IJEP International Journal of New Political Economy

DOI: 10. 52547/jep.4.2.143

Regulatory Quality and Economic Growth in D-8 Countries (PSTR Approach)

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ARTICLE INFO

Article history:

Date of submission: 29-12-2022

Date of acceptance: 04-05-2023

JEL Classification:

E02

O43

G18

Keywords:

Regulatory Quality Index (RQI)

Economic Growth

Panel Smooth Transition Regression (PSTR)

D-8 Countries

ABSTRACT

This study investigates the impact of regulatory quality on economic growth for the D- 8 countries by applying a panel smooth transition regression (PSTR) model from 1996 to 2019. Few studies considered the relationship between regulatory quality and economic growth. In most of them, the linear relationship between the variables has been examined, and non-linear relationships have not been considered. Therefore in this paper the nonlinear association between regulatory quality and economic growth is being examined. For this purpose, the paper uses the regulatory quality index, GDP growth and other variables including financial development, agricultural raw materials exports, inflation rate and gross capital formation. Our empirical results indicate that there is a non-linear relationship between variables under consideration. The results demonstrate that there is one continuous function with two regime and a threshold at regulatory quality of -0.746. In the first regime, financial development, agricultural raw materials and gross capital formation have a significantly positive impact and inflation rate have a significantly negative impact on GDP. At the second regime, agricultural raw materials exports and financial development have a negative impact and inflation rate and gross capital formation have a positive impact on GDP. Since the regulatory quality index in higher levels has a positive impact on economic growth, to achieve a stable economic growth the economic planners and policy makers should pay much attention to creating efficient institutions with transparent regulations.

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1. Introduction

The present study was conducted with the aim of investigating the impact of regulatory quality on economic growth in D-8 countries. The majority of the studies dealt with considering the relationship between institutional quality and economic growth and few studies considered the relationship between regulatory quality and economic growth. However most of the studies considered the quality of this relationship. From the quantity view, just linear relationship between variables was viewed, in which a constant coefficient was used to explain the effect of regulatory quality on economy growth during specific time. It was expected over the time in different levels of generally institutional quality and particularly regulatory quality the coefficients and the way it influence would change. So this study has taken a further step to solve the problem through panel smooth Transition Regression, as the most prominent model of regime-switching to consider the relationship between nonlinear and threshold between two variables. A number of recent papers provide empirical evidence that confirms the importance of institutional quality for economic performance. Zhuang et al (2010) investigate the relationship between governance, institutional quality and economic growth for the Asian developing countries over the period 1998-2008. On the basis of these findings, the paper argues that improving governance in these dimensions could be used as potential entry points of development strategies for many countries in the region. The paper also highlights the need for more efforts to improve the measurement of governance and institutional quality and more research to better understand the complex relationships between institutional and economic developments. Sawyer (2010) investigates the relationship between institutional quality and economic growth in Latin America. This study extensively reviews the literature on the determinants of economic growth in Latin America and shows that the slow growth of total factor productivity (TFP) seems to be the primary problem. Further, this problem is linked to the quality of institutions in the region. Economic development is the primary objective of all nations.

some important non- conomic factors that determine the nature and the rate of economic development are institutions, which are generally defined as the 'constraints that human beings impose on themselves'(Karimi and Heshmati Daiari, 2018). In recent decades, economists have focused on the role of institutions on a country's economic growth, as the conventional approach does not meet the new issues of a country. Economists believe that institutions have great impact on economic growth. Experimental surveys also indicate the major influence of institutions on the economic growth of countries es pecially in developing countries (Glaeser et al, 2004; Bulteet et al, 2005; Acemoglu et al, 2004; Kumssa and Mbeche, 2004; among others). Based on the definition of North (1990), institutions are the rules of the game. In his view, institutions are the constraints (restrictions-limitations) designed by the people that are shaping human interactions. Institutions determine and limit the set of the people's choices. Institutions provide a set of the political, cultural and economic conditions and contexts by protecting the property rights, ensuring the contracts performance, promoting the motivation of entrepreneurs, maintaining macroeconomic stability, risk management of the financial intermediaries, reducing uncertainty and reducing transactions costs, promoting government accountability and criticism which individuals accumulate skills and economic firms engage in capital accumulation and goods production. According to new institutionalism views, the type of governance, regulation and institutions of a country are primary factors in determining of the willingness of peoples to physical investment and gain the skills and technologies. All these factors lead to economic success in greater production, higher income and better economic welfare in the long run (North, 1990). Institutions are the major fractions of the whole society by which the economy is made. It is something abstract rather than something tangible. If these institutions are not treated well and corruption is widespread and not having clear definition of property rights, markets will not do well in the presence of disrespect toward institutions (Arisman et al, 2021) There are different kinds of regulations to be used to promote economic growth. In developing countries, market failure was used to permit

the government's direct involvement in productive activities by promoting industrialization, investing in industry and agriculture and by extending public ownership of companies. The role of regulation was limited to that of ensuring an unchanged policy environment in which efficient markets could do well (Nyasha and Odhiambo, 2019).

The previous studies mostly investigated the relationship between the quality of institutions and economic growth, and the relationship between regulatory quality and economic growth has been less discussed. So the aim of this study is trying to find out the effect of regulatory quality on economic growth in developing countries of group D-8 with the use of PSTR approach during 1996-2019.

The rest of the paper is organized as follows. Section 2 Empirical studies and Section 3 explains the theoretical framework that this section contains growth models, regulation theory, regulatory quality and development outcomes and introduces the panel smooth transition regression model, Section 4 describes the data and presents the estimation results. Finally, Section 5 concludes the paper.

2. Empirical Studies

Ever since the study of development issues in the countries of the world became one of the topics of concern for economists, economic growth has been widely accepted as the best indicator of the economic development of countries. The economic growth literature shows that various factors are effective on this variable, the most important of which are capital, work force and technological progress. Many economists have studied the causes and factors of growth and many growth models have been designed. Neoclassical growth models such as Solow have listed factors such as private investment, population growth, exogenous advancement of technology and the initial level of capita income among the variables affecting growth. In a different perspective, endogenous growth literature has proposed new hypotheses using empirical statements and single-equation

macroeconomic models for cross-sectional data from different countries. In these models, factors such as political institution, political and economic factors, knowledge accumulation or institutional indicators have been effective on economic growth. Jalalabadi et al (1389). During the years when classical thinkers were focused on completing their growth models, other thinkers were also trying to provide an explanation of the causes of economic growth. Among these efforts, the paradigm that stole the lead from the rest was the new institutional economy. Institutional economics has been proposed as a supplement and remedy for some weaknesses of the past models. In recent years the role of a good regulatory framework for a country's development has been emphasized by policy makers, researchers and international organizations alike. The regulations of a country are part of its economic institutions, which – in turn – are shaped by the political institutions (Acemoglu and Robinson 2012). Regulation can take many forms and the form of regulation policy adopted in developing countries has shifted over time (Minogue, 2005).

Few studies have been done around the world about the impact of regulatory quality on economic growth in which some of them are as follow;

Koeniger and Silberberger (2015) examined the relationship between trade and regulatory quality and economic growth for 106 countries. They find that, although trade is also significant, regulatory quality, has a bigger and highly significant, nonlinear, positive impact on economic growth. These results suggest that instead of pushing further trade liberalization, scarce resources of developing countries should be directed towards improving the regulatory framework. Lee et al (2021) in their study, investigated the relationship between financial systems, regulatory quality, and economic growth for nine selected African countries. This study shows that the quality of regulation plays an important role in the finance-growth nexus as it has a mediating effect on both the real and financial sectors. Ahmad et al (2012) investigate the inter-relationships among trade growth,

growth of institutional variables and GDP growth of Pakistan during (1984-2010). They find that there is a negative long-run relationship between real GDP and trade openness. Also the relationship between government stability (GOV_ST) and real GDP is found to be positive whereas the association between real GDP and corruption is found to be negative. Singh et al (2012) investigate the relationship between inclusive growth, institutions and the underground economy. This study analyzes the determinants of the underground economy, with particular emphasis on the role of institutions and the rule of law. They find that when businesses are faced with onerous regulation, inconsistent enforcement and corruption, they have an incentive to hide their activities in the underground economy. Empirical analysis suggests that institutions are a more important determinant of the size of the underground economy than tax rates.

Jalilian et al (2007) has tested the hypothesis that the efficiency and quality of regulation affects the economic performance of an economy. Two proxies for regulatory effectiveness were included separately and then combined as determinants of economic growth performance, using both cross- sectional and panel data methods. The results from both sets of modeling suggest a strong causal link between regulatory quality and economic growth and confirm that the standard of regulation matters for economic performance. Bagheri et al. (2020) investigated the effect of the regulatory quality indictor on the relationship between foreign direct investment and economic growth in four different country groups classified by income level. The panel smooth transition method over the period of 2002-2016 is applied. The result shows that there is a positive and significant relation between regulatory quality and economic growth. Mokhtarifar et al (1400) in a study conducted with a aim of investigating the role of Institutions Quality in Effect of Liquidity Growth on Economic Growth, showed that high institutional quality one of the indicators of which is regulatory quality, can have a positive effect on economic growth through

liquidity growth. Dar and Amirkhalkhali (2011) examine the impact of regulation on economic growth in the context of 23 OECD countries by applying a generalization of the growth accounting model popularized by Solow to data over the 2002-2008 period. They estimate the model using a fixed effects as well as a random effects estimation strategy. Their findings do lend support for the view that the better the quality of regulation, the higher rate of economic growth, but find no support for the view that the strength of the positive growth impact is stronger for countries that rank relatively lower on the regulatory quality scale. Zaei and Gudarzi Farahani (2013) investigate the long-run relationship between regulation and economic growth for a panel of ECO countries over the period 1990–2011 by employing the recently developed panel data unit root tests and the Pedroni panel data cointegration techniques. The results suggest a strong causal link between regulatory quality and economic performance.

By reviewing the literature of this study it was seen that the majority of the studies dealt with considering the relationship between institutional quality and economic growth and few studies considered the relationship between regulatory quality and economic growth. However most of the studies considered the quality of this relationship. From the quantity view, just linear relationship between variables was viewed, in which a constant coefficient was used to explain the effect of regulatory quality on economy growth during specific time. It was expected over the time in different levels of generally institutional quality and particularly regulatory quality the coefficients and the way it influence would change. So this study has taken a further step to solve the problem through panel smooth Transition Regression, as the most prominent model of regime-switching to consider the relationship between nonlinear and threshold between two variables. Also it is essential to point that in PSTR model due to adjustment parameter and threshold variable observations, over the time the estimated coefficient would change in different levels.

3. Theoretical Framework and the model

1.3 Growth Models

In fact, it should be said that the theory of growth goes back to David Hume, who belived in free trade with emphasis on the greater contribution of people, industrial producers and farmers.While Hume's main growth equation was capital formation and trade expansion, his student Adam Smith's growth eqution was based on the three factors of land, capital and work force.Later, in the book of principles of Economics, Marshall reviewed his growth model with emphasis on the determinants of income distribution and the variables of the savings rate and work force efficiency. Keynes, in response to the conditions of economic recession in 1929-1930 that engulfed the capitalist world, proposed his theory to transform economic stagnation into prosperity in 1936. He also stressed the need for government intervention in the economy, as did some of the new classics. From Keynes'point of view, what will happen to the economy in the long run as a result of applying this policy is not an important issue, he thinks about the economy that is being destroyed(Barro 2004). The theory of economic growth from the modern neoclassical point of view was proposed by solow in 1956. In this model, the relationship between saving, capital formation and economic growth is described based on the total production function. During the first half of the 20th century. Important assumptions of this approach are constant returns to scale and diminishing returns to investment, which imply that for a given rate of saving and population growth economies move toward their steady-state growth path. This can be extended to the differences in income levels between countries, to argue that in the long run income per capita levels will converge. A lack of empirical support for convergence and the presence of a large, unexplained ‘‘residual’’ factor in the function estimates have presented a major challenge to these models. The endogenous growth theory put forward by Romer (1986) and Lucas (1988) led to a renewed interest in economic growth analysis. An important advantage of endogenous over traditional growth models is that, through the

assumption of constant or increasing returns to a factor input, in particular human capital, it is possible to explain a lack of growth and income convergence between countries and to account more fully for the residual factor in Solow-type analyses (Jalilian et al. 2007). Neoclassical growth theory was not successful so that new growth models came out in the 1980s (Lucas, 1988; Becker et al., 1990; and Buchanan and Yoon, 1995). The new models suggest that the progress is the result of investing and preparing resources for research. The new growth models justify the fluctuations in growth rates across countries. The newly-minted growth models are not yet applied to empirical studies. Barro (1996) suggested that the early endogenous growth models are no different from the standard neoclassical growth models except that capital was extended to include human components. Institutions are of high importance because economic policies are made in institutional settings. Clague et al (1996) demonstrates that the quality of institutions mostly depend on the type of political regime. North (1990; 1991) argued that institutions can both hinder or increase the economic activity. Hall and Jones (1997) argued that poor institutions will have bad effect on the economic activity. According to Lane and Tornell (1996) most of rich countries in natural resources such as Nigeria, Trinidad and Venezula have poor economic activity because of not being able to regulate and define or protect the resources. In developing countries insecure property rights prevent them from having advanced technology.

2.3 Regulation Theory

Theory of economic regulation dates back to nineteenth century and there are a lot of articles about it (Laffont and Tirole, 1993, 2000; Levy and Spiller, 1994; Newbery, 1999). Economic regulation has been suggested on the existence of market failure that is the result of economies of scale and scope in production, information deficiencies in market transactions, the existence of incomplete markets and income and wealth distribution effects. Market failures are easy to notice and therefore public regulation is stronger

in developing countries (Stiglitz, 1998). More recent theoretical contributions to the regulation literature have provided a model of regulation for network industries that recognizes the particular structural and institutional characteristics of developing countries and have highlighted the role of effective regulation in achieving equitable and sustainable expansion of infrastructure services in the poorer countries of the world (Laffont, 1999a, 2005). Regulation of markets may not improve the social welfare as the economic outcome did under imperfect market conditions. Above all, information imbalance can add to imperfect regulation. The regulator and the regulated have different levels of information about costs, revenues and demand. It is likely that the regulator won't get all the information required to do the regulating to increase social welfare, regulation outcomes and prices will remain not as good as the best when the state both owns and regulates, more information is provided to the regulators. And contracting becomes less problematic. State ownership leads to a reductions in information imbalance, transaction costs of regulation and relative incentives to increase the economic efficiency (Jalilian et al., 2007). Welfare-improving regulation estimates that public interest has an impact on the regulatory authority's actions. Public choice theorists argue that the regulatory process should be analized between groups (Buchanan, 1972). This has been clarified as the concept of "regulatory capture", which has been affected by the particular interests of individuals or groups. In the worst case, the regulatory capture literature concludes that regulation always in unfavorable outcomes because of "inefficient bargaining between interest groups over potential utility rents" (Newbery, 1999; Laffont, 1999b). In the Chicago tradition of regulatory capture (Stigler, 1971; Peltzman, 1976) regulators have assumed that it is good to support producer interests because of the concentration of regulatory benefits and distribution of regulatory costs, which improves the power of lobbying groups as rent seekers (Reagan, 1987). Regulation is also affected by "political capture"; political capture can be a more serious threat than capture by producer groups. When the political

capture happens, the regulatory goals turn to be political purposes (Stiglitz, 1998). It is expected that both the process and outcomes of a regulatory regime will be recognized by the institutional context of an economy that it will be easy to notice in its formal and informal rules of economic transacting (North, 1990). Economic development is seen as a matter of "institution building" to reduce the information imperfections, maximize economic incentives and reduce transacting costs. This institution building includes the laws and political and social rules that are the basis for successful market production and exchange. "Institution building" is one of the most difficult problems for developing countries (Kirkpatrick and Parker, 2004).

3.3 Regulatory Quality and growth

The outcome of regulatory system can be judged on its effectiveness and efficiency. Effective regulation achieves the social welfare goals established by the government for the regulatory authority. In developing countries, the social welfare aims of regulation are involved with the pursuit of economic efficiency and goals to promote development and reduce poverty (Jalilian et al, 2007). Efficient regulation achieves the social welfare goals at minimum economic costs. The economic costs of regulation can take two vast forms: 1) the costs of directly administering the regulatory system, which are internalized within government and reflected in the budget appropriations of the regulatory bodies; and 2) the compliance costs of regulation, which are external to the regulatory agency and fall on consumers and producers in terms of the economic costs of conforming with the regulation and of avoiding and evading them (Guash and Hann, 1999) Regulatory quality can also be evaluated in terms of the criteria for good management. Parker (1999) argues that a well-functioning regulatory system is one that balances accountability, transparency and consistency. Accountability requires the regulatory system agencies to be responsible for the result of their actions, to work within their legal powers, and to observe the rules of the expected process when arriving at their decisions. Transparency relates to regulatory

decisions being reached in a way that is revealed to the interested parties. The third process which provides regulatory legitimacy (validity) is consistency. Inconsistent regulatory decision causes public to lose their trust in a regulatory system. Inconsistency leads to uncertainty for investors, which raises the cost of capital and may seriously damage the willingness to invest. Since political intervention tends to undermine regulatory consistency, and politicians may be prone to alter the regulatory rules of the game for short-term political advantage, consistency is a primary argument for some kind of "independent" regulator (Jalilian et al, 2007). This discussion suggests that the capacity of the state to provide strong regulatory institution will be an important determinant of how well markets perform. An economy with a developed institutional capacity is more likely to be able to design and implement effective regulation, which should contribute to improved economic growth. Weaknesses in institutional capacity to deliver "good" regulation may be predicted to affect adversely economic development (World Bank, 2002). The regulatory state model implies leaving production to the private sector where competitive markets work well and using government regulation where significant market failure exists (World Bank, 2001, p. 1). Arguably, however, the performance of the new regulatory state remains under researched, especially in the context of developing countries with their own peculiar economic and social problems and institutional characteristics. Building effective regulatory structures in developing countries is not simply an issue of the technical design of the regulatory instruments, it is also concerned with the quality of supporting regulatory institutions and capacity (World Bank, 2002, p. 152). Many of the institutions that support markets are publicly provided, and the effectiveness of these regulatory institutions will be an important determinant of how well markets function. The quality of regulatory governance will affect regulatory outcomes, which in turn can be expected to impact on economic growth (Jalilian et al., 2007).

3. PSTR Model

In this section, the panel smooth transition regression model (PSTR) is explaining and the estimates are presenting. Gonzalez et al (2005) are specified a PSTR model with two extreme regimes and one transition function following:

$$y_{it} = \mu_i + \beta'_0 x_{it} + \beta'_1 x_{it}(q_{it};\gamma,c) + u_{it} \qquad i = 1,\ldots,N, t = 1,\ldots,T \tag{1}$$

Where N and T denote the cross-section and time dimensions of the panel, respectively. The dependent variable y_{it} is a scalar x_{it} is a k-dimensional vector of time-varying exogenous variables μ_i represents the fixed individual effect, and u_{it} are the errors. Transition function $g(q_{it};\gamma,c)$ is a continuous function of the observable variable q_{it} and is normalized to be bounded between 0 and 1, and these extreme values are associated with regression coefficients β_0 and $\beta_0+\beta_1$.

We follow Gonzalez et al (2005) by using the logistic specification

$$g(q_{it};\gamma,c) = \left[1+\exp\left(-\gamma\prod_{j=1}^{m}(q_{it}-c_j)\right)\right]^{-1} \qquad \gamma>0, c_1 \le c_2 \le,\ldots,\le c_m \tag{2}$$

Where $c = (c,..,_1 c_m)'$ is an m-dimensional vector of location parameters and the slope parameter γ determines the smoothness of the transitions. The restrictions $\gamma > 0$ and $C_1 \le C_2 \le,\ldots,\le C_m$ are imposed for identification purposes. A generalization of the PSTR model to allow for more than two different regimes is the additive model

$$y_{it} = \mu_i + \beta'_0 x_{it} \sum_{j=1}^{r} [\beta'_j x_{it}] q_j(q^j_{it};\gamma_j,c_j) + u_{it} \tag{3}$$

Where the transition functions $g_j(q^j_{it};\gamma^j,c_j)$, j = 1, . . . , r, are of the logistic type (2). If m = 1, $q^j_{it} = q_{it}$ and $\gamma_i \to \infty$ for all j = 1, . . . , r, the model in (3) becomes a PTR model with r + 1 regimes.

Gonzalez et al (2005) suggest in practice it is usually sufficient to consider m = 1 or m = 2, as these values allow for commonly encountered

types of variation in the parameters. For m = 1, the model implies that the two extreme regimes are associated with low and high values of q_{it} with a single monotonic transition of the coefficients from β_0 to $\beta_0 + \beta_1$ as qit increases, where the change is centred around c_1.When $\gamma \rightarrow \infty$, $g(q_{it}; \gamma, c)$ becomes an indicator function $I[q_{it} > c_1]$, defined as I[A] = 1 when the event A occurs and 0 otherwise. In that case the PSTR model in (1) reduces to the two-regime panel threshold model of Hansen (1999). For m = 2, the transition function has its minimum at $(c_1 + c_2)/2$ and attains the value 1 both at low and high values of qit. When $\gamma \rightarrow \infty$, the model becomes a three-regime threshold model whose outer regimes are identical and different from the middle regime. In general, when m > 1 and $\gamma \rightarrow \infty$, the number of distinct regimes remains two, with the transition function switching back and forth between zero and one at $c_1, \ldots, c_m$. Finally, for any value of m the transition function (2) becomes constant when $\gamma \rightarrow 0$, in which case the model collapses into a homogenous or linear panel regression model with fixed effects.

Estimating the parameters in the PSTR model (1) is a relatively straightforward application of the fixed effects estimator and nonlinear least squares (NLS) that this estimation procedure is equivalent to maximum likelihood (ML) and first is eliminated the individual effects by removing individual-specific means and then is applyed NLS to the transformed data (Gonzalez et al, 2005). But according to studies by Fok et al (2004), Gonzalez et al (2005) and Colletaz and Hurlin (2006) in estimation PSTR model, first testing linearity against the PSTR done and while the null hypothesis is rejected, must specify the number of transition functions to nonlinear behavior between selected variables. For this purpose, the null hypothesis of the existence of one transition function is tested against the hypothesis that there are at least two transition functions. If the null hypothesis is not rejected, including one transition function will suffice to examine the nonlinear relationships among variables. However, if the null hypothesis is rejected, there will be at least two transition function of the PSTR model and in continuing should be tested the null hypothesis of the

existence of two transition functions that there are at least three transition functions. This process should continue until the null hypothesis is accepted.

Testing the linearity can be done by testing H0: γ=0 or H0: β1=0. But in both cases, the test will be non standard since under H0 the PSTR model contains unidentified nuisance parameters as it was the case in the Hansen s PTR model. This issue is well known in the literature devoted to the time series threshold models (Hansen, 1996). However, in the context of the PSTR model, Gonzalez, Teräsvirta and Van Dijk (2005) present an original solution similar to the solution proposed by Luukkonen, Saikkonen and Teräsvirta (1988) for time series models. It consists to replace the transition function gj(qit ; γ, cj) by its first-order Taylor expansion around γ=0. After reparameterization, this leads to the auxiliary regression

$$y_{it} = \mu_i + \beta'^{*}_{0} x_{it} + \beta'^{*}_{1} x_{it} q_{it} + \ldots + \beta'^{*}_{m} x_{it} q^{m}_{it} + u^{*}_{it} \quad (4)$$

Under the equation (4) null linearity hypothesis becomes to $H^{*}0$: $\beta^{*}_{1} = \ldots = \beta^{*}_{m} = 0$ that rejection of the null hypothesis means that the relationship is non-linear and its non rejection suggests the linear model specification. To test this hypothesis according to study of Colletaz and Hurlin (2006) use from three statistics LM_w ,LM_F and LR that are calculated by the following equations:

$$LMw = \frac{TN(SSR0-SSR1)}{SSR0} \quad (5)$$

$$LMF = \frac{(SSR0-SSR1)/km}{[\frac{SSR0}{TN-N-mk}]} \quad (6)$$

$$LR=-2[log(SSR1)- log(SSR0)] \quad (7)$$

In the above equations SSR_0, is the linear panel sum of squared residuals SSR_1 and is the sum of squared residuals of the nonlinear PSTR model. Also *T*, *N*, *K* and *m* denote time period, cross-section number, explanatory variables number and location parameters number respectively. In Testing

the hypothesis of no remaining heterogeneity, Choose a first-order Taylor approximation and it leads to the auxiliary regression.

$$yit=\mu i+ \beta*0\ xit +\beta 1 xitg(qit1;\ \hat{Y},\hat{c})+ \beta*21\ xit\ qi\ (2)+.....+ \beta*2M\ xit\ qit\ (2)m+ \mu*it \quad (8)$$

Where $\hat{Y}_1$and $\hat{c}_1$are estimates under the null hypothesis. The hypothesis of no remaining heterogeneity can then be restated as $H*0 : \beta*_{21} = . . . = \beta*_{2m} = 0$.

Data and PSTR Results

This study investigates the threshold effects of Regulatory Quality on Economic Growth in D-8 Countries including, Iran, Indonesia, Bangladesh, Pakistan, Turkey, Malaysia, Egypt and Nigeria for the period of 1996-2019, using Panel Smooth Transition Regression (PSTR) model. The data used in this study were collected from the WDI website. Also, the regulatory quality dimension of institutional quality provided in the World Bank's Worldwide Governance Indicators (WGI) serves as our measure of quality of regulations (RQ). Variables used in this study are selected according to Chiang et al (2022) and in a general case of PSTR model that provided in equation (3), can be specified as follows1:

$$dly_{it} = \mu i + \alpha 0\ fd_{it} + \beta 0\ ex_{it} + \theta 0\ inf_{it} + \delta 0\ gcf_{it} + \alpha 1\ fd_{it} + \beta 1\ ex_{it} + \theta 1\ inf_{it} + \delta 1 gcf_{it}]\ g(qit\ ;\ \gamma,c) + \varepsilon it \quad (9)$$

where *dly, fd, ex, inf, gcf* are the growth rate of real per capita GDP, financial development(Private credit by deposit money banks to GDP), Agricultural raw materials exports (% of merchandise exports , inflation rate and gross capital formation. The transition function g(qit ; γ,c) is continuous in the observable transition variable.The variables added to the model follow the growth empirics literature, such as jalilian et al (2015), Ibarra (2015) and Lee et al(2020).

Before the estimating of PSTR model, it is necessary stationary testing be performed on variables. In this study, Levin, Lin and Cho (1993) unit root

test is used. The results of this test, as table (1) shows,indicate that all the variables are stationary in the studied period.

Table 1. LLC Test for Unit Root

		variables					
		gdp	**rq**	**fd**	**ex**	**inf**	**gcf**
LLC test	**T- statistic**	-4.021	-0.766	-2.273	-4.963	-4.796	-11.624
	prob	0.000	0.022	0.011	0.000	0.000	0.000

Source: research findings

As was discussed in the previous section, first linearity hypothesis have been tested against hypothesis of the existence of PSTR model with consideration of regulatory quality index as a transition variable. According to the results in Table (2), all statistics for one threshold values reject linearity hypothesis and show nonlinear relationship between variables. After ensuring the nonlinear relationship between variables, to determine the number of transition function, next step is that to be investigated the hypothesis of no remaining heterogeneity. According to the results in Table (2), only existence of one transition function will suffice to explanation the nonlinear relationship between regulatory quality and economic growth.

Table 2. Tests for Linearity and No Remaining Nonlinearity

	M=1			**M=2**		
	LM_W	**LM_F**	**LR**	**LM_W**	**LM_F**	**LR**
H_0: r=0	9.006	2.212	9.224	31.823	4.371	34.793
H_1: r=1	(0.061)	(0.069)	(0.000)	(0.000)	(0.000)	(0.000)
H_0: r=1	4.361	0.999	4.412	4.849	1.381	12.231
H_1: r=2	(0.359)	(0.409)	(0.353)	(0.158)	(0.208)	(0.141)

Notes: *m* is the number of location parameters and *r* is the number of transition functions. The corresponding *p*-values are reported in brackets.
Source: research findings

After were rejected the linear relationship among the variables under consideration and was selected one transition function, then the number of location parameters should be selected for the final model. For this purpose and

to follow Colletaz and Hurlin (2006) and Jude (2010), two PSTR models is estimated with one and two threshold values and the sum of squared residuals, Akaike information criterion and Schwars is calculated for each of them.

In Table 3 the mentioned criteria for both PSTR, models were presented. Even though there is some difference in the calculated results of criteria, all three of them suggest a better model in terms of a threshold value. Thus, a PSTR model with one transition function and one threshold value is selected to investigate the nonlinear behavior of the studied variables.

Table 3. Determination of the Number of Location Parameters

	RSS	**Schwarz Criterion**	**AIC Criterion**
M=1	1.647	2.3129	2.4826
M=2	1.664	2.3295	2.5256

Source: research findings

After PSTR model with one transition function and one threshold value was selected that meaning a two-regime model, the model is estimated in the following that its results are given in Table (4).

Table 4. Parameter's Estimates for Final PSTR Models

Fd	***coefficients***	**Ex**	***coefficients***	**Inf *coefficients***		**Gcf *coefficients***	
$\alpha 0$	0.0725	$\beta 0$	0.6747	$\theta 0$	-0.1749	$\delta 0$	0.1410
	(1.9349)		(2.6064)		(-2.9245)		(2.1766)
$\alpha 1$	-0.1701	$\beta 1$	0.7205	$\theta 1$	0.1297	$\delta 1$	0.2667
	(-3.3697)		(-2.5442)		(2.0043)		(3.4648)
1^{st} regime: $G(q_{it} ; \gamma,c)=0$ $dly_{it} = \mu_i + 0.0725\ Fd_{it} + 0.6747\ Ex_{it} - 0.1749\ Inf_{it} + 0.1410\ Gcf_{it}$							
2^{nd} regime: $G(q_{it} ; \gamma,c)=1$ $dly_{it} = \mu_i - 0.1701 Fd_{it} + 0.7205 Ex_{it} + 0.1297 Inf_{it} + 0.2667 Gcf_{it}$							
		γ=	5.4669	c=-0.7464			

Notes: The values in brackets are the T-statistic. γ and c are the Slope and Location Parameters respectively.

Source: research findings

Table 4 shows the estimated results and based on slope parameter which represents the adjustment speed from one regime to other, is the same as the adjustment speed of 5.4669. The location of regime modification has been estimated -0.7464, so if the index of regulatory quality exceeds the - 0.7464, the behavior of variables will be as a second regime and if it be lower the above mentioned threshold it will be as first regime. Since the variables coefficients modifies based on transition variable and slope parameter and through the time is not equal for different countries, it is not impossible to directly interpret the coefficients score and just the signs should be analyzed.

Clearly this result indicates the asymmetric relationship of regulatory quality index and economic growth in different levels of regulatory quality. Inflation variables have negative impact in first regime and positive impact on second regime on economic growth. Financial development variable has positive impact in first regime and negative impact in second regime on economic growth. The gross capital formation variable in both regimes has a positive impact on economic growth, which indicates that gross capital formation acts as an encouragement of economic growth in D-8 countries, and agricultural raw materials export index has a positive impact on economic growth in first regime and have negative impact in seconed regime.

As it was discussed before, two considered cases were part of extreme regimes and act between two regimes, so the numerical value of the variables coefficients in extreme states cannot be interpreted; To explain the matter it's better to note that the variables coefficients are not equal and based on transition variable and the slope parameter they are changed. To achieve this feature of PSTR model, the estimated coefficients in each variable based on transition variable and the slope parameter were calculated and drawn in diagrams 1 to 4.

Diagram 1 shows that in low levels of the regulatory quality financial development has positive impact on economy growth which changes into negative impact after passing the threshold. So it can be said that the improvement of the regulatory quality in D-8 countries is not provided for

the private sectors by the increased funding, and a remarkable increase of investment efficiency is not accompanied by economic growth. However as it is seen a large amount of coefficients are positive. Also, it can be stated that the way financial markets are liberalized, the weakness of the financial system and the lack of formation of a coherent fanincial system benefiting from regulation, especially in the studied countries that have severe structural weakness, lead to the decrease in investment through non-optimal allocation. Resources and thus has a negative impact on economic growth. In the study conducted by lee et al. (2015), the mediating effect of supervisory quality on both real and financial sectors of the economy is emphasized. They also argued that the quality of regulation plays an important role in the finance-growth nexus.

The way raw materials export affect GDP growth has been shown in diagram 2. According to this diagram the influence coefficient of this variable is posetive in the first regime and negative in the second regime. In this case, it can be stated that excessive reliance on the export of agricultural raw materials and the strong presence of public sectors in the production of goods and services are among the factors that have negative effects on economic growth. With increasing regulatory quality, competitive power increases and the market tends toward industrialization in this regard, reducing the country's dependence on exporting agricultural products in favor of exporting industrial products and subsequently increasing economic growth. In other words, with the increase in regulatory quality and structural change in these countries, it is expected that the export of agricultural raw materials will shift towards value-added products, and the share of raw materials in exports will decrease as well as its impact on economic growth (Faridi, 2012).

The way inflation affects on GDP growth in diagram 3 shows that the inflation has negative impact in first regime and in seconed regime has positive impact on economic growth. Inflation is considered as one of the

main drivers of economic growth in the economic literature, which contributes to economic growth through capital accoumulation. In an economic system where the regulatory quality index is at a low level, rising inflation causes the allocation of resource inefficiency, which reduces economic growth. But in the event of an increase in regulatory quality in the country, financial markets will be more efficient and producers will have to produce more to fill the supply and demand gap.

Finally diagram 4 deals on the positive influence of gross capital formation index on economic growth in D-8 countries and after going over threshold and entering to second regime the amount of influence increase. Capital formation is considered as a prime determinant of economic development in any economy. Increasing capital formation increases production. High regulatory quality index is one of the factors affecting investors' decisions. Government should give priority to enhance economic activities in the economy by investing more on productive sectors of the economy. Such investments will generate more income, there by savings and capital formation will be promoted. The government should create a conducive environment for enhancing savings and Investments in the economy which contribute for sustained economic growth. It can also be stated capital formation helps in making a country self-sufficient and reduces the burden of foreign debts. When a country borrows from a foreign country for long periods, it imposes a heavy burden on the future generations. With every loan, the debt charges increases day by day which can only be rapidly reduced by levying more or/and higher taxes. Thus the burden of taxes increases and money flow out of the economy in the form of debt repayments. This implies that, only capital formation brings freedom from foreign aids, reduces the burden of foreign debt and makes the country self-sufficient. The result are consistent with many studies including Reddy et al. (2020).

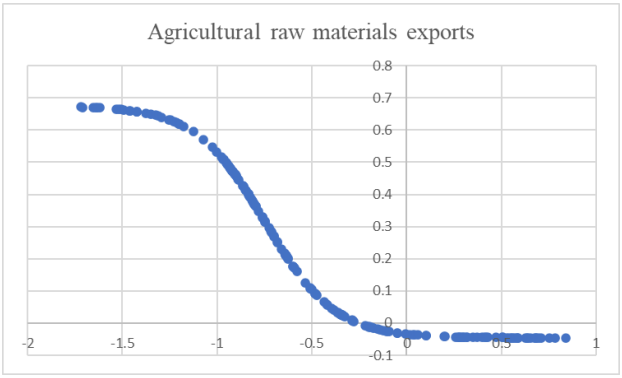

Fig 1

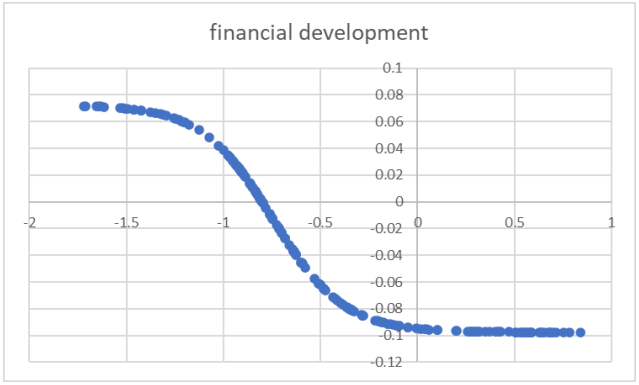

Fig 2

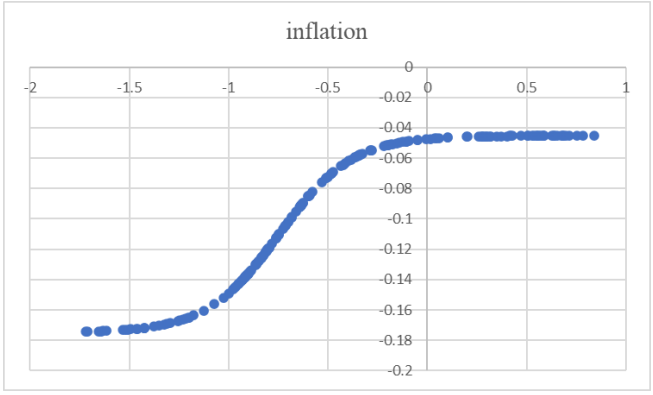

Fig 3

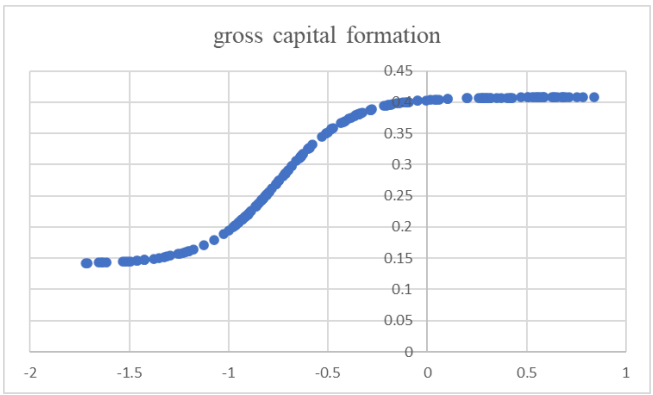

Fig 4

Source: research findings

4. Conclusions

The present study has considered the threshold effects of regularity quality on economic growth in 8 big Islamic countries. To do this work, the Panel Smooth Transition Regression (PSTR) was used which developed by Fok et al (2004), Gonzalez et al (2005), Colletaz and Hurlin (2006). PSTR model as an outstanding regime-switching model not only does not impose any limiting and specific function on the relationship of variables but also the probable nonlinear relationship between variables are continuously modeled through transition function based on threshold variable observations. Also in this model heterogeneous of estimated parameters with coefficients modifications for different countries are solved through time. The estimated results confirm the nonlinear relationship of variables between regulatory quality and economic growth and it is sufficient to consider a transition function with a threshold for accelerating nonlinear behavior. The estimated results of PSTR model show that when the regulatory quality index exceeds the -0.746, the regime changes will occur. The slope parameter which represents the adjustment speed from one regime to another is estimated 5.46.

The estimated coefficients results of variables considered in the model show that the financial development variable has a positive effect in the first regime and a negative in the second regime on economic growth. The inflation tare variables. Although gross capital formation variable in both regimes has a positive impact on economic growth. And agricultural raw materials exports variables have a posistive effect in the first regime and a negative impact in the second regime on economic growth.

Generally, according to the results of PSTR model for D-8 countries it can be concluded that;

1. Since the regulatory quality index in higher levels has a positive impact on economic growth, to achieve a stable economic growth the economic planners and policy makers should pay much attention to creating efficient institutions with transparent regulations.
2. In these countries there are weak financial markets which are unable to allocate the financial resources efficiently in line with investment. So it needs macroeconomic policy makers to pay attention to creating financially comprehensive markets with efficient regulations in line with allocating efficient financial resources.
3. proper support and guidance of the government by regulatory and sovereign laws is necessary to create the necessary dynamics in the production structure of countries.in this regard, it is suggested to pay attention to the creation of converting and processed industries instead of exporting agricultural raw materials and prioritizing investment in production and export of these industries.
4. considering the role of good governance and high regulatory quality in in providing the necessary infrastructure and institutions and a safe and stable environment for investment, it is recommended that governments have a serious focus on optimal allocation of resources in order to increase people’s confidence and motivate investors to promote economic growth.

Funding

This study received no financial support from any organization.

Authors' contributions

All authors had contribution in preparing this paper.

Conflicts of interest

The authors declare no conflict of interest.

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