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Impact of Custom Duties, Energy Import and Government Health Spending on Greenhouse Gas Emission in Thailand

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ABSTRACT

Greenhouse gas emission has become a great problem throughout the world and many countries are facing serious outcomes in this regard. There may be various factors that may affect the emission of greenhouse gases but in this study the author has discussed the impact of custom duty, energy imports and government health spending on greenhouse gas emission. Data was collected from Thailand for research purpose for period of 28 years. Several tests such as unit root test, co-integration test and ARDL test in long and short run have been applied on the collected data for various purposes. The results of these tests indicate that the impact of three independent variables, custom duty, energy imports and government health spending is significant while the impact of only one control variable, energy consumption is significant in regard of greenhouse gas emission. After the detailed discussion of results, the author has mentioned some important implications related to this study in various contexts. These implications revolve around one common point i.e. reduction in greenhouse gas emission. In the last, the limitations associated with the study have also been discussed.

Keywords: Custom Duties, Energy Import, Government Health Spending, Greenhouse Gas Emission

JEL Classifications: H51, K32

1. INTRODUCTION

Rising Global population has exerted pressure on the demand of nonrenewable energy consumption, which consequently has caused the higher emission of greenhouse gases (Dogan and Seker, 2016; Jebli and Youssef, 2015). Various sectors such as transport, household, industry, power are contributing in the greenhouse gas emission in Southeast Asian economies. Furthermore, many studies have also emphasized that besides the agriculture, industrial, and transport industry, the rubber production is also contributing in global warming and greenhouse gas emission in Thailand (Chanchaichujit et al., 2017). In order to control environmental degrading due to rising greenhouse gas emission, alternative energy resource may employed. Sharma et al. (2016) mentioned in their study that greenhouse emission may control by adopting the alternative nonrenewable energy resources. Further, government efforts to bring structure reforms

in the energy sectors to control the rising greenhouse emission will have positive results (Covert et al., 2016; Mohr et al., 2015). This study aims to explore the impact of government policies and role in controlling greenhouse emission. Rising greenhouse emission in Thailand is also mainly attributed to the country high reliance on the nonrenewable energy resources. The purpose of this study is to empirically measure the role of custom duties (on nonrenewable energy resource), energy import and government health spending on greenhouse gas emission. According to literature, tariff policies of government may positively contribute in controlling the environmental degradation and greenhouse gas emission through levying custom duties on environment unfriendly imports (Cottier et al., 2014). Contrastingly, lowering custom duties and tariffs on environmentally friendly machines, goods, or products will encourage the diffusion of cleaner technologies. In addition, energy import in the form of crude oil and natural gas import, has also a striking impact on the diffusion of greenhouse emission in

Thailand. In order to control the prevalent environmental threats, government spending on alternative environmental-friendly energy technology will check the emission of greenhouse gases (Figure 1).

The increasing global warming due to greenhouse gas emission has a matter of concern for policy makers and environmentalist. Greenhouse gas emission is measured on global carbon atlas. According to 2014 data, the Thailand's greenhouse emission level stands on 337 MtCO₂, which is lower than global average and has 0.84% share in global greenhouse gas emission. However, due to increasing consumption of crude oil and natural gas-based energy resources, the country has much miles to go in dealing the global warming problem. Though many studies has uttered this issue but no empirical study has found in literature which has explored the linkages of greenhouse gas emission with customs duties, energy import and government health spending, particularly for Thailand. The study aims to add in the literature of by exploring the empirical relationship of greenhouse gas emission with government fiscal and tariff policies (Khan et al., 2018). Novelty of this study is to examine the role of government's policy in controlling the import of environment unfriendly products. Additionally, the study opted multivariate time series econometric techniques to empirically infer the results.

The objective of the study is to:

- To study the impact of custom duties (tariff policy) on greenhouse gas emission in Thailand.
- To explore the relationship between energy import and greenhouse gas emission in Thailand.
- To find the role of government health spending in greenhouse gas emission in Thailand.

Past studies on greenhouse gas emission have very useful policy implication for alleviating the emission of harmful pollutants (Oertel et al., 2016; Pearson et al., 2017; Prairie et al., 2018). Moreover, the studies have supported policy makers and government to introduce reforms in controlling the greenhouse gas emission and global warming. Additionally, the past studies also presented sufficient theoretical and empirical framework which broaden the aspects of research on greenhouse gas emission. This study also aims to add in the same lines. The study is organized as follows: section two discusses the literature review and theoretical background; section three focuses methodology and data analysis;

section four enunciate the empirical findings and results, section five concludes the results and suggests policy in the light of results.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

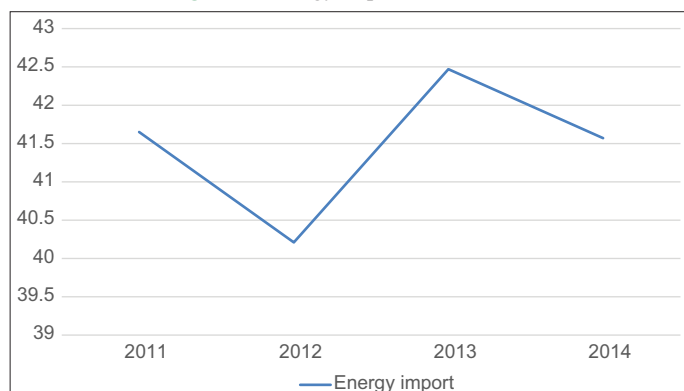
Thailand being the second biggest economy of Southeast Asian countries, after Indonesia has recorded the higher consumption of fossil fuels during recent year. Energy Information Administration (EIA) also stressed that greenhouse emission has enlarged multifold over the last 150 years. The main impetus rising greenhouse emission is majorly emanated from growing consumption of crude oil and energy import. Greenhouse gas emission is the main culprit of global warming and underlying factors behind this issue are industrialization, transportation, electric production through nonrenewable resources, deforestation, commercial residence, and urbanization (Emissions, 2015; Pérez-Lombard et al., 2008). The greenhouse emission in Thailand is also majorly contributed by agriculture sector, industrial sector, and rubber production. However, the country measures such as issuance of oil and gas exploration license in 2014 has able to keep greenhouse gas emission below to global average.

2.1. Custom Duties and Greenhouse Gas Emission

Increasing International trade has contributed in the trade of carbon intensive products which aggravate the emission of greenhouse gases across the world (Andersson, 2018; Kander et al., 2015). Moreover, expansion of international trade due to free trade agreements among the countries has caused gradual reduction of trade barriers such as custom duties. The average duties in Europe and North America reduce from 18% to 15% in 1950s to current average level of 4%, respectively. Consequently, the greenhouse gas emission in the country also decrease drastically. The role of carbon tariffs levied by USA on the imports from China to control the greenhouse gas emission. Custom duties may play significant role in checking the greenhouse gas emission. In order to fulfill the Emission Allowance Requirement (EAR) USA target its major import partners. However the USA carbon tariffs and ERA is against the WTO provision of trade. Cottier et al. (2014) proposed that custom duties and tariffs policy of a country can play key role in controlling the greenhouse gas emission (Bakhtyar et al., 2017). Custom duties on high carbon dioxide releasing goods may mitigate the environmental degradation. Further, increasing duties on trade of pollutants and greenhouse gas emission products are an efficient way to force polluting country to comply international climate agreement. The results indicate that 5% increase in custom duties on pollutant products will cause 1.4% decrease in carbon intensive import. Chen and Guo (2017) analyzed the impact of custom duties on greenhouse gas emission due to China's trade of industrial product to USA, Japan, and European Union. The study deduce that increase in custom duties will decrease the china's export of high carbon intensive product. Moreover carbon tariff will be more effective in mitigating the greenhouse gas emission. Therefore, on the basis of above studies following hypothesis is proposed:

H₁: Custom duties plays key role in controlling greenhouse gas emission in Thailand.

Figure 1: Energy imports of Thailand



2.2. Energy Import and Greenhouse Gas Emission

Greenhouse gas emission is mainly emanated through the energy consumption of nonrenewable fossil fuels such as gas and crude oil (Covert et al., 2016). The growing industrial growth has also bolstered the demand of imported energy, which is considered as stimulus to output growth. High energy import, caused the unbridle increase in the greenhouse gas emission across in Thailand as well. Most of the energy importing countries are energy dependent countries which use the nonrenewable energy resource to generate energy. Therefore, energy import has stimulated the emission of greenhouse gases in Thailand. Moreover, Importing, refining, transporting of crude oil emit considerable greenhouse gas at each level. According to the study the better understanding of greenhouse gas emission by energy import will helpful in switching towards the alternative renewable energy channels. Anwar (2016) also emphasized on the role of primary energy import on environmental emission and energy supply in Pakistan. The study analyzed the data during the period of 2005-2050 by using integrated energy system. The study indicates that 10% reduction in energy import, greenhouse gas emissions will decrease by 8%. The rationalization of nonrenewable energy import will bring significant reduction in greenhouse gas emission. Therefore, on the basis of above studies following hypothesis is built.

H₂: Energy import has significant role in controlling greenhouse gas emission in Thailand.

2.3. Government Health Spending and Greenhouse Gas Emission

The literature of greenhouse emission has explored the impact of economic growth on CO₂ emission, where the impact of government health spending on greenhouse emission is highly ignored. Whereas few studies have highlighted the causal relationship between government health's spending and greenhouse gas emission (Ahmad et al., 2018; Ullah et al., 2019; Wang et al., 2019). Moreover, few studies supports that environmental degradation exert pressure on fiscal budgeting by increasing health expenditure (Khoshnevis Yazdi and Khanalizadeh, 2017). Moreover, Khoshnevis Yazdi and Khanalizadeh (2017) empirically explored the linkages between health care, air pollutants, and economic growth by employing Autoregressive Distributed Lag (ARDL) method on panel data of MENA region from 1995 to 2014. The study inferred that health policy should incorporate environment degradation issues, to control environment degradation; failing to do so will further increase the health spending of government. Moreover, the health care policy of country has potential to spend on controlling environment degradation, by investing on environmental friendly system such as power generation in hospital through renewable energy. Ghorashi and Rad (2017) empirically explored the causal relationship between carbon dioxide emission, economic growth, and health expenditure by using simultaneous equation models. The scope of their study is limited to Iran for the period of 1972-2012. The empirical results indicate that there is significant bilateral relationship between carbon dioxide emission and health expenditures. Government spending of health will cause the installation of environment control devices, renewable energy bases power plants, electric vehicles that will resultantly check the greenhouse gas emission.

Chaabouni et al. (2016) also examined the causal relationship between greenhouse gas emission, economic growth, and health expenditure. The study used the panel data of 51 countries over the year of 1995 and 2013. To empirically analyze the data, study used the dynamic simultaneous equation modeling. The results indicates that health expenditure will helpful in controlling the co2 emission though economic growth which usually limits the environmental degradation. Hence on the light of above discussion following hypothesis can build:

H₃: Government health spending plays significant role in controlling greenhouse gas emission in Thailand.

3. METHODOLOGY

3.1. Data

The variables used in this study include custom duty, energy imports, and government health spending and greenhouse gas emission. Apart from these variables, the author has also included two other variables as control variables named as population growth and energy consumption. Consequently, all these variables have been used in the process of data collection. In other words, data about these variables has been collected. This data comprises of 28 years and has been collected from Thailand. Being the most important and foremost part of a research, data collection requires emphasis and effort in this regard. The author has used World Bank and Global Economy as the databases of data collection process. The detailed discussion about the variables has been given in the next part.

3.2. Model Specification

In model specification, the author has categorized the variables into three categories i.e. dependent, independent and control variables. Custom duty, energy import and government health spending have been put in the category of independent variables while greenhouse gas emission is considered to be the dependent variable. Two control variables, population growth and energy spending have also been considered. Moving towards the measurement units' allocation, the greenhouse gas emission has the measurement unit of thousands of tons. In the same way, custom duty has the measurement units of US dollars. Energy import has the measurement units of the percentage of total imports while government spending on health has the measurement unit of US dollars. The measurement unit of population, a control variable is number of people of a country while that of energy consumption is billion kilowatt hours. After designating the measurement units to all the variables, the author has formed a regression equation by using specific notations for each variable.

$$GGE_t = \alpha + \beta_1 CD_t + \beta_2 EI_t + \beta_3 GHS_t + \beta_4 POP_t + \beta_5 ENE_t + \varepsilon_t$$

In the above given equation, the notations are used according to the variables, the details of which are given here. *GGE* has been used to represent greenhouse gas emission, *CD* for custom duty, *EI* for energy imports, *GHS* for government health spending, *POP* for population growth and *ENE* for energy consumption. Apart from these, ε_t is used for error term.

3.3. Estimation Procedure

As the collected data is time series data and particular test must be used for this type of data. In this study the author has used unit root test, bounds co-integration test and ARDL long run and short run estimation test. The details as well as results of these tests have been given in the upcoming portions.

3.4. Unit Root Test

First step in the research process is to determine the order of integration as well as the stochastic properties of the variables and the collected data. The reason behind this exploration of order of integration is that variables with specific order of integration may only move further in the research process (Dickey and Fuller, 1981). There are two conditions in this regard i.e. the order of integration of dependent variables be zero while that of independent variables be zero and one i.e. mixed order. The variables that are not fulfilling these conditions will be restricted to move forward in the process. For this purpose, the unit root tests are generally used and in this particular study, the author has used two types of unit root tests i.e. ADF (augmented Dickey Fuller) and LLC (Levin Lin Chu). These tests involve null and alternate hypothesis where null hypothesis indicating the presence of unit root and non-stationary state of the data while alternate hypothesis indicating the absence of unit root and stationary state of the collected data. These tests can be used in accordance with the following equations:

$$\Delta X_t = \alpha + \alpha X_{t-1} + \beta T + cD_t$$

$$\Delta X_t = \beta + \beta X_{t-1} + ct + bDT_t + \sum_{j=1}^k dj\Delta X_{t-j} + \varepsilon_t$$

$$\Delta X_t = \gamma + \gamma X_{t-1} + ct + b + dDT_t + \sum_{j=1}^k dj\Delta X_{t-j} + \varepsilon_t$$

$$\Delta X_t = \Omega + \Omega X_{t-1} + ct + dD_t + dDT_t + \sum_{j=1}^k dj\Delta X_{t-j} + \varepsilon_t$$

In this equation, t represents the time period.

3.5. Bounds Co-integration Test

The next step after determination of order of integration and stationary properties of the collected data is to find out that whether co-integrated or long run equilibrium relationship between the variables exists or not (Pesaran et al., 2001). An important point that must be noted here is that smaller the sample size of data, more accurate will be the results. In this regard, Wald test and F test are the mostly used options that are used in accordance with the following equation:

$$\begin{aligned} \Delta \ln GGE_t = & \beta_0 + \sum_{i=0}^p \beta_i \Delta \ln GGE_{t-i} + \sum_{k=0}^q \beta_k \Delta \ln CD_{t-k} + \\ & \sum_{l=0}^r \beta_l \Delta \ln EI_{t-l} + \sum_{m=0}^s \beta_m \Delta \ln GHS_{t-m} + \lambda_{GGE} \ln GGE_{t-1} \\ & + \lambda_{CD} \ln CD_{t-1} + \lambda_{EI} \ln EI_{t-1} + \lambda_{GHS} \ln GHS_{t-1} + v_t \end{aligned}$$

In the above equation v_t represents the error while Δ shows the first difference level. There is an important point regarding the application of Wald test that is it will only be applied if the coefficient of short run variable is >1 but as in this study the coefficient of short run variables in zero, the Wald test cannot be applied here. The author is left with F test to apply in this case. As unit root test, this test also involves null and alternate hypotheses but with different conditions. In this test, null hypothesis will indicate the absence of co-integrated relationships while alternate hypothesis will indicate the presence of co-integrated relationships. A very important and main aspect of this test is the F statistic value that is generally compared with the estimated values called as upper bound and lower bound values. These values are actually based on the levels of significances i.e. 90%, 95% and 99%. The comparison of F statistic value with lower and upper bound may have three outcomes. It may be greater than the upper bound value indicating the rejection of null hypothesis, it may be lower than lower bound value indicating the acceptance of null hypothesis or it may be in between the both lower and upper bound values creating ambiguity in the results. After this comparison, the elasticity of coefficients of the variables is estimated both in long run and short run in accordance with the following equation:

$$\begin{aligned} \ln GGE_t = & \alpha_1 + \sum_{i=1}^p \phi_1 \ln GGE_{t-i} + \sum_{k=1}^q \omega_1 \ln CD_{t-k} \\ & + \sum_{l=1}^r \phi_1 \ln EI_{t-l} + \sum_{m=1}^s \phi_m \ln GHS_{t-m} + \mu_t \end{aligned}$$

4. EMPIRICAL RESULTS

4.1. Results of Unit Root Test

The detailed results of ADF and LLC unit root tests have been given in Table 1. As these tests were used for the purpose of exploring the order of integration and stationary properties of the collected data, the results are interpreted accordingly. In results of ADF test, it can be seen that all the variables in level series have rejected the null hypothesis but greenhouse gas emission and government health spending have accepted the null hypothesis. On the other hand, all the variables in first difference series have rejected the null hypothesis. It can be stated that the data in level series is non stationary while it becomes stationary when first difference is applied to it. In the same way, LLC unit root tests can also be interpreted. All the variables in level series except government health spending have accepted the null hypothesis but all of them have rejected it in the first difference section giving the same results as that in ADF test.

4.1.1. Results of bounds co-integration test

After unit root test, the next test that was applied on the data in this study was co-integration test and F test was preferred over Wald test. In this regard, different estimated values were determined according to the AIC criteria as well as proper lag length and then these values i.e. upper bound and lower bound values were compared with the actual value of F statistic. The results of this test can be seen in Table 2 which shows that the value of F statistic is greater than the upper bound estimated values therefore it can

Table 1: Unit root analysis

Constructs	ADF test		LLC test	
	Level	1 st difference	Level	1 st difference
GGE	4.7548*	6.7486***	-1.7476	-2.8547***
CD	7.7547	8.2757**	-3.3565	-4.3528***
EI	5.2354	11.9675**	-4.9546	-3.8547***
GHS	3.8543*	5.2457***	-2.2424*	-5.3435***
POP	4.5432	7.8437***	-3.8547	-3.6478***
ENE	8.9885	3.2658***	-1.2434	-7.4575**

Table 2: Co-integration test

O.P.L. length (A.I.C)	F-Stat. (bound test)	V.C	L.B.C.V.	U.B.C.V.
(4,0,0,0,0)	7.7357**	3%	3.23	6.92
		7%	5.725	5.23
		11%	3.624	4.34

be stated that the null hypothesis has been rejected in this case. It would have been accepted if F statistic value was lesser than lower bound estimated value. As in this case, the null hypothesis of no co-integration is rejected it can be stated that there is co-integrated and long run relationship between the variables.

4.2. Results of ARDL Long Run and Short Run

After the determination of co-integrated relationship between the variables, the next step was the application of long run and short run ARDL tests so that the elasticity of coefficients of the variables can be determined. The results of short run ARDL have been presented in Table 3 and interpreted here. In the table, it can be seen that custom duty has negative significant and elastic impact on greenhouse gas emission with 10% significance level. With 1% increase in custom duty, greenhouse gas emission will be decreased by 12.6%. In the same fashion, the impact of energy imports is also significant, positive and elastic in regard of greenhouse gas emission. It means that with 1% increase in energy imports, the greenhouse gas emission will be increased by 28.64%. Government health spending however has insignificant impact in this regard. Apart from these independent variables, the impact of the control variable, energy consumption has also significant and elastic impact on greenhouse gas emission with 5% significance. These results can be summarized by stating that custom duty, energy imports and energy consumption have significant impacts in short run on greenhouse gas emission.

After analyzing the results of short run ARDL, the results of long run ARDL have been presented in Table 4 and are interpreted by the author. According to the table, the impacts of all the independent and control variables except population growth is significant and elastic in regard of greenhouse gas emission with different significance values. In other words, with increase of 1% custom duty, greenhouse gas emission will drop by 27.2%. In the same way, with increase of 1% energy imports, the greenhouse gas emission will also increase by 12.3%. When the government will increase 1% spending on health, the greenhouse gas emission will show a decrease by 23.3%. In short, custom duty, energy imports, government health spending and energy consumption have significant impacts in long run on greenhouse gas emission.

Table 3: ARDL short run results

Variable	Coefficient	SE	t-Stat.
CD	0.1264	0.241	3.532***
EI	0.2864	0.423	4.522***
GHS	0.2832	0.134	2.826
POP	1.2643	0.425	0.725
ENE	0.2764	0.286	3.275**
ECT _{t-1}	-0.8235	0.274	-6.275
R ²	0.1653	F-Stat	130.254***
Adj. R ²	0.8163	D.W.	1.762
Diagnostic test	X ² SC	X ² W	X ² AR
Indonesia	5.13 (1.753)	21.21 (1.754)	0.53 (0.754)

Table 4: ARDL long run results

Variable	Coefficient	SE	t-Stat.
GGE	1.7476	0.173	2.241***
GGE (-1)	-0.7254	1.836	3.425
GGE (-2)	0.2643	0.919	2.836***
CD	0.2725	0.133	6.725***
EI	0.1235	0.631	3.275***
GHS	0.2333	0.724	4.235*
POP	1.0916	1.725	3.286
ENE	0.1357	0.913	2.245**
C	0.1863	0.234	4.254***
R ²	0.9163	F-Stat	243.725***
Adj. R ²	0.1753	D.W.	5.45
Diagnostic test	X ² SC	X ² W	X ² AR
Indonesia	2.864 (2.724)	5.32 (1.376)	1.35 (0.344)

5. DISCUSSION AND CONCLUSION

5.1. Discussion

In this portion, the acceptance or rejection statuses of all the hypotheses formed for the purpose of this study have been discussed. The basic aim of this study was to find out and study the impact of custom duty, energy imports and government health spending on the emission of greenhouse gases. The first hypothesis in this regard was that custom duty has significant impact on greenhouse gas emission. This hypothesis was accepted according to the results and this is in accordance with a relevant past study (Blodgett et al., 2008). The second hypothesis was that energy imports have significant impact on greenhouse gas emission. The author has also accepted this hypothesis on the basis of the results obtained. The same results are evident in a past study conducted by another researcher (Knudson, 2009). The last hypothesis was that government health expenditure has significant impact on greenhouse gas emission and ultimately this hypothesis was also considered as accepted by the author. This behavior has also been shown by a past study (Chaabouni and Saidi, 2017). Apart from these variables, the impact of two control variables was also studied. The impact of population has been rejected as being significant but the impact of energy consumption has been accepted by the author. This result is exactly in concordance with a past study (Bilgen, 2014).

5.2. Conclusion

Custom duty, energy imports and government health spending are the aspects that may have direct or indirect impact on the emission of greenhouse gases. In this study, the author is supposed to investigate the same impact i.e. of the above given aspects on

greenhouse gases. The author has collected data from Thailand for 28 years in context of the above mentioned variables and after collecting, the data has been carefully analyzed. The tests that are used in the analysis of the collected data include unit root, bounds co-integration and ARDL tests. It has been evident from the results of these tests that the impact of all the independent variables i.e. custom duty, energy imports and government health spending have significant impact on greenhouse gas emission both in long run and short run. In addition, it has also been investigated that the impact of one control variable i.e. energy consumption has been found as significant in context of greenhouse gas emission. The author has identified and discussed some of the important theoretical, practical and policy making implications of this study. Some basic limitations have also been discussed along with the ways to improve them.

5.3. Implications

This study has found to have some theoretical, practical and policy making implications in different aspects. First of all, this study contains detailed literature to be used especially by the researchers, authors or any other person. This will not provide knowledge to them but may also give the direction of research. In addition, this study will also guide the custom department to consider their rates of duty as well as to manage the energy imports so that the greenhouse gas emission may be decreased. It will also provide guidance to the government to increase spending for health purposes in order to increase awareness about the harmful effects of greenhouse gases so that it may be controlled. The policy making and regulatory authorities may also get guidance from this study to make policies of high custom prices, low energy imports and high spending on health. All these policies will ultimately lead towards the decrease in greenhouse gas emission.

5.4. Limitations and Future Research Indications

In the last of the study, the author has discussed some of the limitations that have the scope of improvement by the future researchers. In this regard, the sample size of data may be increased by other researchers, which is very small in this study. In addition, the other researchers may go to the other variables as well in order to increase the scope of their researches. They may go to some other country for data collection purpose other than Thailand so that more places can be explored in context of this study. As the data was time series, particular tests were used in this study. The future researchers may use some other sets of tests that are suitable for time series data.

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