Causal Relationship Between Economic Growth and Energy Consumption in Jordan

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Abstract: Due to the current situation of the Jordanian economy, this paper aims to evaluate the impacts of economic growth on the energy consumption in a developing country like Jordan, a country with limited resources such as oil, agricultural land, and water.

This study is very important since the energy bill reflects a notable share in the GDP for Jordan, especially in the recent decade that witnessed energy bill rising due to different political and financial crisis events.The study investigates the causal relationship between the per capita energy consumption and economic growth (proxies by real gross domestic product per capita in constant prices) over the 1975-2011 period. A Granger causality test is utilized on annual time series data. The results of the study confirm a neutral relationship between real GDP and energy consumption, indicating that per capita increase in economic growth may not cause any perpetual rise in energy consumption in Jordan.

Keywords: Energy Consumption; Economic Growth; Granger Causality; Jordan.

العلاقة السببية بين النمو الاقتصادي

واستهلاك الطاقة في الاردن

ملخص: نظرا للاوضاع الحالية للاقتصاد الأردني، تهدف هذه الدراسة إلى تقييم العلاقة بين النمو الاقتصادي واستهلاك الطاقة في بلد نام محدود الموارد مثل الأردن الذي يعاني من شح في المياه والطاقة والأراضي الصالحة للزراعة. تعتبر هذه الدراسة مهمة حيث ان فاتورة الطاقة تنعكس على الناتج المحلي الإجمالي خصوصا في العقد الأخير الذي شهد إرتفاعاً في فاتورة الطاقة متأثراً بالأحداث السياسية والأزمات المالية. تحقق هذه الدراسة في العلاقة السببية بين نصيب الفرد من استهلاك الطاقة والنمو الاقتصادي (ممثلا بنصيب الفرد من الناتج المحلي الإجمالي الحقيقي بالأسعار الثابتة) في الأردن للفترة 1975-2011. استخدمت الدراسة اختبار جرانجر للسببية باستخدام بيانات السلاسل الزمنية. أكدت نتائج الدراسة العلاقة المحايدة مابين الناتج المحلي الإجمالي الحقيقي واستهلاك الطاقة، مما يشير إلى أنه إذا ازداد نصيب الفرد من النمو الاقتصادي فإن ذلك لا يؤثر على الارتفاع الدائم في استهلاك الطاقة في الاردن.

الكلمات المفتاحية: استهلاك الطاقة، النمو الاقتصادي، جرانجر للسببية، الاردن.

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Introduction:

The relationship between energy consumption (EC) and economic growth (ECG) has attracted numerous studies since the study of Kraft and Kraft (1978). Also, there are intensive literature suggesting a strong relationship between EC and economic growth. This indicates that an increase in energy consumption directly impacts economic growth and that economic growth also stimulates further energy consumption such as (Lee and Chang, 2005; Hu and Lin, 2008; Huang et al., 2008; Odhiambo, 2010; Tsani, 2010; Eggoh et al., 2011; Dagher and Yacoubian,2012; Shahbaz and Lean, 2012; and Dergiades et al.,2013).

Most of these studies are based on the directions of causal relationship between the EC and the ECG that could be classified into four types: First, unidirectional hypothesis (conservation): running from economic growth to energy consumption. If such is the case, energy conservation policies prepared to reduce energy consumption and waste will have a little or no impact on economic growth (see, Fatai, et al., 2004; Lee and Chang, 2005; Bekhet and Othman, 2011; Sbia et al., 2014). Second, neutrality hypothesis: it is supported if there is no causality relationship between EC and real GDP. Neutrality hypothesis clarify that energy conservation policies will have no impact on economic growth (see, Thoma, 2004; Chen et al., 2007; Narayan and Prasad, 2008; Tang et al., 214).

Third, bidirectional hypothesis: It states that there is two-way causality between economic growth and energy consumption. It is important to attain empirically whether there is a causal relation between economic growth and energy consumption and the way of that causality. This is because the direction of causality has significant policy implications for governments in constructing and application of its electricity policy (Narayan and Prasad, 2008; Chen et al., 2007; Yuan et al., 2008; Omri and Kahouli, 2014).

Fourth, growth hypothesis: implies that causality runs from energy consumption to economic growth. The growth hypothesis suggests that energy consumption plays an important role in the economic growth. In this case, the depression in EC represented by electricity consumption due to electricity conservation-oriented policies may have a destructive effect on economic growth (Ozturk & Acaravci, 2011).

Study objectives:

This paper aims to evaluate the impacts of economic growth on the EC in developing country like Jordan a country with limited resources such as oil resources, limited agricultural land, and scarce water. However, despite this ordeal and a troubled regional environment, Jordan keeps a stable economic growth rate compared to other emerging economies in the Middle East countries. This is due to the recent extensive economic improvement by the government, resulting in the opening up of key sectors to FDI and vibrant economic activity beside different developments, innovations and regulations (IMF, 2010).

Problem statement and importance of the study:

this study is important for different parties such as policy makers, domestic and foreign investors, corporations and government. However, the importance of this study stems from the reason that energy and electricity bill reflect a notable share in the GDP for Jordan. Also, the prices of electric bill affected by oil have went up very high especially during the (2008-2013) period. Thus, the increase in the oil prices affect the prices of electricity positively. However, the problem focuses on the main reasons of increasing the energy bill in Jordan which became the main challenges that faces the Jordanian economy, one of this factors is the economic and financial development. Therefrore,this study sheds the light on the relationship between economic growth and energy economics.

Study hypotheses:

over the past decades the relationship between economic growth and EC has been extensively researched in developed countries. Yet, there seems to be no consensus regarding the relationship in developing

countries. Furthermore, this study will be the first study that examines the relationship between economic growth and EC particularly in Jordan to fill the gap in the existence literature. The current paper adopts the Granger causality technique. Subsequently, we hypothesized a short-run equilibrium relationship between EC and economic growth represented by GDP per capita with a bidirectional causality relationship between them as H_1.

H_2: unidirectional causality relationship is running between EC and GDP.

H_3: Neutral (no causality) relationship is running between EC and GDP.

The rest of the paper is organized as follows: The next section sheds light on Jordanian economy and the energy consumption in Jordan. Section 3 explores the literature review. Section 4 provides data and methodology. Section 5 reports the empirical results while conclusions, limitation and managerial implications are presented in the last section.

An Overview of the Economy and Energy Consumption in Jordan

Jordan is a small open economy with few natural resources and little manufacturing, but has a large skilled population that works abroad. Jordan has incompetent supplies of water with a large proportion of desert soil and around 4% arable land. However, the main natural resources in Jordan are phosphate and potash. Currently, the main challenges facing Jordan are reducing the budget deficit, reducing foreign grants and dependence, and creating investment incentives to promote job creation. A fundamental percentage of the population, 38% is under the age of fourteen resulting in a rapid increase in the working age population (Amara, 2008).

During the past decades, Jordan's economy witnessed several political events and conflicts that occur in the Middle East, such as Gulf-War1991 and Iraqi-War 2003. These conflicts caused massive resource shortages. For example, Jordan's economy suffered heavily as a result of the 1990-1991Gulf-War that the Gulf countries council decided to limit economic relations by declining their worker's recruitment, oil supplements, traditional export markets, and substantial foreign aid revenues. However, Jordan's favorable trade relations with Iraq had ended and years of heavily discounted and even free oil ceased. IMF (1991) estimated that Jordan's GDP declined by15-20% and the unemployment rate had risen near 25% making Jordan a main victim after Kuwait and Iraq themselves of the Gulf-War (Park and Agtmael, 1994). Also, a new challenge to the Jordan's economy was the Amman bombing 2005 and recently the 2011 Arab revolutions (Arab Spring) especially in Syria.

Figure 1 shows the growth rate of Jordan's real GDP per capita which was at 1% for the (1975-2011) period. Also, it indicates a gradually upward trend over the targeted period. Despite the global financial crisis effect and other events during this study period, Jordan's GDP reached US $16 billion in 2011. Over the 2000–2009 period, Jordan's economy has slowed down sharply due to the global and regional downturn. It was consistent with the global economic slowdown, in 2009 where output growth fell sharply and economic activity is expected to rise modestly (IMF, 2010; Bekhet and Matar, 2012).

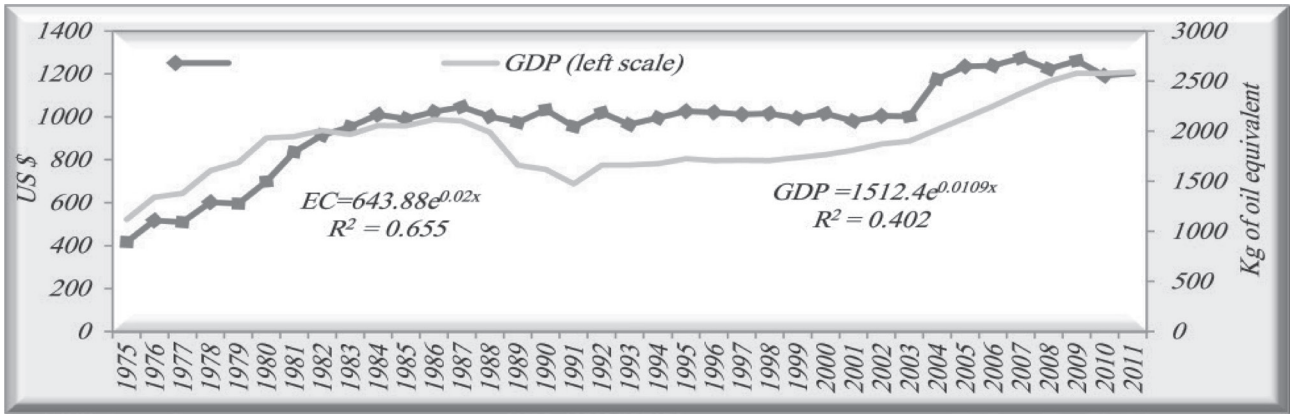

Figure 1: GDP & EC in Jordan
Source: World Bank (2013), Jordan data, available at http://data.worldbank.org/country/jordan

Electrical power consumption is considered a dependent variable of other related independent variables such as GDP per capita that affect the consumption of energy positively besides, the Price of electricity variable that affect the consumption of electricity variable negatively. During the (2007-2008) period many privatization operations were executed in the electricity sector which resulted in partial privatization for the sector. However, the price index for mineral fuels and lubricants category increased by 32% due to the increase in the prices of oil. Therefore, the fuel and electricity category price index has increased by 49%. In addition, the electrical power consumption grew notably during the (1976-2011) period where the average annual growth rate during this period was 4.5%. the greatest amount of ECP was in 2011 with 2610 KW, the greatest consumption came from the household sector that consumed about 41% of total followed by industrial sector which consumed 25% of total then commercial sector with consumption share of 17% followed by water pumping sector that consumed 14% then by street lighting sector which consumed 3% (see Figure 2).

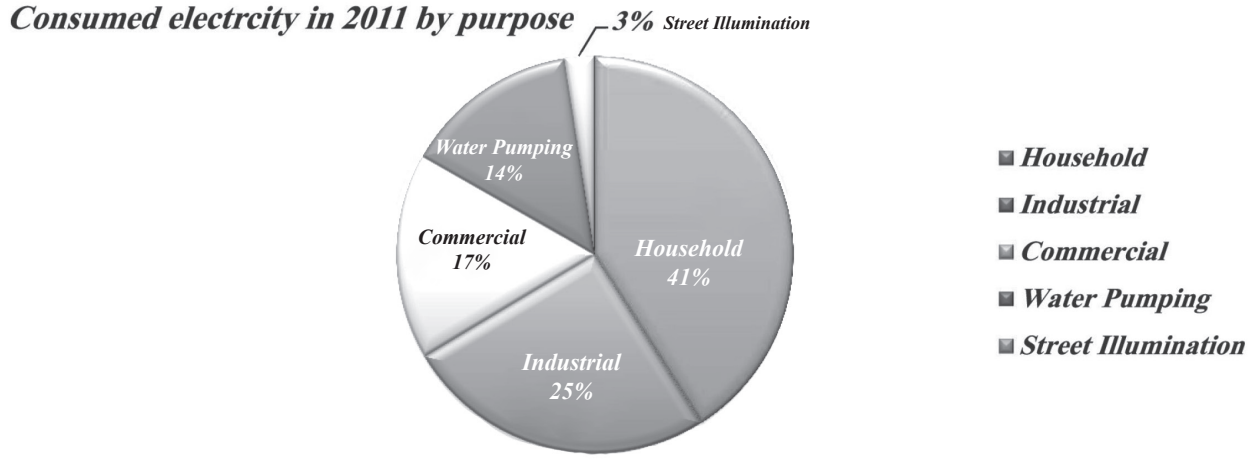

Figure 2: EC in Jordan in 2011(by purpose).
Source: Department of Statistics, Jordan (2013), available at http://www.dos.gov.jo/dos_home_a/main/jorfig/2011/14.pdf.

Literature Review:

Some literatures have chosen to examine single countries, while others have studied many countries simultaneously in a panel data analysis framework. Some studies like Fatai et al. (2004) compared the relationship between EC and GDP in New Zealand economy with Australia and different Asian economies. They suggested that energy conservation policies may not have significant impacts on GDP growth in New Zealand and Australia compared to some Asian economies. Lee and Chang (2005) found that the co-integration between EC and GDP in Taiwan is unstable, and some economic events may affect the stability between them. Soytas and Sari (2007) suggested a unidirectional causality relationship from electrical consumption to value added in Turkey. Zamani (2007) found a unidirectional causality running from GDP to EC in Iran during the 1976-2003 period.

Hu and Lin (2008) confirmed a non-linear co-integration relationship between GDP and EC in Taiwan. Huang et al., (2008) examined the relationship between GDP and EC for 82 countries by using panel data. They categorized the data into high income, upper middle income, lower middle income, and low income group. The results suggested that in the high income group countries the GDP leads EC negatively; while in the middle income group (upper and lower) the GDP leads EC positively; and there is no causal relationship between GDP and EC in the low income group. Sari et al., (2008) implied that employment and real output are long-run forcing variables for nearly all measures of disaggregating energy consumption in the United States.

Chiou-Wei et al. (2008) found a neutrality causal relationship between GDP and EC for the United States, South Korea, and Thailand. However, they detected a unidirectional causality running from GDP to EC in

Philippines and Singapore. In addition, EC may have affected GDP for, Malaysia, Hong Kong, Taiwan, and Indonesia. Yuan et al. (2008) suggested a short-run Granger causality runs from GDP to total energy consumption in China. In India, Gosh (2009) proposed the existence of a unidirectional long-run causality running from economic growth to crude oil import. Using a panel data for 51 countries, Ozturk et al. (2010) study revealed a bidirectional causality relationship between GDP and EC and a long-run causality relationship runs from GDP to EC for low income countries.

Wolde-Rufael (2010) suggested a unidirectional causality relationship running from nuclear EC to the GDP in India. Tsani (2010) found the existence of unidirectional causality relationship running from total EC to the real economic growth in Greece. Eggoh et al. (2011) proposed a long-run equilibrium relationship between real GDP, EC, labor, capital, and prices for 21 African countries. Zhixin and Xin (2011) suggested a long-run and bidirectional causality relationships between EC and the economic growth in China. Dagher and Yacoubian (2012) found a bidirectional causality relationship between EC and economic growth in Lebanon.

In Canada, Hamit-Haggar (2012) proposed a unidirectional causality relationship running from economic growth to the EC in the short-run and a unidirectional causality running from EC to the economic growth and greenhouse gas emissions in the long-run. Wesseh and Zoumara (2012) indicated a bidirectional causality relationship between energy consumption and economic growth in Liberia. Pirlogea and Cicea (2012) suggested that EC affects the GDP in the short-run in Romania. Besides, they found a unidirectional causality between EC with GDP and natural gas in Spanish.

Sebri and Abid (2012) proposed that both aggregated and disaggregated EC and trade openness Granger causes agricultural value added in Tunisia. Yildirim et al. (2012) found only one unidirectional causal relationship running from biomass-waste-derived energy consumption to real GDP in USA. Dergiades et al. (2013) indicated a unidirectional causal relationship running from total useful energy to economic growth in Greece. Islam et al. (2013) suggested that the EC is influenced by economic growth and financial development in Malaysia in short and long-run, but for the population-energy relationship holds only in the long-run.

Recently, the relationship between economic growth and energy consumption has earned various studies. For instance, Samargandi et al. (2014) analyzed the impact of financial development and economic growth on the oil-rich economy. They found that financial development has insignificant impact on economic growth and oil-sector growth. In contrast, its impact on the growth of the non-oil sector is positive. Nasreen and Anwar (2014) explored the causal relationship between energy consumption, trade openness, and economic growth using data of fifteen Asian countries. The results revelaed the bidirectional causality between trade openness and energy consumption, economic growth and energy consumption. Omri and Kahouli (2014) investigated the dynamic relationship between economic growth, FDI, and energy consumption using data of 65 countries. they found mixed results (bidirectional, unidirectional, and neutral) interrelationsip between economic growth, FDI, and energy consumption.

Omri et al. (2015) examined the causal relationship between economic growth and energy consumption for seventeen developing and developed countries. the results indicated three types of causality relationship (unidirectional, bidirectional, and no causality or neutral) running between the two variables. Bloch et al. (2015) invetigated the relationship between Chinese aagregate consumption and production by using the ARDL and VECM models. Their reusluts revealed that the renewable energy consumption reduces emissions, while coal consumption causing pollutin. Besides, no significant causality relationship is found between emissions and oil.

Methodology and Data

Yearly time series data for the 1975-2011 period were used. The data for all variables are obtained from the (World Bank development indicators, 2013). To avoid the hestroscedasticity problem, all variables have been transformed into natural logarithmic by using SPSS (20), and E-views 7.2 packages. The functional form of EC as a function of GDP assumed as in Equation 1.

$$lEC_t = f(lGDP_t)$$

Where, EC represents the energy consumption per capita measures in kilogram of oil equivalent; GDP per capita in constant price 2000 US $ is proxy for the growth in real gross domestic product (economic growth) in Jordan.

Several studies have employed Johansen-Juselius and Autoregressive distributed lags (ARDL) models to test the co-integration relationship among the variables. The Granger Causality test (Engle and Granger, 1987) is used to test the short-run causality relationship between dependent and independent variables. Grange Causality test shows the presence of bidirectional or unidirectional causality relationship, whether one variable causes the other variable or not. If the variables X and Y are individually I(1) or individually I(0) and co-integrated then Granger causality tests may use I(1) data It can be formulated as in Equations (2) and (3):

$$\Delta x_t = \gamma_0 + \sum_{i=1}^{n} \beta_1 \Delta x_{t-1} + \sum_{i=1}^{n} \beta_2 \Delta x_{t-2} + \ldots + \sum_{i=1}^{n} \beta_i \Delta x_{t-i} + \sum_{j=1}^{m} \alpha_1 \Delta y_{t-1} + \sum_{j=1}^{m} \alpha_2 \Delta y_{t-2} + \ldots + \sum_{j=1}^{m} \alpha_j \Delta y_{t-j} + \varepsilon_t \quad (2)$$

$$\Delta y_t = \delta_0 + \sum_{j=1}^{m} \alpha_1 \Delta y_{t-1} + \sum_{j=1}^{m} \alpha_2 \Delta y_{t-2} + \ldots + \sum_{j=1}^{m} \alpha_i \Delta y_{t-j} + \sum_{i=1}^{n} \beta_1 \Delta x_{t-1} + \sum_{i=1}^{n} \beta_2 \Delta x_{t-2} + \ldots + \sum_{i=1}^{n} \beta_j \Delta x_{t-i} + v_t \quad (3)$$

Y Granger causes X if H_0: $\alpha_1 = \alpha_2 = \ldots = \alpha_n = 0$ is rejected, against H_1: at least one $\alpha \neq 0$, j =1…n, and X Granger cause Y if H_0: $\beta_1 = \beta_2 = \ldots = \beta_n = 0$ is rejected, against H_1: at least one $\beta \neq 0$. Theoretically, it is possible that one variable Granger causes the other; whilst in actual evidence no causal relationship can be detected between two variables (Huang, et al., 2000). Eventually, the word (causality) according to Granger-causality does not mean that movements of one variable cause movements of another, it means that only a correlation between the current value of one variable and the past values of others (Brooks,2008).

Results Analysis

Table 1. shows the Augmented Dicky-Fuller test of stationary for all variables, both in levels and in first-differences.

Table 1. ADF Tests

Variables	(ADF I(0	P-value	Variables	(ADF I(1	P-value	Order of Integration
lEC	***-4.3883	0.0013	ΔlnEPC	***-6.3978	0.0000	(I (0
lGDP	-2.2095	0.2067	ΔlnGDP	***-5.1542	0.0002	(I (1

Note: ***, **, * denotes significant level of 1%, 5%, 10% respectively.

Source: output of EViews Package, version 7.The results exist that we cannot reject the null hypothesis of unit roots for the GDP variable in level forms and we can except it for lEC that is stationary at level I(0). However, the null hypothesis is rejected when the ADF test applied to the first differences of each variable. This means that the variables of the study are stationary of level and order one I(1) and I(0).

Another important step before testing the existence of causal relationship between the selective variables, choosing the optimal lag length is based on the most popular criterions of selecting lags length like Schwarz Bayesian information criterion (SBC), Akaike (1973) Information Criteria (AIC), Hannan-Quinn Criterion (HQ), Final Prediction Error (FPE), and Log-Likelihood Ration (LR) in vector autoregressive (VAR) model.

Table 2. Lag length selection criterion for co-integration.

Lag	Log L	LR	FPE	AIC	SBC	HQ
0	30.0214	-	0.00	-1.601	-1.512	-1.570
1	109.931	146.121	9.04	-5.938	-5.672	-5.846
2	115.943	*10.3054	8.08	*-6.053	*-5.609	*-5.900

Note: 1. * indicates lag order selected by the criterion.
2. LR: sequential modified LR test statistic (each test at 5% level of significance).
Source: output of EViews Package, version 7.2.

To compute the F-statistic for co-integration test, we consider lag 2, based on the minimum values of AIC, SBC and HQ criteria (Table 2).

To check the direction of the causality relationship among the variables, we need to run the Pair-wise Granger causality relationship between the variables. As seen, the directional causality among all variables is included in Table 3 at the 1, 5, and 10% levels of significance. The results of the Granger test suggested there is no causality relationship among the variables in the short-run.

Table 3. Pair-wise Granger causality

	lEPC	lGDP	P-Value	Direction of Causality
lEC	-	1.9156	0.1648	lEC lGDP
lGDP	2.3869	-	0.1091	lGDP lEPC

Note: The (_____) represents no Granger causality.

Source: EViews 7 Outputs.

Table 4 reveals that we cannot accept this relationship for the rest of the variables, since their Wald-test (chi-square) results are insignificant at the 5 percent level of significance.

Table 4. The Wald–test of short-run causality between *lEC* and variable.

Wald-test results	lEC	lGDP
X^2 (2)	0.2642	0.6282
Prob (F-statistic)	(0.2804)	(0.6330)

Notes. 1. The Wald tests are distributed as ÷² with two degrees of freedom.
2. Figures in brackets are p-values.
3. ** denotes 5 percent level of significance.

Source: EViews 7 Output.

Conclusion and Managerial Implications

The paper analyzed the relationship between EC and economic growth. It has used the Granger causality time series and Wald-test approaches for the 1975-2011 period. The empirical results provided strong evidence against the null hypotheses of unit roots of the series under investigation. The pair-wise granger causality test suggests no causal relationship between real GDP and the EC in the short-run; this implies that the reduction of the per capita EC will not impact the future economic growth in Jordan. Besides, the Wald-test also confirms the same result of Granger causality. Subsequently, the results are consistent with the earlier findings (for example, (Thoma, 2004; Chen et al., 2007; and Narayan and Prasad, 2008; Samargandi et al., 2014; Omri et al, 2015; Bloch et al, 2015). On the other hand, the results of this study are inconsistent with the previous findings such as (Soytas and Sari, 2007; Zamani, 2007; Ghosh, 2009; Zhixin and Xin, 2011; Dagher and Yacoubian, 2012; Dergiades et al., 2013).

The novelty of this study is to apply the relationship between EC and GDP in Jordan where it considered as one of the first studies that has been applied in Jordan. However, we add to the existing literature by investigating

this relationship and fill the gap in the literature. In addition, studying the relationship between EC and GDP can shed some light on the energy response to economic factors in Jordan since the prices of electricity start to rise in recent couple years. This study is very important for different parties like, policymakers, energy sectors, and academic researchers. The policymakers will need to pay more attention to the increase in the rate of consumption by the population; this will help to reduce the imports of oil as main source of electricity running. Finally, for further studies, we suggest more factors that may cause the obvious structural breaks on EC and make several variation on the results such as (Financial development, Trade oppeness, FDI, consumer price index, pollutions, and political events).

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