Fresh evidence on growth, expenditure and energy debate: GMM, Quantile and Threshold approaches

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Fresh evidence on growth, expenditure and energy debate: GMM, Quantile and Threshold approaches

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Abstract

This study examines the debate on energy consumption, expenditure and growth on different income groups of countries by giving fresh evidence using different techniques. Studying the impact of energy consumption and expenditure on growth using GMM and quantile shows that the high and upper-middle-income groups need to adopt a conservative measure in energy consumption to impact growth, and also spend inappropriately for growth to be impacted. The lower-middle and low-income groups, however, need to channel their expenditure judiciously to spur economic growth. We also examine the threshold of energy-growth relationship by using a simple threshold technique. The results are presented, and suggestions are made to the policymakers.

Keywords: Growth, expenditure, energy consumption, GMM, Quantile, Threshold

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1. Introduction

Economic growth is one of the most crucial macroeconomic indices used in knowing how well a government has performed over a certain period. It is also an important indicator in measuring the level of good living of a specific country's citizens. Policymakers equally use economic growth as a focal indicator to adjudge whether their policies are a success or a failure. At this time, when several economies are globally facing recessions of different forms, policymakers need to be on the alert to ensure that economic growth is sustained over the long run.

For economic growth to be sustained, various factors that drive growth need to be accorded significant attention while making policies that affect the lives of the populace. Energy and expenditure, as macroeconomic variables, are vital in driving forward any economy that is aimed for growth. The essentiality of these economic variables cannot be overemphasised, especially at this crucial time when oil exporting nations are facing crises due to recurrent plunge in oil prices.

Economic growth varies across countries of different growth rate and income level. The growth rates of developed economies like that of United States, Canada, and the United Kingdom, are not similar to those of emerging economies like Malaysia Thailand, Nigeria and South Africa. The level of income level also matters while discussing the economic growth. Consequently, the growth rate of countries with high-income level is expected to be different from those with low income.

Theoretically and empirically, there have been studies, which establish that relationships exist among these three macroeconomic variables; energy consumption, expenditure and economic growth. The results of these studies remain mixed up till present.

Based on theories in the literature, four different hypotheses have, so far, been established on the relationship that exists between energy and growth. These have received substantial attention from researchers, and the results remain mixed and multiplex. The established theories, so far, are: the growth hypothesis; which states that energy consumption results in economic growth, the conservative hypothesis; which opines that growth is responsible for energy consumption, the feedback hypothesis; which states the relationship is bi-directional, and the neutrality theory; it states that there is no relationship between the two variables. Each of the hypotheses has empirically been proven by previous researches, which, therefore, make the issue of energy-growth relationship unresolved.

The relationship between government expenditure and economic growth can also be said to be unresolved theoretically. Hypothetically, there are two hypotheses on the relationship between government expenditure and economic growth. Wagner argues that for any country, the causal chain between government expenditure and economic growth is led by economic growth. Government expenditure constantly rises as economic growth increases. In other words, economic growth is the driving force for government expenditure (Wijeweera & Garis, 2009). Contrary to that, Keynes argues (theoretically) that economic growth is only achievable provided that government expenditure rises (Hasnul, 2015). These two prominent hypotheses have been established by several empirical studies, which therefore make the results remain mixed.

Premising on the mixed findings, this paper is a humble attempt to examine, firstly, the impact of energy consumption and expenditure (as focused variables) on economic growth in a unidirectional model. In other words, our model focuses on the impact of energy and consumption on growth and not vice-versa. Secondly, we will further examine the impact of energy consumption and expenditure on the growth level of the income groups at different percentiles. Lastly, we aim to provide fresh evidence on the impact of energy consumption on growth by exploring whether there exist threshold levels of energy consumption in the energy-growth relationship. There exists a possibility that the relationship between energy and growth depends on the level of energy consumption of a country, such that, energy promotes economic growth after a country's energy consumption exceeds a certain threshold level.

Examining the previous studies, on the relationship between energy consumption and economic growth, most of the researches have employed either the Granger causality, the unit root or the cointegration technique. These techniques have been used to examine the nexus between energy consumption and economic growth. These previous studies have well been documented using, mostly, time series dataset. There have, however, been fewer adoption of panel dataset in checking for the relationship between these two variables. Analogous analyses on the linkage between expenditure and growth show that most of the researches have either used the Granger causality test, or the Vector Error Correction Models (VECM). Fewer of these studies have adopted the panel techniques in examining the relationship. Hence, our study extends the literature by adopting rarely used techniques.

Firstly, to examine the dynamic linkages of energy consumption and expenditure on economic growth across income groups, we adopt generalized method of moments (GMM) estimator. GMM is preferred to address our first objective because it corrects for the endogeneity that may emerge as a result of the reverse causality between energy consumption and economic growth. Other panel techniques fall short of these qualities. Secondly, we adopt a Quantile technique to address the second objective of our study because the method considers the distributional heterogeneity by providing a detailed impact of energy consumption and expenditure on economic growth at different levels of percentiles. Lastly, we adopt the advanced panel threshold technique developed (B. E. Hansen, 1999) to examine whether there are positive and negative impacts of electricity consumption on economic growth. There is an advantage of quantifying the threshold level of electricity consumption, with the adoption of this estimation procedure, as compared to ad hoc classification procedure of splitting the sample.

The objectives and contributions of this paper can be summarized as follow:

The objectives are three, namely:

1) What is the impact of energy consumption and expenditure on economic growth of different income groups?

2) Are impacts of energy and expenditure on growth the same for different income groups at different percentiles?

3) Does there exist any threshold levels of energy consumption in the energy-growth relationship?

The contributions are two, namely:

1) This study extends the literature by using the quantile regression technique putting into consideration, the income level of countries rather than regions. This is among the few studies to have used this technique on income groups

2) This study also doubles as one among the few studies to be using threshold technique on the long debate on the relationship between energy consumption and economic growth.

The expected findings of our study are to serve as propositions, which policymakers can employ to developing the best strategy and taking the necessary steps to sustain economic growth.

The rest of the paper is organized as follow. Section 2 reviews the literature on the two principal linkages that we study, which are the impacts of energy on growth, and that of expenditure on energy. Section 3 presents the dataset, the methods, and the discussion of results. Section 4 of this focuses attention on the policy implications of the results, and the importance of taking the threshold level of energy consumption into account. The concluding section highlights the contributions of this study, as well as the limitations and the future.

2. Literature Review

In this study, the literature is divided into two parts. The first will be dedicated to reviewing literature that has been written on the impact of energy consumption on growth, while the second will be on those written about the impact of expenditure on growth.

2.1. The impact of energy on growth

Previous literature that studies the relationship between energy consumption on economic growth has shown divided results. Energy consumption as a function of economic growth has received wide concentration by academics over time. Kraft & Kraft (1978), using the gross national product (GNP) as a proxy for economic growth, argues that the causal relationship between energy and growth, for postwar period, is unidirectional from growth to energy, and not vice versa. Since, studies have supported the unidirectional findings of Kraft & Kraft (1978). Amongst these are studies by Wolde-Rufael (2009); Kahsai, Nondo, Schaeffer, & Gebremedhin (2012). A similar result was found by (Ouedraogo, 2013) in the study of ECOWAS[1] nations. These findings imply that economic growth leads the way for energy consumption. Thus, conserving energy for any purpose will not reduce the rate of growth of an economy.

Contrary to that, several other studies have also shown a unidirectional link between both variables, but from energy to growth. Beaudreau (1995), argues that underrating the function of energy in economic growth, as shown by previous studies, is not correct. Beaudreau (1995), further contends that it is impossible for production to thrive in the absence of energy consumption. Several other studies like Ghali & El-Sakka (2004), conducted on energy use in Canada shows that energy is an important factor for growth. Ghali & El-Sakka (2004) argues that an important policy implication is that energy can be considered as a limiting factor to output growth. Similar results was found by Altinay and Karagol, (2005); Masih and Masih, (1996); Narayan and Smyth, (2005); Odhiambo, (2009); Soytas and Sari, (2003); Squalli, (2007); Stern, (2000). This finding is often termed as the growth hypothesis of unidirectional causality. These results intuitively mean that there cannot be economic growth without having energy consumption at a higher percentage.

[1] ECOWAS is the Economic Community of West African States

Furthermore, the feedback hypothesis asserts that the causal relationship between energy consumption and economic growth is bidirectional. In other words, each variable affects the other. The findings by (Akinlo, 2008; Atems & Hotaling, 2018; Belke, Dobnik, & Dreger, 2011) confirms the feedback hypothesis. Empirical findings by (Coers & Sanders, 2013; Costantini & Martini, 2010) shows similar feedback effect. This means that both economic growth and energy work together over time. As energy is causing growth, growth is also causing energy. Hence, the reason for the term feedback.

Lastly, is the neutrality hypothesis which states that there is no connection between the two variables. The neutral effect indicates that electricity consumption does not lead to economic growth and vice versa. The Neutral hypothesis implies that there is no or minor role of electricity consumption in stimulating economic growth. In such circumstances, energy conservation policies are suitable because they have no adverse effect on economic growth. Similar can be said about the conservation theory. Studies by Chontanawat, Hunt, & Pierse, 2008; Śmiech & Papiez, 2014; Wolde-Rufael, 2009 have so far validated this hypothesis.

2.2. The impact of expenditure on growth

Literature on the relationship between both expenditure and economic growth are uncountable. Empirical studies have validated both the Wagner's and Keynesian law of public expenditure. The results so far, have been mixed just like economic growth and energy. Singh & Sahni (1984) study the causal link between government expenditure and national income for India. Their finding suggests a feedback relationship which neither confirms Wagner nor Keynes theories. In a cross-country analysis by Afxentiou & Serletis (1996) and Ansari, Gordon, & Akuamoah (1997), their results found evidence supporting the Keynes theory and not the Wagner's law. A similar result was found by (Abizadeh & Yousefi, 1998). Contrary to Keynes proposition, of the G7 countries examined by (Bohl, 1996), they found that Wagner's law was valid only for the United Kingdom and Canada. Analysis by Zaman, Khan, Ahmad, and Khilji, 2011 demonstrates that, in the long run, Wagner's Law does not hold in Pakistan.

3. Data, Methodology and Results

3.1. Data Source and definitions of variables

To conduct our study, we collected data for macroeconomic variables and institutional quality variables from the World Development Indicator (WDI) database World Governance Indicator (WGI) database of the World Bank Group.

For the initial objective that required the application of empirical techniqes of Pooled OLS, Fixed effects, GMM and Quantile techniques in our panel setting, we collected a data of ### countries over the 18-year period from the year 2000-2017. To fulfil the objective of our investigation, the dataset obtained was categorised based on the World Bank income group classification; sections of the population categorised according to their level of income. According to The World Bank Group, economies are divided according to 2009 GNI per capita, and grouped by level of income. The groups are the high income, $12,196 or more; upper middle income, $3,946 - $12,195; lower middle income, $996 - $3,945; and low-income groups, $995 or less The World Bank, (2011).

While the dataset used for of our study, using the Panel Threshold technique, is from the year 2002-2014 of the same World Bank dataset.

Our variables are defined based on the World Bank definitions as follow:

Dependent variable:

GDP per capita (Annual %) is gross domestic product divided by midyear population. We used it as a proxy, in its log level form, for our macroeconomic variable. In our model specifications, it is our dependent variable and denoted as LGDPc.

Focus variables:

Electric power consumption (in KWh per capita) measures the production of power plants and combined heat and power plants less transmission, distribution, and transformation losses and own use by heat and power plants. We used electric power consumption as the proxy for energy consumption. We took the log form and denoted it as LEC in our models.

Final consumption expenditure (% of GDP), is the sum of household final consumption expenditure (private consumption) and general government final consumption expenditure (general government consumption). We employ its log form and represent it as LFC in our model.

Control variables:

Inflation (in annual %), is proxied by consumer price index (CPI). It reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. We denote it as LINF in our models by using its log form.

Real interest rate (in %) is the lending interest rate adjusted for inflation as measured by the GDP deflator. In our dataset, we used the logged form of the variable and denoted it as LRIR.

Internet users (in % of population), are individuals who have used the internet (from any location) in the last 3 months. Internet users include those who have accessed internet via the computer, mobile phone, personal digital assistant, games machine, digital TV and so forth. It is our proxy for technology, and we took the log form, and it is indicated as LTEC.

Trade (% of GDP), is the sum of exports and imports of goods and services measured as a share of gross domestic product. We also use it log-level form and denote it as LTRD in our models.

Rule of Law, indicated as LRL in our model specifications, "*captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. The estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.*"

3.2. Methodology

Pooled OLS

The adopted *OLS* model can be represented as thus:

$$LGDPc = \alpha_0 + \beta_1 LEC + \beta_2 LFC + \beta_3 LTRD + \beta_4 LRIR + \beta_5 LTEC + \beta_6 LINF + \beta_7 LRL + \varepsilon$$

Eq. 1

Fixed Effects

The *Fixed Effects* model can be represented as thus:

$$LGDPc = \alpha_0 + \beta_1 LEC + \beta_2 LFC + \beta_3 LTRD + \beta_4 LRIR + \beta_5 LTEC$$

$+ \beta_6 LINF + \beta_7 LRL + \varepsilon$

Eq. 2

One step System GMM

To capture dynamic effects in our models, we employ GMM techniques. The dynamic linkages that exist from energy consumption and expenditure on economic growth are captured using one-step system GMM.

The *one-step System GMM* model can be represented as thus:

We estimated the following growth equation.

$$LGDPc_{it} = \alpha_i LGDPc_{it-1} + \beta_1 LEC_{it} + \beta_2 LFC_{it} + \beta_3 LTRD_{it} + \beta_4 LRIR_{it} + \beta_5 LTEC_{it} + \beta_6 LINF_{it} + \beta_7 LRL_{it} + \varepsilon_{it}$$

Eq. 3

The model can be rewritten as thus:

$$Y_{it} = \alpha_i Y_{it-1} + \beta_i X_{it} + \gamma_{it} Z_{it} + v_i + \mu_t + \varepsilon_{it}$$

Eq. 4

Where:

i indicates the country (i = 1,...N) and t indicates the time period (t = 1...T).

Y_{it} ($LGDPc_{it}$) stands for the Economic Growth (proxied by GDP per capita) of income group i at the end of period t,

Y_{it-1} stands for growth of income group i at period t-1

X_{it} (LEC_{it} and LFC_{it}) is a vector of our focused variables, energy consumption and expenditure (proxied by electricity consumption and final consumption respectively),

Z_{it} is a vector of other control variables hypothesised to affect output growth,

α, β, γ and δ are the parameters and vectors of parameters to be estimated,

v_i are country-specific effects,

μ_t are period-specific effects and,

ε_{it} is the error term.

Quantile Regression (QR Model)

To examine the impact of energy consumption and expenditure on economic growth, which is our dependent variable, in percentiles, we employed the Quantile regression technique, which was developed by Koenker & Bassett, (1978). Quantile technique is used to transform a conditional distribution function into a conditional quantile function by slicing it into segments. These segments describe the cumulative distribution of a conditional-dependent variable Y given the explanatory variable x_i with the use of quantiles. Assuming that the θ th quantile of the conditional distribution of the explained variable is linear in x where Quant Xi, the conditional QR model can be expressed as follows:

$$Y_i = x'_i.\beta_\theta + u_{\theta i}$$
$$Quant\theta\ (y_i | x_i) = \inf\{y : F_i\ (y | x)\ \theta\} = x'_i.\beta_\theta$$
$$Quant\theta\ (u_{\theta i}\ x_i) = 0$$

Eq. 5

where $Quant_\theta\ (y_i | x_i)$ represents the Θ the conditional quantile of y_i on the regressor vector x_i; β_Θ is the unknown vector of parameters to be estimated for different values of Θ in (0,1); $u_{\Theta i}$ is the error term assumed to be continuously differentiable c.d.f. (cumulative density function) of F_i (y|x)Θ and a density function F_i (y|x)Θ. The value F_i (y|x)Θ denotes the conditional distribution of y conditional on x. Varying the value of u from 0 to 1 reveals the entire distribution of y conditional on x. The estimator for b u is obtained from

$$\min \sum_{i:u\theta\geq 0}^{n} \theta^{x}\ |u\theta| + \sum_{i:u\theta\leq 0}^{n} 1-\theta^{x}\ |u\theta i|$$
$$= \sum_{i:yi-x'i.\beta\theta>=0} \theta^{x}\ |yi - x'i.\beta\theta| + \sum_{i:yi-x'i.\beta\theta<=0} (1-\theta)^{x}\ |yi - x'i.\beta\theta|$$

Eq. 6

Threshold

We adopt the threshold autoregressive model developed by B. E. Hansen, (1999) is estimated. The panel threshold autoregressive model takes the following form:

$$V_{it.} = \begin{cases} \mu_i + \theta' h_{it} + \beta_1 d_{it} + \varepsilon_{it} & \text{if } d_{it} \leq \gamma \\ \mu_i + \theta' h_{it} + \beta_2 d_{it} + \varepsilon_{it} & \text{if } d_{it} > \gamma \end{cases}$$

$$\theta = (\theta_1, \theta_2, \theta_3, \theta_4, \theta_5, \theta_6)'$$

$$h_{it} = (s_{it}, g_{it}, p_{it})'$$

Eq. 7

V_{it} represents an income group's economic growth which is measured by GDPc; d_{it} (energy consumption) is the explanatory variable and also the threshold variable. There are six control variables hit which may affect economic growth. $\theta_1, \theta_2, \theta_3, \theta_4, \theta_5, \theta_6$ represent the coefficient estimates of the control variables; μ_i is the fixed effect that represents the heterogeneity of income groups under different economic conditions; β_1 is the threshold coefficient when the threshold value is lower than γ; β_1 is the threshold coefficient when the threshold value is higher than γ; the errors ε_{it} are assumed to be independent and identically distributed (i.i.d.), with mean zero and finite variance σ^2 ($\varepsilon_{it} \sim$ i.i.d.$(0, \sigma^2)$); *i* represents different income groups and *t* represents different periods

3.3. Discussion of Results

Descriptive Statistic Table

High Income							
	Mean	Standard deviation	Skewness	Kurtosis	Interquantile range (75-25)	Min	Max
Electricity Consumption per Capita(KW/h)	8506.486	6691.949	3.23269	18.93903	4611.129	1266.522	54799.18
Final consumption expenditure (% of GDP)	71.63707	13.26705	-1.116769	4.577953	11.90611	24.45039	109.1626
GDP per capita growth (annual %)	64.80842	4.128865	0.0350366	8.65055	3.692884	40.04394	91.34734
Individuals using the Internet (% of populatic	56.76969	24.95853	-0.3343521	2.051907	40.45361	2.210692	98.32361
Inflation consumer prices (annual %)	21.61176	2.849455	3.730606	35.61284	2.395563	14.24532	56.07336
Real interest rate (%)	75.9673	8.115032	3.502223	32.7856	5.3204	51.30983	165.3542
Trade (% of GDP)	115.2628	82.51389	3.018394	16.3381	61.8489	19.79813	860.8
Rule of Law Estimate	4.250358	0.183092	-0.8506123	3.962368	0.2743082	3.478605	4.522021
Upper Middle Income							
	Mean	Standard deviation	Skewness	Kurtosis	Interquantile range (75-25)	Min	Max
Electricity Consumption per Capita(KW/h)	2332.33	1312.429	1.039313	3.724307	1685.863	330.451	6617.136
Final consumption expenditure (% of GDP)	78.02515	20.20502	-0.3520641	4.118282	24.28275	4.192788	142.5984
GDP per capita growth (annual %)	66.21911	6.998007	5.173478	103.9572	4.751911	1.000013	186.1934
Individuals using the Internet (% of populatic	25.37692	20.53724	0.6358885	2.335471	33.2931	0.1	80.14048
Inflation consumer prices (annual %)	26.26161	14.47386	9.362515	129.5056	5.589874	9.041107	274.0571
Real interest rate (%)	78.07015	9.956948	0.5175526	8.078058	8.181808	30.20955	124.982
Trade (% of GDP)	89.33947	39.66172	1.503346	8.169613	50.65535	22.10598	351.1057
Rule of Law Estimate	3.740712	0.3496502	-1.167517	6.195356	0.4066722	1.626556	4.359847
Lower Middle Income							
	Mean	Standard deviation	Skewness	Kurtosis	Interquantile range (75-25)	Min	Max
Electricity Consumption per Capita(KW/h)	793.7755	772.899	1.549368	5.161964	988.7853	32.75085	3662.443
Final consumption expenditure (% of GDP)	84.31433	18.46452	1.273175	10.87781	18.09911	26.64199	217.7431
GDP per capita growth (annual %)	66.49337	4.941582	2.170418	29.07939	4.237354	35.4408	121.3943
Individuals using the Internet (% of populatic	12.64289	14.20842	1.548033	4.972817	16.75	0.0002893	71
Inflation consumer prices (annual %)	26.84772	14.85248	14.16034	275.7461	6.285415	0.9999699	344.1055
Real interest rate (%)	78.26344	8.848783	-0.0050289	18.32392	8.11911	10.65777	150.2188
Trade (% of GDP)	83.49255	35.00286	0.0638707	2.654127	49.49522	0.1674176	200.3093
Rule of Law Estimate	3.609593	0.2797251	-0.2742712	2.681538	0.3997641	2.732641	4.205441
Low Income							
	Mean	Standard deviation	Skewness	Kurtosis	Interquantile range (75-25)	Min	Max
Electricity Consumption per Capita(KW/h)	384.0566	548.7805	1.922298	5.704999	435.0603	22.64894	2161.608
Final consumption expenditure (% of GDP)	96.79504	18.71844	3.371588	22.52597	12.99914	53.22293	241.9739
GDP per capita growth (annual %)	64.71209	6.096033	-2.957963	26.75484	3.844677	9.173144	91.94362
Individuals using the Internet (% of populatic	4.318799	5.737002	1.959635	6.792759	5.55	0.0045614	31.86963
Inflation consumer prices (annual %)	29.28539	34.40415	11.40878	144.8548	7.773445	10.13386	533.0154
Real interest rate (%)	84.60549	44.53989	9.963238	114.8848	11.54504	0.9999422	644.3754
Trade (% of GDP)	65.11293	30.14195	3.599116	25.15776	28.3078	20.96405	311.3553
Rule of Law Estimate	3.316222	0.5468089	-3.272086	21.28946	0.5540636	-1.611436	3.964003

The common descriptive statistics on the data are presented in (Descriptive Statistic Table) above. These cover energy consumption, expenditure and GDP growth (in per capita terms) for all the 4 panels considered in this study. In the 4 panels, the mean per person energy consumption over the 2000–2017 period is highest in High Income Group and lowest in Low Income Group. Upper Middle and Lower Middle-Income Groups fall in between the aforementioned regarding mean per person energy consumption 2000–2017. For expenditure, the mean over the 2000–2017 period is highest in Low Income Group and lowest in High Income Group. Upper Middle and Lower Middle-Income Groups fall in between those above regarding mean in the same 2000–2017 period.

All panels for energy consumption exhibit excess Kurtosis and positive skewness, which indicates that energy consumption has a thicker tail and a higher peak than a normal distribution. Relative to the other panels, the coefficient of variation for energy consumption is highest for High-income group, suggesting strong variability in these data.

Our result, in **Table 1 for countries of the high-income level**, shows the impact of energy consumption and expenditure (our focused variables) on economic growth, which is our dependent variable.

The result of pooled OLS, in model 1, shows that energy consumption (LEC) has a significant negative impact on economic growth at 5%, while expenditure (LFC) shows a positive impact, significant at 1%. This is consistent with the study by **(Ansari et al., 1997).** Other controlled variables, specifically, trade (LTRD) and real interest rate (LRIR) show a positive and a negative impact respectively at 1%. Intuitively, the pooled OLS result, for countries with high-income level, shows that economic growth is driven by expenditure. High-income countries have more economic benefit when they spend more rather than consuming more energy. This boils down to energy consumption efficiency of these high-income countries.

The fixed effect result, in model 2, shows that both energy consumption have no significant impact on economic growth. Our result on the expenditure-growth debate is consistent with the study by (Facchini & Seghezza, 2018). However, examining the other controlled variables, real interest rate shows a negative impact on growth at a significant level of 5%.

In our dynamic models, one system GMM has been applied in this paper. Given that what is essential in dynamic GMM is the second-order autocorrelation, we only reported the AR2 p-value using Arrelano and Bond test. Our model 3 and 4 reports show that the null hypothesis of no second-order autocorrelation is rejected (at a p-value of 0.004) for the "system" GMM, but not rejected for the second-order autocorrelation for the "system" GMM robust (at a p-value of 0.549). Our results for model 4 confirm the use of dynamic panel data model in which several lag variables are instrumented to remove autocorrelation in the second order. For the GMM estimator to be consistent, error term assumption of no serial correlation and exogeneity of its instruments must be valid. STATA offers two sets of specification tests namely: Sargan and Hansen test by L. P. Hansen, (1982) of over-identification to validate the assumptions. This study employed both the Sargan and Hansen tests and both tests confirmed the validity of instruments

In both one step system GMM and system GMM robust, our result shows that both energy consumption and expenditure have no significant impact on economic growth. Therefore, for the dynamic model, the impact of energy consumption and expenditure is insignificant. This is the same with the fixed effect results as earlier stated.

In our quantile model, model 5 to be specific, energy consumption has no significant impact on growth in quantile regression at Q25 and Q75 percentiles respectively. The similar insignificant result is recorded for expenditure except in Q75 percentile, where it has a significant negative impact on the growth of countries with an economic growth rate of 4.235%. The implication, among high income level countries, is that, the higher the rate of economic growth, the more insignificant the impact of energy consumption on the growth of their economies. While, as economic growth increases, expenditure shows a more negative impact on growth at Q75 percentile. The same negative results at Q75 percentile is shown for rule of law, an institutional quality variable used as control variable.

Table 1

High Income Group

	High Income Group					
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5** Quantile Regression	
	POLS	*Fixed Effect*	*One step System GMM*	*One step System GMM Robust*	Q25	Q75
LEC	-0.012b	-0.018	-0.062	-0.029	-0.026	0.024
	-0.01	-0.03	-0.04	-0.05	-0.02	-0.02
LFC	0.057a	-0.029	0.001	0.034	0.012	-0.063c
	-0.01	-0.05	-0.06	-0.08	-0.04	-0.03
LTRD	0.022a	-0.003	0.01	0.005	-0.001	0.007
	0	-0.01	-0.01	-0.02	-0.01	-0.01
LRIR	-0.106a	-0.123b	-0.089b	-0.057	-0.101	0.071
	-0.03	-0.05	-0.04	-0.17	-0.08	-0.08
LTEC	-0.007	-0.001	0.013	-0.017	0.011	-0.011
	-0.01	-0.01	-0.02	-0.02	-0.01	-0.01

LINF	0.014	-0.008	-0.001	-0.455b	0.017	0.007
	-0.02	-0.03	-0.02	-0.2	-0.04	-0.04
LRL	0.006	0.028	0.078	0.013	0.004	-0.130a
	-0.02	-0.07	-0.07	-0.11	-0.05	-0.05
L.LGDPc			0.279a	0.546b		
			-0.1	-0.24		
_cons	4.356a	4.925a	3.519a	3.650b	4.674a	4.507a
	-0.17	-0.41	-0.55	-1.53	-0.4	-0.37
N	349	167	349	314	167	167
R-Squared	0.151	0.065				
Adjusted R-Squared			-2.899	0.6		
No of Groups		14	36	34		
No of Instruments	8	8	9	9	8	8
Quantile					0.25	0.75
Quantile Value					4.173	4.235
Sargan Test			0.605	0.171		
Hansen Test				0.214		
AR2 Test			0.004	0.549		

a b and **c** indicate significance at the **1% 5%** and **10%** levels respectively. Standard errors are in parentheses

Table 2

Upper Middle Income Group

	Upper Middle Income					
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	
	POLS	*Fixed Effect*	*One step System GMM*	*One step System GMM Robust*	Quantile Regression Q25	Q75
LEC	0.021a	0.207a	0.013	0.152	-0.007	0.006
	-0.01	-0.06	-0.07	-0.09	-0.01	-0.01
LFC	-0.031b	0.009	0.266c	0.04	-0.026	0.016
	-0.01	-0.06	-0.16	-0.08	-0.02	-0.02
LTRD	0.014	0.178a	0.022	-0.117c	-0.009	0.01
	-0.01	-0.05	-0.02	-0.07	-0.02	-0.02
LRIR	0.037	-0.018	-0.044	-0.878b	-0.023	-0.055
	-0.03	-0.05	-0.09	-0.39	-0.05	-0.06
LTEC	-0.019a	-0.057a	-0.026	-0.070a	-0.024a	-0.011
	0	-0.01	-0.02	-0.02	-0.01	-0.01
LINF	0.001	-0.002	0.006	-0.204	0.039	0.009
	-0.02	-0.03	-0.02	-0.18	-0.02	-0.03

LRL	-0.01	-0.068	-0.058b	0.03	0.042c	-0.021
	-0.01	-0.08	-0.03	-0.1	-0.02	-0.03
L.LGDPc			0.621c	-0.275		
			-0.32	-0.24		
_cons	4.036a	2.158a	0.705	9.093a	4.220a	4.355a
	-0.19	-0.68	-1.52	-2.18	-0.28	-0.33
N	405	145	405	371	145	145
R-Squared	0.084	0.23				
Adjusted R-Squared			1.284	-1.385		
N0 of Groups		14	36	36		
N0 of Instruments	8	8	9	9	8	8
Quantile					0.25	0.75
Quantile Value					4.129	4.203
Sargan Test			0.975	0.296		
Hansen Test				0.343		
AR2 Test			0.199	0.166		

a b and **c** indicate significance at the **1% 5%** and **10%** levels respectively. Standard errors are in parentheses

Our result, in Table 2 for countries of **Upper middle-income group**, shows the impact of energy consumption and expenditure (our focused variables) on economic growth, which is our dependent variable.

The results of pooled OLS, in model 1, shows that energy consumption (LEC) has a positive impact on economic growth, and significant at 1%, while expenditure (LFC) shows a negative impact, and significant at 5%. All other controlled variables show at 1%. Intuitively, the pooled OLS result, for countries in upper-middle-income group level, shows that energy consumption is a very crucial factor that determines economic growth for the countries in this group. This result support the unidirectional growth hypothesis which is also consistent with (Ouedraogo, 2013) and (Odhiambo, 2009).

The fixed effect result, in model 2, shows that only energy consumption have a significant impact on economic growth. A significant positive impact at 1%. This is same as the Pooled OLS result, which is consistent with the study by (Odhiambo, 2009). The result of expenditure on economic growth is not significant. It is consistent with (Facchini & Seghezza, 2018). However, examining the other controlled variables, real interest rate shows a negative impact on growth at a significant level of 5%.

In our dynamic models, models 3 and 4 respectively, the reports show that we fail to reject the null hypothesis of no second-order autocorrelation for the one step “system” GMM (at a p-value of 0.199), and one step "system" GMM robust (at a p-value of 0.166). Our results confirm the use of dynamic panel data model in which several lag variables are instrumented to remove autocorrelation in the second order. Both the Sargan and Hansen tests both confirmed the validity of our instruments in Table 2.

In both one step system GMM and one step system GMM robust, our result shows that both energy consumption and expenditure have no significant impact on economic growth except in Model 3. In Model 3, expenditure shows a significant positive effect at 10%. For upper middle-income countries, the Keyne's law is supported by our dynamic model. The result is consistent with Ansari et al., (1997) and Fatai, (2015).

In our quantile model, model 5 to be specific, both energy consumption and expenditure have no significant impact on growth in quantile regression at Q25 and Q75 percentiles respectively. The implication, among upper middle-income level countries, is that the higher the rate of economic growth, the more insignificant the impact of energy consumption and expenditure on the growth of their economies. These results are counterintuitive to the reality of these countries. The same negative results at Q25 percentile is shown for the rule of law, an institutional quality variable used as control variable.

Table 3

Lower Middle Income Group

	Lower Middle Income					
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5** Quantile Regression	
	POLS	*Fixed Effect*	*One step System GMM*	*One step System GMM Robust*	Q25	Q75
LEC	0.012b	0.045b	0.018	0.019	-0.007	0.005
	-0.01	-0.02	-0.03	-0.04	-0.01	-0.01
LFC	-0.079a	0.050c	-0.175c	0.016	0	-0.011
	-0.02	-0.03	-0.1	-0.07	-0.03	-0.03
LTRD	-0.008c	0.106a	-0.007	0.005	0.022c	0.01
	0	-0.03	-0.01	-0.01	-0.01	-0.01
LRIR	0.019	-0.093a	0.011	0.132	-0.038	-0.014
	-0.03	-0.03	-0.04	-0.34	-0.04	-0.03
LTEC	-0.004	-0.009c	-0.003	-0.016	0.002	0.005
	0	-0.01	-0.01	-0.01	-0.01	-0.01

LINF	0.056a	-0.060a	0.052b	-0.217	-0.04	-0.048b
	-0.02	-0.02	-0.02	-0.13	-0.03	-0.02
LRL	0.022	0.023	0.01	-0.015	0.048b	0.008
	-0.02	-0.04	-0.04	-0.05	-0.02	-0.02
L.LGDPc			0.037	0.268		
			-0.22	-0.27		
_cons	4.173a	3.742a	4.486a	3.093b	4.231a	4.354a
	-0.19	-0.38	-1.08	-1.45	-0.29	-0.24
N	277	224	277	254	224	224
R-Squared	0.108	0.191				
Adjusted R-Squared			-2.358	-0.76		
No of Groups		18	25	25		
No of Instruments	8	8	9	9	8	8
Quantile					0.25	0.75
Quantile Value					4.161	4.208
Sargan Test			0.11	0.144		
Hansen Test				0.515		
AR2 Test			0.018	0.447		

a b and **c** indicate significance at the **1% 5%** and **10%** levels respectively. Standard errors are in parentheses

Our result, in Table 3 for countries of **Lower middle income** group, shows the impact of energy consumption and expenditure (our focused variables) on economic growth, which is our dependent variable.

The results of pooled OLS, in model 1, shows that energy consumption (LEC) has a positive impact on economic growth, and significant at 5%, while expenditure (LFC) shows a negative impact, and significant at 1%. All other controlled variables show at 1%. Intuitively, the pooled OLS result, for countries in a lower middle-income group level, shows that energy consumption is a very crucial factor that determines economic growth for the countries in this group. This result supports the unidirectional growth hypothesis which is also consistent with the study by (Ouedraogo, 2013) for the lower middle-income group.

The fixed effect result, in model 2, shows that both energy consumption and expenditure have a significant impact on economic growth — a significant positive impact at 5% and 10% for energy consumption and expenditure respectively. This is same as the Pooled OLS result, which is consistent with the study by (Odhiambo, 2009) on the economic-growth relationship. The result of the positive significance of expenditure on economic growth is consistent with the study by (Afxentiou & Serletis, 1996). The implication of this is that spending more on energy consumption is actually good for the economic growth of countries with middle income. However, examining the other controlled variables, real interest rate and inflation both show a negative impact on growth at a significant level of 1%.

In our dynamic models, models 3 and 4 respectively, the reports show that we fail to reject the null hypothesis of no second-order autocorrelation for one step "system" GMM robust (at a p-value of 0.447), while one step "system" GMM (at a p-value of 0.018) is rejected for second-order autocorrelation. This renders our one-step system GMM unreliable because of autocorrelation. The use of a dynamic panel data model in which several lag variables are instrumented to remove autocorrelation in the second order is confirmed for model 4. Both the Sargan and Hansen tests both confirmed the validity of our instruments in Table 3.

In both one step system GMM and one step system GMM robust, our result shows that both energy consumption and expenditure have no significant impact on economic growth except in Model 3. In Model 3, expenditure shows a negative significant effect at 10%. For lower middle-income countries, Wagner's law is supported by our dynamic model. The result is consistent with (Zaman et al., 2011).

In our quantile model, model 5 to be specific, both energy consumption and expenditure have no significant impact on growth in quantile regression at Q25 and Q75 percentiles respectively. The implication, among lower-middle income level countries, is that the higher the rate of economic growth, the more insignificant the impact of energy consumption and expenditure on the growth of their economies. These results are counterintuitive to the need of these countries, which is energy to spur growth through production and manufacturing.

Table 4

Low Income Group

	Low Income					
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	
	POLS	*Fixed Effect*	*One step System GMM*	*One step System GMM Robust*	Q25	Q75
LEC	0.013a	-0.032	0.064b	0.024	-0.029a	-0.007
	0	-0.03	-0.03	-0.02	-0.01	-0.01
LFC	-0.102b	-0.005	-0.707a	-0.062	-0.001	0.002
	-0.05	-0.06	-0.22	-0.17	-0.02	-0.02

LTRD	-0.004	0.077a	-0.064	-0.047	0.016	0.036a
	-0.02	-0.03	-0.06	-0.1	-0.01	-0.01
LRIR	-0.049	-0.169a	-0.061	-0.209	-0.100c	-0.03
	-0.06	-0.06	-0.05	-0.26	-0.06	-0.05
LTEC	-0.005	-0.027a	0.003	-0.01	-0.014a	-0.039a
	0	0	0	-0.01	0	0
LINF	-0.02	-0.043	0.005	-0.143c	-0.013	0.02
	-0.02	-0.03	-0.02	-0.07	-0.03	-0.03
LRL	-0.029	-0.093c	-0.099b	-0.093	0.018	-0.003
	-0.02	-0.06	-0.04	-0.07	-0.02	-0.02
L.LGDPc			-0.199a	-0.139		
			-0.02	-0.25		
_cons	4.980a	5.463a	8.740a	6.821a	4.790a	4.327a
	-0.41	-0.57	-1.29	-2.02	-0.37	-0.3
N	111	328	111	104	328	328
R-Squared	0.183	0.213				
Adjusted R-Squared			-0.131	0.413		
No of Groups		36	13	13		
No of Instruments	8	8	9	9	8	8
Quantile					0.25	0.75
Quantile Value					4.163	4.236
Sargan Test			0.75	0.516		
Hansen Test				0.32		
AR2 Test			0.896	0.679		

a, b and **c** indicate significance at the **1% 5%** and **10%** levels respectively. Standard errors are in parentheses

Our result, in **Table 4** for countries of **Low-income group**, shows the impact of energy consumption and expenditure (our focused variables) on economic growth, which is our dependent variable.

The results of pooled OLS, in model 1, shows that energy consumption (LEC) has a positive impact on economic growth, and significant at 1%, while expenditure (LFC) shows a negative impact, and significant at 5%. All other controlled variables are insignificant. Intuitively, the pooled OLS result, for countries in a low income group level, shows that energy consumption is a very crucial factor that determines economic growth for the countries in this group. This result supports the unidirectional growth hypothesis for an energy-growth relationship, which is also consistent with (Odhiambo, 2009). The insignificance result of expenditure can mean expenditures in this group are being used mostly, for non-economic driving activities. Perhaps, most of the expenditures are used for recurrent expenditure like salary payment of workers, and not expended on capital projects that can stimulate growth.

The fixed effect result, in model 2, shows that both energy consumption and expenditure have no significant impact on economic growth. The implication of this is that spending more on energy consumption does not translate to momentous economic growth for countries with low-income level. This is counterintuitive to the realities and the need of this country because they need energy and more expenditure to spur growth. However, let us reconcile other controlled variables, like trade, which shows a positive significance at 1%, and the rule of law, which shows a significant negative impact at 10% for economies with low income. Most of the economic driving activities of these group are spurred by trading, hence, the reason for the positive impact of trade. Taking into account, for these groups, the negative impact of institutional quality proxied by the rule of law. These groups are commonly rich with natural resources, which are majorly managed by multinational companies MNCs. These MNCs explore these resources, then make production outside the territory of these groups. Hence, the use of electricity might be insignificant. This is because production and manufacturing, which require energy consumption are not readily taking place in these countries. On the reason for insignificant expenditure, income realised by governments of these groups, from the exploration of natural resources, are commonly looted by leaders, hence, the reason why expenditure does not reflect on their growth. The result of the rule of law speaks volume on the negative impact of institutional quality of these groups on growth.

In our dynamic models, models 3 and 4 respectively, the reports show that we fail to reject the null hypothesis of no second-order autocorrelation for both the one-step "system" GMM (at a p-value of 0.896), and one step "system" GMM robust (at a p-value of 0.679).

In the one-step system GMM, our result shows that energy consumption is positively significant at 5% impact on growth. This implies that more energy consumption adds value to the economy of this group. Expenditure, on the other hand, shows a significant negative impact on economic growth at 1 %. This implies that the increase in expenditure leads to a shrink in economic growth. The one-step system GMM robust, model 4, shows that both energy consumption and expenditure are not significantly different for low-income groups.

In our quantile model, model 5 of Table 4, both energy consumption and expenditure have no significant impact on growth in quantile regression at Q25 and Q75 percentiles except for energy consumption at Q25. Energy for low-income countries has a significant negative impact on economic growth. The implication for countries at this percentile, (Q25), is that an increase in energy consumption per person impacts negatively on the economic growth. These results are counterintuitive to the need of these countries, which is energy to spur growth through production and manufacturing.

Table 5:

Estimated coefficients: single threshold model

	Model 1 **High Income**	*Model 2* **Upper Middle Income**	*Model 3* **Lower Middle Income**	*Model 4* **Low Income**
LEC	-0.150a	0.121a	-0.011b	-0.092a
	(0.05)	(0.02)	(0.01)	(0.02)
LFC	-0.150a	0.121a	-0.011b	-0.092a
	(0.05)	(0.02)	(0.01)	(0.02)
LINF	-0.020c	-0.039b	-0.007	0.031a
	(0.01)	(0.02)	(0.01)	(0.01)
LRIR	0.007a	-0.001	-0.000	-0.004
	(0.00)	(0.01)	(0.00)	(0.00)
LRL	0.072	-0.166c	0.006	0.072
	(0.06)	(0.09)	(0.03)	(0.05)
LTEC	-0.026a	-0.010	0.005	0.008
	(0.01)	(0.01)	(0.00)	(0.00)
LTRD	0.052c	0.091	-0.000	0.115a
	(0.03)	(0.06)	(0.01)	(0.03)
_cons	4.399a	3.581a	4.333a	4.099a
	(0.47)	(0.61)	(0.16)	(0.26)
LEC Threshold estimate γ	**8.5888**	**7.7411**	**5.1236**	**6.0278**
Energy Consumption Threshold (KWh/Capita)	**5371**	**2301**	**168**	**415**
β_1LEC ≤ γ *(Regime I)*	0.003	0.068	-0.009	-0.058
	(0.03)	(0.06)	(0.02)	(0.04)
β_2LEC > γ *(Regime II)*	-0.001	0.053	-0.015	-0.074b
	(0.03)	(0.06)	(0.02)	(0.04)
N	250	190	155	65
R-Squared	0.214	0.252	0.101	0.491
N0 of Groups	50	38	31	13
N0 of Instruments	9	9	9	9
number of thresholds	1	1	1	1

a b and c indicate significance at the 1% 5% and 10% levels respectively Standard errors are in parentheses

Table 5 presents the estimated coefficients based on OLS standard errors for each income group. In the result (Table 5), we see that energy consumption (LEC) has a negative and significant effect on economic growth in all our models except in model 2, where it has a significant positive effect. All the models are significant at 1% except for model 3, where it is significant at 5%.

The coefficient of our primary interest are those regression coefficients, β_1; β_2, by each regime. Similarly, we are interested in estimated value of the single threshold (*LEC Threshold estimate* γ), and what the threshold values equate regarding energy consumption per capita (*Energy Consumption Threshold (KWh/Capita)*) for each model.

The regime I estimated coefficients (β_1) for models 1, 2, 3, and 4 are 0.003, 0.068, -0.009, -0.058 respectively. The coefficients are not significantly different in regime I, while models 1 and 2 are positive, models 3 and 4 are negative. The regime II estimated coefficients (β_2) for models 1, 2, 3, and 4 are -0.001, 0.053, -0.015, -0.074 respectively. The coefficients are not significantly different in all the models except in model 4 for low-income group, where the impact is negative and significant at 5%.

Cross-analysis of regimes I and II for income groups:

In model 1 (High-income group), the estimated value of the single threshold **8.5888** is equivalent, regarding energy consumption (proxied by electricity consumption), to **5371 KW/h**. The first regime's estimated coefficient is **0.003**, which is not significantly different. In the second regime, if energy consumption is greater than **5371 KW/h**, the estimated coefficient (**-0.001**) is also not significantly different. Nevertheless, the coefficients are insignificant in both regimes. The implication is that there is no relationship between energy consumption and economic growth when energy consumption is lesser or greater than **5371 KW/h** for high-income groups. Our findings of a single threshold effect of energy consumption on economic growth corroborate the findings of Śmiech and Papież, (2013) for most EU countries (mostly high-income nations).

In model 2 (Upper middle-income group), the estimated value of the single threshold **7.7411** is equivalent, regarding energy consumption, to **2301 KW/h**. The first regime's estimated coefficient is **0.068**, which is not significantly different. In the second regime, if energy consumption is greater than **2301 KW/h**, the estimated coefficient (**0.053**) is also not significantly different. Nevertheless, the coefficients are insignificant in both regimes. The implication is that there is no relationship between energy consumption and economic growth when energy consumption is lesser or greater than **2301 KW/h** for upper middle-income groups. Our findings of a single threshold effect of energy consumption on economic growth corroborate the findings of Soytas and Sari, (2009) on Turkey, an upper middle-income country.

In model 3 (Lower middle-income group), the estimated value of the single threshold **5.1236** is equivalent, regarding energy consumption, to **168 KW/h**. The first regime's estimated coefficient is **-0.009**, which is not significantly different. In the second regime, if energy consumption is greater than **168 KW/h**, the estimated coefficient (-**0.015**) is also not significantly different. Nevertheless, the coefficients are insignificant in both regimes. The implication is that there is no relationship between energy consumption and economic growth when energy consumption is lesser or greater than **168 KW/h** for lower middle-income groups. Our findings of a single threshold effect of energy consumption on economic growth corroborate the findings of Soytas and Sari, (2003) on India, a lower middle-income country.

In model 4 (Low-income group), the estimated value of the single threshold **6.0278** is equivalent, regarding energy consumption, to **415 KW/h**. The first regime's estimated coefficient is **-0.058**, which is not significantly different. In the second regime, if energy consumption is greater than **415 KW/h**, the estimated coefficient is (-**0.074**), which is significantly different at 5% with a negative effect. This implies that 1 KW/h in energy consumption will impact on economic growth by -0.074 per cent for low-income groups that have energy consumption greater than **415 KW/h**. In other words, and intuitively, the finding is suggesting that energy beyond the threshold value of more than 64.33 per cent would have no impact on the firm value and would just add to the existing level of the firm leverage

Robustness Check

Fig. 1 and Fig. 2 shows our robustness check for the study. We conducted a series of robustness check by conducting additional regressions to test the robustness of the relationship between energy consumption, expenditure and economic growth. Consequently, we conducted difference GMM at one and two steps, and also two steps system GMM. The results are different, and also show autocorrelation of second order. That makes our model in the study more applicable. Similarly, we have estimated the different quantile regressions as shown in *Fig. 1 and Fig. 2. We chose* lower (Q10) and higher (Q90) quantiles different from the ones we adopted for the study. The effect was not significantly different except for high-income groups.

4. Conclusion and policy implications

In this study, we examined the relationship between economic growth, energy consumption, and government expenditure. The study used annual data for period 2000-2017 for examining this relationship using GMM and quantile regressions. The study finds in general that High-income group need to adopt a more conservative approach on energy, as the impact is negative on the economy. Same goes for the Upper middle-income countries. The lower middle and low-income groups, however, need to ensure that they use spend judiciously on the energy consumption to spur growth in their economies. From the results, policymakers need to ensure that energy production is increased and made available to every populace to enhance the growth of the economy in lower middle and low-income groups. While the high income and upper middle groups need to and Our results for expenditure must be expended in a way that it will increase growth in the lower middle and low-income groups.

Our threshold results show that only the low-income group will have a negative significance impact of increasing electricity consumption after the first regime. The other incomes groups show that before and after the threshold limit, the impact of electricity consumption is not significantly different.

5. Limitations and Futures

This study only used 18 years period of observation, from 2000-2017 for our first two objectives. Hence, the results generated in this study can be biased as a result of a few samples of observation. Though the Quantile and Threshold techniques adopted in this study seems to give more detailed and close to reality information about the groups, there is still need for further use of other techniques like quantile on quantile and dynamic threshold that can predict more accurate relationship among the focus variables and dependent variable.

Fig. 1

High Income								
	Two step System GMM	*Two step System GMM Robust*	*One step Difference GMM*	*One step Difference GMM Robust*	*Two step Difference GMM*	*Difference GM*	Quantile Q10	Q90
LEC	-0.075b	-0.061	-0.245	-0.827	-0.295c	0.008	-0.008	-0.004
	-0.03	-0.07	-0.17	-1.06	-0.15	-0.46	-0.02	-0.02
LFC	-0.025	0	-0.018	-0.395	0.212	-0.209	0.057	-0.161a
	-0.04	-0.1	-0.3	-0.75	-0.28	-0.63	-0.04	-0.04
LTRD	0.003	-0.004	0.172a	0.851c	0.168b	0.798a	-0.007	0.006
	-0.01	-0.02	-0.05	-0.44	-0.07	-0.28	-0.01	-0.01
LRIR	-0.03	0.035	-0.063	-0.152	-0.102	0.043	-0.092	0.163b
	-0.04	-0.18	-0.11	-0.25	-0.08	-0.15	-0.08	-0.08
LTEC	0.02	-0.012	0.009	-0.161	0.03	-0.244b	0	-0.011
	-0.01	-0.02	-0.03	-0.17	-0.03	-0.1	-0.01	-0.01
LINF	0.024	-0.558a	-0.005	0.041	0.027	-0.155	0.070c	0.012
	-0.02	-0.17	-0.04	-0.48	-0.05	-0.3	-0.04	-0.04
LRL	0.099c	0.003	0.107	3.228	0.110c	2.409b	-0.007	-0.032
	-0.06	-0.11	-0.13	-2.21	-0.06	-1.07	-0.05	-0.05
L.LGDPc	0.240a	0.357	0.207	-0.454	0.125	-0.365		
	-0.09	-0.28	-0.17	-0.34	-0.18	-0.22		
_cons	3.495a	4.846a					4.209a	4.358a
	-0.46	-1.63					-0.39	-0.4
N	349	314	311	279	311	279	167	167
R-Squared								
Adjusted R-S	-2.687	0.143	-3.831	-1.091	-2.863	-1.171		
N0 of Groups	36	34	33	32	33	32		
N0 of Instrur	9	9	8	8	8	8	8	8
Quantile							0.1	0.9
Quantile Value							4.138	4.277
Sargan Test	0.605	0.171	0.113	0.616	0.113	0.092		
Hansen Test	0.367	0.214		0.708	0.148	0.163		
AR Test	0.007	0.886	0	0.275	0.004	0.241		
NB: Reader's inferential discretion is advised								
a b and c indicate significance at the 1% 5% and 10% levels respectively Standard errors are in parentheses								
c p<0.1, b p<0.05, a p<0.01								

Lower Middle Income								
	Two step System GMM	*Two step System GMM Robust*	*One step Difference GMM*	*One step Difference GMM Robust*	*Two step Difference GMM*	*Two step Difference GMM Robust*	Quantile Q10	Q90
LEC	0.026	0.016	0.02	0.335	-0.106c	0.108	-0.009	0.012
	-0.03	-0.03	-0.14	-1.27	-0.06	-0.24	-0.01	-0.01
LFC	0.023	-0.036	-0.026	0.276	-0.031	-0.567	-0.042	0.024
	-0.1	-0.12	-0.22	-0.73	-0.18	-0.48	-0.06	-0.04
LTRD	-0.001	0.004	0.015	0.002	0.018c	0.06	-0.023	0.028b
	-0.01	-0.01	-0.02	-0.21	-0.01	-0.13	-0.02	-0.01
LRIR	-0.099b	0.238	-0.045	-0.564	-0.097c	0.087	-0.123c	0.071
	-0.05	-0.58	-0.06	-0.69	-0.06	-0.48	-0.07	-0.05
LTEC	-0.01	-0.015	-0.007	-0.1	0.016	-0.023	-0.004	0.008
	-0.01	-0.01	-0.02	-0.21	-0.01	-0.03	-0.01	-0.01
LINF	0.004	-0.174c	0.021	-0.127	0.014	0.156	-0.022	-0.055c
	-0.03	-0.09	-0.04	-0.52	-0.04	-0.34	-0.04	-0.03
LRL	-0.002	0.013	-0.02	0.895	-0.06	-0.032	0.071b	0.009
	-0.03	-0.05	-0.08	-2.03	-0.07	-2.34	-0.03	-0.02
L.LGDPc	0.619b	0.316	0.136	-0.395	0.28	-0.389		
	-0.25	-0.51	-0.33	-0.83	-0.22	-0.94		
_cons	1.783	2.437					4.835a	3.740a
	-1.14	-1.53					-0.5	-0.33
N	277	254	251	229	251	229	224	224
R-Squared								
Adjusted R-S	-1.269	-0.315	-1.137	-0.012	-2.337	-0.312		
N0 of Groups	25	25	25	25	25	25		
N0 of Instrur	9	9	8	8	8	8	8	8
Quantile							0.1	0.9
Quantile Value							4.127	4.238
Sargan Test	0.11	0.144	0.087	0.489	0.087	0.012		
Hansen Test	0.103	0.515		0.511	0.1	0.228		
AR Test	0.204	0.753	0.256	0.99	0.019	0.755		
NB: Reader's inferential discretion is advised								
a b and c indicate significance at the 1% 5% and 10% levels respectively Standard errors are in parentheses								
c p<0.1, b p<0.05, a p<0.01								

Fig. 2

Upper Middle Income								
	Two step System GMM	*Two step System GMM Robust*	*One step Difference GMM*	*One step Difference GMM Robust*	*Two step Difference GMM*	*Two step Difference GMM Robust*	Quantile Q10	Q90
LEC	0.012	0.154	-0.476	0.73	-0.148	0.235	-0.021	0.05
	-0.05	-0.12	-0.51	-3.3	-0.18	-0.4	-0.03	-0.03
LFC	0.266c	0.123	0.611	1.878	0.603	1.212	-0.026	0.035
	-0.14	-0.08	-1.36	-11.34	-0.94	-1.08	-0.05	-0.07
LTRD	0.023	-0.143c	0.199c	0.541	0.214b	0.633	-0.002	0.01
	-0.02	-0.07	-0.1	-1.33	-0.09	-0.65	-0.05	-0.06
LRIR	-0.037	-1.154a	-0.032	-0.546	-0.055	-0.491c	0.014	0.054
	-0.08	-0.41	-0.32	-0.53	-0.21	-0.25	-0.12	-0.15
LTEC	-0.024b	-0.066b	0.049	-0.019	0.011	0.031	-0.014	-0.052b
	-0.01	-0.03	-0.07	-0.15	-0.03	-0.07	-0.02	-0.02
LINF	0	-0.129	0.046	0.205	0.009	0.111	0.025	0.055
	-0.02	-0.23	-0.06	-1.96	-0.05	-0.22	-0.06	-0.08
LRL	-0.055	0.101	-0.239	-2.018	-0.114	-2.115	0.024	-0.046
	-0.04	-0.13	-0.32	-4.98	-0.19	-1.31	-0.06	-0.07
L.LGDPc	0.683a	-0.467a	0.69	-0.264	0.466	-0.46		
	-0.17	-0.16	-0.73	-0.99	-0.44	-0.28		
_cons	0.423	10.314a					4.197a	3.561a
	-1.16	-2.36					-0.7	-0.87
N	405	371	367	335	367	335	145	145
R-Squared								
Adjusted R-S	1.145	-2.287	0.849	-0.689	0.884	-1.11		
N0 of Groups	36	36	36	36	36	36		
N0 of Instrur	9	9	8	8	8	8	8	8
Quantile							0.1	0.9
Quantile Value							4.089	4.231
Sargan Test	0.975	0.296	0.943	0.562	0.943	0.87		
Hansen Test	0.972	0.343		0.767	0.889	0.923		
AR Test	0.252	0.022	0.396	0.491	0.377	0.267		
NB: Reader's inferential discretion is advised								
a b and c indicate significance at the 1% 5% and 10% levels respectively Standard errors are in parentheses								
c p<0.1, b p<0.05, a p<0.01								

Low Income								
	Two step System GMM	*Two step System GMM Robust*	*One step Difference GMM*	*One step Difference GMM Robust*	*Two step Difference GMM*	*Two step Difference GMM Robust*	Quantile Q10	Q90
LEC	0.024	0.033	0.162	0.298	0.085	0.250c	-0.009	-0.004
	-0.03	-0.15	-0.19	-0.62	-0.15	-0.13	-0.02	-0.02
LFC	-0.258	-0.161	0.213	1.179	-0.052	-0.06	-0.046	-0.049
	-0.25	-0.36	-0.73	-1.99	-0.4	-0.33	-0.05	-0.05
LTRD	-0.01	-0.065	0.04	-0.181	0.069b	0.048	0.022	0.025
	-0.03	-0.6	-0.04	-0.46	-0.03	-0.26	-0.02	-0.02
LRIR	-0.157	-0.3	-0.064	-0.35	-0.026	0.279	-0.165	0.031
	-0.14	-2.06	-0.11	-1.86	-0.07	-0.47	-0.11	-0.11
LTEC	0	-0.01	-0.009	-0.029	-0.004	-0.016	-0.021b	-0.051a
	-0.01	-0.02	-0.01	-0.05	0	-0.04	-0.01	-0.01
LINF	-0.008	-0.125	0.013	0.035	0.018	0.096	-0.066	0.051
	-0.03	-0.3	-0.04	-0.37	-0.03	-0.13	-0.06	-0.06
LRL	-0.043	-0.111	0.019	1.305	-0.027	0.485	0.003	0.003
	-0.03	-0.46	-0.09	-1.44	-0.04	-0.35	-0.04	-0.04
L.LGDPc	-0.164a	-0.098	-0.124c	-1.702	-0.176a	-1.083a		
	-0.03	-0.62	-0.07	-1.4	-0.04	-0.23		
_cons	6.828a	7.533					5.287a	4.259a
	-0.76	-10.23					-0.7	-0.68
N	111	104	97	90	97	90	328	328
R-Squared								
Adjusted R-S	1.117	0.311	2.564	-1.038	1.118	-1.707		
N0 of Groups	13	13	13	12	13	12		
N0 of Instrur	9	9	8	8	8	8	8	8
Quantile							0.1	0.9
Quantile Value							4.128	4.272
Sargan Test	0.75	0.516	0.713	0.827	0.713	0.372		
Hansen Test	0.853	0.32		0.748	0.346	0.286		
AR Test	0.264	0.756	0.01	0.299	0.263	0.088		
NB: Reader's inferential discretion is advised								
a b and c indicate significance at the 1% 5% and 10% levels respectively Standard errors are in parentheses								
c p<0.1, b p<0.05, a p<0.01								

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