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ABSTRACT
This paper examines the association between economic development and two measures of public spending on education, namely the 'national effort' (total spending as a percentage of GDP) and 'budget share' (total spending as a percentage of total government spending). Using data for a large sample of countries from 1989 to 2015, we illustrate a novel application of Wagner's law. We compare mean levels of national effort and budget share measures for economically and politically distinct groups of countries. We find that the signs of the associations between the level of economic development and the two education spending measures differ. This implies that richer countries have larger public sectors than do poorer countries, consistent with Wagner's Law. The findings are summarized in the form of three inequality propositions about the national effort, budget share and size of government for richer versus poorer countries. In addition, for comparable levels of economic development, democratic countries tend to spend more on education than is the case for their non-democratic counterparts.

JEL Classification: H52, I22, I25

Keywords: education spending, Wagner's law, economic development, democracy, least squares dummy variables (LSDV) estimation

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1. Introduction

Wagner's law (after Adolph Wagner, 1835-1917) postulates that the size of the public sector (including public education spending) is positively related to the level of economic development (Wagner, 1883, 1958; Musgrave and Peacock, 1958). Wagner (1892) attributes growth in public sector activity to progress in the state of the cultural and economic environment, so social progress and income growth are associated with bigger government (Kuckuck, 2014). Richer, more developed, countries have greater resources with which to fund various social programmes, such as education (Brown and Hunter, 2004). When the public sector expands, public provision of education is also likely to expand if governments view education as a productive component of their spending. Despite uncertainty about the direction of causation, Wagner's law represents a testable empirical regularity. Indeed, income per capita has been widely used as an explanatory variable in studies of education spending; see, for example, recent studies by Afonso and Alves (2017), Cockx and Francken (2016) and Garritzmann and Seng (2016).

Whether richer countries, on average, are necessarily associated with greater public spending on education, regardless of the measure used, is a matter of empirical inquiry. For instance, we do not know how the mean levels of two 'headline' measures of public spending on education, namely the 'national effort' (total spending as a percentage of GDP) and 'budget share' (total spending as a percentage of total government spending), vary across different groups of countries, where the groups are defined by economic and political characteristics. Do richer countries have larger public education sectors in *both* national effort and budget share terms? Our paper addresses this question, provides a global comparative view of education spending patterns, and delivers a novel perspective on Wagner's Law.

The key question to be answered is whether there exist differences in the mean levels of the national effort or budget share measures for economically and politically distinct groups of

countries. Several hypotheses can be formulated from the relevant empirical literature. Contemporary evidence suggests a positive relationship between the national effort measure and economic development (Cockx and Francken, 2016; Akanbi and Schoeman, 2010; Huber, et al., 2008; Busemeyer, 2007; Stasavage, 2005; Baqir, 2002; Ram, 1995; Tilak, 1989). Evidence concerning the budget share is more limited. The few existing studies mostly report a positive association between budget share and economic development (Fosu, 2010; Stasavage, 2005; Baqir, 2002), although the relationship is not always significant and the studies by Fosu and Stasavage are for African countries only. However, it is reasonable to suppose that, as countries grow and develop, the size and complexity of their respective public sectors (the *variety* of public goods to be financed by government) should grow, so education will comprise a reducing share of the total budget allocation, *ceteris paribus*. This would certainly be true if education is a 'necessity' with respect to total government spending.

In addition, regardless of the outcome measure (national effort or budget share), democratic countries can be expected to spend more on education, *ceteris paribus*, because socio-political pressures placed on governments compel them to be more accountable to the citizenry. Spending more on socially productive public goods, such as education, provides a politically popular way for governments to demonstrate accountability and broaden their voter pool. Brown and Hunter (2004), for example, make this point with respect to spending on primary education in Latin America. Many empirical studies find evidence in favour of higher public education spending in democracies; see, for example, Garritzmann and Seng (2016), Avelino et al. (2005), Stasavage (2005) and Baqir (2002). Consequently, in our analysis, countries are categorized by political regime as well as by levels of income.

The rest of this paper proceeds as follows. Section 2 describes the data and outlines the empirical method to be applied. Section 3 reports the empirical results and checks for robustness. Section 4 discusses the main findings. Section 5 concludes.

2. Data and Empirical Method

We use annual panel data for up to 193 countries from 1989 to 2015, although the number of available observations depends on the variables being considered. Table 1 presents details of the data collected. Two different continuous outcome measures for public education spending are examined, namely the national effort (*psegdptot*) and budget share (*psegovtot*). Three key categorical explanatory measures are used. The level of economic development (*ypc2015*) is represented by a set of dummy variables, categorizing countries into five groups adapted from the World Bank's Country and Lending Groups as at 2015, based on gross national income (GNI) per capita in US dollars. The sample contains representation across the full range of income levels. The richest group consists of the 'core' 21 Organisation for Economic Co-operation and Development (OECD) countries. The other four groups are high income (non-OECD), upper middle income, lower middle income, and low income countries. Appendix Table A1 gives a list of countries included in each income group.

An alternative classification of countries by development status is based on a binary richer-country/poorer-country split, defined in terms of regional country groupings (*region*). Appendix Table A2 provides a list of countries included in each type of group. A binary perspective on education spending patterns can be explored by using a pair of regional dummy variables representing rich versus poor countries.

A classification of countries depending on whether they are democratic or non-democratic (*poldemoc*) is used to represent different political regime types. A classification of countries by regime type (democratic versus non-democratic) is not listed because this can vary over time. For all three of the key categorical explanatory measures, sample selection bias is mitigated because the economic groupings of countries are invariant over the study period, and the political regime type typically varies only very slowly over time in most countries.

Table 1
Data definitions and sources.

Variable name	Description of the variable	Source
	Dependent Variables	
psegdptot	Public spending on education, total (% of GDP)	World Bank EdStats
psegovtot	Public spending on education, total (% of total government spending)	World Bank EdStats
	Explanatory Variables	
ypc2015	GNI per capita country grouping in 2015, 21 OECD countries	World Bank (Atlas Method)
region	Richer (versus poorer) country regions	Authors' compilation
poldemoc	Political democracy classification: yes; no	Freedom House
	Control Variables	
pop024	Population aged 0-24 (% of total population)	World Bank EdStats
urban	Urban population (% of total population)	World Bank WDI
trade	Exports plus imports of goods & services (% of GDP)	World Bank WDI
hci	Human capital index	Penn World Table 9.0
pop65	Population aged 65 and above (% of total population)	World Bank WDI
military	Military expenditure (% of GDP)	World Bank WDI
fiscbal	Fiscal balance (% of GDP)	World Bank DPG
debt	General government gross debt (IMF, % of GDP)	World Bank TCdata360

Notes: EdStats refers to the World Bank's Education Statistics database (World Bank, 2017a). TCdata360 refers to the World Bank's TCdata360 database (World Bank, 2017b). WDI refers to the World Bank's World Development Indicators database (World Bank, 2017c). DPG refers to the World Bank's Development Prospects Group: A Cross-Country Database of Fiscal Space (World Bank, 2017d). The *pop024* variable is the sum of *pop014* and *pop1524* variables from the World Bank EdStats database. Freedom House refers to the Freedom in the World survey data (Freedom House, 2016). See Feenstra et al. (2015) for the Penn World Table 9.0 source.

Several potentially important control variables are included in the analyses. The size of the school-going population up to age 24 (*pop024*) captures the positive demographic effect of the proportion of young people on education spending (Busemeyer, 2008, 2007; Brown and Hunter, 2004; Castles, 1989). The urbanisation ratio (*urban*) captures the positive effect of a greater concentration of the total population in urban areas on a government's propensity to act in favour of fundamental social needs, such as education (Akanbi and Schoeman, 2010; Huber et al., 2008; Avelino et al., 2005; Baqir, 2002; Schultz, 1988). Total international trade (*trade*) is often included in empirical analyses of education spending (Busemeyer, 2009; Huber et al., 2008; Iversen and Stephens, 2008; Kaufman and Segura-Ubiergo, 2001). This allows for two possible effects: a positive compensation effect, in which government 'compensates' society for the adverse effects of globalisation through greater social and welfare spending, and a negative efficiency effect, in which government sees increased globalisation as a mechanism

to promote competitiveness, reducing the need for social and welfare spending.[1] Which trade effect dominates is an empirical question.

A number of other control variables are used for robustness checking. The size of the population aged 65 and above (*pop65*) represents a demographic cohort that competes for education spending in the form of transfer payments to the elderly population (Busemeyer, 2008; Iversen and Stephens, 2008; Avelino et al., 2005; Brown and Hunter, 1999). Military spending (*military*) is also expected to compete for education's share of public resources, especially in countries with a large military presence (Baqir, 2002). The fiscal balance (*fiscbal*) and gross public debt stock (*debt*) are both expected to have implications for how much of the public purse is allocated to education (Busemeyer, 2009; Huber et al., 2008; Tilak, 1990, 1989). Human capital development, as measured by the Penn World Table human capital index (*hci*), is not typically used in this empirical literature, but is included to control for the current-period stock of human capital as a proxy for the quality of education in a country.

Table 2 reports pooled descriptive statistics for each variable. Data availability is a pervasive problem in the literature on education spending. The two measures of education spending are available for fewer countries (*N*) and a smaller average number of time-series observations than are any of the explanatory variables: the sample is roughly half as large in most cases. Descriptive results are not reported for *ypc2015*, *region* and *poldemoc* because these are sets of binary variables used to characterize broad political and economic categories.

The approach we adopt – a (conditional) generalized-form *t*-test in the context of a factor-variable interaction model – aims for a descriptive characterization of average differences

[1] More detailed explanations of the compensation and efficiency hypotheses are provided by Walter (2010), Adserà and Boix (2002), Garrett (1998a, 1998b, 2001), Rodrik (1998), Katzenstein (1985), Ruggie (1982) and Cameron (1978).

Table 2
Descriptive statistics.

Variable Name	Data coverage	*N*	Countries	Years	Mean	Std dev.	Minimum	Maximum
psegdptot	1989-2015	2551	193	13.2	4.505	2.007	0.781	44.334
psegovtot	1989-2015	2255	181	12.5	14.849	5.036	2.563	47.279
ypc2015	1989-2015	5859	217	27.0	n/a	n/a	n/a	n/a
region	1989-2015	3024	112	27.0	n/a	n/a	n/a	n/a
poldemoc	1989-2015	5105	193	26.5	n/a	n/a	n/a	n/a
pop024	1990-2015	4714	184	25.6	49.977	13.687	20.160	73.288
urban	1989-2015	5799	215	27.0	55.788	24.901	5.342	100.000
trade	1989-2015	4785	193	24.8	86.996	52.290	0.021	531.737
hci	1989-2014	3703	143	25.9	2.342	0.694	1.028	3.734
pop65	1989-2015	5234	195	26.8	7.073	4.814	0.697	26.342
military	1989-2015	3870	166	23.3	2.433	3.210	0	117.388
fiscbal	1990-2015	4184	191	21.9	-2.299	13.715	-505.442	122.188
debt	1989-2015	3796	186	20.4	57.015	49.714	0	789.833

Notes: Years refers to the average number of years (time-series observations) for each country. Std dev. refers to the overall standard deviation. Two changes were made to the original data for the *psegdptot* variable. The zero observation for Turkey in 1998 was deleted (because there were no other 0% values in the dataset; nil or negligible appeared in the original UNESCO source data for this observation) and the observation for Tuvalu in 1997 (3730833.5%) was deleted as an obvious mistake; this extreme value for this observation also appeared in the original UNESCO source data.

between broad groupings of countries, rather than implying specific causal linkages. The method is a variant of fixed effects estimation, but instead of estimating country fixed effects, more highly aggregated group effects are estimated. Testing for differences in the mean levels of education spending for the economic and political groupings is equivalent to performing multiple *t*-tests using a joint regression modelling framework. An advantage of this method is that mean differences can be estimated while controlling for other relevant variables. The regression equations include interactions of political and economic dummy variables, allowing for different intercepts in each political-economic group. However, no other interaction terms are included, and the parameters for the controls are assumed to be constant across all countries. Allowing for heterogeneous group parameters would mean having to interact all of the group dummies with the control variables, leading to a proliferation of explanatory variables and excessive multicollinearity.

The models in equations (1) and (2) represent the empirical specifications to be tested. Separate single-equation models are estimated for national effort and budget share. The model

in equation (1) interacts categorical variables for five economic groups and two political groups (democratic, non-democratic), yielding 10 categories. The model in equation (2) interacts categorical variables for two regional groups (richer, poorer) with the two political groups, yielding four categories.

$$Y_{it} = \sum_{j=1}^{5}\sum_{m=0}^{1} \alpha_{jm}(E_{jit} \times P_{mit}) + \sum_{n=1}^{N} \beta_n X_{nit} + \varepsilon_{it} \quad (1)$$

$$Y_{it} = \sum_{r=0}^{1}\sum_{m=0}^{1} \alpha_{rm}(R_{rit} \times P_{mit}) + \sum_{n=1}^{N} \beta_n X_{nit} + \varepsilon_{it} \quad (2)$$

Here, Y is either the national effort or budget share measure of total education spending; E_j (j = 1, …, 5) constitutes a set of five (1/0) dummy variables, one for each of the five GNI per capita country groups; P_m (m = 0, 1) is a set of two (1/0) dummy variables, one for each of the political groupings, i.e., democratic, (m = 1) or non-democratic (m = 0); R_r (r = 0, 1) is a set of two (1/0) dummy variables, one for each of the two regional country groups (poorer or richer); X_n (n = 1, …, N) is a set of continuous control variables comprising a minimum of three or a maximum of eight controls; and ε is a generic random error term. Subscripts i and t denote observations for country i and time t, respectively, and α_{jm}, α_{rm} and β_n are parameters.

In order to focus on differences in national effort and budget share across groups, we reparameterize equations (1) and (2). We include an intercept term and, if there are k distinct economic/political categories, k–1 dummies are included, to avoid perfect multicollinearity. The base category is then represented by the intercept. For equation (1), the base category is the group of 21 OECD countries that are democratic. For equation (2), the base category is richer countries (or, more accurately, regions comprising the richest countries of the world) that are democratic. In the reparameterized model, the coefficients on the interacted dummy variables represent mean differences in the education spending measure for the relevant

composite economic/political category relative to the base category. So, for example, for comparisons of different economic groups with a common political categorization, a series of positive (negative) mean differences indicates that poorer countries have higher (lower) levels of the associated education spending measure relative to the relevant base category.

There are three types of robustness check. The least-squares dummy-variable (LSDV) estimator with heteroskedasticity-robust standard errors is used to obtain the baseline set of results. The first set of robustness checks examines a number of different estimators of the standard errors.[2] These include one-way (country or year) and two-way (country and year) clustering, Newey-West heteroskedasticity and autocorrelation consistent (HAC) standard errors (Newey and West, 1987, 1994), and Driscoll and Kraay's (1998) standard errors, which are robust to heteroskedastic, autocorrelated and cross-sectionally dependent errors. Second, quantile (median) regression and robust regression estimates of the parameters are examined to check for sensitivity to outlier observations.[3] Third, time dummies are included to control for year effects.[4]

[2] All estimates are obtained using Stata, version 15. Huber/White heteroskedasticity-robust standard errors are obtained using 'vce(robust)'. One-way clustering of standard errors is performed using 'cluster(country)' or 'cluster(year)'. Two-way clustering is performed with the user-written program 'vce2way' (Yoo, 2017). Note that 'one-way' or 'two-way' in the tables of results refers to the type of clustering procedure used and not the type of fixed effects. Baum, Nichols and Schaffer (2010) and Cameron and Miller (2015) provide a practical discussion of cluster-robust inference. The Newey-West procedure (Newey and West, 1987, 1994) is implemented using the 'newey' command. The Driscoll-Kraay procedure (Driscoll and Kraay, 1998) is performed with the user-written programme 'xtscc' by Hoechle (2007). Hoechle's code was updated in April 2018 to calculate more 'conservative' standard errors that take account of a small-sample adjustment. These are reported in our results.

[3] Robust estimation uses the 'rreg' routine in Stata, version 15. An initial screening based on Cook's distance is used to remove gross outliers. Starting values are then calculated, and Huber iterations performed, followed by biweight iterations, to determine the down-weighting of any outliers; see Hamilton (1991) for further details.

[4] Country dummies (country fixed effects) are not included in any of the specifications. It would not make sense to include both components of heterogeneity, such as time-invariant group effects and time-invariant country effects, because this would be tantamount to 'double counting' fixed effects, with the former being a more aggregated version of the latter. In practice, including both types of (fixed) effects on the right-hand side would result in near perfect collinearity in the estimation procedure.

3. Empirical Results

Tables 3 and 4 report the empirical estimates for the national effort and budget share, respectively, for the model with 10 economic/political categories; the corresponding results for the model with four categories are reported in Tables 5 and 6. In the tables of results, the coefficient estimates are labelled '*j*#*m*' ($j = 1, \ldots, 5$; $m = 0, 1$) for equation (1) and '*r*#*m*' ($r = 0, 1$; $m = 0, 1$) for equation (2). 'BASE' represents the intercept estimate. In each table, eight sets of results are reported. Each estimator is applied to a model with no controls (A), and with three controls (B). Note that there are no non-democratic OECD or richer countries, so there are no results for this combination.

Robustness checks appear in Appendix Tables A3 and A4 (using LSDV estimation), and Tables A5 and A6 (using robust estimation). These tables report results using more than three controls and year dummies.

Estimated coefficients on the control variables have the expected signs. Both the youth population and urbanisation variables have positive coefficients. The coefficient on the trade variable is positive in most cases, which supports the compensation hypothesis. The largest standard errors are those clustered by country (as opposed to by year or by country and year). This is not surprising, because there are many countries for which very few observations are available for the dependent variable, and this makes it difficult to estimate coefficients precisely when clustering by country. Although the explanatory power of each model (as measured by *R*-squared) is not a major focus, accounting for outliers using the two methods of weighting observations (quantile and robust estimation) improves the goodness of fit.

The most important finding from Tables 3 and 4 (Equation (1)), and Tables 5 and 6 (Equation (2)) is a reversal in the pattern of mean differences for the levels of the national effort compared to the budget share. Interacting the economic and political dummies (Tables 3 and 4) or regional and political dummies (Tables 5 and 6), reveals a pattern of significant *negative*

mean differences (compared to the base category) for the national effort but *positive* mean differences for the budget share. These patterns are similar regardless of whether no controls or three controls are used. Controlling for political categorization, richer (poorer) countries tend to spend more, on average, in national effort (budget share) terms, although the association is not always monotonic.

Whether a country has a democratic political system is associated with its education spending patterns, with significant mean differences within the same economic or regional group. For example, regardless of the spending measure (national effort or budget share), controlling for economic or regional group, democratic countries tend to spend more on average than do their non-democratic counterparts. Table 7 reports a summary of the results from a series of pairwise Wald tests, conducted on the robust regression estimates obtained from Tables 3 to 6, for the null hypothesis of parameter equality (i.e., no difference in the mean levels of education spending for countries with democratic versus non-democratic systems, within the same economic or regional group). For example, we can test whether the mean level of education spending in low-income democratic countries differs significantly from that of low-income countries that are not democratic. Because the intercept term is the common base category for all economic/political groups, we can ignore that and focus on the differences in the relevant coefficient estimates. We are conducting multiple hypothesis tests, which inflates the overall 'familywise' Type I error rate, so we apply a Bonferroni correction to the level of significance used for each individual test by dividing the familywise error rate (set at 0.05) by the number of tests (e.g., 0.05/4 tests = 0.0125). Even with such a correction, most pairwise comparisons still reveal statistically significant differences.

Table 3

Mean differences in the national effort by income group and regime type.

Dependent Variable: *psegdptot*	LSDV		LSDV (One-way; Country)		LSDV (One-way; Year)		LSDV (Two-way)		Newey-West		Driscoll-Kraay		Quantile		Robust	
	(A)	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**
1#0. Low income & not democratic	-1.551***	-1.635***	-1.551***	-1.635*	-1.551***	-1.635***	-1.551***	-1.635*	-1.551***	-1.635***	-1.551***	-1.635***	-1.787***	-1.885***	-1.979***	-2.013***
	(0.254)	(0.359)	(0.544)	(0.911)	(0.265)	(0.394)	(0.549)	(0.926)	(0.311)	(0.486)	(0.294)	(0.531)	(0.133)	(0.260)	(0.130)	(0.207)
1#1. Low income & democratic	-1.684***	-1.756***	-1.684***	-1.756**	-1.684***	-1.756***	-1.684***	-1.756**	-1.684***	-1.756***	-1.684***	-1.756***	-1.757***	-1.877***	-1.724***	-1.759***
	(0.123)	(0.257)	(0.330)	(0.774)	(0.129)	(0.255)	(0.332)	(0.773)	(0.178)	(0.389)	(0.185)	(0.371)	(0.127)	(0.257)	(0.153)	(0.216)
2#0. Lower middle income & not democratic	-1.152***	-1.412***	-1.152***	-1.412**	-1.152***	-1.412***	-1.152***	-1.412**	-1.152***	-1.412***	-1.152***	-1.412***	-1.170***	-1.578***	-1.362***	-1.611***
	(0.130)	(0.220)	(0.406)	(0.688)	(0.108)	(0.197)	(0.399)	(0.681)	(0.196)	(0.338)	(0.152)	(0.290)	(0.209)	(0.259)	(0.116)	(0.171)
2#1. Lower middle income & democratic	-0.454***	-0.663***	-0.454	-0.663	-0.454***	-0.663***	-0.454	-0.663	-0.454*	-0.663**	-0.454***	-0.663***	-0.739**	-1.126***	-0.979***	-1.123***
	(0.158)	(0.199)	(0.484)	(0.627)	(0.108)	(0.131)	(0.470)	(0.609)	(0.235)	(0.305)	(0.162)	(0.169)	(0.318)	(0.287)	(0.117)	(0.159)
3#0. Upper middle income & not democratic	-1.090***	-1.389***	-1.090**	-1.389*	-1.090***	-1.389***	-1.090**	-1.389*	-1.090***	-1.389***	-1.090***	-1.389***	-1.357***	-1.669***	-1.432***	-1.764***
	(0.155)	(0.230)	(0.534)	(0.801)	(0.131)	(0.140)	(0.527)	(0.780)	(0.244)	(0.369)	(0.195)	(0.193)	(0.166)	(0.177)	(0.129)	(0.146)
3#1. Upper middle income & democratic	-0.819***	-1.097***	-0.819***	-1.097**	-0.819***	-1.097***	-0.819***	-1.097***	-0.819***	-1.097***	-0.819***	-1.097***	-0.797***	-1.131***	-0.935***	-1.133***
	(0.097)	(0.132)	(0.295)	(0.423)	(0.085)	(0.119)	(0.292)	(0.419)	(0.141)	(0.203)	(0.092)	(0.159)	(0.106)	(0.156)	(0.106)	(0.127)
4#0. High income (non-OECD) & not democratic	-1.123***	-1.987***	-1.123**	-1.987***	-1.123***	-1.987***	-1.123**	-1.987***	-1.123***	-1.987***	-1.123***	-1.987***	-1.478***	-1.933***	-1.329***	-2.047***
	(0.183)	(0.217)	(0.514)	(0.702)	(0.197)	(0.192)	(0.519)	(0.695)	(0.249)	(0.332)	(0.273)	(0.259)	(0.152)	(0.195)	(0.171)	(0.189)
4#1. High income (non-OECD) & democratic	-0.814***	-0.768***	-0.814**	-0.768**	-0.814***	-0.768***	-0.814**	-0.768**	-0.814***	-0.768***	-0.814***	-0.768***	-0.644***	-0.654***	-0.777***	-0.721***
	(0.091)	(0.101)	(0.338)	(0.357)	(0.049)	(0.064)	(0.329)	(0.348)	(0.144)	(0.156)	(0.059)	(0.085)	(0.123)	(0.130)	(0.106)	(0.111)
5#0. High income (OECD) & not democratic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5#1. High income (OECD) & democratic BASE	5.352***	3.668***	5.352***	3.668***	5.352***	3.668***	5.352***	3.668***	5.352***	3.668***	5.352***	3.668***	5.226***	3.107***	5.325***	3.449***
	(0.055)	(0.312)	(0.225)	(0.945)	(0.058)	(0.171)	(0.226)	(0.908)	(0.089)	(0.467)	(0.083)	(0.200)	(0.056)	(0.334)	(0.073)	(0.260)
Youth population		0.016***		0.016		0.016***		0.016		0.016*		0.016**		0.022***		0.018***
		(0.006)		(0.018)		(0.005)		(0.018)		(0.009)		(0.007)		(0.006)		(0.004)
Urban population		0.009***		0.009		0.009***		0.009		0.009**		0.009***		0.011***		0.011***
		(0.002)		(0.008)		(0.001)		(0.007)		(0.004)		(0.002)		(0.003)		(0.002)
Trade		0.008***		0.008**		0.008***		0.008**		0.008***		0.008***		0.008***		0.007***
		(0.001)		(0.004)		(0.001)		(0.003)		(0.002)		(0.001)		(0.001)		(0.001)
Covariates	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.060	0.100	0.060	0.100	0.060	0.100	0.060	0.100	n/a	n/a	0.060	0.100	0.074	0.107	0.123	0.190
F-value	35.86***	34.89***	3.78***	3.79***	78.63***	120.42***	n/a	n/a	15.83***	15.72***	60.00***	387.40***	n/a	n/a	43.22***	48.51***
Countries	183	169	183	169	183	169	183	169	183	169	183	169	183	169	183	169
Years	27	26	27	26	27	26	27	26	27	26	27	26	27	26	27	26
Observations	2468	2288	2468	2288	2468	2288	2468	2288	2468	2288	2468	2288	2468	2288	2468	2288

Notes: BASE group is high income (OECD) and democratic countries. Three controls are used: youth population (*pop024*); urban population (*urban*) and trade (*trade*). A pseudo R-squared is reported for the quantile regression. Not applicable (n/a) means the respective statistic was not available or not reported. The LSDV and quantile estimators use Huber/White heteroskedasticity-robust standard errors. The various LSDV estimators use one-way (country or year) and two-way (country and year) cluster-robust standard errors. The Newey-West and Driscoll-Kraay estimators use their own covariance matrix corrections to compute heteroskedasticity and autocorrelation consistent (HAC), and cross-sectional or spatial correlation consistent standard errors under different data-generating assumptions, respectively. The various standard errors are given in parentheses. Significance levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4

Mean differences in the budget share by income group and regime type.

Dependent Variable: *psegovtot*	LSDV		LSDV (One-way; Country)		LSDV (One-way; Year)		LSDV (Two-way)		Newey-West		Driscoll-Kraay		Quantile		Robust	
	(A)	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**
1#0. Low income & not democratic	3.633***	-0.012	3.633***	-0.012	3.633***	-0.012	3.633***	-0.012	3.633***	-0.012	3.633***	-0.012	3.948***	-0.162	3.387***	-0.210
	(0.436)	(0.726)	(1.208)	(2.003)	(0.292)	(0.682)	(1.163)	(1.988)	(0.644)	(1.069)	(0.314)	(0.984)	(0.608)	(0.696)	(0.392)	(0.614)
1#1. Low income & democratic	4.796***	1.339*	4.796***	1.339	4.796***	1.339*	4.796***	1.339	4.796***	1.339	4.796***	1.339	5.135***	1.290**	4.821***	1.467**
	(0.381)	(0.686)	(0.832)	(1.748)	(0.310)	(0.754)	(0.802)	(1.776)	(0.500)	(0.966)	(0.451)	(1.092)	(0.366)	(0.581)	(0.467)	(0.643)
2#0. Lower middle income & not democratic	4.304***	1.081*	4.304***	1.081	4.304***	1.081*	4.304***	1.081	4.304***	1.081	4.304***	1.081	4.231***	0.614	4.196***	0.850*
	(0.368)	(0.600)	(1.148)	(1.791)	(0.348)	(0.563)	(1.142)	(1.779)	(0.555)	(0.899)	(0.468)	(0.803)	(0.595)	(0.531)	(0.353)	(0.511)
2#1. Lower middle income & democratic	4.852***	2.421***	4.852***	2.421*	4.852***	2.421***	4.852***	2.421**	4.852***	2.421***	4.852***	2.421***	4.137***	1.661***	4.224***	1.830***
	(0.369)	(0.446)	(1.009)	(1.236)	(0.214)	(0.390)	(0.963)	(1.217)	(0.548)	(0.639)	(0.219)	(0.440)	(0.470)	(0.419)	(0.348)	(0.468)
3#0. Upper middle income & not democratic	2.520***	-0.022	2.520*	-0.022	2.520***	-0.022	2.520*	-0.022	2.520***	-0.022	2.520***	-0.022	2.058***	-0.131	2.317***	-0.128
	(0.455)	(0.503)	(1.380)	(1.502)	(0.461)	(0.378)	(1.382)	(1.465)	(0.663)	(0.749)	(0.668)	(0.547)	(0.748)	(0.371)	(0.405)	(0.450)
3#1. Upper middle income & democratic	3.643***	1.708***	3.643***	1.708	3.643***	1.708***	3.643***	1.708	3.643***	1.708***	3.643***	1.708**	3.556***	1.205***	3.411***	1.347***
	(0.279)	(0.354)	(0.862)	(1.053)	(0.230)	(0.415)	(0.847)	(1.076)	(0.409)	(0.524)	(0.280)	(0.617)	(0.331)	(0.179)	(0.318)	(0.374)
4#0. High income (non-OECD) & not democratic	0.987**	-2.057***	0.987	-2.057	0.987**	-2.057***	0.987	-2.057	0.987	-2.057**	0.987*	-2.057***	0.034	-3.107***	0.683	-2.852***
	(0.499)	(0.566)	(1.699)	(1.648)	(0.378)	(0.407)	(1.668)	(1.600)	(0.770)	(0.830)	(0.516)	(0.339)	(0.751)	(0.356)	(0.502)	(0.543)
4#1. High income (non-OECD) & democratic	0.568**	-0.038	0.568	-0.038	0.568***	-0.038	0.568	-0.038	0.568	-0.038	0.568**	-0.038	0.923***	0.308	0.471	-0.099
	(0.249)	(0.254)	(0.834)	(0.815)	(0.188)	(0.211)	(0.818)	(0.803)	(0.372)	(0.379)	(0.260)	(0.284)	(0.308)	(0.342)	(0.333)	(0.338)
5#0. High income (OECD) & not democratic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5#1. High income (OECD) & democratic BASE	12.245***	4.332***	12.245***	4.332**	12.245***	4.332***	12.245***	4.332**	12.245***	4.332***	12.245***	4.332***	11.973***	0.885	12.217***	2.576***
	(0.122)	(0.831)	(0.500)	(2.156)	(0.088)	(0.602)	(0.493)	(2.079)	(0.196)	(1.172)	(0.128)	(0.621)	(0.166)	(0.643)	(0.214)	(0.768)
Youth population		0.146***		0.146***		0.146***		0.146***		0.146***		0.146***		0.191***		0.164***
		(0.015)		(0.038)		(0.013)		(0.038)		(0.021)		(0.017)		(0.010)		(0.013)
Urban population		0.029***		0.029		0.029***		0.029		0.029***		0.029***		0.046***		0.040***
		(0.007)		(0.020)		(0.006)		(0.020)		(0.010)		(0.009)		(0.006)		(0.006)
Trade		0.017***		0.017***		0.017***		0.017***		0.017***		0.017***		0.022***		0.021***
		(0.003)		(0.006)		(0.003)		(0.006)		(0.004)		(0.002)		(0.003)		(0.002)
Covariates	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.141	0.198	0.141	0.198	0.141	0.198	0.141	0.198	n/a	n/a	0.141	0.198	0.092	0.146	0.136	0.226
F-value	64.55***	56.40***	7.16***	8.08***	234.33***	201.25***	n/a	n/a	29.30***	26.94***	315.69***	476.80***	n/a	n/a	42.96***	54.58***
Countries	175	165	175	165	175	165	175	165	175	165	175	165	175	165	175	165
Years	27	26	27	26	27	26	27	26	27	26	27	26	27	26	27	26
Observations	2194	2069	2194	2069	2194	2069	2194	2069	2194	2069	2194	2069	2194	2069	2194	2069

Notes: BASE group is high income (OECD) and democratic countries. The model uses three controls: youth population (*pop024*); urban population (*urban*) and trade (*trade*). See the notes for Table 3. The various standard errors are given in parentheses. Significance levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5

Mean differences in the national effort by country region and regime type.

Dependent Variable: *psegdptot*	LSDV		LSDV (One-way; Country)		LSDV (One-way; Year)		LSDV (Two-way)		Newey-West		Driscoll-Kraay		Quantile		Robust	
	(A)	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**
0#0. Poorer country regions & not democratic	-1.298*** (0.147)	-2.031*** (0.216)	-1.298*** (0.396)	-2.031*** (0.582)	-1.298*** (0.128)	-2.031*** (0.168)	-1.298*** (0.389)	-2.031*** (0.566)	-1.298*** (0.199)	-2.031*** (0.315)	-1.298*** (0.152)	-2.031*** (0.218)	-1.633*** (0.117)	-1.756*** (0.234)	-1.681*** (0.104)	-1.760*** (0.199)
0#1. Poorer country regions & democratic	-0.804*** (0.104)	-1.412*** (0.166)	-0.804** (0.343)	-1.412*** (0.467)	-0.804*** (0.081)	-1.412*** (0.135)	-0.804** (0.336)	-1.412*** (0.457)	-0.804*** (0.158)	-1.412*** (0.239)	-0.804*** (0.110)	-1.412*** (0.162)	-1.163*** (0.121)	-1.235*** (0.180)	-1.110*** (0.098)	-1.178*** (0.166)
1#0. Richer country regions & not democratic	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a
1#1. Richer country regions & democratic BASE	5.169*** (0.069)	2.095*** (0.375)	5.169*** (0.264)	2.095** (0.989)	5.169*** (0.052)	2.095*** (0.255)	5.169*** (0.260)	2.095** (0.950)	5.169*** (0.110)	2.095*** (0.534)	5.169*** (0.064)	2.095*** (0.319)	5.114*** (0.062)	2.047*** (0.404)	5.213*** (0.074)	2.520*** (0.348)
Youth population		0.034*** (0.007)		0.034** (0.017)		0.034*** (0.005)		0.034** (0.016)		0.034*** (0.010)		0.034*** (0.005)		0.025*** (0.007)		0.019*** (0.006)
Urban population		0.016*** (0.003)		0.016** (0.008)		0.016*** (0.002)		0.016** (0.008)		0.016*** (0.004)		0.016*** (0.002)		0.022*** (0.003)		0.020*** (0.002)
Trade		0.013*** (0.002)		0.013*** (0.004)		0.013*** (0.002)		0.013*** (0.004)		0.013*** (0.002)		0.013*** (0.002)		0.011*** (0.002)		0.011*** (0.001)
Covariates	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.057	0.167	0.057	0.167	0.057	0.167	0.057	0.167	n/a	n/a	0.057	0.167	0.090	0.170	0.154	0.313
F-value	52.61***	63.60***	5.45***	6.80***	148.23***	109.08***	n/a	n/a	24.89***	31.33***	161.84***	103.56***	n/a	n/a	135.10***	125.25***
Countries	102	97	102	97	102	97	102	97	102	97	102	97	102	97	102	97
Years	27	26	27	26	27	26	27	26	27	26	27	26	27	26	27	26
Observations	1486	1382	1486	1382	1486	1382	1486	1382	1486	1382	1486	1382	1486	1382	1486	1382

Notes: BASE group is richer country regions that are democratic. The model uses three controls: youth population (*pop024*); urban population (*urban*) and trade (*trade*). See the notes for Table 3. The various standard errors are given in parentheses. Significance levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6

Mean differences in the budget share by country region and regime type.

Dependent Variable: *psegovtot*	LSDV		LSDV (One-way; Country)		LSDV (One-way; Year)		LSDV (Two-way)		Newey-West		Driscoll-Kraay		Quantile		Robust	
	(A)	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**
0#0. Poorer country regions & not democratic	3.880*** (0.305)	1.492** (0.612)	3.880*** (0.909)	1.492 (1.609)	3.880*** (0.229)	1.492*** (0.360)	3.880*** (0.887)	1.492 (1.531)	3.880*** (0.452)	1.492* (0.892)	3.880*** (0.210)	1.492*** (0.466)	4.046*** (0.499)	0.726 (0.764)	3.757*** (0.303)	1.108* (0.597)
0#1. Poorer country regions & democratic	5.077*** (0.233)	3.321*** (0.458)	5.077*** (0.711)	3.321** (1.397)	5.077*** (0.141)	3.321*** (0.236)	5.077*** (0.686)	3.321** (1.341)	5.077*** (0.345)	3.321*** (0.684)	5.077*** (0.157)	3.321*** (0.301)	4.833*** (0.287)	2.284*** (0.496)	4.923*** (0.283)	2.945*** (0.491)
1#0. Richer country regions & not democratic	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a
1#1. Richer country regions & democratic BASE	11.944*** (0.127)	5.333*** (1.193)	11.944*** (0.506)	5.333 (3.265)	11.944*** (0.116)	5.333*** (0.952)	11.944*** (0.504)	5.333* (3.185)	11.944*** (0.203)	5.333*** (1.719)	11.944*** (0.176)	5.333*** (1.039)	11.849*** (0.160)	2.093** (0.960)	11.943*** (0.212)	3.705*** (1.036)
Youth population		0.104*** (0.021)		0.104* (0.059)		0.104*** (0.013)		0.104* (0.056)		0.104*** (0.030)		0.104*** (0.015)		0.163*** (0.019)		0.127*** (0.019)
Urban population		0.029*** (0.008)		0.029 (0.023)		0.029*** (0.008)		0.029 (0.023)		0.029** (0.012)		0.029*** (0.009)		0.044*** (0.008)		0.037*** (0.007)
Trade		0.018*** (0.004)		0.018** (0.009)		0.018*** (0.004)		0.018** (0.009)		0.018*** (0.005)		0.018*** (0.004)		0.017*** (0.004)		0.021*** (0.003)
Covariates	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.195	0.222	0.195	0.222	0.195	0.222	0.195	0.222	n/a	n/a	0.195	0.222	0.140	0.171	0.189	0.247
F-value	270.00***	113.21***	25.86***	13.06***	723.40***	323.35***	n/a	n/a	118.36***	51.83***	611.34***	290.39***	n/a	n/a	158.19***	84.82***
Countries	99	96	99	96	99	96	99	96	99	96	99	96	99	96	99	96
Years	27	26	27	26	27	26	27	26	27	26	27	26	27	26	27	26
Observations	1360	1299	1360	1299	1360	1299	1360	1299	1360	1299	1360	1299	1360	1299	1360	1299

Notes: BASE group is richer country regions that are democratic. The model uses three controls: youth population (*pop024*); urban population (*urban*) and trade (*trade*). See the notes for Table 3. The various standard errors are given in parentheses. Significance levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 7
Wald tests for parameter equality of the factor-variable interactions.

Wald tests for parameter equality from Tables 3 and 4

	Robust Estimator					
	(A)			(B)		
Dependent Variable: *psegdptot*	Wald Statistic	Uncorrected Significance (α = 0.05)	Corrected Significance (α = 0.0125)	Wald Statistic	Uncorrected Significance (α = 0.05)	Corrected Significance (α = 0.0125)
Test parameter 1#0 = 1#1	F (1, 2459) = 2.19 p = 0.1388	No	No	F (1, 2276) = 2.33 p = 0.1273	No	No
Test parameter 2#0 = 2#1	F (1, 2459) = 8.90 p = 0.0029	Yes	Yes	F(1, 2276) = 14.79 p = 0.0001	Yes	Yes
Test parameter 3#0 = 3#1	F (1, 2459) = 14.38 p = 0.0002	Yes	Yes	F(1, 2276) = 24.17 p = 0.0000	Yes	Yes
Test parameter 4#0 = 4#1	F (1, 2459) = 10.20 p = 0.0014	Yes	Yes	F(1, 2276) = 51.44 p = 0.0000	Yes	Yes
	Robust Estimator					
	(A)			(B)		
Dependent Variable: *psegovtot*	Wald Statistic	Uncorrected Significance (α = 0.05)	Corrected Significance (α = 0.0125)	Wald Statistic	Uncorrected Significance (α = 0.05)	Corrected Significance (α = 0.0125)
Test parameter 1#0 = 1#1	F (1, 2185) = 7.33 p = 0.0068	Yes	Yes	F (1, 2057) = 11.37 p = 0.0008	Yes	Yes
Test parameter 2#0 = 2#1	F (1, 2185) = 0.00 p = 0.9438	No	No	F (1, 2057) = 6.75 p = 0.0094	Yes	Yes
Test parameter 3#0 = 3#1	F (1, 2185) = 6.88 p = 0.0088	Yes	Yes	F (1, 2057) = 13.88 p = 0.0002	Yes	Yes
Test parameter 4#0 = 4#1	F (1, 2185) = 0.16 p = 0.6852	No	No	F (1, 2057) = 25.58 p = 0.0000	Yes	Yes

Wald tests for parameter equality from Tables 5 and 6

	Robust Estimator					
	(A)			(B)		
Dependent Variable: *psegdptot*	Wald Statistic	Uncorrected Significance (α = 0.05)	Corrected Significance (α = 0.05)	Wald Statistic	Uncorrected Significance (α = 0.05)	Corrected Significance (α = 0.05)
Test parameter 0#0 = 0#1	F (1, 1483) = 33.66 p = 0.0000	Yes	Yes	F (1, 1376) = 35.80 p = 0.0000	Yes	Yes
	Robust Estimator					
	(A)			(B)		
Dependent Variable: *psegovtot*	Wald Statistic	Uncorrected Significance (α = 0.05)	Corrected Significance (α = 0.05)	Wald Statistic	Uncorrected Significance (α = 0.05)	Corrected Significance (α = 0.05)
Test parameter 0#0 = 0#1	F (1, 1357) = 16.59 p = 0.0000	Yes	Yes	F (1, 1293) = 37.70 p = 0.0000	Yes	Yes

Notes: The '#' naming convention accords with that in the respective table of results. Using interaction models with applicable controls, 'Yes' means the relevant interaction parameters are statistically significantly different ('No' means not significantly different) from one another for the respective pairwise comparison at the conventional (uncorrected) 5% level of significance or Bonferroni (corrected) level of significance. (A) refers to the model with no controls (unconditional mean differences) and (B) refers to the model with controls (conditional mean differences). Because there is only one pairwise test of parameter equality performed on the estimates from Tables 5 and 6, α (= 0.05) is the same for both the uncorrected and corrected critical level of significance.

The empirical patterns are robust to using two different estimators (LSDV and robust) and differences in model specification (employing more than three controls and including year dummies). In the robustness checks, only the more parsimonious regional and political specification (in equation (2)) is used, because a richer versus poorer interpretation is the key

focus of our study. Appendix Tables A3, A4, A5 and A6 report these results. The estimates for the various year fixed effects and controls are excluded from the tables to save space. A detailed description of each model specification is given in the notes to Table A3.

We make three observations about the robustness results. Firstly, including year dummies leaves the substantive patterns of mean differences unchanged; signs of the estimated coefficients are unaffected in all cases, although there are some changes in marginal levels of statistical significance for some of the budget share results. Secondly, if a robust estimator is used to deal with outliers, the empirical patterns are exhibited more clearly regardless of the specification used. Thirdly, the signs of the coefficients on the various additional controls (*hci*, *pop65*, *military*, *fiscbal* and *debt*) are as expected in most cases. Introducing an additional control each time entails an increasingly more complex specification that either does not confound or only partially confounds the empirical patterns.[5] The most comprehensive specification (using eight controls) provides additional support for the empirical patterns in the baseline results. The observed empirical patterns of negative (positive) mean differences for the national effort (budget share), compared to the base category, are robust to the use of different estimators for the coefficients and standard errors, and to plausible changes to the specification.

4. Discussion

From the perspective of the 2 × 2 categorization in equation (2), richer (developed) countries tend to make a greater national effort towards education (they spend more on average

[5] Partial confounding refers to the case where only poorer countries that are not democratic are shown to have significantly different means from the base group (richer and democratic countries), and with the expected sign. No confounding refers to the case where, either, both poorer country groups (irrespective of the state of democracy), or, poorer and democratic countries are shown to have significantly different means from the base group, and with the expected sign.

on education as a share of GDP). In contrast, they tend to have lower budget shares (they spend less on average on education as a share of total government spending) relative to poorer (less-developed) countries. This implies richer countries, on average, have larger public sectors (total government spending as a share of GDP) than do poorer countries – consistent with Wagner's law.

In terms of national effort, richer country governments do not necessarily value education more highly than do poorer country governments, but they have greater capacity to leverage income from taxes. They can raise more income from taxes because they have larger formal private-sector economies. They are therefore less fiscally constrained, and can spend more on areas such as education. The inability of poorer-country governments to extract revenue from a relatively small tax base constrains not only the growth of these countries' public sectors – a point noted by Holcombe (2005), albeit in more general terms – but also their national effort towards education.

Poorer countries tend to have more informal-sector, cash-based economic activity relative to the size of the formal private-sector economy (Schneider and Enste, 2000), which means it is more difficult for governments in such countries to extract the tax revenue necessary to finance public education. From a budget share perspective, poorer countries tend to spend more on education as a share of total government spending because they generally have smaller public sectors, which means education tends to comprise a larger share of the total public sector budget. However, richer countries are more likely to have large, complex public sectors with a greater variety of fiscal components to be financed from tax revenue. For example, the larger role of the state in providing various kinds of welfare support in richer countries could lead to other forms of public spending, such as education, being assigned a lower priority. An implication of this reasoning is that publicly provided education, as a whole, might take on the characteristics of a necessity with respect to public sector spending in richer countries.

Consequently, from a fiscal varieties perspective, education's share of the total 'fiscal pie' tends to be smaller in richer countries with larger public sectors and a greater variety of fiscal components to be paid for from the public purse, explaining why the budget share allocation to education spending is lower (higher) in richer (poorer) countries.

There is also a political aspect to this explanation, which reinforces the Wagnerian view, because the priorities for education spending differ among poorer countries with contrasting levels of democracy. Political pressures compel governments in poorer, democratic countries to spend more on areas such as education, but when poorer democratic countries grow, they can more easily leverage income from taxes.

Regardless of the state of economic development, democratic governments tend to be more educationally benevolent, and spend more on education. On the other hand, our empirical results for the robust estimator with controls (Table 6 and Table A6) show that poorer, non-democratic countries have low budget shares that are not necessarily different from those of richer (democratic) countries. This suggests that the former not only have smaller public sectors, but also have lower allocations to education from the public purse. This might partly explain why such countries remain poor and less developed.

Table 8 summarizes the key empirical findings in this study in the form of three inequality propositions with respect to richer versus poorer countries. To the best of our knowledge, such a characterization of education spending (Propositions 1 and 2) and, by implication, the size of the public sector (Proposition 3) has not been presented in this form before. Because the inequalities in Propositions 1 and 2 are different for national effort compared to budget share, they imply that richer (poorer) countries have larger (smaller) public sectors, consistent with

the Wagnerian hypothesis.[6] This provides a novel way to characterize and empirically test Wagner's law of public sector expansion.

Table 8
Three inequality propositions.

Description	Richer Countries		Poorer Countries
Proposition 1 (national effort)	$\left(\frac{E}{Y}\right)_R$	>	$\left(\frac{E}{Y}\right)_P$
Proposition 2 (budget share)	$\left(\frac{E}{G}\right)_R$	<	$\left(\frac{E}{G}\right)_P$
Proposition 3 (public sector)	$\left(\frac{G}{Y}\right)_R$	>	$\left(\frac{G}{Y}\right)_P$

Notes: *E* refers to public spending on education, *Y* to national income (GDP) and *G* to total public spending. Subscripts *R* and *P* refer to richer and poorer countries, respectively. If Propositions 1 and 2 hold true, then they imply Proposition 3.

5. Conclusion

We examine whether there are mean differences in the levels of public spending on education for two widely used national-level measures (national effort and budget share) for different economic (or regional) and political groupings of countries. Controlling for the state of democracy, we find that richer (poorer) countries tend to spend, on average, a larger (smaller) share of GDP on education, but a smaller (larger) share of total government spending on education. Richer countries, on average, make a greater national effort towards education, whereas poorer countries make a greater budget share allocation to education. By implication,

[6] We note two points relating to these inequalities. First, it does not matter whether *E*, *Y* and *G* are measured in real or nominal terms, provided both the numerator and denominator of the relevant ratio are measured in the same nominal or real terms (using the same deflator). Second, the same estimated size of the public sector in any one country, as given by sources such as the IMF, cannot simply be obtained by taking the quotient of the national effort and budget share for that country because these education spending measures are estimates. The quotient will give only a rough approximation of the size of government, especially for countries that have less accurate education spending data.

richer countries, on average, have larger public sectors than do poorer countries. In addition, for comparable levels of economic development, democratic countries tend to spend more on education than is the case for their non-democratic counterparts.

The findings with respect to levels of development can be summarized in the form of three inequality propositions. Examination of education spending patterns reveals a novel way to test Wagner's law empirically. These patterns provide support for the Wagnerian hypothesis, which postulates a positive association between the size of government and economic development. From a public policy perspective, it would also be informative to test these inequality propositions with respect to other components of the government's budget allocation (e.g., the national effort and budget share of health, military or welfare spending).

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Appendices

Table A1

List of countries and territories by GNI per capita group in 2015 (*ypc2015*).

Low income (31)	Lower middle income (52)	Upper middle income (56)	High income (non-OECD) (57)	High income (OECD) (21)
Afghanistan	Armenia	Albania	Andorra	Australia
Benin	Bangladesh	Algeria	Antigua and Barbuda	Austria
Burkina Faso	Bhutan	American Samoa	Aruba	Belgium
Burundi	Bolivia	Angola	Bahamas, The	Canada
Central African Republic	Cabo Verde	Argentina	Bahrain	Denmark
Chad	Cambodia	Azerbaijan	Barbados	Finland
Comoros	Cameroon	Belarus	Bermuda	France
Congo, Dem. Rep.	Congo, Rep.	Belize	British Virgin Islands	Germany
Eritrea	Cote d'Ivoire	Bosnia and Herzegovina	Brunei Darussalam	Greece
Ethiopia	Djibouti	Botswana	Cayman Islands	Ireland
Gambia, The	Egypt, Arab Rep.	Brazil	Channel Islands	Italy
Guinea	El Salvador	Bulgaria	Chile	Japan
Guinea-Bissau	Ghana	China	Croatia	Netherlands
Haiti	Guatemala	Colombia	Curacao	New Zealand
Korea, Dem. People's Rep.	Honduras	Costa Rica	Cyprus	Norway
Liberia	India	Cuba	Czech Republic	Portugal
Madagascar	Indonesia	Dominica	Estonia	Spain
Malawi	Kenya	Dominican Republic	Faroe Islands	Sweden
Mali	Kiribati	Ecuador	French Polynesia	Switzerland
Mozambique	Kosovo	Equatorial Guinea	Gibraltar	United Kingdom
Nepal	Kyrgyz Republic	Fiji	Greenland	United States
Niger	Lao PDR	Gabon	Guam	
Rwanda	Lesotho	Georgia	Hong Kong SAR, China	
Senegal	Mauritania	Grenada	Hungary	
Sierra Leone	Micronesia, Fed. Sts.	Guyana	Iceland	
Somalia	Moldova	Iran, Islamic Rep.	Isle of Man	
South Sudan	Mongolia	Iraq	Israel	
Tanzania	Morocco	Jamaica	Korea, Rep.	
Togo	Myanmar	Jordan	Kuwait	
Uganda	Nicaragua	Kazakhstan	Latvia	
Zimbabwe	Nigeria	Lebanon	Liechtenstein	
	Pakistan	Libya	Lithuania	
	Papua New Guinea	Macedonia, FYR	Luxembourg	
	Philippines	Malaysia	Macao SAR, China	
	Samoa	Maldives	Malta	
	Sao Tome and Principe	Marshall Islands	Monaco	
	Solomon Islands	Mauritius	Nauru	
	Sri Lanka	Mexico	New Caledonia	
	Sudan	Montenegro	Northern Mariana Islands	
	Swaziland	Namibia	Oman	
	Syrian Arab Republic	Palau	Poland	
	Tajikistan	Panama	Puerto Rico	
	Timor-Leste	Paraguay	Qatar	
	Tonga	Peru	San Marino	
	Tunisia	Romania	Saudi Arabia	
	Ukraine	Russian Federation	Seychelles	
	Uzbekistan	Serbia	Singapore	
	Vanuatu	South Africa	Sint Maarten (Dutch part)	
	Vietnam	St. Lucia	Slovak Republic	
	West Bank and Gaza	St. Vincent and the Grenadines	Slovenia	
	Yemen, Rep.	Suriname	St. Kitts and Nevis	
	Zambia	Thailand	St. Martin (French part)	
		Turkey	Trinidad and Tobago	
		Turkmenistan	Turks and Caicos Islands	
		Tuvalu	United Arab Emirates	
		Venezuela, RB	Uruguay	
			Virgin Islands (U.S.)	

Source: Adapted from the World Bank's historical classification.

Notes: Groups are adapted from the World Bank's Country and Lending Groups for the 2015 calendar year, based on GNI per capita calculated using the World Bank Atlas Method, except for the high-income (OECD) group, which includes the 21 countries comprising the 'core' OECD nations (excluding Chile, Czech Republic, Estonia, Hungary, Iceland, Israel, Korea, Latvia, Luxembourg, Mexico, Poland, Slovak Republic, Slovenia and Turkey, which are included in the broader 35 OECD countries). Numbers in parentheses show the total number of countries in each group. The historical classification is available from: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.

Table A2
List of countries by two regional country groups (*region*).

Poorer Country Regions				
Central Africa (8)	Central America (8)	East Africa (12)	South America (12)	South Asia (8)
Cameroon	Belize	Burundi	Argentina	Afghanistan
Central African Republic	Costa Rica	Comoros	Bolivia	Bangladesh
Chad	El Salvador	Djibouti	Brazil	Bhutan
Congo, Dem. Rep.	Guatemala	Eritrea	**Chile**	India
Congo, Rep.	Honduras	Ethiopia	Colombia	Maldives
Equatorial Guinea	Mexico	Kenya	Ecuador	Nepal
Gabon	Nicaragua	Rwanda	Guyana	Pakistan
Sao Tome and Principe	Panama	Somalia	Paraguay	Sri Lanka
		South Sudan	Peru	
		Sudan	Suriname	
		Tanzania	**Uruguay**	
		Uganda	Venezuela, RB	
Southeast Asia (11)	Southern Africa (13)	West Africa (16)		
Brunei Darussalam	Angola	Benin		
Cambodia	Botswana	Burkina Faso		
Indonesia	Lesotho	Cabo Verde		
Lao PDR	Madagascar	Cote d'Ivoire		
Malaysia	Malawi	Gambia, The		
Myanmar	Mauritius	Ghana		
Philippines	Mozambique	Guinea		
Singapore	Namibia	Guinea-Bissau		
Thailand	**Seychelles**	Liberia		
Timor-Leste	South Africa	Mali		
Vietnam	Swaziland	Mauritania		
	Zambia	Niger		
	Zimbabwe	Nigeria		
		Senegal		
		Sierra Leone		
		Togo		
Richer Country Regions				
North America (3)	Nordic Countries (5)	Western Europe (22)		
Bermuda	Denmark	Andorra		
Canada	Finland	Austria		
United States	Iceland	Belgium		
	Norway	Channel Islands		
	Sweden	Faroe Islands		
		France		
		Germany		
		Gibraltar		
		Greece		
		Greenland		
		Ireland		
		Isle of Man		
		Italy		
		Liechtenstein		
		Luxembourg		
		Monaco		
		Netherlands		
		Portugal		
		San Marino		
		Spain		
		Switzerland		
		United Kingdom		

Source: Authors' compilation.
Notes: The numbers in parentheses show the total number of countries in each sub-group of the respective country regions. For the poorer country regions, Equatorial Guinea, Chile, Uruguay, Brunei Darussalam, Singapore and Seychelles (the countries in bold) are excluded because they are classified as high-income (non-OECD) countries for most or all of the time period under investigation (from 1989 to 2015).

Table A3

A summary of changes to the model specification (national effort and LSDV estimator).

Dependent Variable: *psegdptot*	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
0#0. Poorer country regions	-2.031***	-2.183***	-1.764***	-1.866***	-0.991***	-1.072***	-0.568*	-0.692*	-0.800***	-1.146***	-0.906***	-1.163***
& not democratic	(0.216)	(0.242)	(0.224)	(0.258)	(0.275)	(0.365)	(0.296)	(0.383)	(0.268)	(0.293)	(0.279)	(0.307)
0#1. Poorer country regions	-1.412***	-1.543***	-1.379***	-1.448***	-0.578**	-0.631**	-0.028	-0.102	-0.021	-0.277	-0.042	-0.241
& democratic	(0.166)	(0.155)	(0.176)	(0.167)	(0.237)	(0.288)	(0.258)	(0.315)	(0.257)	(0.279)	(0.265)	(0.288)
1#0. Richer country regions	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
& not democratic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1#1. Richer country regions	2.095***	1.504***	-1.863**	-2.243***	-5.403***	-5.626***	-7.503***	-7.711***	-6.685***	-6.649***	-6.539***	-6.743***
& democratic BASE	(0.375)	(0.518)	(0.760)	(0.790)	(1.427)	(1.549)	(1.550)	(1.713)	(1.241)	(1.295)	(1.297)	(1.370)
R-squared	0.167	0.187	0.201	0.223	0.208	0.229	0.223	0.245	0.353	0.375	0.365	0.384
F-value	63.60***	15.33***	103.09***	23.20***	91.08***	22.81***	80.33***	21.89***	69.88***	21.30***	60.49***	19.72***
Countries	97	97	86	86	86	86	85	85	84	84	84	84
Years	26	26	25	25	25	25	25	25	25	25	25	25
Year fixed effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Covariates (controls)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of control variables	3	3	4	4	5	5	6	6	7	7	8	8
Are the patterns confounded?	No	No	No	No	No	No	Partially	Partially	Partially	Partially	Partially	Partially
Observations	1382	1382	1256	1256	1256	1256	1174	1174	1101	1101	1030	1030

Notes: BASE group is richer country regions that are democratic. All models use a LSDV estimator and robust standard errors. I and II use homogeneous slopes and three controls (*pop024*, *urban* and *trade*). III and IV use homogeneous slopes and four controls (*pop024*, *urban*, *trade* and *hci*). V and VI use homogeneous slopes and five controls (*pop024*, *urban*, *trade*, *hci* and *pop65*). VII and VIII use homogeneous slopes and six controls (*pop024*, *urban*, *trade*, *hci*, *pop65* and *military*). IX and X use homogeneous slopes and seven controls (*pop024*, *urban*, *trade*, *hci*, *pop65*, *military* and *fiscbal*). XI and XII use homogeneous slopes and eight controls (*pop024*, *urban*, *trade*, *hci*, *pop65*, *military*, *fiscbal* and *debt*). See Table 1 for a description of each control variable used. Time (year) dummies are used in even-numbered specifications (II, IV, VI, VIII, X and XII). The estimates for the various controls and year fixed effects are excluded to save space. Huber-White heteroskedasticity-robust standard errors are given in parentheses. Significance levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A4

A summary of changes to the model specification (budget share and LSDV estimator).

Dependent Variable: *psegovtot*	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
0#0. Poorer country regions	1.492**	0.985	1.296**	0.737	1.358**	0.499	2.207***	1.514**	1.962***	1.269*	1.803***	1.668**
& not democratic	(0.612)	(0.664)	(0.644)	(0.700)	(0.637)	(0.718)	(0.661)	(0.755)	(0.656)	(0.749)	(0.667)	(0.756)
0#1. Poorer country regions	3.321***	2.799***	2.970***	2.451***	3.035***	2.204***	3.784***	3.186***	3.717***	3.162***	3.561***	3.391***
& democratic	(0.458)	(0.499)	(0.481)	(0.530)	(0.518)	(0.596)	(0.548)	(0.628)	(0.539)	(0.621)	(0.552)	(0.630)
1#0. Richer country regions	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
& not democratic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1#1. Richer country regions	5.333***	3.726***	-3.448**	-4.803***	-3.737	-3.794	-4.396	-4.194	-1.745	-1.109	-1.285	-1.221
& democratic BASE	(1.193)	(1.443)	(1.686)	(1.810)	(2.738)	(2.805)	(2.840)	(2.923)	(2.867)	(2.948)	(2.897)	(2.955)
R-squared	0.222	0.237	0.296	0.311	0.296	0.311	0.331	0.343	0.347	0.360	0.415	0.423
F-value	113.21***	20.02***	110.62***	23.58***	100.86***	24.23***	91.63***	23.86***	92.91***	27.10***	96.81***	31.64***
Countries	96	96	85	85	85	85	84	84	84	84	84	84
Years	26	26	25	25	25	25	25	25	25	25	25	25
Year fixed effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Covariates (controls)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of control variables	3	3	4	4	5	5	6	6	7	7	8	8
Are the patterns confounded?	No	No	No	No	No	No	No	No	No	No	No	No
Observations	1299	1299	1175	1175	1175	1175	1099	1099	1091	1091	1024	1024

Notes: BASE group is richer country regions that are democratic. All models use a LSDV estimator and robust standard errors. See the notes for Table A3. Huber-White heteroskedasticity-robust standard errors are given in parentheses. Significance levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A5

A summary of changes to the model specification (national effort and robust estimator).

Dependent Variable: *psegdptot*	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
0#0. Poorer country regions	-1.760***	-2.022***	-1.489***	-1.729***	-1.240***	-1.615***	-0.926***	-1.311***	-0.930***	-1.332***	-1.077***	-1.418***
& not democratic	(0.199)	(0.206)	(0.199)	(0.208)	(0.260)	(0.275)	(0.274)	(0.291)	(0.279)	(0.297)	(0.274)	(0.297)
0#1. Poorer country regions	-1.178***	-1.403***	-1.111***	-1.310***	-0.844***	-1.188***	-0.455*	-0.785***	-0.424*	-0.734***	-0.522**	-0.797***
& democratic	(0.166)	(0.172)	(0.165)	(0.172)	(0.239)	(0.252)	(0.253)	(0.267)	(0.256)	(0.271)	(0.250)	(0.268)
1#0. Richer country regions	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
& not democratic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1#1. Richer country regions	2.520***	1.764***	0.251	-0.321	-1.013	-0.848	-2.635***	-2.416**	-3.139***	-2.862***	-2.688***	-2.624**
& democratic BASE	(0.348)	(0.425)	(0.520)	(0.566)	(0.924)	(0.951)	(0.965)	(0.998)	(1.002)	(1.041)	(0.988)	(1.053)
R-squared	0.313	0.335	0.331	0.351	0.333	0.351	0.338	0.357	0.340	0.363	0.373	0.392
F-value	125.25***	22.67***	103.17***	22.06***	88.81***	21.32***	74.25***	19.81***	62.34***	18.39***	60.71***	18.87***
Countries	97	97	86	86	86	86	85	85	84	84	84	84
Years	26	26	25	25	25	25	25	25	25	25	25	25
Year fixed effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Covariates (controls)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of control variables	3	3	4	4	5	5	6	6	7	7	8	8
Are the patterns confounded?	No	No	No	No	No	No	No	No	No	No	No	No
Observations	1382	1382	1256	1256	1256	1256	1174	1174	1101	1101	1030	1030

Notes: BASE group is richer country regions that are democratic. All models use a robust estimator. See the notes for Table A3. Significance levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A6

A summary of changes to the model specification (budget share and robust estimator).

Dependent Variable: *psegovtot*	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
0#0. Poorer country regions	1.108*	0.522	1.000*	0.310	1.122	0.172	1.972**	1.255	1.798**	1.077	1.614**	1.315*
& not democratic	(0.597)	(0.626)	(0.588)	(0.617)	(0.761)	(0.806)	(0.771)	(0.829)	(0.751)	(0.804)	(0.702)	(0.767)
0#1. Poorer country regions	2.945***	2.335***	2.626***	1.919***	2.760***	1.777**	3.292***	2.617***	3.268***	2.608***	3.037***	2.724***
& democratic	(0.491)	(0.517)	(0.479)	(0.503)	(0.697)	(0.737)	(0.709)	(0.757)	(0.690)	(0.734)	(0.642)	(0.694)
1#0. Richer country regions	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
& not democratic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1#1. Richer country regions	3.705***	1.652	-4.570***	-6.683***	-5.296*	-5.963**	-5.074*	-5.589**	-2.121	-2.119	-1.306	-1.495
& democratic BASE	(1.036)	(1.400)	(1.533)	(1.748)	(2.708)	(2.810)	(2.701)	(2.838)	(2.692)	(2.821)	(2.531)	(2.719)
R-squared	0.247	0.264	0.328	0.348	0.328	0.347	0.373	0.386	0.402	0.421	0.483	0.492
F-value	84.82***	15.18***	94.92***	20.35***	81.47***	19.61***	81.11***	20.98***	80.84***	23.30***	94.69***	28.19***
Countries	96	96	85	85	85	85	84	84	84	84	84	84
Years	26	26	25	25	25	25	25	25	25	25	25	25
Year fixed effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Covariates (controls)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of control variables	3	3	4	4	5	5	6	6	7	7	8	8
Are the patterns confounded?	No	No	No	No	No	No	No	No	No	No	No	No
Observations	1299	1299	1175	1175	1175	1175	1099	1099	1091	1091	1024	1024

Notes: BASE group is richer country regions that are democratic. All models use a robust estimator. See the notes for Table A3. Significance levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.