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Original Research Article

Institutions and Economic Growth: A Panel Granger Causality Analysis

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Abstract: This paper revisits the direction of causality between institutions and economic growth for a sample of 119 countries over the period 1999-2018, divided into four groups according to income level: high income, upper middle income, lower middle income and low income. The study uses two institutional datasets, the International Country Risk Guide (ICRG) for the main estimation and the World Governance Indicators (WGI) for check the robustness of the results. Using the non-causality Granger test in a heterogeneous panel model with fixed coefficients, developed by Dumitrescu and Hurlin (2012), the empirical results show a unidirectional relationship for all panels except for lower middle-income countries, where causality is bidirectional. The findings also suggest that causality patterns are heterogeneous and depend on the level of development of the countries. Based on these results, we propose some interesting recommendations. The types of reforms to prioritize must be determined according to the direction of causality between institutions and economic growth. Moreover, heterogeneous causality implies the implementation of different policies adapted to the level of development of each panel, rather than considering a common policy.

Keywords: Institutions, economic growth, panel data, Granger causality, Dumitrescu and Hurlin (2012).

INTRODUCTION

There is large literature on institutions and economic growth. It confirms that institutions are an important determinant of economic growth (North, 1990; Knack and Keffer, 1995; Hall and Jones, 1999; Acemoglu, Jhonson and Robinson, 2001; Dollar and kraay, 2002; Rodrick, 2003). Nevertheless, most studies examine the impact of institutions on economic growth. However, it is also important to check whether economic growth has an impact on institutions. This second track; less dominant; has not been the subject of much research. Indeed, among the few papers that have studied the impact of economic growth on institutions, we note (Lipset, 1960; Barro, 1996; Glaeser *et al*., 2004; ...etc). They find that as societies become richer, the demand for better institutions increases. They show that economic growth has a positive impact on institutions through the accumulation of human and social capital. For these authors, institutions are not the ultimate determinant of economic growth, as they act as a secondary factor. The first order effect comes from human and social capital, which affects both productivity and institutions.

Do institutions cause economic growth or does economic growth cause institutions? The cited above literature does not allow us to decide on these

questions, as the regressions do not say anything about the direction of causality. In order to answer this question, we take stock of the work that has empirically investigated Granger's causal relationships bringing greater precision to the outcome of these links. Some postulate that there is a causal link in both directions (bidirectional causality). Institutions affect economic growth and economic growth in turns contribute to improve institutions. Others argue that causality operates in only one direction (unidirectional causality). These studies show that patterns of causality vary from country to country, depending on the level of development under consideration.

The purpose of this paper is to re-examine the direction of causality between institutions and economic growth. The study covers the period from 1999 to 2018, and includes 119 countries organized into four samples classified by income level: high income (44), upper middle income (32), lower middle income (30) and low-income (13). There are two main reasons for choosing to analyze the causality between institutions and economic growth using panel data (Hurlin, 2005). First, economically, this issue like other major issues does not have a specific national dimension. Consequently, its extension to an international context has the advantage of strengthening the robustness of the results. Second, from a statistical point of view, the use of panel data allows for the expansion of information, which helps to improve test statistics. However, there is the problem of heterogeneity of the causal relationship. To overcome this difficulty, we use the Granger test of non-causality in heterogeneous panel model with fixed coefficients, developed by Dumitrescu and Hurlin (2012). The test accounts for heterogeneity in both the causal relationship and the regression model used. In addition, it has very good statistical properties and is suitable for unbalanced panels. The study contributes to the literature with several added values:

- It is a part of rare literature that deals with Granger causality (causality is studied in both directions);
- It is based on cylindrical panels, which increases the statistical efficiency of the result obtained, unlike papers that force cylindrical data, a necessary condition for the Granger causality test;
- It refers to a good estimation approach to the problem of heterogeneity in panel data (Dumitrescu and Hurlin, 2012), which is robust even for small samples (T and N small);
- Two databases are used to represent the institutions: the ICRG produced by the PRS Group (Howel, 2011) and the World Governance Indicators (WGI) provided by (kaufman *et al*., 2010);
- Finally dividing countries into panels classified by income level allows us to highlight the different causality patterns that exist, whose interpretation is crucial for policy-making.

The results indicate the presence of unidirectional causality for all panels, except for the lower middle-income panel, where the relationship is bidirectional. However, the patterns of causality are different and depend on the panel considered. The paper is structured as follows: introduction, literature review, methodology and data, empirical results and conclusions.

MATERIALS AND METHODS

Literature Review

We focus on empirical papers that have dealt with Granger causality between institutions and economic growth. As already mentioned, the topic has gained much more ground in panel data than in time series. Obviously, this is due to the unavailability of sufficiently long time series on institutions and the nature of the problematic. In addition, although the present studies use different econometric approaches, they represent an extension of the Granger causality test (Granger, 1969). The results are mixed and comparisons are difficult due to the number of parameters involved.

Moreover, looking at a single panel of countries - regardless of differences in income / development levels – give different results in terms of causality patterns than grouping them into sub-panels classified bye income/ development levels.

Chong and Calderon (2000) find that causality is unidirectional (from growth to institutions) for the full sample –developed and developing countries- while it becomes bidirectional when the panel is reduced to developing countries only, with exception of the « contract enforcement » variable, whose causality from institutions to economic growth is not significant. Subsequently, the authors changed the institutional measurement database. Also, they expanded the panel of developing countries while keeping the panel of developed countries constant. The findings are consistent for the full sample, but there is a considerable divergence between the two estimates for the panel of developing countries. This show how sensitive the causal relationships are to changes in the panel and suggests the need to another, more rigorous classification of countries-other than that based on level of development – in order to obtain more precise results.

Law *et al*., (2013) classified countries into four sub-panels: high income, upper middle-income, lower middle income and low income. They highlight the existence of a bidirectional relationship for the full panel, while it becomes unidirectional for the four groups. Furthermore, the direction of causality is different. In high-income and upper middle-income countries, institutions cause economic growth. In contrast, in low-income countries and middle-income countries, economic growth causes institutions.

Soyigit (2019) examined the causal relationship between structural change and institutions for two panels: the E-7 group of developing countries and the G-7 group of developed countries. The results show that causal relationship is not always bidirectional and sometimes event absent. Overall, however economic performance in the E-7 countries seems to be more influenced by institutional factors than in the G-7 countries. The author concluded that developing countries need to pay special attention to institutions in order to improve their economic performance.

Gui-diby and Mosle (2017) extended the causality study to the relationship between institutions and economic and social development for 160 countries (classified by income level and UN ranking). Causality is bidirectional for all development indicators except GDP for capita and FDI, for which it is mainly unidirectional. By retaining only the causality between institutions and GDP, this study is consistent with Law *et al*., (2013) in terms of causality which is unidirectional for sub-panels.

Aixala and Fabro (2008) expanded the analysis of the causality between institutions and economic growth by examining the relationship with investment in physical and human capital. They argue that institutions have an indirect effect on economic growth through the channel of investment in physical and human capital. Institutions are represented by three dimensions and estimated individually: economic freedom, civil liberties, and political rights. They find bidirectional relationship between civil liberties/ economic freedom and economic growth, and unidirectional causality from political rights to economic growth. Investment in physical capital is determined by economic freedom, but the causality is not significant for the other institutional variables. With regard to investment in human capital, causality is bidirectional for all institutions. The authors show that political freedom has positive effect on physical capital, through the following vicious cycle: political freedom – human capital – economic freedom – physical capital. The present paper is interesting, but it concerns a single panel grouping countries with different incomes. This brings into play the results obtained, which may be different if we consider countries classified bye income level in several panels.

In addition, we can cite two other papers that have chosen to study this causality for a single country. The first is that of Azimi and Shafiq (2020), in which the authors have specified their analysis to the case of Afghanistan. They find the existence of bidirectional causality, with the exception of the "voice and responsibility" indicator which the causality is unidirectional from economic growth to this variable. For his part, Wislon (2016) examined the causality between governance and economic growth in China at the provincial level. The results show that economic growth has a significant effect on governance, while governance is not a key determinant of economic growth. This finding are consistent with the idea that when there are many economic inefficiencies, as in the case of China, other factors can boost economic growth even in the absence of good institutions. On the other hand, the positive impact of economic growth on governance means that the reforms introduced to boost economic growth have led to improvements in governance. The author agrees with the findings of Lipset (1960); Barro (1996); Glaeser *et al*., (2004) …etc., that institutions have a secondary effect on economic growth.

Others papers have assessed the causality between institutional components (Aixala and Fabro, 2008; Soyigit, 2019; Azimi and Shafiq, 2020). The conclusions are of great interest for guiding the decisions of economic policy makers. Thus, the existence of a causal relationship between two institutional variables means that if a shock occurs in one of countries in the panel within the framework of this relationship, it would also affect the other countries in the panel. Conversely, the absence of a causal relationship between two institutional variables means that if a shock occurs in one country, it will not affect the others. Similarly comparisons between panels are interesting. Soyigit (2019) found that the interactions between institutional variables are more intense in developing countries than in developing countries need to put more effort into institutional reform than developed countries.

We can see that these empirical findings have more differences than similarities. As a result, caution should be exercised when comparing study results, as they highly sensitive to the choice of institutional measures (synthetic / individual indicator; sub-indicator), the database used to measure institutions, the study period, the countries comprising the panel and the sample size. However, the conclusions are still very interesting in terms of economic policy decisions, as policymakers are led to

implement policies by groups of countries rather than a common policy.

Methods

Empirical Model

Dumitrescu and Hurlin (2012) propose a non-causality Granger test in a heterogeneous panel model with fixed coefficients. The main advantage of this test is that it allows us to take into account the heterogeneity – by including fixed coefficients – that exists both in the causal relationship from X to Y and in the regression model used. It also has very good properties compared to time series tests, even when N and T are small. This is an advantage when analyzing small samples. Finally, it adapts to the case of unbalanced panels and/or different orders of delay in the autoregressive process.

X and Y are two stationary variables observed for N individuals on T periods. For each individual $i = 1,..,N$, at time $t = 1,..,T$, Dumitrescu and Hurlin (2012) consider the following linear model:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \varepsilon_{i,t}$$

With $K \in N^*$ and $\beta_i = (\beta_i^{(1)}, \dots\dots, \beta_i^{(k)})$. For simplicity, the individual effects α_i are supposed to be fixed in time dimension. Initial conditions $(y_i, -k, \dots\dots, y_{i,0}) and\ (x_i, -k, \dots\dots, x_{i,0})$ of both individual processes $y_{i,t}$ et $x_{i,t}$ are given and observable. The lag orders K are assumed identical for all cross-section units and the panel is balanced. Autoregressive parameters $\gamma_i^{(k)}$ and the regression coefficients slopes $\beta_i^{(k)}$ differ across groups. The model is a fixed coefficients model with fixed individual effects. For each panel unit, the individual residuals $\varepsilon_{i,t}$ are independently and normally distributed.

Given the problem of heterogeneity – due to the presence of individual effects α_i and parameters β_i – the authors propose to test two hypotheses:

- The null hypothesis of homogenous non causality (HNC): it implies that there is no causal relationship from X to Y.
  $H_0: \beta_i = 0\ \forall\ i = 1,..N$. With $\beta_i = (\beta_i^{(1)}, \dots, \beta_i^{(k)})'$.

Some individual vectors β_i may be equal to zero (non causality assumption) and may differ from group to another (model heterogeneity).

- The alternative hypothesis: this means that there is a subgroup for which there is no Granger causal relationship and another subgroup for which there is a Granger causal relationship.

They assume that there are $N_1 < N$ individual non causal processes from X to Y. The alternative hypothesis can be written as follows:

$$H_1 : \beta_i = 0\ \forall\ i = 1,..N_1$$
$$: \beta_i \neq 0\ \forall\ i = N_1 + 1, N_1 + 2, .., N$$

With N_1 is unknown and satisfies the condition $0 \leq {}^{N}/_{N_1} < 1$. The ratio ${}^{N}/_{N_1}$ is necessary less than 1. If $N_1 = N$, there is no causality for any of the individuals in the panel. This is the HNC null hypothesis. If $N_1 = 0$, there is causality for all individuals.

The test is conducted by calculating the mean statistic $W_{N,T}^{HNC}$ associated with the null hypothesis homogenous non causality (HNC), defined as follows:

$$W_{N,T}^{HNC} = \frac{1}{N} \sum_{i=1}^{N} W_{i,T}$$

With $W_{i,T}$ is the individual Wald statistic associated with the individual test $H_0: \beta_i = 0$

The next step is to determine the distribution of the mean statistic under the null hypothesis of homogenous non causality. We distinguish two cases: the asymptotic case when T and N tend to infinity, and the semi-asymptotic case when T is fixed and N tends to infinity.

In the asymptotic case, the distribution of the mean Wald statistic is deduced from the Lindberg-Levy central limit theorem:

$$Z_{N,T}^{HNC} = \sqrt{\frac{N}{2K}} \left(W_{N,T}^{HNC} - K\right) \xrightarrow[T,N \to \infty]{d} N(0,1)$$

In the semi-asymptotic case, it is derived from Lyapunov's central limit theorem:

$$Z_N^{HNC} = \frac{\sqrt{N}\left[W_{N,T}^{HNC} - N^{-1} \sum_{i=1}^{N} E(W_{i,T})\right]}{\sqrt{N^{-1} \sum_{i=1}^{N} Var\ (W_{i,T})}} \xrightarrow[N \to \infty]{d} N\ (0,1)$$

In both situations, the decision rule is as follows: if the realization of the normalized statistic $Z_{N,T}^{HNC}$/ Z_{N}^{HNC} is greater than the corresponding normal critical value, we reject the null hypothesis.

Moreover, if H_0 is accepted, the variable X does not cause Y in the Granger sense for all individuals in the panels. If H_0 is rejected and $N_1 = 0$, causal relationships are observed for all individuals in the panel, but the regression model may not be homogeneous, i.e. parameters estimators differ between groups. If H_0 is rejected and $N_1 > 0$, the regression model and causal relationship are different from one individual to another.

Data

The data are annual and cover a panel of 119 countries classified into four groups (World Bank ranking): high income (44), upper middle income (32), lower middle income (30), and low income (13). We follow the lessons of the literature review that causality patterns differ according to the level of development of countries (Chong and Calderon, 2000; Law *et al*., 2013; Gui-diby and Mosle, 2017…etc.). All samples are cylindrical and range from 1999-2018.

Economic growth is represented by real GDP per capita (US$ 2015 constant price), obtained from the World Bank's (https://databank.worldbank.org/source/world-development-indicators). In the main estimation, the quality of institutions is measured by the ICRG (International Country Risk Guide) database (https://www.prsgroup.com/explore-our-products/cdo/) produced by the PRS (Political Risk Service) group, and then by the World Governance Indicators (WGI) provided by (Kaufman *et al*., 2010) to ensure the robustness of the model. These two institutional bases are widely used in the literature. All variables are in natural logarithmic form.

The ICRG model consists of three families of indicators: political risk which assesses a country's political stability; economic risk which evaluates its current economic strengths and weaknesses, and financial risk which reflects a country's ability to pay its debts. The result is total of 22 variables, 12 of which relate to political risk and remaining 10 to economic and financial risk. The papers that focus on analyzing the quality of institutions refer to political risk. Thus, it includes 12 components: government stability, socioeconomic conditions, investment profile, internal conflicts, corruption, military in politics, religious tensions, law and order, ethical tensions, democratic accountability, bureaucratic quality (Howel, 2011). In addition, for the World Governance Indicators (WGI), there are six: voice and accountability, political stability and absence of violence/ terrorism, efficiency of public authorities, quality of regulation, rule of law, control of corruption (Kaufman *et al*., 2010). Thus, for lack of data (to have a cylindrical sample), we are forced to start the analysis from 2002 to 2018.

For the purposes of this article, we have chosen a synthetic indicator with five components (an arithmetic mean): law and order, corruption, investment profile, bureaucratic quality and government quality. Indeed, after an exhaustive review of empirical work, it seems that these institutional components are the ones that have most interested researchers (Cf. literature review). To compare the results of the main estimation, we consider a synthetic WGI indicator composed of four variables (an arithmetic mean): from database of (Kaufman *et al*., 2010). Three indicators are equivalent to law and order, corruption and bureaucratic quality variables in the previous database: rule of law, control of corruption and government effectiveness. We ignore the equivalent of the investment profile and government stability, as their exact counterparts do not exist in the WGI database, and added the regulatory quality variable.

The following table summarizes the descriptive statistics on GDP per capita and institutional quality (ICRG) for all panels.

Table 1: Summary of descriptive statistics

	Overall sample	**High income**	**Upper middle income**	**Lower middle income**	**Low income**
lnGDP					
Mean	8.7656	10.2884	8.6647	7.6173	6.5427
Std.Dev.	1.4374	0.5982	0.5143	0.5682	0.6098
Maximum	11.6299	11.6299	10.2352	9.1176	7.9092
Minimum	5.5383	8.7243	7.0986	5.7364	5.5383
Observations	2380	880	640	570	260
lnICRG					
Mean	3.0235	3.4258	3.0709	3.0536	1.4643
Std.Dev.	0.5886	0.1176	0.1443	0.1660	0.1487
Maximum	3.6452	3.6452	3.4204	3.3672	1.7917
Minimum	0.9808	3.0325	2.6360	2.2900	0.9808
Observations	2380	880	640	570	260

Source: Results obtained from Stata estimation. List of countries:

High income: Australia, Austria, Bahamas, Bahrain, Belgium, Brunei, Canada, Chile, Croatia, Cyprus, Estonia, Denmark, Finland, France, Germany, Greece, Hong Kong, Hungary, Iceland, Ireland, Italy, Israel, Japan, Kuwait, Latvia, Lithuania, Luxembourg, Netherlands, New Zealand, Norway, Oman, Poland, Portugal, Saudi Arabia, Singapore, Slovenia, Spain, Sweden, Switzerland, Trinidad & Tobago, United Arab Emirates, United Kingdom, Uruguay.
Upper middle income: Albania, Argentina, Armenia, Azerbaijan, Belarus, Botswana, Brazil, Bulgaria, China, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Gabon, Guatemala, Guyana, Jamaica, Jordan, Kazakhstan, Libya, Malaysia, Malta, Mexico, Moldova, Nambia, Namibia, Paraguay, Peru, Russia, Romania, South Africa, Suriname, Turkey.
Lower middle income: Algeria, Angola, Bangladesh, Bolivia, Cameroon, Republic of Congo, Egypt, El Salvador, Honduras, India, Indonesia, Iran, Kenya, Mongolia, Morocco, Lebanon, Myanmar, Nicaragua, Nigeria, Pakistan, Papua New Guinea, Philippines, Senegal, Sri Lanka, Tanzania, Tunisia, Ukraine, Vietnam, Zambia, Zimbabwe.
Low income: Burkina Faso, Gambia, Guinea, Guinea-Bissau, Madagascar, Malawi, Mozambique, Niger, Sudan, Uganda, Yemen, Syria, Ethiopia.

The statistics show heterogeneity in the data between countries for both variables, due to the presence of countries at different levels of development. For example, the maximum and minimum values for institutions are 3.6452 and 3.0325, respectively, for the panel of high-income countries, while they are 1.7917 and 0.9808, respectively, for the panel of low- income countries.

The scatter plot (see Figure 1) shows the correlation between institutions and economic growth for 119 countries. It shows that the data are grouped into two different blocks. This observation makes it legitimate to study this relationship taking into account the income levels of the countries. The correlation coefficient is 0.72. This shows a strong positive correlation between the two variables. However, this close relationship seems to be largely due to the upper block. As for the lower block, it shows the presence of positive correlation and relatively less significant. Linking this to the literature review, three explanations can be offered:

- Good institutional quality has a positive effect on economic growth;
- Higher incomes lead to better quality institutions;
- There are other factors that improve country's wealth, and they are related to institutions;
- The process of institutional reform takes time to have a positive impact on economic growth.

In fact, a simply observing a positive association between these two variables is not enough to disentangle the causal directions underlying this relationship. It is likely that institutions cause economic growth in some countries (unidirectional causality) and that economic growth causes institutions in other countries (unidirectional causality). Similarly, causality may operate in both directions (bidirectional causality).

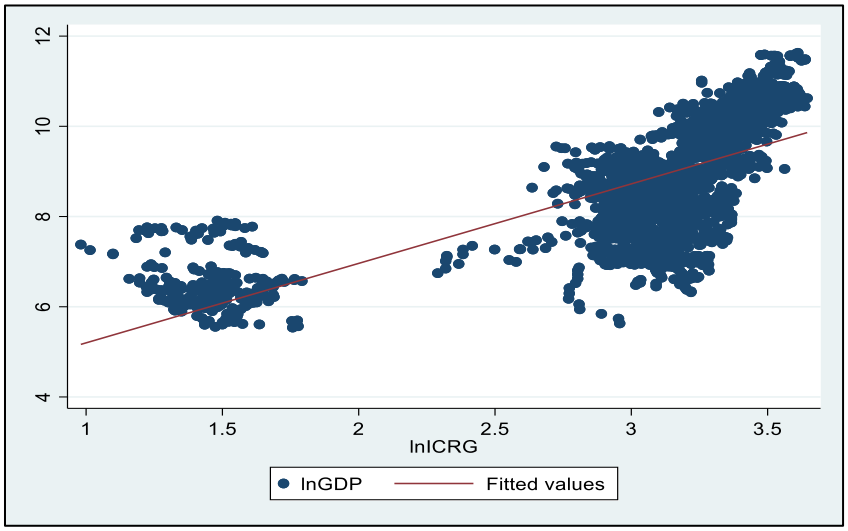

Figure 1: Correlation between institutions and economic growth (1999-2018)
Source: Own evaluation.

RESULTS AND DISCUSSION

Results

In order to perform the Granger causality test developed by Dumitrescu and Hurlin (2012), the variables must be stationary. However, to conduct the stationarity test (Hurlin and Mignon, 2005), we need to apply the dependence tests to know which generation of unit root tests to use. If there is cross-

sectional dependence, first-generation tests should be used. Otherwise, second generation tests are appropriate.

a. Dependence tests

Dependence tests (Breusch-Pagan LM test, Breusch-Pagan LM squared test, Pesaran CD test) are presented in table 2. This involves testing the null hypothesis, H0: there is cross-sectional independence, against the alternative hypothesis, H1: there is cross-sectional dependence. The p-values associated with the calculated statistics are highly significant for both the GDP and ICRG variables. Therefore, it is recommended to use the first generation tests. In addition, given that the panels under study are highly balanced, the following tests are used: the test of Levin, Lin and Chu (2002), the test of Harris and Tzavalis (1999), the test of Breitung (2000) and LM test of Hadri (2000).

Table 2: Dependence tests

Tests	Breusch-Pagan LM	Breusch-Pagan LM squared	Pesaran CD
Full sample			
GDP	87441***	678.66***	201.52***
ICRG	34199***	229.36***	115.18***
High income			
GDP	11155***	234.71***	62.607***
ICRG	5113***	95.8***	51.242***
Upper middle income			
GDP	6999.6***	206.49***	67.238***
ICRG	2488.9***	63.274***	34.429***
Lower middle income			
GDP	6187.3***	195.02***	72.883***
ICRG	1510.5***	36.464***	18.202***
Low income			
GDP	751.85***	53.951***	7.8396***
ICRG	631.36***	44.304***	22.581***

Notes: * p-value < 10%, ** p-value < 5%, *** p-value < 1%. For the two variables GDP and INS_{ICRG}, the tests show a p-value < 2.2e-16.

Source: Results obtained from R estimation.

b. Unit root tests: In the following, we expose the results of panel unit root tests (Cf. Tables 3, 4, 5, 6 and 7).

Table 3: Results of panel unit root tests (overall sample)

Variables	Level			First difference			Order of integration
	no C+no T	C	C+T	no C+no T	C	C+T	
lnGDP							
LLC	24.7827 (1.0000)	-4.9931*** (0.0000)	-6.9017*** (0.0000)				I(0)
HT	1.0023 (0.6287)	0.9439 (1.0000)	0.9954 (1.0000)	0.3940*** (0.0000)	0.1054*** (0.0000)	0.2688*** (0.0000)	I(1)
Breitung	20.1249 (1.0000)	19.6674 (1.0000)	7.6980 (1.0000)	-12.0811*** (0.0000)	-15.5430*** (0.0000)	-13.7718*** (0.0000)	I(1)
Hadri		107.2089*** (0.0000)	66.0139*** (0.0000)				I(0)
ICRG							
LLC	-5.3387*** (0.0000)	-8.8555*** (0.0000)	-14.3685*** (0.0000)				I(0)
HT	0.9979 (0.3846)	-5.6549**** (0.0000)	0.9991 (1.0000)				I(0)
Breitung	-4.8253*** (0.0000)	-2.8256*** (0.0024)	0.9997 (0.8413)				I(0)
Hadri		58.9533*** (0.0000)	41.7494*** (0.0000)				I(0)

Notes: (…) are the p-values corresponding to the statistics * p-value < 10%, ** p-value < 5%, *** p-value < 1%. C=constant, T=trend.

Source: Results are obtained from Stata estimation.

Table 4: Results of panel unit root tests (High income)

Variables	Level			First difference			Ordre of integration
	no C+no T	C	C+T	no C+ no T	C	C+T	
lnGDP							
LLC	12.5139	-4.9155***	-5.2269***				I(0)
	(1.0000)	(0.0000)	(0.0000)				
HT	1.0014	0.9179	0.9857	0.5549***	0.3992***	0.4968***	I(1)
	(0.5478)	(0.9982)	(1.0000)	(0.0000)	(0.0000)	(0.0001)	
Breitung	10.6332	8.9213	1.9631	-7.6892***	-9.3054***	-7.6892***	I(1)
	(1.0000)	(1.0000)	(0.9752)	(0.0000)	(0.0000)	(0.0000)	
Hadri		59.0604***	37.2189***				I(0)
		(0.0000)	(0.0000)				
lnICRG							
LLC	-9.9317***	-4.4962***	-2.3363***				I(0)
	(0.0000)	(0.0000)	(0.0097)				
HT	0.9991	0.8013**	0.9416				I(0)
	(0.4692	(0.0187)	(1.0000)				
Breitung	-1.7005**	-2.9134***	0.4253				I(0)
	(0.0455)	(0.0018)	(0.6647)				
Hadri		22.1428***	37.7984***				I(0)
		(0.0000)	(0.0000)				

Notes: (…) are the p-values corresponding to the statistics * p-value < 10%, ** p-value < 5%, *** p-value < 1%. C=constant, T=trend.

Source: Results are obtained from Stata estimation.

Table 5: Results of panel unit root tests (Upper middle income)

Variables	Level			First difference			Ordre of integration
	no C+no T	C	C+T	no C+ no T	C	C+T	
lnGDP							
LLC	12.6687	-4.8558***	-3.6981***				I(0)
	(1.0000)	(0.0000)	(0.0001)				
HT	1.0033	0.9233	0.9713	0.1811***	-0.1592***	-0.0141***	I(1)
	(0.5976)	(0.9963)	(1.0000)	(0.0000)	(0.0000)	(0.0000)	
Breitung	11.7315	10.4798	5.5111	-6.8165***	-8.0386***	-7.0026***	I(1)
	(1.0000)	(1.0000)	(1.0000)	(0.0000)	(0.0000)	(0.0000)	
Hadri		56.8567***	34.0649***				I(0)
		(0.0000)	(0.0000)				
lnICRG							
LLC	-3.8469***	-5.0228***	-5.8332***				I(0)
	(0.0001)	(0.0000)	(0.0000)				
HT	0.9971	0.7476***	0.8785				I(0)
	(0.4164)	(0.0001)	(1.0000)				
Breitung	-3.9000***	-0.9631	-0.5774				I(0)
	(0.0000)	(0.1677)	(0.2818)				
Hadri		29.6213***	21.8827***				I(0)
		(0.0000)	(0.0000)				

Notes: (…) are the p-values corresponding to the statistics * p-value < 10%, ** p-value < 5%, *** p-value < 1%. C=constant, T=trend.

Source: Results are obtained from Stata estimation.

Table 6: Results of panel unit root tests (Lower middle income)

Variables	Level			First difference			Ordre of integration
	no C+ no T	C	C+T	no C+ no T	C	C+T	
lnGDP							
LLC	20.2951 (1.0000)	-1.5184** (0.0645)	-2.8937*** (0.0019)				I(0)
HT	1.0035 (0.6003)	0.9702 (1.0000)	0.9855 (1.0000)	0.6809*** (0.0000)	0.3705*** (0.0000)	0.5123*** (0.0023)	I(1)
Breitung	14.8357 (1.0000)	13.0849 (1.0000)	5.1653 (1.0000)	-3.5390*** (0.0002)	-7.7470*** (0.0000)	-7.7221*** (0.0000)	I(1)
Hadri		56.0430*** (0.0000)	35.9867*** (0.0000)				I(0)
lnICRG							
LLC	-3.7304*** (0.0001)	-3.8996*** (0.0000)	0.9237 (1.0000)				I(0)
HT	0.9974 (0.4256)	0.7199*** (0.0000)	0.9237 (1.0000)				I(0)
Breitung	-3.4852*** (0.0002)	-1.2168 (0.1118)	0.8432 (0.8005)				I(0)
Hadri		21.9840*** (0.0000)	21.6184*** (0.0000)				I(0)

Notes: (…) are the p-values corresponding to the statistics * p-value < 10%, ** p-value < 5%, *** p-value < 1%. C=constant, T=trend. Results are obtained from Stata estimation.

Table 7: Results of panel unit root tests (Low income)

Variables	Level			First difference			Ordre of integration
	no C+ no T	C	C+T	no C +no T	C	C+T	
lnGDP							
LLC	9.9623 (1.0000)	0.2344 (0.5927)	-1.3213 (0.0932)				I(0)
HT	1.0016 (0.5307)	1.0054 (0.9998)	0.9780 (1.0000)	0.4156 (0.0000)	0.2277 (0.0000)	0.3828 (0.0001)	I(1)
Breitung	5.7842 (1.0000)	5.7615 (1.0000)	2.3050 (0.9894)	-6.4891 (0.0000)	-5.5897 (0.0000)	-4.9961 (0.0000)	I(1)
Hadri		33.0283 (0.0000)	22.3124 (0.0000)				I(0)
lnICRG							
LLC	-3.1917*** (0.0007)	-4.3754*** (0.0000)	-6.7312*** (0.0000)				I(0)
HT	0.9908 (0.3320)	0.8393 (0.4014)	0.8980 (1.0000)	0.0558*** (0.0000)	0.0018*** (0.0000)	0.0155*** (0.0000)	I(1)
Breitung	-3.3247*** (0.0000)	-0.1252 (0.4502)	1.7255 (0.9578)				
Hadri		26.3530*** (0.0000)	15.3109*** (0.0000)				

Notes: (…) are the p-values corresponding to the statistics * p-value < 10%, ** p-value < 5%, *** p-value < 1%. C=constant, T=trend.

Source: Results are obtained from Stata estimation.

c. Granger causality test (Dumitrescu and Hurlin, 2012)

After the stationarity of the non-sationary variables, we apply the Granger Causality test developed by Dumitrescu and Hurlin (2012) for all panels and in both directions (institutions to economic growth, economic growth to institutions). On the other hand, it should be noted that in autoregressive models, the number of lags to include is often a problem. As in the paper of Dumitrescu and Hurlin (2012), there is no guidance about this point, we choose the optimal number of lags by minimizing the Akaike information Criteria like Lopez and Weber (2017).

Causality results are reported in Table 8. Two statistics are displayed Z bar ($Z_{N,T}$) and Z bar tilde ($\widetilde{Z_N}$). The interpretation of the results is related to the values of Z bar tilde ($\widetilde{Z_N}$) statistic derived from

Lyapunov's central limit theorem in the semi-asymptotic case (when T is fixed). A significant variable means that Granger's null hypothesis of non-causality is rejected (p-value of the Z bar tilde ($\widetilde{Z_N}$) statistic is less than 10%, 5% or 1%).

The results show unidirectional causality for all panels, except for middle-income countries where the causality is bidirectional. Moreover, the patterns of causality depend on the level of development of the countries, as demonstrated by the empirical papers.

Looking in the direction from institutions to economic growth, the causality is positive and highly significant for the upper-middle-income countries, lower-middle-income countries and the low-income countries. This means that improving of the quality of institutions had a positive and highly significant impact on income in these countries. Empirical studies have confirmed that this effect is more reactive in middle-income and low-income countries (Chong and Calderon, 2000; Law and Bany-Ariffin, 2008; Lee and kim, 2009; Law, Lim and Ismail, 2013). On the other hand, institutions do not cause economic growth for the full panel and for high-income countries. Indeed, for high-income countries, the empirical review highlights either insignificant causality (Gui-Diby and Mosle, 2017) or minimal impact on growth (Chong and Calderon, 2000; Law, Lim and Ismail, 2013; Law and Bany-Ariffin, 2008). The result is obvious and does not imply that institutions are not important for economic growth, but is due to the fact that high-income countries have good institutions, so the variability of the data is low.

In the direction from economic growth to institutions, the causality is positive and highly significant for the full panel, the high-income countries and the lower-middle-income countries. An explication for this finding is that economic performance and market growth in these countries increase the demand for better institutions to raise incomes and create favorable business environment. While economic growth does not cause institutions for upper-middle-income countries and low-income countries. This means that the growth policies available in these countries are not sufficient to bring about institutional improvements. Thus, other growth reforms must me sought to have a significant impact on institutions.

Table 8: Granger causality test results (Dumitrescu and Hurlin, 2012), ICRG data (1999-2018)

Direction of causality	**Statistics/ Lags (AIC)**	**Overall sample N=2380**	**High income N=880**	**Upper middle income N=640**	**Lower middle income N=600**	**Low income N=260**
Institutions → Economic growth	Zbar ($Z_{N,T}$)	9.8585*** **(0.0000)**	0.0355 **(0.9717)**	3.5805*** **(0.0003)**	6.8903*** **(0.0000)**	6.8440*** **(0.0000)**
	Zbar tilde ($\widetilde{Z_N}$)	0.7150 **(0.4746)**	-0.5271 **(0.5981)**	2.2779** **(0.0227)**	4.8355*** **(0.0000)**	4.9564*** **(0.0000)**
	Lags(AIC)	4	1	1	1	1
Economic growth → Institutions	Zbar ($Z_{N,T}$)	18.9348*** **(0.0000)**	17.1811*** **(0.0000)**	6.9121*** **(0.0000)**	5.0287*** **(0.0000)**	1.3952 **(0.1630)**
	Zbar tilde ($\widetilde{Z_N}$)	3.7404*** **(0.0002)**	4.1636*** **(0.0000)**	0.9707 **(0.3317)**	2.6762*** **(0.0074)**	0.7705 **(0.4410)**
	Lags(AIC)	4	4	4	2	1

Notes : (…) are the p-values corresponding to the statistics. * p-value < 10%, ** p-value < 5%, *** p-value < 1%. H0: institutions / economic growth do (es) not cause economic growth / institutions in Granger's sense. H1: Institutions / economic growth cause (s) economic growth / institutions in Granger's sense.
Source: Results are obtained from Stata estimation.

Robustness Test

To test the robustness of the results, we repeat the same estimation approach considering a synthetic index representative of institutional quality composed of four variables from the world Governance Indicators (WGI). Once the dependency and unit root tests have been performed, the causality results are displayed directly (Cf. Table 9).

Analysis of the table below reveals a non-significant causality for the full sample, high income countries and low income countries. While, there is a unidirectional causality from economic growth to institutions for middle income countries (upper and lower). Indeed, the results based on the WGI data are relatively different from previous findings. However, there is similarity between two data bases for the samples of lower middle income countries and high income countries. Thus, the difference in institutional

components has a significant impact on the causality results. This confirms the findings of empirical studies which conclude that the analysis period, the level of development countries, institutional components are all important element that make difficult to compare results.

Table 9: Granger causality test results (Dumitrescu and Hurlin, 2012), WGI data (2002-2018)

Direction of causality	Statistics/ Lags (AIC)	Overall sample N=2023	High income N=748	Upper middle income N=544	Lower middle income N=510	Low income N=221
Institutions → Economic growth	Zbar ($Z_{N,T}$)	2.5993*** **(0.0093)**	-0.3615 **(0.7177)**	2.6194*** **(0.0088)**	2.9331*** **(0.0034)**	2.1412** **(0.0323)**
	Zbar tilde ($\widetilde{Z_N}$)	0.7509 **(0.4527)**	-0.9236 **(0.3557)**	1.2930 **(0.1960)**	0.9690 **(0.3325)**	1.1593 **(0.2463)**
	Lags(AIC)	1	1	1	2	1
Economic growth → Institutions	Zbar ($Z_{N,T}$)	2.0813** **(0.0374)**	0.5261 **(0.5988)**	8.4763*** **(0.0000)**	15.0981*** **(0.0000)**	0.4358 **(0.6630)**
	Zbar tilde ($\widetilde{Z_N}$)	0.3828 **(0.7019)**	-0.2928 **(0.7697)**	1.7861** **(0.0741)**	5.4304*** **(0.0000)**	-0.0526 **(0.9580)**
	Lags(AIC)	1	1	3	3	1

Notes : (…) are the p-values corresponding to the statistics. * p-value < 10%, ** p-value < 5%, *** p-value < 1%. H0: institutions / economic growth do (es) not cause economic growth / institutions in Granger's sense. H1: Institutions / economic growth cause (s) economic growth / institutions in Granger's sense.
Source: Results are obtained from Stata estimation.

CONCLUSIONS

The study examines the causal relationship between institutions and economic growth using the panel Granger causality test, developed by Dumitrescu and Hurlin (2012). It consists for 119 countries divided into four samples, according to their level of development: high income, upper middle income, lower middle income and low income. The empirical results show that the relationship is unidirectional for all samples, except for upper middle income which causality is bidirectional. Also, the direction of causality is different from one sample to another.

These findings are in line with empirical researches. The paper reveals that causality patterns are heterogeneous and depend on the level of development of countries. This implies a very interesting recommendation, which is to implement different policies according to causality results, instead of common policy for all countries. At this point, several questions can be asked: what factors explain the institutional differences between countries? Which institutional elements promote economic growth? Is there threshold above which institutions have a positive effect on economic growth? Of course, all these questions have to be answered in the light of the level of development of the countries.

Finally, there are two limitations to the Granger causality test, developed by Dumitrescu and Hurlin (2012). First, the test requires the sample to be cylindrical, forcing researchers to drop many observations. Second, because the test is based on the concept of stationarity, it excludes any long-run causality (Hurlin, 2005).

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