



# The Perspective for the Economy in Cambodia, Laos, Myanmar, Vietnam and Thailand: Economic Growth, Inequality, and Environmental Considerations

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**Abstract.** The aim of the study was to examine the sustainability (environmental, social and economic impacts) in Cambodia, Laos, Myanmar, and Vietnam (CLMV countries) and Thailand. We evaluated sustainable development through three perspectives such as environmental indicators assessed include carbon emissions, social indicators include inequality, and the economic indicator is the growth rate of real GDP. Our theoretical model introduced Bayesian kink regression model. From the results of the study, it was found that economic development is correlated with the level of inequality. While economic development does not affect the amount of carbon emissions. This demonstrates that economic development has a greater effect on inequality than environmental problems. Economists and policymakers can use the results of empirical studies to come up with guidelines or policies that can be implemented for finding ways to develop the economy further, taking into account the impact of creating more inequality from economic development.

**Keywords:** CLMV · Thailand · Economic growth · Inequality · Carbon emission

## 1 Introduction

Over the past few years, the direction of global investment has gradually shifted towards emerging markets. One target that has continued to gain popularity is Cambodia, Laos, Myanmar and Vietnam (CLMV countries). The four countries are members of the Association of Southeast Asian Nations (ASEAN), like Thailand. For CLMV economies, these economies have maintained remarkable growth over the years despite global economic slowdowns. The educational goals of the CLMV countries are interesting. At the same time, Thailand, which is considered to be bordering the CLMV countries, is also a developing country. This is the researcher's desire to see how the economies of these two groups are similar or different. Because the researchers believe that although these two groups are similar and adjacent to each other, the effects of economic development on the environment and social are different.

The economic growth based on real The GDP of CLMV countries and Thailand tends in similar direction as shown in Fig. 1. In 2020, the COVID-19 epidemic has caused all countries to suffer the same economic impact. At that time, the country CLMV and Thailand have dropped real GDP levels but after that, all 5 countries gradually recovered and improved accordingly.

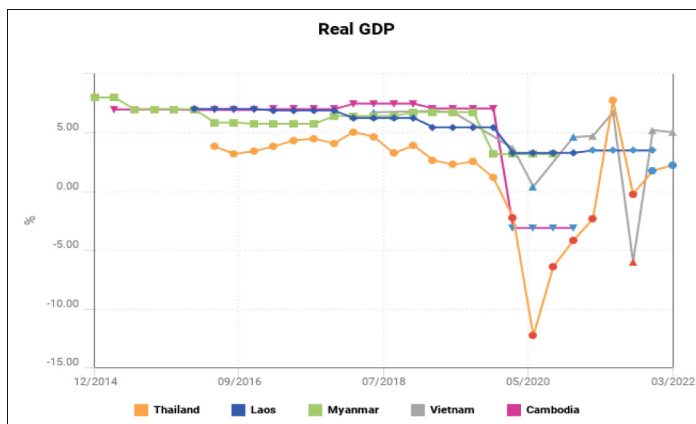


Fig. 1. The real GDP of CLMV countries and Thailand

When a country changes or develops rapidly, there will be consequences. The main impacts of economic development are environmental impacts and inequality effects. Because authors are aware of the sustainability-related issues listed in the Sustainable Development Goals (SDGs) and look to build a green economy. In this study, the researchers attempted to explore three issues to create three sustainability principles: social, economic and environmental, in accordance with the SDGs' primary objectives. The researchers believe that economic development alone cannot contribute to the sustainability of the country. The country should also develop in other areas such as the environment and society to achieve long-term sustainable development. Thus, the main objective in this study is to study how the continuous economic development of the five countries will affect the carbon emissions which is an environmental impact and affect the income inequality of the people in the country. It is an economic and social impact.

## 2 Literature Review

[1] stated that the big controversy that has long been the issue of the relationship between economic growth and environmental quality. One controversy is the view that greater economic activity inevitably leads to environmental degradation and ultimately to economic and ecological collapse. This has resulted in extensive studies of the relationship between the environment and sustainable economic development. Some studies agree with Shafik's statement, but others have opposite results. For instance, [2] examined the reduced-form relationship between per capita income and various environmental indicators such as urban air pollution, the state of the oxygen regime in river basins, fecal

contamination of river basins, and contamination of river basins by heavy metals. The result finds no evidence that environmental quality deteriorates steadily with economic growth. Moreover, the economic growth causes environmental deterioration initially but later improvements occur. [3] agrees that a key factor in achieving sustainable economic development is the prudent use of environmental resources. Furthermore, there are many studies of economic growth on social impacts such as poverty and unemployment rate. For instance, [4] analyzed the relationship between economic growth, unemployment and poverty in Vietnam. The research results indicate public investment has a positive effect on economic growth but negatively affects poverty. [5] analyzed the causal link between growth versus poverty. They concluded that growth is good for poverty alleviation but it is not enough. When we connect these three aspects, namely economic, social and environmental, it will lead to sustainable development. Sustainable development is gaining momentum in every region around the world in every sector. The relationship between economic, social and environmental impacts has been studied extensively in various perspectives. [6] studied the case of wildfires in Australia. They believe that wildfires often result in widespread destruction and damage to a range of economic, social and environmental assets and functions. [7] studied the impacts of cruise tourism on the economic, social, and environmental. They compare community impacts before and after the opening of a cruise ship port. The result found some negative evidences such as the ability of the local population to provide for necessities and obtain sufficient food worsened, corruption increased, and there were substantial negative environmental impacts. Large cruise tourism projects can fail to provide benefits for local populations in some ways. [8] investigated the sustainability (environmental, social and economic impacts) of tea manufacturing in Sri Lanka. The study found many issues including energy efficiency of the industry, Green House Gas (GHG) emissions, and occupational health hazards during processing stage. From most types of tea, low grown orthodox tea is the most efficient in terms of labor use, energy use and carbon emissions. [9] evaluated the potential impacts of removing energy subsidies on the Malaysian economy. The result of the study was unexpected. There are both positive and negative impacts of removing energy subsidies. It is shown that removing petroleum and gas subsidy would improve economic efficiency, increase GDP, and reduce budget deficit. However, households would be worse off due to higher price level. Recently, the issue of sustainability has been continuously studied. [10] interested in Bioeconomy because it is as a chance to focus on a sustainable mode of production and consumption. They assess its impact for implementing policies. [11] assessed the impacts of social, economic and environmental factors on the logarithm of housing prices in Hong Kong. The findings indicated that factors that are significant to house prices are economic factors and environmental factors. However, demographic factors are not as significant as expected in affecting housing prices. From the past research, we can see that the study raises the issue of various situations to look at the economic, social and environmental impact. But the difference in this study is that the researchers looked at the relationship between economic development (real GDP) and environmental impacts based on carbon emissions (carbon Emission) and social impacts in terms of inequality (Gini Index). This type of study is not widely studied, especially in emerging and developing countries such as CLMV countries and Thailand. Therefore, with all of the above, this study is an extension and

doing something new that has never been studied before, especially in countries with continuous growth rates such as CLMV countries and Thailand.

### 3 Data and Methodology

#### 3.1 Data

This study uses panel data of CLMV countries and Thailand, from 1997 to 2020, and uses carbon emissions (CO<sub>2</sub>) as a proxy of environmental degradation, Gini coefficient as an indicator of inequality of income and consumption of people in the country and real GDP as an indicator of economic development. In addition, this study uses yearly time series data running from 1997 to 2020 of carbon emissions, Gini index and the growth rate of real GDP of 5 individual countries, which are member countries of the two groups, including Cambodia, Laos, Myanmar, Vietnam, and Thailand. Table 1 describes the variables employed in the study.

**Table 1.** Description of variables.

Variable	Description and data source	Symbol
Environmental degradation	Environmental degradation is measured using territorial CO <sub>2</sub> emissions, which come from the burning of fossil fuels due to human activities as well as production processes. This variable is considered a dependent variable in our analysis (unit: kt). (from CEIC data)	CO <sub>2</sub>
Economic Development	Economic development in this analysis is measured by real GDP per capita. (from CEIC data)	GDP
Inequality	Inequality of income and consumption of people in the country (from CEIC data)	GINI

### 4 Methodology

#### 4.1 Bayesian Approach for Panel Kink Regression Model

[12] utilized Bayesian kink regression to estimate unobserved thresholds, and they found that this approach worked very well to find out the unknowable threshold. In this study, we applied Bayesian kink regression in the case of the panel kink regression model with an unknown threshold (see Eq. (1)).

$$Y_{it} = \beta_1^- (X_{1,it} - \gamma)_- + \beta_1^+ (X_{1,it} - \gamma)_+ + \beta_2' X_{2,it} + \alpha_i + \varepsilon_{it} \quad (1)$$

$$i = 1, \dots, N, t = 1, \dots, T$$

where  $Y_{it}$ ,  $X_{1,it}$ ,  $\varepsilon_{it}$  are the random scalars and the  $X_{2,it}$  is a vector of regressor. The  $\alpha_i$  is the unobserved heterogeneity of the  $i$  th individual which can be correlated with  $X_{it} = (X_{1,it}, X'_{2,it})$ . Define that the  $(\alpha)_- = \min(\alpha, 0)$  and the  $(\alpha)_+ = \max(\alpha, 0)$ . Moreover, the  $\beta_1^-$  is the slope of  $X_{1,it}$  and the  $\beta_1^+$  is the slope of  $X_{2,it}$ . The  $\gamma$  is the unknown threshold point and  $\gamma \in \Gamma$ . The objective is estimating unknown parameters  $(\beta_1^-, \beta_1^+, \beta'_2, \gamma)$  and testing for the Kink effect of  $X_{1,it}$  when  $N$  goes to infinity while  $T$  is fixed. The model (Eq. (2)) has wide potential applications. One prominent example is originally from Reinhart and Rogoff (2010, 2011). Their study is called debt-threshold effect on economic growth. To investigate the relationship across different countries, one can consider a panel regression model as follows the Eq. (2).

$$gdp_{it} = \beta_1^-(Debt_{it} - \gamma)_- + \beta_1^+(Debt_{it} - \gamma)_+ + \beta'_2 X_{2,it} + \alpha_i + \varepsilon_{it} \tag{2}$$

where the  $gdp_{it}$  is the real GDP growth rate in  $t$  th year for the  $i$  th country. And  $Debt_{it}$  is the debt to GDP ratio from the previous year. Addition, the  $X_{2it}$  is includes other variables which may affect economic growth. The result found that economic growth tends to be slow when the level of government debt relative to GDP exceeds a threshold. After that the study is recently re-examined by many researchers. The difference between them is the use of tools of threshold regression. Furthermore, the model can be adapted to investigate in many aspects such as the kink effects of income inequality on economic growth [13], the kink effects of cash flow on investment [14], and the kink effects of capital structure on firm value [15], and so on.

In this study, the authors would like to find the correlation of inequality and carbon emission to economic growth phenomena among CLMV countries and Thailand. Thus, the panel data of each group of countries are constructed and the panel kink regression model is used to fit these data. The model (Eq. (2)) can be adapted to investigate the kink effects of carbon emission and inequality on economic growth in CLMV countries and Thailand. To investigate the relationship between carbon emission and economic growth across CLMV countries and Thailand, one can consider a panel regression model as follows the Eq. (3).

$$gdp_{it} = \beta_1^-(CO2_{it} - \gamma)_- + \beta_1^+(CO2_{it} - \gamma)_+ + \beta'_2 X_{2,it} + \alpha_i + \varepsilon_{it} \tag{3}$$

where  $gdp_{it}$  is the real GDP growth rate in  $t$  is the year for the  $i$  is the country ( $i =$  Cambodia, Laos, Myanmar, Vietnam, Thailand). And the  $CO2_{it}$  is the carbon emission from the previous year. Addition, the  $X_{2it}$  is included other variables which may affect economic growth. To investigate the relationship between inequality and economic growth across CLMV countries and Thailand, one can consider a panel regression model as follows the Eq. (4).

$$gdp_{it} = \beta_1^-(GINI_{it} - \gamma)_- + \beta_1^+(GINI_{it} - \gamma)_+ + \beta'_2 X_{2,it} + \alpha_i + \varepsilon_{it} \tag{4}$$

where the  $gdp_{it}$  is the real GDP growth rate in  $t$  is year for the  $i$  is country ( $i =$  Cambodia, Laos, Myanmar, Vietnam, Thailand). And the  $GINI_{it}$  is the Gini coefficient from the previous year. Addition, the  $Z_{it}$  includes other variables which may affect economic growth.

## 5 Empirical Results

### 5.1 Data Descriptive

From Table 2 shows the descriptive statistics of all variables such as the growth rate of real GDP (**G\_REAL\_GDP**), the Gini coefficient (**GINI**), and the carbon emission (**CO<sub>2</sub>**) respectively. The economic growth of CLMV and Thailand has no effect on carbon emission, but affects the level of inequality.

**Table 2.** Data descriptive and data visualization.

Items	G_REAL_GDP	GINI	CO <sub>2</sub>
Mean	5.629612	36.23400	0.639652
Median	6.534114	35.80000	0.570000
Maximum	13.62797	43.10000	1.560000
Minimum	-7.634035	30.70000	0.160000
Std. Dev.	4.247341	3.038310	0.366288
Skewness	-0.595870	0.026920	0.877496
Kurtosis	3.656324	2.899716	2.759816
Normality test			
Jarque-Bera	8.869400	0.062079	15.03473
Probability	0.011859	0.969437	0.000544
Panel unit root test			
Levin, Lin & Chu t*	-1.93283	-1.87357	-1.98219
Probability	(0.0266)	(0.0305)	(0.0237)
Observations	115	115	115

\* Stationary at zero level (I(0)) by significance level of 0.05

**Source:** Author

### 5.2 Model Estimation

From Table 3, it shown that the appropriated model for investigating the relationship between the economic development and inequality is the fixed effect Bayesian kink regression model. On the other hand, the appropriated model for investigating the relationship between the economic development and carbon emission is the pooled effect Bayesian kink regression model.

The R-squared for Bayesian Regression Models was created by [16] and is shown in more detail in Eq. (5).

$$Bayesian R_s^2 = \frac{V_{n=1}^N y_n^{pred s}}{V_{n=1}^N y_n^{pred s} + var_{res}^s}, y_n^{pred s} = E(\tilde{y}|X_n, \theta^s) \quad (5)$$

**Table 3.** The value of Bayesian R<sup>2</sup> from model estimation

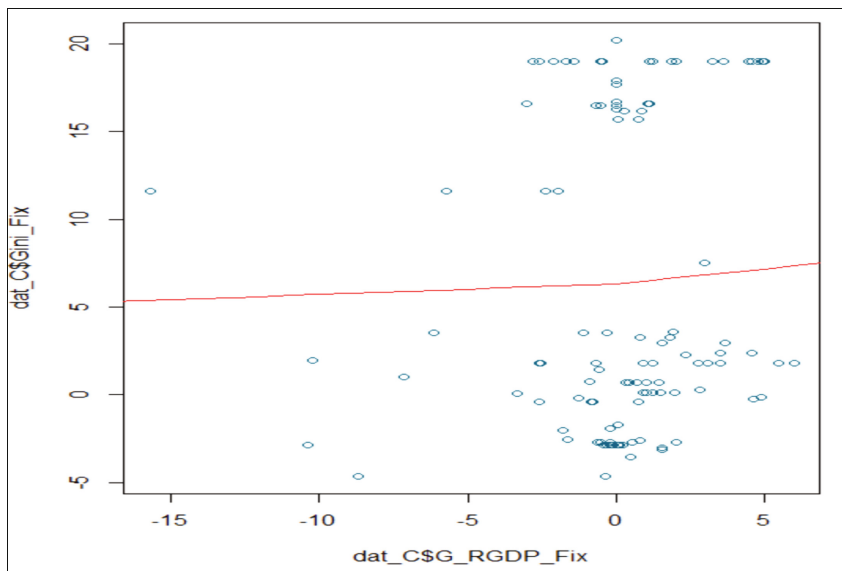
Model estimation	Bayesian R <sup>2</sup>	
	Real GDP-Gini	Real GDP-CO <sub>2</sub>
Pooled effect	0.03059025	<b>0.183269*</b>
Fixed effect	<b>0.9294682*</b>	0.04930859
Random effect	0.9270009	0.04874109
Mixed effect	0.8665936	0.08445103

\* The 1st highest Bayesian R<sup>2</sup>

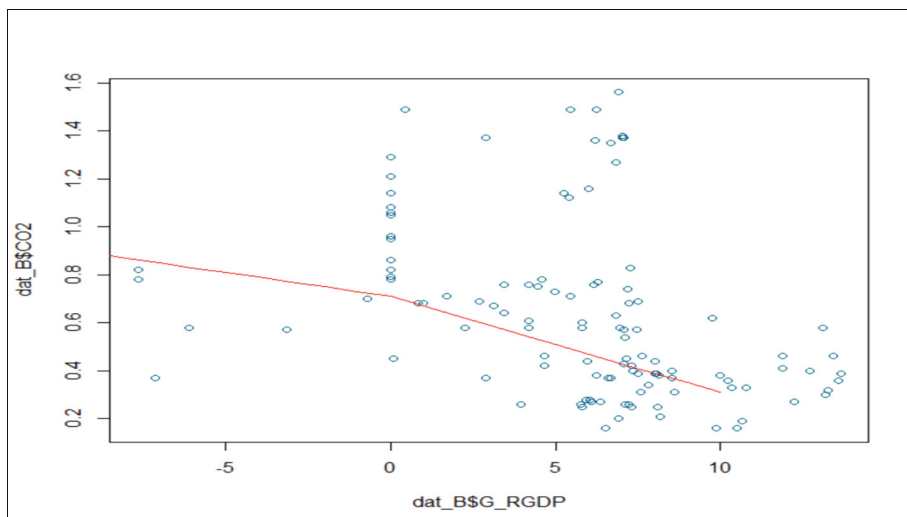
**Source:** Author

The  $y_n^{pred\ s} = E(\tilde{y}|X_n, \theta^s)$  is the predicted value of the Bayesian regression models, and the  $var_{res}^s$  is the expected residual variance of the Bayesian regression models. The statistical value of the Bayesian R<sup>2</sup> is equal to 0 and 1. If the value of this statistic approaches 1, which indicates that the Bayesian regression model is appropriate, then it was suggested that this regression model is very appropriate or useful to conduct the knowledge to formulate the policy recommendation. In this case, the fixed effect model is the appropriate model because the Bayesian R<sup>2</sup> is very high (0.9294682\*) compared with another model. Therefore, this model was utilized to explain the relationship between the Gini index and the growth rate of real GDP (see Fig. 2). From Fig. 2, we would be able to confirm that there is more economic expansion (economic growth: the growth rate of real GDP) and then more inequality (Gini coefficient) for each of the CLMV countries and also for Thailand. The pooled effect model was chosen as the appropriate model to describe the relationship between environmental protection (CO<sub>2</sub> emissions) and economic growth. Because, when compared to other models, this model has the greatest Bayesian R<sup>2</sup> value (0.183269\*). However, this pooled effect model still points out a weak association between environmental protection (CO<sub>2</sub> emissions) and economic growth for the CLMV countries and Thailand (see Fig. 3).

In Fig. 3, the regression line (the red line) was conducted by the pooled effect model, which is quite bad at describing the relationship between CO<sub>2</sub> emissions and the growth rate of real GDP for the CLMV countries and Thailand. Normally, the pooled effect model is utilized as the reference to be the baseline model when comparing another panel model. The baseline means that there is no need to design the pattern of panel data to be estimated by the fixed effect model, the random effect model, or the mixed effect model. In this economic sense, this study would confirm that the overview of CLMV countries and Thailand still maintains economic expansion or economic growth and environmental protection in balance.



**Fig. 2.** The regression line (Fixed effect model) shows the relationship between the Gini index and real GDP for the CLMV countries and Thailand.



**Fig. 3.** The regression line (Pooled effect model) shows the relationship between the CO<sub>2</sub> emission and the growth rate of real GDP for the CLMV countries and Thailand.



## 6 Conclusion and Policy Recommendation

We summarize that the relationship between the economic development and inequality from fixed effect Bayesian kink regression model in Cambodia, Laos, Myanmar, and Vietnam (CLMV countries) and Thailand have the same direction. We can conclude that an increase in GDP will result in an increase in inequality levels. The study in CLMV countries and Thailand shows that economic development (considering the growth rate of real GDP) does not reduce inequality (considering the Gini index). Therefore, when formulating policies on economic development especially economic growth in the CLMV countries and Thailand, the negative impact of inequality should also be taken into account. On the other hand, CLMV countries and Thailand may not have a problem with emissions (considering carbon emissions) caused by economic development, especially economic balance growth (considering the growth rate of real GDP), since the finding illustrated that economic development did not affect emission levels. The results of this study show important implications: although CLMV countries and Thailand have continued economic development, at the same time, we should take into account the consequences of these economic developments. Especially on the issue of inequality arising from the rapid economic development of these countries. This is because the study found that greater economic development in terms of real GDP would result in greater inequality by using the Gini coefficient variable as a representative measure of inequality. As for the issue of environment and economic development in the CLMV countries and Thailand, it may not be much of a problem if compared to the inequality mentioned earlier. This is because the results of the study show that economic development has not yet affected carbon emissions. Therefore, in order to achieve sustainable development in the future, CLMV countries and Thailand should also consider the inequality that will arise from economic development. Policymakers should not only look at the need for economic development while ignoring these issues when implementing policies. This study makes several research contributions. First, it is one of the first studies to examine the relationship between economic impact and social impact (inequity, as referred to the welfare economics (socio-economic impacts)) [17] and between economic impact and environmental impact in CLMV countries and Thailand. Our study contributes to the understanding of economic development dynamics in CLMV countries and Thailand from a more holistic perspective by comparing the impacts of economic, social, and environmental factors. Second, the empirical results reveal various interesting effects. For instance, an increase in economic development (considering the growth rate of real GDP) will result in an increase in inequality levels (considering the Gini index), but the economic development (considering the growth rate of real GDP) will not affect emission levels (considering carbon emissions). The results thus have important implications: Current policy instruments to stimulate economic development are focused on increasing real GDP in a nation (economic factors), while little attention is paid to social or environmental factors. Our findings suggest that an increase in real GDP may be a source of inequality among the population within a country. Therefore, efforts should be made to improve economic stimulus policies while simultaneously paying attention to the issue of inequality. CLMV countries and Thailand should not focus solely on stimulating economic development based on real GDP, as perhaps economic development will lead to inequality. Therefore, in order to achieve sustainable development,

these two issues should be considered together. Regarding research limitations, future research is needed to examine the economic impact beyond just the value of GDP. This is because economic growth in one country can be viewed from a different perspective than the GDP value. Moreover, social and environmental impacts can be viewed from other angles than inequality and carbon emissions.

## References

1. Shafik, N.: Economic development and environmental quality: an econometric analysis. *Oxford Econ. Pap.* **46**, 757–773 (1994)
2. Grossman, G.M., Krueger, A.B.: Economic growth and the environment. *Q. J. Econ.* **110**(2), 353–377 (1995)
3. Awan, A.G.: Relationship between environment and sustainable economic development: a theoretical approach to environmental problems. *Int. J. Asian Soc. Sci.* **3**(3), 741–761 (2013)
4. Quy, N.H.: Relationship between economic growth, unemployment and poverty: analysis at provincial level in Vietnam. *Int. J. Econ. Financ.* **8**(12), 113–119 (2016)
5. Škare, M., Družeta, R.P.: Poverty and economic growth: a review. *Technol. Econ. Dev. Econ.* **22**(1), 156–175 (2016)
6. Stephenson, C., Handmer, J., Betts, R.: Estimating the economic, social and environmental impacts of wildfires in Australia. *Environ. Hazards* **12**(2), 93–111 (2013)
7. MacNeill, T., Wozniak, D.: The economic, social, and environmental impacts of cruise tourism. *Tour. Manage.* **66**, 387–404 (2018)
8. Munasinghe, M., Deraniyagala, Y., Dassanayake, N., Karunaratna, H.: Economic, social and environmental impacts and overall sustainability of the tea sector in Sri Lanka. *Sustain. Prod. Consumption* **12**, 155–169 (2017)
9. Li, Y., Shi, X., Su, B.: Economic, social and environmental impacts of fuel subsidies: a revisit of Malaysia. *Energy Policy* **110**, 51–61 (2017)
10. Ferreira, V., Fabregat-Aibar, L., Pié, L., Terceño, A.: Research trends and hotspots in bio-economy impact analysis: a study of economic, social and environmental impacts. *Environ. Impact Assess. Rev.* **96**, 106842 (2022)
11. Li, J., Fang, W., Shi, Y., Ren, C.: Assessing economic, social and environmental impacts on housing prices in Hong Kong: a time-series study of 2006, 2011 and 2016. *J. Housing Built Environ.* **37**(3), 1433–1457 (2022)
12. Moeltner, K., Ramsey, A.F., Neill, C.L.: Bayesian kinked regression with unobserved thresholds: an application to the von Liebig hypothesis. *Am. J. Agr. Econ.* (2021). <https://doi.org/10.1111/ajae.12185>
13. Savvides, A., Stengos, T.: Income inequality and economic development: evidence from the threshold regression model. *Econ. Lett.* **69**(2), 207–212 (2000)
14. Seo, M.H., Shin, Y.: Dynamic panels with threshold effect and endogeneity. *J. Econometrics* **195**(2), 169–186 (2016)
15. Masulis, R.W.: The impact of capital structure change on firm value: some estimates. *J. Financ.* **38**(1), 107–126 (1983)
16. Gelman, A., Goodrich, B., Gabry, J., Vehtari, A.: R-squared for Bayesian regression models. *Am. Stat.* **73**, 1–6 (2018)
17. Berger, L., Emmerling, J.: Welfare as equity equivalents. *J. Econ. Surv.* **34**(4), 727–752 (2020). <https://doi.org/10.1111/joes.12368>