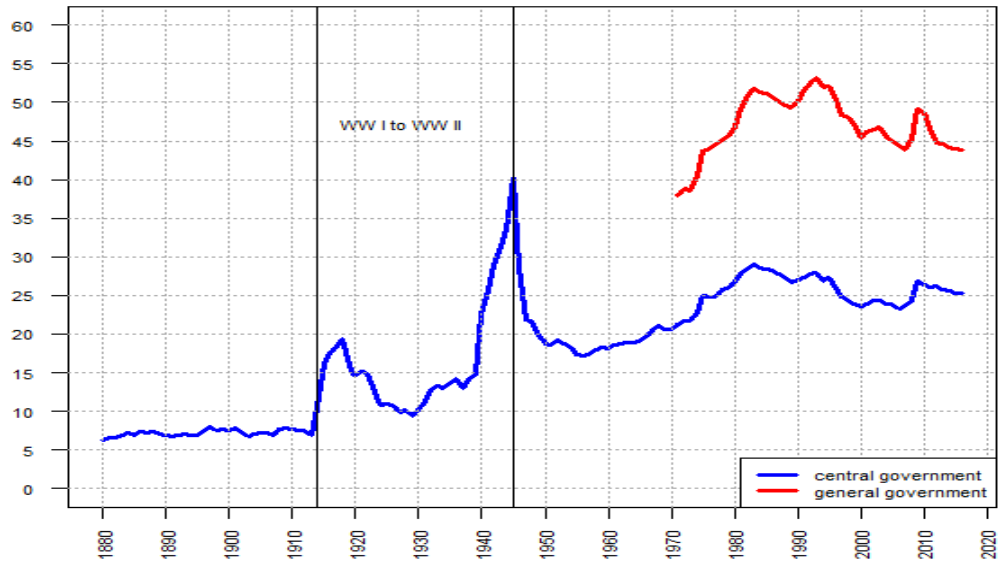
regarding the role of government. A limitation of the historical data set might be that the most comprehensive measure for government size, the ratio of general government expenditure to GDP, is not at our disposal. However, we think central government expenditure is highly suited as a measure for government size because the largest peace-time expansion of government after WW II can be mainly explained by an enlargement of the central level. After WW II the government sector has been mainly expanded due to three reasons: i) anti-cyclical Keynesian demand management, i.e. fiscal policy serves as an active stabilisation measure, ii) a comprehensive build-up of the social system has taken place and iii) in the cold war defense expenditure has been increased. For each of these areas the main responsibility is borne by central government. Thus, the variation of central government expenditure reflects the change in the predominant economic-policy paradigm from 'laissez-faire' before WW II to the Keynesian revolution immediately after WW II. A caveat is that for potentially growth-relevant government functions such as regional or local infrastructure and education sub-national government levels often bear responsibility. However, even in strongly decentralized countries such as Switzerland central government co-finances these outlays by intra-governmental transfers.

The development of cross-country averages of the central-government-to-GDP ratio support our hypothesis that government is relative small before WW II and relatively big after WW II reflecting different economic-policy paradigms (see Figure 1, blue line). While the overall average of this ratio is equal to 18%, the pre-WW-II ratio is substantially lower at 10%.[2] After WW II the average ratio of central government expenditure is more than double as high as before WW II and stands at 23% of GDP. These results prop up our procedure to run separate estimations for the pre-WW-II and post-WW-II period.

[2] Note that the inter-WW-period central-government-expenditure-to-GDP ratio is only slightly above the average for the whole pre-WW-II period at 13%.

Figure 1

Annual cross-country averages of central- (blue line) and general government expenditure (red line) (as % of GDP)[1]



Source. Mauro et al. (2015), Jordá et al. (2017), OECD – Annual National Accounts.

[1] Because of limited data availability concerning general government expenditure, we use only 12 out of 17 countries from 1971 to 2016 to calculate cross-country averages. Data for Finland, France, Portugal, Spain and Sweden are not included.

In the first years after WW II from 1946 to 1954 the ratio of central government expenditure to GDP goes down from 26 % to 17% because debt obligations from WW II were reduced. From 1955 to 1983 the central-government-expenditure-to-GDP ratio continuously increases from 17% to 28%. For the remaining time range until 2016, the ratio hoovers around an annual average of 26% with a modest downward trend. At the end of the 1970-ties a second economic-policy paradigm shift was triggered by the stagflation period in the 1970-ties caused by two oil-price crises and the breakdown of the fixed-exchange Bretton-Woods system installed after WW II. The stagflation period saw rising public-expenditure- and debt-to-GDP ratios. A widely held view is that Keynesian anti-cyclical fiscal policy was ineffective to fight off stagflation and led to none-sustainable public finances. As a consequence, supply-side policies later dubbed as Washington Consensus (Neoliberalism) replaced the Keynesian paradigm. Based on

the insights from Monetarism and New Political Economy fiscal policy was downgraded to a passive role. Furthermore, the Washington Consensus is characterised by privatization, de-regulation, in particular of financial and labour markets, a substantial reduction of tax rates, primarily for firms and wealthy individuals, a pushback of the welfare state and free movement of capital (Ostry et al. 2016; Haffert 2019). While the liberalisation of financial markets ignited a series of financial crises, the liberalisation of labour markets decoupled real wage growth from productivity growth and resulted in an increasingly unequal income distribution with a falling labour share in GDP (Bezemer and Grydaki 2014; Van Treeck 2014; Ostry et al. 2016; Komlos and Schubert 2020). These developments led, for example, to a massive increase of private household debt in the USA and sparked the outbreak of the Global Financial Crisis 2008 (GFC). In the aftermath of GFC a gradual shift in the Washington Consensus View set off with a re-appreciation of fiscal policy and equity.

From 1971 onwards, the ratio of general government expenditure to GDP shows almost the same development, only at a higher level of an average of 47% of GDP, as the corresponding ratio of central government expenditure (see Figure 1).[3] Despite differences in centralisation across the countries of our sample, central government is on average responsible for the major share in general government expenditure. The annual average corresponds to 55%. The close correlation between the two variables of 87% reflects this fact. Since general government expenditure is a linear combination of expenditure by government level, the variation of general government expenditure decomposed by government level is indicated by the determination coefficient R squared. For the period from 1971 to 2016 R squared corresponds to 70%. This means that the variation of central government expenditure is responsible for 70% of the variation in general government expenditure in terms of GDP. Consequently, central and general government co-move to a substantial extent, which is confirmed by the regression

[3] A balanced panel is a necessary condition in order to make a valid cross-country comparison. Therefore, it is not possible to make use of all available data for general and central government expenditure (see Figure 1, fn. 1).

analysis that applies the sample ranging from 1960 to 2016 (see section 4). Due to the reasons outlined in the previous paragraph, one can plausibly assume that the co-movement should have been even closer in the years from 1955 to 1983.

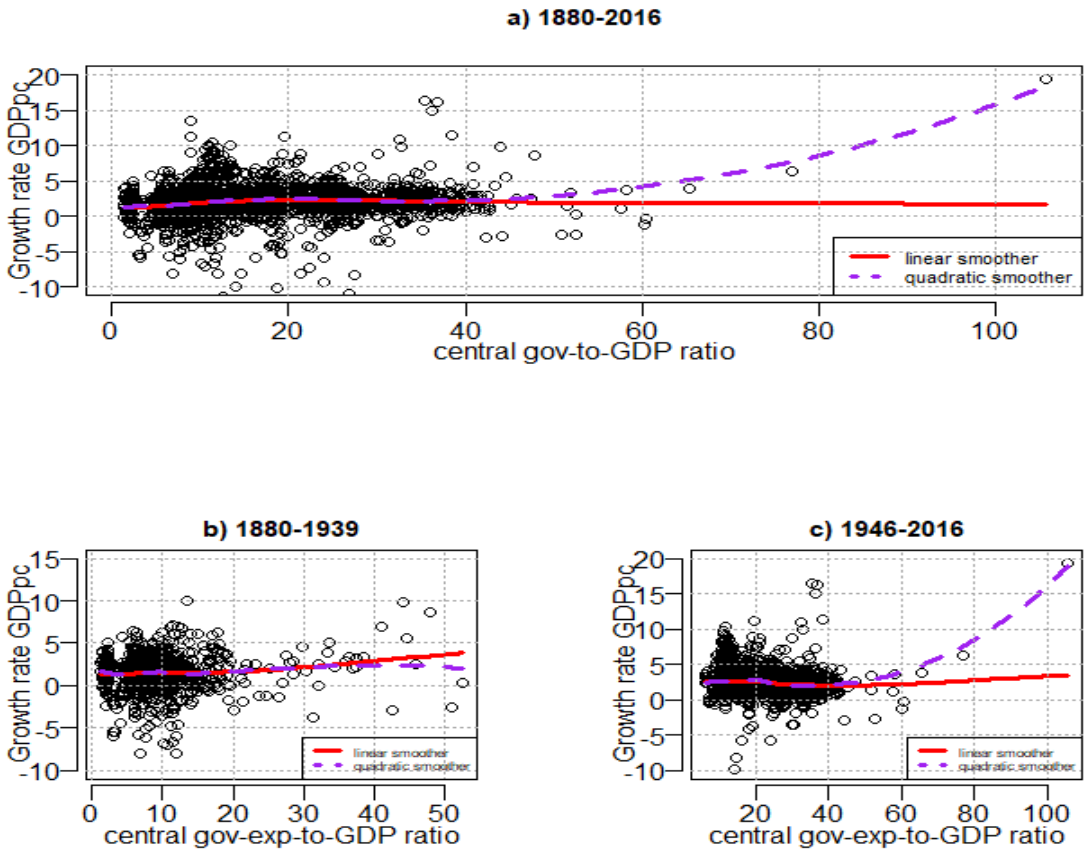
4. Results

4.1 Central government expenditure

To yield first useful clues about the relationship between the ratio of central government expenditure to GDP and the growth rate of real GDP per capita we apply an outlier-robust non-parametric locally weighted polynomial regression smoother (LOWESS) assuming two different polynomial degrees (see Figure 2). This method has the advantage over regression analysis that the functional relationship is determined by a local fit of the data. The functional relationship has not to be stipulated in advance. This is a first test of the Armey-curve hypothesis and gives guidance for the functional specification of the regression model.

Figure 2

Simple correlation between central-public-outlays-to-GDP ratio (lagged by 5 years) and real GDP per capita growth rate in historical data set (5-year moving averages, as %)



Source: own calculations

In line with our estimation strategy, we set the polynomial degrees to 1, linear smoother, and to 2, quadratic smoother. We calculate the smoother for the whole sample, pre-WW-II and post-WW-II period. The linear smoother for the full sample suggests that the variables are at best loosely associated. For the pre-WW-II period a clear positive linear relationship is indicated, while it is more modest for the post-WW-II period. The quadratic smoother reveals a non-linear, however, economically counter-intuitive relationship for the full sample and the post-WW-II period. According to the smoother analysis, the relationship predicted by the Armey curve is inverted. However, our analysis suggests that this outcome depends on outliers. If the upper 0.5 percentile of the distribution of government expenditure is excluded, i.e. central-government-expenditure-to-GDP ratios above 50%, the non-linear relationship vanishes (see Appendix,

Figure A1). Overall, the smoother analysis does not support the hypothesis of a non-linear relationship predicted by the Armey curve and suggests a modest positive linear relationship.

To take the structure of the panel-data set into account, we run regressions with the fixed-within estimator. First, we present the results of the linear model. Overall, our regressions show a rather good fit. The adjusted R square is at least equal to 50%. In the baseline model, we include unobserved heterogeneity across countries and over time as well as conditional convergence (see Table 1). For the full sample, we find a statistically negative significant coefficient of government size. Thus, central government expenditure seems to exert an adverse effect on per-capita GDP growth in the long run.

Table 1: Government size and growth - baseline regressions with linear model

	Growth rate of real GDP per capita					
	1880-2016	Pre WW II	Post WW II	1880-2016	Pre WW II	Post WW II
	(1)	(2)	(3)	(4)	(5)	(6)
Real GDP per capita	-0.01* (0.01)	-0.001 (0.02)	-0.04*** (0.01)	-0.03* (0.02)	-0.03 (0.03)	-0.05*** (0.02)
Central public outlays/GDP	-0.01** (0.003)	0.002 (0.01)	-0.003 (0.01)	-0.01 (0.004)	0.005 (0.01)	-0.01 (0.01)
Crisis dummy				0.003 (0.002)	0.01** (0.003)	-0.0002 (0.003)
Country FE	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes
Country-specific trends	no	no	no	yes	yes	yes
Adj. R2	0.56	0.51	0.51	0.57	0.54	0.77
No. of countries	17	17	17	17	17	17
Observations	2,135	836	1,197	2,135	836	1,197

Notes *p<0.1; **p<0.05; ***p<0.01

All variables are in 5-year moving averages; continuous variables that are not interest rates or prices are in natural logs; public-outlays-to-GDP ratio is lagged by 5 years; robust HAC and spatially consistent standard errors by Driscoll and Kraay (1998).

However, this result is neither robust to the sample split into pre- and post-WW-II period nor to the inclusion of country-specific time trends. The latter refines our strategy to identify heterogeneity across countries. The inclusion of further controls does not change the results concerning the growth impact of central government expenditure (see Table 2). In none of the equations one can detect a systematic relationship between government size and economic

growth. Across the models (7) to (9), the other regressors show the expected signs with a stable statistically positive and negative significant coefficient respectively for the investment ratio and the inflation rate respectively. The F test on the instability of individual coefficients ('poolability' test) indicates that only for the period after WW II heterogeneity across countries may cause different coefficients of the regressor variables. However, the 'poolability' test does not provide information which covariate is particularly affected by individual heterogeneity. Therefore, we run a Wilcoxon signed rank test to test whether the individual coefficients differ in a statistically significant way from the fixed-effects within estimate $\hat{\beta}$. In the case of the full sample the Wilcoxon signed rank test shows that individual coefficients differ in a systematic way for the full sample and the post-WW period. This suggests that results for individual countries may differ from the panel-regression outcome.

Table 2: Government size and growth - extended regressions with linear model

	Growth rate of real GDP per capita		
	1880-2016	Pre WW II	Post WW II
	(7)	(8)	(9)
Real GDP per capita	-0.05*** (0.02)	-0.08*** (0.03)	-0.07*** (0.02)
Central public outlays/GDP	-0.002 (0.003)	0.002 (0.01)	0.01 (0.01)
Investment/GDP	0.09** (0.04)	0.12*** (0.03)	0.16*** (0.03)
Inflation rate	-0.06*** (0.01)	-0.14*** (0.04)	-0.08*** (0.005)
Real long-term-interest rate	-0.02 (0.06)	-0.19** (0.09)	-0.10*** (0.03)
Exchange rate dom. currency/US-	0.000*** (0.00)	-0.0003 (0.0004)	0.000** (0.00)
Openness	0.01 (0.01)	-0.01 (0.005)	0.03* (0.02)
Crisis dummy	0.002 (0.003)	0.004 (0.003)	-0.001 (0.003)
Country FE	yes	yes	yes
Time FE	yes	yes	yes
Country-specific trends	yes	yes	yes
Adj. R2	0.56	0.51	0.51
No. of countries	17	17	17
Observations	2,001	738	1,182
Instability test (F test)	0.92	0.94	2.12***
Wilcoxon signed rank test individual coefficient central public outlays/GDP (V test)	127**	78	106*
Notes	*p<0.1; **p<0.05; ***p<0.01 see notes Table 1; 'Poolability' test on the instability of individual coefficients, F test, H0: stability; Wilcoxon signed rank test, V test: H0: $\beta_i = \hat{\beta}\ \forall\ i$.		

The baseline regression of the non-linear model in the full-sample case indicates a systematically negative linear relationship between central government expenditure and the growth rate of GDP per capita (see Table 3). For the subsamples our baseline regressions provide evidence for a non-linear, however, counter-intuitive U-shaped relationship. If time-variant individual heterogeneity is taken into account the statistically significant coefficients of the full sample and the pre-WW-II period vanishes. Thus, no systematic relationship is indicated. In contrast, the systematic non-linear U-shaped functional relationship between government size and economic growth is confirmed for the period after WW II.

Table 3: Government size and growth - baseline regressions with non-linear model

	Growth rate of real GDP per capita					
	1880-2016	Pre WW II	Post WW II	1880-2016	Pre WW II	Post WW II
	(10)	(11)	(12)	(13)	(14)	(15)
Real GDP per capita	-0.01* (0.01)	-0.001 (0.02)	-0.04*** (0.01)	-0.03* (0.01)	-0.03 (0.03)	-0.05*** (0.02)
Central public outlays/GDP	-0.01* (0.01)	-0.01* (0.01)	-0.07** (0.03)	-0.01 (0.02)	-0.01 (0.01)	-0.11*** (0.04)
Central public outlays/GDP squared	0.002 (0.002)	0.003*** (0.001)	0.01** (0.005)	0.001 (0.003)	0.003 (0.002)	0.02*** (0.01)
Crisis dummy				0.003 (0.002)	0.01** (0.003)	-0.0001 (0.003)
Country FE	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes
Country-specific trends	no	no	no	yes	yes	yes
Adj. R2	0.56	0.52	0.51	0.57	0.54	0.77
No. of countries	17	17	17	17	17	17
Observations	2,135	836	1,197	2,135	836	1,197
Notes	*p<0.1; **p<0.05; ***p<0.01 see notes Table 1					

These results are insensitive to the inclusion of further covariates (see Table 4). Note that in contrast to the smoother analysis the results remain stable even if the outlying observations of the ratio of central government expenditure to GDP, i.e. the upper 0.5 percentile of the distribution, is excluded from the sample. However independent from the sample, the 'poolability' tests suggests that individual coefficients deviate in a statistically significant way from pooled coefficient estimates. We carry out a Wilcoxon rank sign test to identify if the linear or the quadratic coefficient of GDP-ratio of central government expenditure is affected directly by individual heterogeneity. As in the linear case, the test results indicates that individual heterogeneity matter for the post-WW-II period.

Table 4: Government size and growth - extended regressions with non-linear model

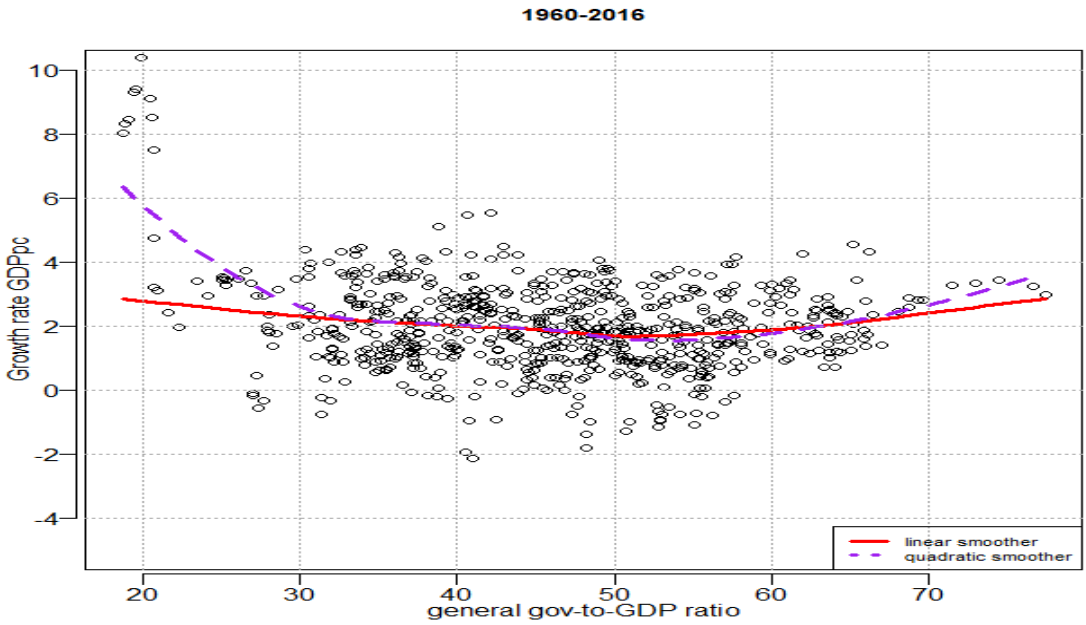
	Growth rate of real GDP per capita		
	1880-2016	Pre WW II	Post WW II
	(16)	(17)	(18)
Real GDP per capita	-0.05*** (0.02)	-0.08*** (0.03)	-0.07*** (0.02)
Central public outlays/GDP	-0.01 (0.01)	-0.02 (0.01)	-0.08** (0.03)
Central public outlays/GDP squared	0.002 (0.002)	0.005* (0.003)	0.02*** (0.01)
Investment-GDP ratio	0.09** (0.04)	0.13*** (0.03)	0.17*** (0.03)
Inflation rate	-0.06*** (0.01)	-0.13*** (0.04)	-0.08*** (0.005)
Real-long-term-interest rate	-0.01 (0.05)	-0.17* (0.09)	-0.09*** (0.03)
Exchange rate dom. currency/US-	0.0000*** (0.0000)	-0.0004 (0.0004)	0.0000 (0.0000)
Openness	0.01 (0.01)	-0.01 (0.01)	0.04*** (0.01)
Crisis dummy	0.002 (0.003)	0.004 (0.003)	-0.001 (0.003)
Country FE	yes	yes	yes
Time FE	yes	yes	yes
Country-specific trends	yes	yes	yes
Adj. R2	0.56	0.51	0.51
No. of countries	17	17	17
Observations	2,001	738	1,182
Instability test (F test)	1.36***	2.11***	1.28***
Wilcoxon signed rank test individual coefficient central public outlays/GDP (V test) (linear; quadratic term)	66; 87	86; 56	20***; 132***
Notes	*p<0.1; **p<0.05; ***p<0.01 see notes Table 1; 'Poolability' test on the instability of individual coefficients, F test, H0: stability; Wilcoxon signed rank test, V test: H0: $\beta_i = \hat{\beta}\ \forall\ i$.		

4.2 General government expenditure

To analyse the impact of the ratio of general government to GDP on the growth rate of GDP per capita for the years from 1960 to 2016, we use again the outlier-robust non-parametric LOWESS smoother and compare it with the growth impact of the ratio of central government expenditure to GDP. The linear as well as the quadratic smoother curve show that in the range of the general government expenditure between 30% and 60% of GDP has only a loose relationship with GDP-per-capita growth (see Figure 4). While for ratios above 60% a positive growth impact is indicated, it is the opposite for ratios below 30%, which is economically counterintuitive. This might be a statistical artefact because reduced density of observations at the margins can bias the LOWESS smoother.

Figure 3

Simple correlation between general-public-outlays-to-GDP ratio and real GDP per capita growth rate from 1960 to 2016 (5-year moving averages, as %)

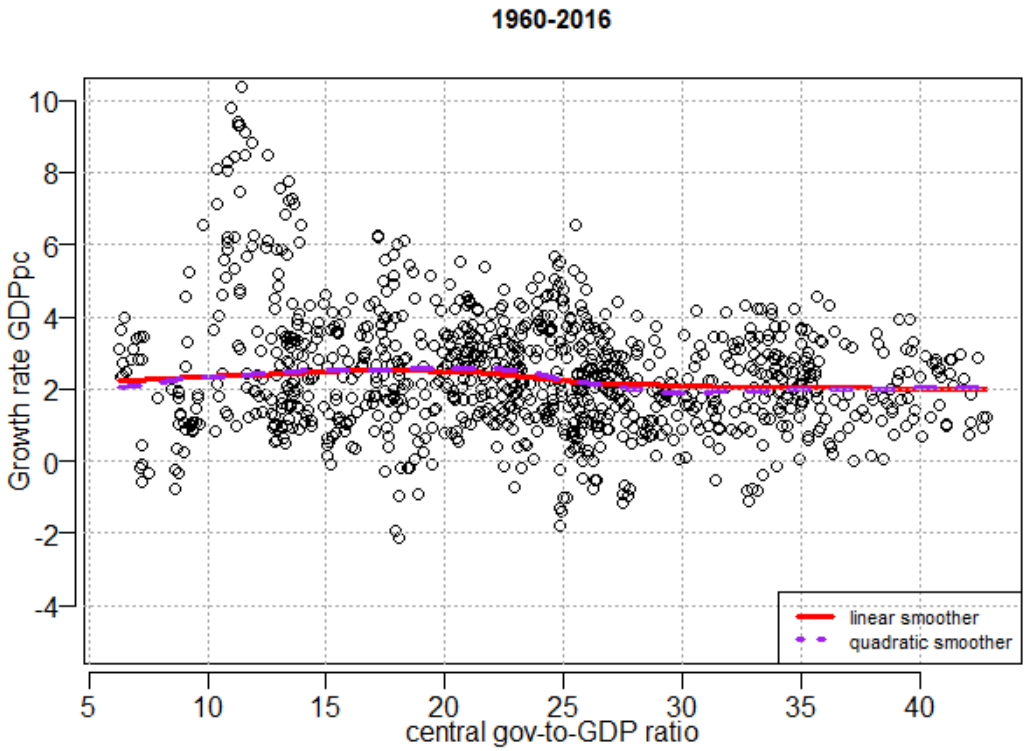


Source: own calculations

The results with respect to the central-government-expenditure-to-GDP ratio and the growth rate are similar. Irrespectively, from the smoother, the analysis suggests that central government expenditure does not seem to have a strong impact on economic growth. This is largely in line with evidence shown for general government expenditure.

Figure 4

Simple correlation between central-public-outlays-to-GDP ratio and real GDP per capita growth rate from 1960 to 2016 (5-year moving averages, as %)



Source: own calculations

Overall, the goodness of fit in the fixed-effects regressions is substantially higher for the period from 1960 to 2016 than for the historical data set. The values of R squared ranges from 85% to 90%. This suggests that the sample for this time range is more homogeneous than the historical dataset. The baseline regression of the linear model shows a systematic negative relationship of general government expenditure in terms of GDP with the growth rate of real GDP per capita (see Table 5, model (19)). However, this result does not survive if one introduces unobserved time-varying individual heterogeneity by the inclusion of country-specific trends. The coefficient of general government expenditure turns statistically positive significant. Adding further possibly growth-relevant factors does not alter the results. These results suggests a systematic positive linear relationship between government size and economic growth. However, the impact is rather modest. An increase in general-government-expenditure-to-GDP

ratio of 1 percentage point would accelerate the growth rate of real GDP only modestly by a maximum of 0.04 percentage point.

Table 5: Government size and growth - regressions general government expenditure

	Growth rate of real GDP per capita, 1960-2016, linear model		
	baseline	baseline plus	extended
	(19)	(20)	(21)
Real GDP per capita	-0.05*** (0.01)	-0.04*** (0.01)	-0.06*** (0.01)
General public outlays/GDP	-0.02*** (0.01)	0.03*** (0.01)	0.04*** (0.01)
Investment-GDP ratio			0.18*** (0.03)
Inflation rate			-0.09*** (0.04)
Real-long-term-interest rate			0.10 (0.08)
Exchange rate dom. currency/US-			0.0000* (0.0000)
Openness			0.04*** (0.01)
Crisis dummy		0.001 (0.001)	0.0001 (0.001)
Country FE	yes	yes	yes
Time FE	yes	yes	yes
Country-specific trends	no	yes	yes
Adj. R2	0.85	0.89	0.89
No. of countries	17	17	17
Observations	697	697	697
Notes	*p<0.1; **p<0.05; ***p<0.01		
	see notes Table 1		

The regression analysis with the fixed-effects within estimator confirm the results of the smoother analysis. No evidence for a non-linear relationship is found (see Table 6). To test the robustness of our results we decompose general government expenditure by central- and sub-national government expenditure (see Tables A4 and A5). Not only are the results with the ratio of general government to GDP confirmed but also the size of the coefficient of central government expenditure virtually equals the one of general government expenditure (see Table A4). This demonstrates that the variation of general government expenditure is mainly determined by the central government level.

Table 6: Government size and growth - regressions general government expenditure

	Growth rate of real GDP per capita, 1960-2016, non-linear model		
	baseline	baseline plus	extended
	(1)	(2)	(3)
Real GDP per capita	-0.05*** (0.01)	-0.04*** (0.01)	-0.06*** (0.01)
General public outlays/GDP	-0.18 (0.13)	0.02 (0.11)	-0.02 (0.11)
General public outlays/GDP squared	0.02 (0.02)	0.001 (0.01)	0.01 (0.01)
Investment-GDP ratio			0.18*** (0.03)
Inflation rate			-0.09*** (0.03)
Real-long-term-interest rate			0.10 (0.08)
Exchange rate dom. currency/US-			0.0000 (0.0000)
Openness			0.04*** (0.01)
Crisis dummy		0.0004** (0.0002)	0.001*** (0.0001)
Country FE	yes	yes	yes
Time FE	yes	yes	yes
Country-specific trends	no	yes	yes
Adj. R2	0.85	0.89	0.89
No. of countries	17	17	17
Observations	697	697	697
Notes	*p<0.1; **p<0.05; ***p<0.01		
	see notes Table 1		

5. Conclusion

The question whether government size affects economic growth positively or negatively is controversial in economics and the empirical evidence is inconclusive (Gemmell and Au 2013; Colombier 2015; Churchill et al. 2017, Brändle 2020). We contribute to the literature by exploiting a longitudinal historical dataset that covers periods with different economic-policy paradigms, by a refined identification strategy for individual heterogeneity and by losing the gap with regard to test the non-linear hypothesis.

We cannot provide evidence for a systematic correlation between government size as measured by central government expenditure and economic growth between 1880 to 2016 and for the pre-WW-II period. This can be explained by the fact that before WW II government size was small because the economic-policy paradigm of 'laissez-faire' dominated. For the period after WW II that has seen a large expansion of government size, our analysis indicates a puzzling U-shaped relationship that literally inverts the expected inverted U-shaped relationship by endogenous growth theory (Armey curve). Testing the 'poolability' restriction shows that this outcome might be originated by differences across countries. A supplementary analysis for the period from 1960 to 2016 with general government expenditure as a measure of government size provides strong evidence that government size is conducive to economic growth, albeit the impact is small. Moreover, our hypothesis that general government expenditure is mainly driven by the central government level is supported.

To sum up, our analysis indicates a loosely positive causal association of government size with economic growth. While this outcome contrasts with the overall empirical evidence of the literature, it is in line with evidence given by panel-data studies that take account of reversed causality and average data by a minimum of 5 years respectively (Churchill et al. 2017). In contrast to the more recent literature, our analysis provide evidence against the hypothesis of a non-linear relationship (Hajamini and Falahi 2018). The evidence given in this paper points to the fact that the relationship between government size and economic growth can differ across

countries. The outcome of this paper suggests two things: first, further research should pay greater attention to the analysis within countries as proposed by Gemmell and Au (2013). Second, the quality of government, i.e. the decomposition of government expenditure and governance, seem to play a greater role than the sheer size of government. Our analysis confirms the conclusion of some previous studies that on average government size in developed countries has so far not reached a level that is growth-hindering (Colombier 2009; Colombier 2015). To be more precise, from our results one can infer that either the tipping point of government size is at levels that has not been reached so far or is inexistent. One should bear in mind that the relationship between government size is much more complex than suggested by endogenous growth theory. The derivation of a non-linear function between government expenditure and economic growth rests on rather simplifying assumptions such as perfect competition and a single-good economy. Potential factors such as the quality of governmental institutions or imperfect markets are not taken into account. Overall, our evidence suggests that policy-makers should not worry so much about the sheer size government but are advised paying close attention to run government affairs efficiently and providing high-quality public services.

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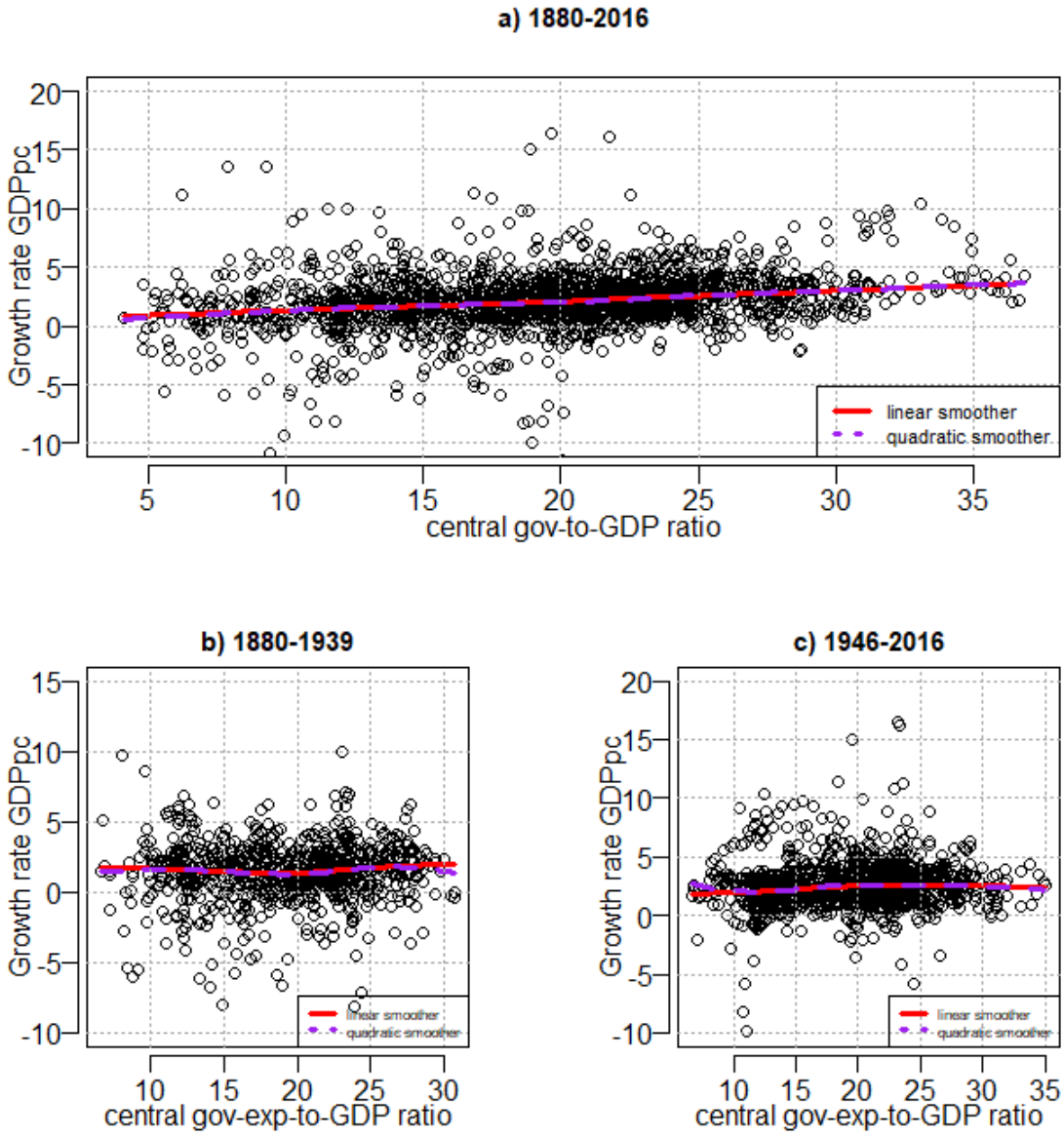
Appendix

Figure A1

Simple correlation between central-public-outlays-to-GDP ratio (lagged by 5 years) and real GDP per capita growth rate in historical data set without extreme outliers (5-year moving averages, as %)[1]



Source: own calculations.

[1] Upper 0.5 percentile of the distribution of central-government-expenditure-to-GDP ratio, i.e. x>50, is excluded. These observations are: Netherlands from 1945 to 1949; United Kingdom 1918, 1919 and from 1943 to 1947.

Table A1: Descriptive statistics

Statistic	N x T	Max	Mean	Median	Min	Pctl(25)	Pctl(75)	St. Dev.
Growth real GDPpc	2,321	0.66	0.02	0.02	-0.51	0.003	0.04	0.05
Real GDPpc	2,321	36,359.37	9,188.57	5,818.15	829.30	3,149.31	14,522.06	7,599.48
Central public outlays/GDP	2,248	1.06	0.18	0.15	0.01	0.09	0.25	0.11
General government outlays/GDP	782	0.77	0.47	0.47	0.19	0.39	0.54	0.10
Investments/GDP	2,133	0.39	0.19	0.20	0.02	0.14	0.23	0.06
Inflation rate	2,321	0.97	0.04	0.02	-0.38	0.003	0.05	0.09
Real long-term interest rate	2,298	0.36	0.02	0.03	-0.46	0.004	0.05	0.07
Exchange rate to US-$	2,320	2,197.06	52.04	3.74	0.00	1.00	6.77	213.56
Openness	2,279	2.97	0.43	0.38	0.01	0.25	0.52	0.33

Notes: Data availability for general government expenditure is restricted to maximum range 1960-2016; inflation rate without years of hyper-inflation in Germany.
pc:= per capita; openness:= ratio of sum of export and import to GDP.

Table A2: Pearson's correlation matrix full sample

	Growth real GDPpc	Real GDPpc	Central public outlays/ GDP	Public debt/GDP	Investm./ GDP	Inflation rate	Real long-term interest rate	Exchange rate to US-$	Openness
Growth real GDPpc	1	-0.044	-0.019	-0.127	0.182	-0.111	0.035	0.039	-0.036
Real GDPpc	-0.044	1	0.531	0.103	0.469	-0.034	0.022	0.098	0.171
Central public outlays/GDP	-0.019	0.531	1	0.274	0.250	0.160	-0.070	0.198	0.138
Investments/GDP	-0.127	0.103	0.274	1	-0.274	-0.059	0.027	0.121	0.130
Inflation rate	0.182	0.469	0.250	-0.274	1	0.047	-0.045	0.116	0.039
Real long-term interest rate	-0.111	-0.034	0.160	-0.059	0.047	1	-0.809	0.094	-0.068
Exchange rate to US-$	0.035	0.022	-0.070	0.027	-0.045	-0.809	1	-0.041	0.040
Openness	0.039	0.098	0.198	0.121	0.116	0.094	-0.041	1	-0.027
	-0.036	0.171	0.138	0.130	0.039	-0.068	0.040	-0.027	1

Notes: see Notes Table A1.

Table A3: Pearson's correlation matrix 1960-2016

	Growth real GDPpc	Real GDPpc	Central public outlays/ GDP	General public outlays to GDP	Pulblic debt/GDP	Investm./ GDP	Inflation rate	Real long-term interest rate	Exchange rate to US-$	Openness
Growth real GDPpc	1	-0.227	-0.091	-0.260	-0.145	0.237	0.011	0.027	0.005	-0.068
Real GDPpc	-0.227	1	0.044	0.159	0.293	-0.307	-0.541	0.028	-0.147	0.149
Central public outlays/GDP	-0.091	0.044	1	0.665	0.046	-0.341	0.090	0.238	0.156	0.285
General government outlays/GDP	-0.260	0.159	0.665	1	0.307	-0.510	-0.125	0.418	0.113	0.497
Investments/GDP	-0.145	0.293	0.046	0.307	1	-0.410	-0.360	0.117	0.280	0.272
Inflation rate	0.237	-0.307	-0.341	-0.510	-0.410	1	0.367	-0.374	-0.047	-0.194
Real long-term interest rate	0.011	-0.541	0.090	-0.125	-0.360	0.367	1	-0.510	0.086	-0.106
Exchange rate to US-$	0.027	0.028	0.238	0.418	0.117	-0.374	-0.510	1	0.023	0.017
Openness	0.005	-0.147	0.156	0.113	0.280	-0.047	0.086	0.023	1	-0.063
	-0.068	0.149	0.285	0.497	0.272	-0.194	-0.106	0.017	-0.063	1

Notes: see Notes Table A1

Table A4: Government size and growth - regressions decomposition of general government expenditure

	Growth rate of real GDP per capita, 1960-2016, linear model		
	baseline	baseline plus	extended
	(1)	(2)	(3)
Real GDP per capita	-0.06*** (0.01)	-0.04*** (0.01)	-0.06*** (0.01)
Central public outlays/GDP	0.005 (0.01)	0.03*** (0.01)	0.03*** (0.01)
Sub-national public outlays/GDP	-0.01*** (0.003)	0.01*** (0.005)	0.02** (0.01)
Investment-GDP ratio			0.19*** (0.03)
Inflation rate			-0.09** (0.03)
Real-long-term-interest rate			0.09 (0.08)
Exchange rate dom. currency/US-			0.0000 (0.0000)
Openness			0.04*** (0.01)
Crisis dummy		0.001 (0.001)	-0.0000 (0.001)
Country FE	yes	yes	yes
Time FE	yes	yes	yes
Country-specific trends	no	yes	yes
Adj. R2	0.85	0.9	0.9
No. of countries	17	17	17
Observations	697	697	697
Notes	*p<0.1; **p<0.05; ***p<0.01		
	see notes Table 1		

Table A5: Government size and growth - regressions decomposition of general government expenditure

	Growth rate of real GDP per capita, 1960-2016, non-linear model		
	baseline	baseline plus	extended
	(4)	(5)	(6)
Real GDP per capita	-0.07*** (0.01)	-0.05*** (0.01)	-0.07*** (0.01)
Central public outlays/GDP	-0.05 (0.05)	0.06 (0.04)	-0.001 (0.05)
Central public outlays/GDP squared	0.01 (0.01)	-0.005 (0.01)	0.01 (0.01)
Sub-national public outlays/GDP	-0.06*** (0.01)	-0.04*** (0.01)	-0.04*** (0.01)
Sub-national public outlays/GDP squared	-0.01*** (0.002)	-0.01*** (0.002)	-0.01*** (0.002)
Investment-GDP ratio			0.19*** (0.03)
Inflation rate			-0.11*** (0.04)
Real-long-term-interest rate			0.04 (0.08)
Exchange rate dom. currency/US-			0.0000 (0.0000)
Openness			0.04*** (0.01)
Crisis dummy		0.0001 (0.001)	-0.001 (0.001)
Country FE	yes	yes	yes
Time FE	yes	yes	yes
Country-specific trends	no	yes	yes
Adj. R2	0.86	0.9	0.9
No. of countries	17	17	17
Observations	697	697	697
Notes	*p<0.1; **p<0.05; ***p<0.01 see notes Table 1		

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