The New Empirics of the Relationship between Stock Market Development and CO2 Emissions- Testing in Nonlinear Heterogeneous Panels

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Abstract

The rapid expansion of CO_2 emissions changes in both foreign trade and developed markets has prompted policymakers to raise important questions about their macroeconomic impact. This study we test unit root tests for nonlinear heterogeneous panels and found that strong evidence of the relationship between CO_2 emissions and other variables are non-linear. We used the panel smooth transition regression model and found that strong evidence of trade off correlation between foreign trade and the CO_2 emissions. Different from the other articles, we also found that strong evidence of the higher level belong to stock market development have resisted effect for CO_2 emissions.

Keywords: foreign trade, stock market development, CO_2 emissions.

1. Introduction

Foreign trade impact on economic growth crucially depend on globalization and its has brought about changes in the economic and financial scenarios of the developing countries. There is no denying that foreign trade is beneficial for the countries involved in trade, if practiced properly. Foreign trade opens up the opportunities of global market to the entrepreneurs of the countries.

The impact of foreign trade on the stock market development, recently attracted the attention of many economists, as companies can get more capital through the stock market, so as an international trade company, more flexibility in capital utilization. Hung-Gay Funga et al. [1995] they use vector autoregressive analysis to examine the dynamic interactions of monthly real stock returns, return volatility, exchange rates, export growth and import growth for Hong Kong, Korea, Singapore, and Taiwan for the period 1975 – 1991. they find that exports and imports have significant interactions. The results also indicate that stock returns in Hong Kong and Singapore Granger-cause trade flows. Return volatility is found to react strongly to trade news in all four countries, a result supporting the efficient-market hypothesis.

However, the effects of global warming have been devastating, affecting both the environment and human being in habiting the environment. The human activities that propagated these CO2 emissions are the burning of coal, gas, oil and so on. CO2 emissions has been causing harmful effects to the environment and even to the whole earth. However, the trade to meet international orders must through manufacturing, and requires a lot of labor and production scale, and as such, many countries may earn a lot of foreign exchange earnings, and create economic development or stock development, but the manufacturing process may produce more pollution, they began to worry about pollution problems recently.

Manufacturing facilities are one of the main industries that directly combust fossil fuel and create CO2 emissions. The steam and the heat from the burned fossil fuels are needed to manufacture different products and it varies through the different stages of production. Another is that these manufacturing facilities use huge amounts of electricity compared to houses and establishments, and huge amount of electricity translate to huge amount of CO2 emission, on the other hand,

manufacturing requires a lot of labor, Claudia Kemfert and Heinz Welsch[2000] although the economic effects of CO2 abatement depend substantially on the degree to which capital and labor can substitute for energy, the issue of energy-capital-labor substitution is surrounded by considerable uncertainty. Soytas et al. [2007] study the long run Granger causality between emissions, energy use, and growth for US economy, with additional considerations for labor and capital. Though they do not find any evidence of causality between carbon emissions and income; and energy consumption and income, but verify that energy use is the foremost source of emissions.

It is an obvious fact that as the Hecksher-Ohlin trade theory suggests that, under free trade, developing countries would specialize in the production of goods that are intensive in the factors that they are endowed with in relative abundance: labor and natural resources. The developed countries would specialize in human capital and manufactured capital intensive activities. Trade entails the movement of goods produced in one country for either consumption or further processing. This implies that pollution is generated in the production of these goods is related to consumption in another country.

There is no consensus on the effect of international trade on the environment, in particular on the effect of trade on global emissions. Neither the theoretical nor the empirical literature provides a clean cut answer to the link between trade and CO2 emissions. The empirical literature on the link between trade in goods and emissions is also inconclusive. Batrakova and Davies[2010] find that, for low fuel intensity firms, fuel expenditures are positively correlated with exporting. Finally, Rodrigue and Soumonni[2011] employ Indonesian firm-level data to investigate the impact of environmental investment on productivity dynamics and exports. They find that while productivity dynamics do not appear to be affected, growth in exports is positively affect by environmental investments.

The relationships between economic growth and environmental pollution, as well as economic growth and energy consumption, have been intensively analyzed empirically over the past two decades. The first nexus is closely related to testing the validity of the so-called environmental Kuznets curve (EKC) hypothesis. A recent

and emerging line of literature seems to incorporate both nexuses into multivariate framework. This approach facilitates the examination of the dynamic relationships between economic growth, energy consumption and environmental pollutants altogether, see for example, Tamazian and Rao [2010] applied the GMM approach to find the effects of institutional, economic, and financial developments on CO2 emissions for transitional economies. They presented that these factors help lower CO2 emissions and also found support in favor of the EKC. Jalil and Feridun [2010] investigated the impact of financial development, economic growth and energy consumption on CO2 emissions in the case of China from 1953 to 2006. The results of the analysis revealed a negative sign for the coefficient of financial development, suggesting that financial development in China has not taken place at the expense of environmental pollution. On the contrary, it is found that financial development save environment from degradation. Moreover, the results confirm the existence of a long-run relationship between carbon emissions, income, energy consumption and trade openness while supporting the presence of EKC hypothesis.

However, growing interest among macroeconomists over the past decade in the role of the financial sector in promoting economic activity has produced a burgeoning literature. Rousseau and Wachtel [2000]they find that the rapid expansion of organized equity exchanges in both emerging and developed markets has prompted policymakers to raise important questions about their macroeconomic impact, yet the need to focus on recent data poses implementation difficulties for econometric studies of dynamic interactions between stock markets and economic performance in individual countries.

Different from the other articles, the foregoing discussion shows a lack of consensus on the effect of the stock development and CO2 emissions base on different threshold of foreign trade . This may be due to country specific conditions which need to be considered and analyzed. It is against this back drop that the present study is undertaken to better understand the relationship in the context of OECD countries. Our empirical study's dataset consists of monthly CO2 emissions, foreign trade, stock market development, bank development ,employment ratio and so on . The sample period for the study covers ten years from January 1997 to June

2007, containing a total of OECD countries. We find strong evidence of the different foreign trade attributes of OECD countries produce completely different CO2 emissions and stock market development. In sum, the threshold of foreign trade is an important index between with CO2 emissions .

The remainder of the paper is organized as follows. Section 2 is a brief review of the PSTR model. Section 3 provides the empirical results. Section 4 is conclusion and remarks.

2. METHODOLOGY

Methodology, model specifications and variable constructions

We follow EKC and use the panel data model to estimate the CO_2 emissions, to explain the relation CO_2 emissions and foreign trade. we use several important variables as independent variables:

$$C_{it} = f(EC_{it}, Y_{it}, Y_{it}^2, BD_{it}, SD_{it}, L_{it}, TR_{it}) \quad (1)$$

where CO_2 emissions per capita (C_{it},CO_2) is a function of energy use per capita (EC_{it},energy consumption), real gross domestic income per capita (Y_{it},GDP), the square of real gross domestic income per capita (Y_{it}^2,GDP^2), private credit extended by deposit money in banks to GDP is used to measure financial development (BD_{it},bank), market capitalization of listed companies of GDP (SD_{it},stock), measure the employment of labor (L_{it},labor), and exports of goods and services (TR_{it},trade),we express the log equation as follows:

$$\text{Panel A}: \ln C_{it} = \alpha_{0i} + \delta_i t + \beta_{1i} \ln EC_{it} + \beta_{2i} \ln Y_{it} + \beta_{3i} \ln Y_{it}^2 + \beta_{4i} \ln L_{it} + \beta_{5i} \ln BD_{it} + \varepsilon_{it} \quad (2)$$

$$\text{Panel B}: \ln C_{it} = \alpha_{0i} + \delta_i t + \beta_{1i} \ln EC_{it} + \beta_{2i} \ln Y_{it} + \beta_{3i} \ln Y_{it}^2 + \beta_{4i} \ln L_{it} + \beta_{5i} \ln BD_{it} + \beta_{6i} \ln SD_{it} + \varepsilon_{it} \quad (3)$$

$$\text{Panel C}: \ln C_{it} = \alpha_{0i} + \delta_i t + \beta_{1i} \ln EC_{it} + \beta_{2i} \ln Y_{it} + \beta_{3i} \ln Y_{it}^2 + \beta_{4i} \ln L_{it} + \beta_{5i} \ln BD_{it} + \beta_{6i} \ln SD_{it} + \beta_{7i} \ln TR_{it} + \varepsilon_{it} \quad (4)$$

We estimate Equation(2),(3),(4) using the panel approach that takes into consideration both country i and year t, while α_{0i}, $\delta_i t$, and ε_{it} are the fixed effects, deterministic trends, and error terms, respectively. We observed increment or decrement the size and performance relationship, signs of β_{4i}, β_{5i}, β_{6i} and β_{7i} should be expected.

Both a conventional unit root test, the augmented Dickey-Fuller (ADF) test, and a

more recently developed test by KSS (2003) are utilized for the study.1 The two tests have the same null hypothesis of a unit root, but the alternative hypothesis of the ADF is linear stationarity while KSS allow for nonlinear stationarity in the alternative. For yt being the de-meaned or de-meaned and de-trended series of interest, the KSS tests are based on the following auxiliary regression:

$$\Delta y_t = \delta y_{t-1}^3 + \sum_{j=1}^{k} \rho_j \Delta y_{t-j} + \text{error} \tag{5}$$

which is obtained from a first-order Taylor series approximation of an ESTAR model specified in KSS (2003). The null hypothesis of nonstationarity to be tested with (1) is H_0: $\delta = 0$ against the alternative of (nonlinear) stationarity H_1: $\delta < 0$. The augmentations $\sum_{j=1}^{k} \rho_j \Delta y_{t-j}$ are included to correct for serially correlated errors. KSS (2003) use the t-statistic for $\delta = 0$ against $\delta < 0$, referred to as the KSS statistic, and tabulated the asymptotic critical values of the KSS statistics via stochastic simulations.

In this study, we propose a novel approach that can be used to examine non-linear relationship between CO_2 emissions and under the different Trade stage. For this purpose, we use the panel smooth transition regression (PSTR) model that imposes a common regime-switching mechanism while allowing for considerable heterogeneity in the timing of the regime changes across series. We will first briefly review the PSTR model. The basic PSTR model with two extreme regimes is defined as follows:

$$y_{it} = \mu_i + \beta_0^{'} x_{it} + \beta_1^{'} x_{it} g(q_{it}; \gamma, c) + u_{it} \tag{6}$$

for i = 1, . . . , N, and t = 1, . . . , T, where N and T denote the cross-section and time dimensions of the panel, respectively. The dependent variable yit is a scalar, xit is a k-dimensional vector of time-varying exogenous variables, μi represents the fixed individual effect, and uit are the errors. Transition function $g(q_{it}; \gamma, c)$ is a continuous function of the observable variable qit and is normalized to be bounded between 0 and 1, and these extreme values are associated with regression coefficients

[1] The results of a preliminary investigation indicate that using French or German currency as one of numeraire currencies would not make a qualitative difference in the conclusions of this study.

β_0 and $\beta_0 + \beta_1$. More generally, the value of qit determines the value of $g(q_{it};\gamma,c)$ and thus the effective regression coefficients $\beta_0 + \beta_1 g(q_{it};\gamma,c)$ for individual i at time t. The widely used transition function is a logistic specification as in equation (7)

$$g(q_{it};\gamma,c) = \left(1+\exp\left(-\gamma\prod_{j=1}^{m}(q_{it}-c_j)\right)\right)^{-1}$$
$$with\ \gamma > 0\ \ and\ \ c_1 \le c_2 \le \cdots \le c_m \tag{7}$$

where c = (c1, . . , cm)' is an m-dimensional vector of location parameters and the slope parameter γ determines the smoothness of the transitions. The restrictions $\gamma > 0$ and c1≤ . . . ≤ are imposed for identification purposes. In practice it is usually sufficient to consider m = 1 or m = 2, as these values allow for commonly encountered types of variation in the parameters. For m = 1, the model implies that the two extreme regimes are associated with low and high values of qit with a single monotonic transition of the coefficients from β_0 to $\beta_0 + \beta_1$ as qit increases, where the change is centered around c1. When $\gamma \to \infty$, $g(q_{it};\gamma,c)$ becomes an indicator function $I[q_{it} > c_1]$, defined as I [A] = 1 when the event A occurs and 0 otherwise. In that case the PSTR model in equation (1) reduces to the two-regime panel threshold model of Hansen (1999). For m = 2, the transition function has its minimum at (c1 + c2)/2 and attains the value 1 both at low and high values of qit. When $\gamma \to \infty$, the model becomes a three-regime threshold model whose outer regimes are identical and different from the middle regime. In general, when m > 1 and $\gamma \to \infty$, the number of distinct regimes remains two, with the transition function switching back and forth between zero and one at c1, . . . , cm. Finally, for any value of m the transition function becomes constant when $\gamma \to 0$, in which case the model collapses into a homogenous or linear panel regression model with fixed effects.

A generalization of the PSTR model to allow for more than two different regimes is the additive model:

$$y_{it} = \mu_i + \beta_0^{'} x_{it} + \sum_{j=1}^{r} \beta_j^{'} x_{it} g_j(q_{it}^{(j)};\gamma_j,c_j) + u_{it} \tag{8}$$

Where the transition functions $g_j(q_{it}^{(j)};\gamma_j,c_j)$,j=1,⋯,r, are of the logistic type. If m = 1, $q_{it}^{(j)} = q_{it}$ and $\gamma_j \to \infty$, for all j = 1, . . . , r, the model in equation (8) becomes a PTR model with r + 1 regimes. Consequently, the additive PSTR model can be

viewed as a generalization of the multiple regime panel threshold model in Hansen (1999). Additionally, when the largest model that one is willing to consider is a two-regime PSTR model with r = 1 and m = 1 or m = 2, equation (8) plays an important role in the evaluation of the estimated model. In particular, the multiple regime equation (8) is an obvious alternative in diagnostic tests of no remaining heterogeneity.

The building procedure of PSTR model consists of specification, estimation and evaluation stages. Specification includes testing homogeneity, selecting the transition variable yit and, if homogeneity is rejected, determining the appropriate form of the transition function, that is, choosing the proper value of m in equation (4). Statistically, the PSTR model is not identified if the data-generating process is homogenous, and a homogeneity test is necessary to avoid the estimation of unidentified models. As to the estimation of parameters $\theta = (\beta_0^{'}, \beta_1^{'}, \gamma, c^{'})^{'}$ in the PSTR model is a relatively straightforward application of the fixed effects estimator and nonlinear least squares. Whereas evaluation of an estimated PSTR model is an essential part of the model building procedure, including the tests of parameter constancy over time and of no remaining nonlinearity.

3. Empirical estimation and analysis

By using the nonlinear time series framework, hereafter KSS, and the panel unit root testing framework, hereafter IPS, this paper proposes unit root tests for nonlinear heterogeneous panels. Table1 the bootstrap empirical distribution of OU statistic and Min. KSS statistics, generated by employing 5000 replications, are used to have their p-values. The same procedure is also applied for the IPS statistics IPS_{tar} and IPS_{zar}. Our tests provide evidence for CO2, EC, GDP, GDP^2, Labor, Bank, Stock and Trade convergence when only an intercept is included as well as when both an intercept and a time trend are considered in the regression. The result for IPS_{tar} and IPS_{zar} obtained from the linear version of regression both of only intercept and with intercept and trend fails to reject the null hypothesis of no stochastic. On the other hand, the result for OU statistic and Min. KSS is significantly rejected when the same regression equation contains only intercept and with intercept and trend. The

indicate that unit root tests are for nonlinear by all variables. In other words, all variables are integrated of order one.

Table 1. Results of KSS with Fourier test

	Only intercept				Intercept and trend			
	OU statistic	Min. KSS	IPS_{tar}	IPS_{zar}	OU statistic	Min. KSS	IPS_{tar}	IPS_{zar}
CO2	-1.761	-0.686	-2.243	-3.809	-2.808	-4.100	-2.873	-3.383
	(0.000)	(0.000)	(0.021)	(0.026)	(0.000)	(0.000)	(0.006)	(0.004)
EC	-2.146	-2.712	-2.159	-3.356	-2.972	-5.063	-3.362	-7.024
	(0.000)	(0.000)	(0.011)	(0.012)	(0.000)	(0.000)	(0.000)	(0.000)
GDP	-1.307	1.699	-1.245	1.542	-2.648	-3.154	-2.596	-2.369
	(0.000)	(0.000)	(0.158)	(0.158)	(0.000)	(0.000)	(0.088)	(0.088)
GDP^2	-2.649	-3.162	-2.597	-2.376	-1.333	1.560	-1.205	1.756
	(0.000)	(0.000)	(0.068)	(0.068)	(0.000)	(0.000)	(0.193)	(0.156)
Labor	-1.985	-1.868	-2.688	-2.929	-3.302	-7.011	-1.939	-2.175
	(0.000)	(0.000)	(0.331)	(0.216)	(0.000)	(0.000)	(0.026)	(0.026)
Bank	-2.811	-6.206	-1.973	-2.363	-2.674	-3.306	-1.973	-2.363
	(0.000)	(0.000)	(0.331)	(0.216)	(0.000)	(0.000)	(0.426)	(0.456)
Stock	-2.102	-2.480	-1.419	0.610	-2.585	-2.781	-2.323	-0.707
	(0.000)	(0.000)	(0.175)	(0.177)	(0.000)	(0.000)	(0.086)	(0.084)
Trade	-1.209	-7.375	-1.185	1.867	-3.363	-7.375	-3.346	-6.922
	(0.000)	(0.000)	(0.056)	(0.066)	(0.000)	(0.000)	(0.413)	(0.425)

Note: P-value is the probability that the data come from the normal distribution, according to the Jarque-Berra normality test.

Table 2 exhibits the estimated coefficients of fix effected results .We apply nonlinear fixed effects models above to observe the CO_2 emissions between CO2, EC, GDP, GDP^2, labor, bank, stock and trade. In order to robust of the relationship between CO2 emissions and trade via Panel A, Panel B and Panel C.

We analyze individual CO_2 emissions and BD. From Panel A (with consideration of BD), we see CO_2 emissions and EC as a positive significant relationship, means that increase in energy consumption, the impact of increase CO_2 emissions. However the higher of bank development to reduce the use of CO_2 emissions. Therefore, an increase in bank development, the impact of decreased CO_2 emissions.

The second from Panel B (with consideration of BD and SD), we also see that the relationship between CO_2 emissions and bank development as a negative relationship and stock development as a negative significant relationship, fount that

an increase in bank development and stock development, the impact of decreased CO_2 emissions.

The third from Panel C (with consideration of BD, SD and TR), we find that the coefficient of trade for the CO2 emissions is negative and statistically significant for OECD countries, between of CO_2 emissions and stock development as a negative significant relationship.

Over all that CO_2 emissions and GDP, the relationship GDP^2, in line with environmental Kuznets curve, we find that the coefficient of bank development and stock development for the CO2 emissions is negative for OECD countries, on the hand, labor as a positive significant relationship, means that increase in labor, the impact of increase CO2 emissions.

Table 2. Estimated coefficients of fix effected results

	Panel A	Panel B	Panel C
EC	0.8874	0.9025	1.0177
	(0.000)***	(0.000)***	(0.000)***
GDP	0.040	0.1301	0.0524
	(0.894)	(0.658)	(0.658)
GDP^2	-0.0011	-0.0101	-0.8067
	(0.980)	(0.764)	(0.658)
Labor	0.0006	0.0011	0.8067
	(0.656)	(0.358)	(0.658)
Bank	-0.0013	-0.0012	-5.0502
	(0.343)	(0.656)	(0.661)
Stock		-0.0017	-6.0724
		(0.000)***	(0.082)*
Trade			-0.0493
			(0.000)***

Notes: The numbers in brackets indicate p-values. ***, **, and * indicate significance at the 0.01, 0.05 and 0.1 level, respectively.

In empirical design, we set the foreign trade, stock market development, and bank development as threshold variable and control variables include EC,GDP, GDP^2, Labor, Bank, Stock and Trade. The table 3 presents the test of linearity results

between the foreign trade, stock market development, bank development and CO_2 emissions. The LM, Fisher and LRT linearity tests clearly lead to the rejection of the null hypothesis of linearity for the model. This result implies that there is strong evidence of the relationship between foreign trade, stock market development, and bank development and CO_2 emissions is non-linear.

Furthermore, we apply the sequence of tests to determine the order m of the logistic function. In practice, it is usually sufficient to consider m = 1 (monotonically increasing with two regimes) or m=2 (symmetric or exponential with three regimes) transition function, as these values allow for commonly encountered types of variation in the parameters. The results of the specification test sequence, shown in Table 4, we will select m = 1 if the rejection of H_{02} is the strongest one. We find that the monotonically increasing in Figure 1- Figure 3.

Table 3 .Test of linearity

	Panel A:with consideration of BD		Panel B:with consideration of BD, SD		Panel C:with consideration of BD, SD,TR	
H_0:linear model against H1:PSTR model with at least one threshold variable ($r \geq 1$)						
	Statistics	P-value	Statistics	P-value	Statistics	P-value
Wald Tests (LM)	26.111	0.000*	95.602	0.000*	89.015	0.000*
Fisher Tests (LM_F)	3.584	0.000*	6.46	0.000*	4.953	0.000*
LRT Tests (LRT)	27.152	0.000*	110.12	0.000*	101.422	0.000*

Note: *denote significant at 5% significance level. The LM and pseudo LRT statistics have a chi-square distribution with mK degrees of freedom, whereas the F statistics has a F (mK; TN – N- K (m + r + 1)) distribution. LM_F is its F-version. Pseudo LRT can be computed according to the same definitions by adjusting the number of degree of freedom. For detail, see also Colletaz and Hurlin (2006).

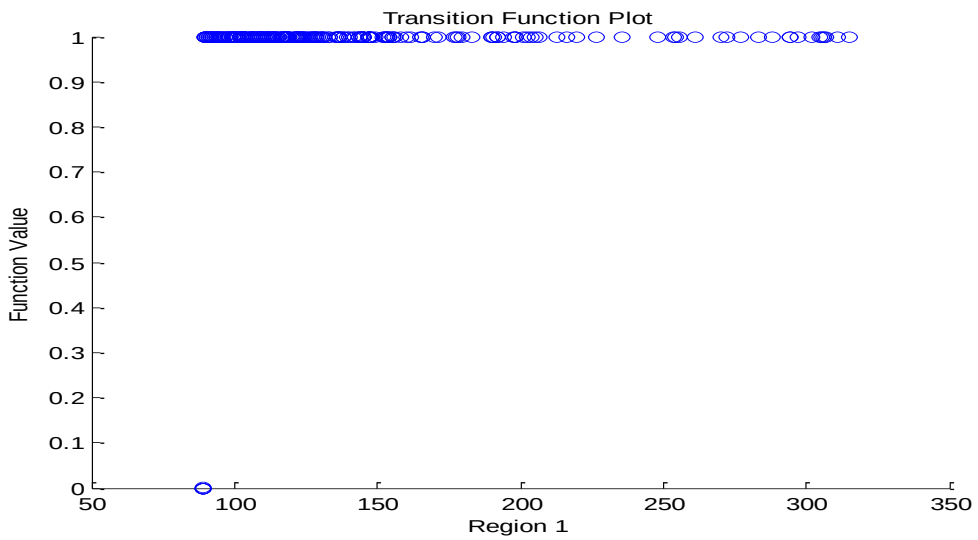
Table 4. Sequence of homogeneity tests for selecting m

	Panel A:with consideration of BD	Panel B:with consideration of BD, SD	Panel C:with consideration of BD, SD,TR

Select m=2 if the rejection of H02 is the strongest one, otherwise select m=1.						
	Statistics	P-value	Statistics	P-value	Statistics	P-value
H_{03}:B3=0	F3 = 0.714	0.819	F3 = 1.195	0.262	F3 = 0.755	0.774
H_{02}:B2=0|B3=0	F2 = 1.844	0.014	F2 = 0.422	0.983	F2 = 2.571	0.000*
H_{01}:B1=0|B2=B3=0	F1 = 2.435	0.000*	F1 =4.546	0.000*	F1 = 1.344	0. 144

The next step is to determine the number of transitions in the model. Table 5 testing for non remaining nonlinearity consists of checking whether there is one transition function ($H_0 : r = 1$) or whether there are at least two transition functions ($H_1 : r = 2$), the testing results show that the reasonable numbers of threshold r =1, which means that there are one regions. Each region has two regimes.

Panel A:with consideration of BD



Panel B:with consideration of BD, SD

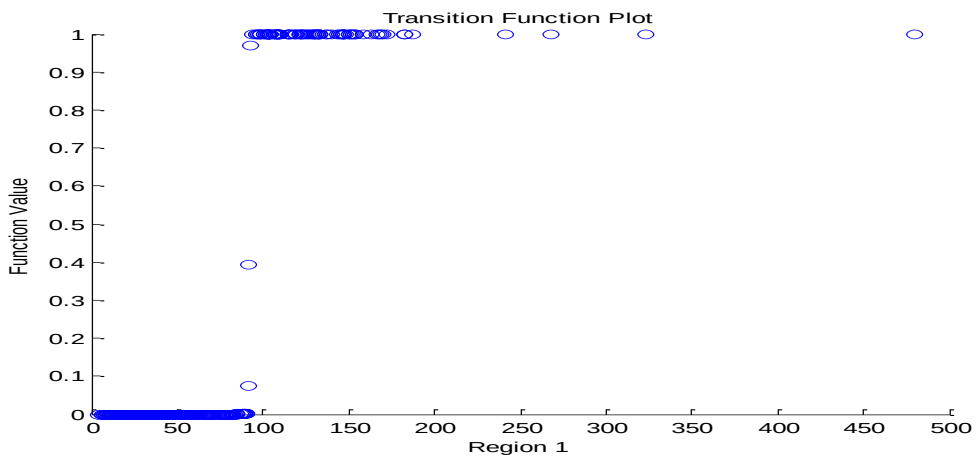


Figure 2: Transition Function with m = 1

Panel C:with consideration of BD, SD,TR

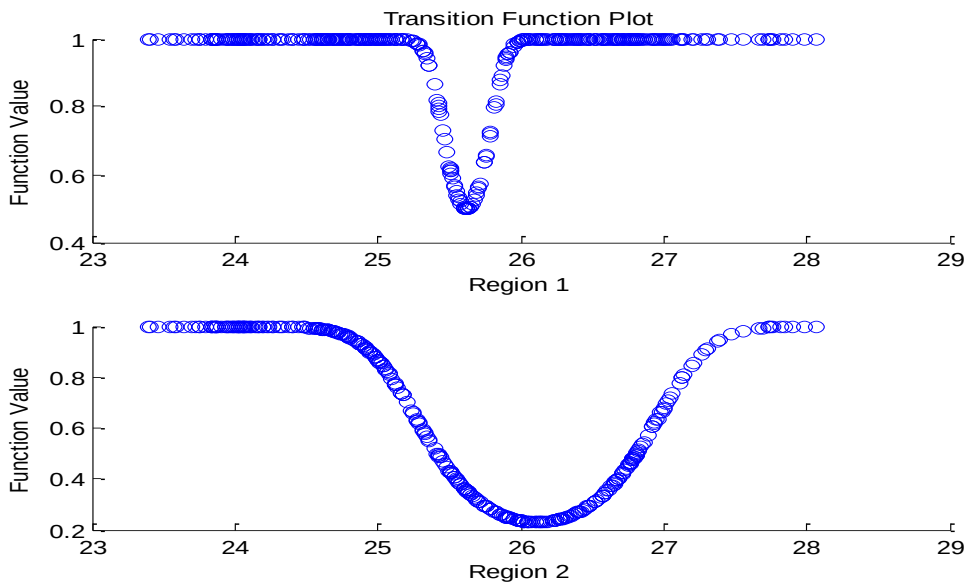


Figure 3: Transition Function with m = 2

Table 5. Testing the Number of Regimes: Tests of no Remaining non-linearity

	Panel A:with consideration of BD		Panel B:with consideration of BD, SD		Panel C:with consideration of BD, SD,TR	
H0: PSTR with r = 1 against H1: PSTR with at least r = 2						
	Statistics	P-value	Statistics	P-value	Statistics	P-value
Wald Tests (LM)	26.111	0.000*	37.407	0.000*	28.503	0.217
Fisher Tests (LMF)	3.584	0.000*	6.242	0.000*	6.963	0.225
LRT Tests (LRT)	27.052	0.000*	39.378	0.000*	28.952	0.216

Note. 1. *denote significant at 5% significance level.

2. max r=1，m=1, the reasonable numbers of threshold r=1.

Table 6 shows the parameters estimate results of PSTR models and robust analysis of the relationship between the CO_2 emissions with individual BD, SD and TR. We found that TR, BD, SD to have a consistent impact on CO_2 emissions, belonging to a higher threshold of TR BD SD, for a significant reduction in CO_2 emissions effect.

From Panel A, The transition function is logistic specification (m=1 with two

regimes), C is location parameters, in the region, the value are 89.4332 with BD. The above result shows that there are structure changes at the point (see also Figure 1). The transition function is logistic specification. With regard to the control parameters, we observe that the EC is Positive, the EC increase then the CO_2 emissions will increase. Whereas the threshold value is below than 1.0049, the BD indicate that the value increase will decrease the CO_2 emissions. Whereas the volatility is greater than 1.0049, the BD decrease then the CO_2 emissions will also decrease too. We think that the bank have lending function for enterprises, the banks were also given to social responsibility, to review the conditions for enterprises engaged in extending loans, the corporate environmental indicators for the assessment will be added, so companies will be attention to the situation of environmental protection.

From Panel B, the explanations for this region are that when the threshold variable is below or greater than 5.1284 , the SD increase then the CO_2 emissions will decrease, and consistent with BD, implicit emphasis on the environment of listed companies and has a good environmental performance, share price for listed companies is helpful, so listed companies would be willing to put in more research and technology development to reduce the CO_2 emissions.

From Panel C, whereas the threshold value is below than 25.6215(belong to low threshold) , the TR indicate that the value increase will increase the CO_2 emissions. Whereas the threshold value is between 25.6215 and 26.8090(belong to middle and high threshold), and greater than 26.8090, the TR indicate that the value increase will decrease the CO_2 emissions, and the trade off correlation between foreign trade and the CO2 emissions, implies the growth of foreign trade reached a certain volume, will boycott increase CO_2 emissions and we think trade between countries in the importance of environmental awareness, will require exporters to have an environmentally friendly way to produce environmentally friendly nature of the product, so trade higher national output, for technical or innovative production methods to replace energy or pollution is very important. On the other hand, A low threshold of TR, the relationship of stock development, bank development and CO_2 emissions is not a significant negative relationship, mean that the countries of low threshold , stock development and bank development for CO_2 emissions reduction

effect is limited, relative, belong to middle and high threshold of TR, the relationship of stock development, bank development and CO_2 emissions is significant positive relationship, we think that stock development and bank development have a certain size, so for enterprises and environmental protection have effect of power.

Therefore we get the robustness of the results, foreign trade, stock market development, and bank development to have the effect of reducing CO_2 emissions. These market forces to bring people should pay attention to environmental protection and quality of life, government agencies committed to setting environmental regulations, guide industry towards environmental protection, in addition to being returned to the people a good living environment, but also further enhance the foreign trade as an important indicator because the advanced countries import conditions may be based on environmental conditions, decided to countries with good production environment and comply with environmental behavior imported products.

Overall, the EC increase then the CO_2 emissions will increase, the higher the economic development of the country, can resist the effect of CO_2 emissions addition, when the higher labor input, but also to have the effect of reducing CO_2 emissions, we believe that when countries with high labor input to a certain stage, which means that people also enhance income, as like economic growth is also driven by income increase, people will require should pay attention to environmental protection and quality of life.

Table 6. Parameter Estimation Results for PSTR Model

Panel A:with consideration of BD		
	β_0	$\beta_o + \beta_1$
EC	0.9304 ***	1.06***
	(0.0411)	(0.0252)
GDP	0.2501***	0.087***
	(0.1757)	(0.0550)
GDP^2	-0.0404	-0.0106***
	(0.0218)	(0.0080)
L	0.0007	-0.0002***
	(0.0008)	(0.0006)

BD	-0.0004	-0.0006
	(0.0001)	(0.0001)
(C1)	(89.4332)	
(γ1)	(1.0049)	
SSE	0.716	

Panel B:with consideration of BD, SD

	β_0	$\beta_o + \beta_1$
EC	0.9181 ***	1.0294***
	(0.0439)	(0.0265)
GDP	0.5244***	0.0855***
	(0.1006)	(0.0348)
GDP^2	-0.0634	-0.0372***
	(0.0133)	(0.0069)
L	0.0009***	-0.0002
	(0.0006)	(0.0008)
BD	-0.0003***	-0.0005***
	(0.0001)	(0.0001)
SD	-0.0003***	-0.0004***
	(0.0003)	(0.0003)
(C1)	(92.1919)	
(γ1)	(5.1284)	
SSE	0.152	

Panel C:with consideration of BD, SD,TR

	β_0	$\beta_o + \beta_1$	$\beta_o + \beta_1 + \beta_2$
EC	9.3154***	7.0564***	10.9337***
	(0.0382)	(0.0382)	(0.0382)
GDP	0.8276***	0.2619***	0.1538***
	(0.1006)	(0.1006)	(0.0348)
GDP^2	-0.2890*	-0.3325*	-0.0585***
	(0.0644)	(0.0133)	(0.0069)
L	0.0059***	-0.0049	-0.0076***
	(0.0001)	(0.0001)	(0.0001)
BD	-0.0012	-0.0003**	-0.0015***

	(0.0001)	(0.0001)	(0.0001)
SD	-0.0006	-0.0001***	-0.0008***
	(0.0003)	(0.0001)	(0.0003)
TR	0.1479 ***	-0.1863***	-0.0404***
	(0.0469)	(0.0472)	(0.0098)
(C1)	(36.0073 2.4915)		
(γ1)	(25.6215 26.8090)		
SSE	0.110		

Note：1. ***, **,* denote significant at 1%, 5%, 10% significance levels, respectively.
2. C is location parameters; γ is slope parameter (smooth parameter or transition speed).
3. Threshold variable: volatility; control variables: BD, SD and TR .

3. Conclusions

Our empirical results show that by using the nonlinear time series framework, the result for OU statistic and Min. KSS is significantly rejected when the same regression equation contains only intercept and with intercept and trend. The indicate that unit root tests are for nonlinear by all variables. In other words, all variables are integrated of order one.

We used the PSTR model to reexamine the nonlinear dynamic relationships between OECD countries' foreign trade and CO_2 emissions. We found that strong evidence of trade off correlation between foreign trade and the CO_2 emissions. the foreign trade indicate that the value increase will decrease the CO2 emissions, implies the growth of foreign trade reached a certain volume, will boycott increase CO2 emissions and we think foreign trade between countries and others countries in the importance of environmental awareness, so the higher foreign trade of OECD countries, for technical or innovative production methods to replace energy or pollution is very important. We also found that the foreign trade of below than threshold value, the relationship between foreign trade and CO2 emissions belong to a positive relationship, we think that these countries may need to expand trade in the development stage, so these countries are less emphasis the pollution.

Different from the other articles, We observe the impact of stock market development for CO2 emissions effect, the CO_2 emissions will be different under the stock market development threshold value and the control variables. What is more,

the different stock market development of OECD countries produce completely different CO_2 emissions. Stock market development for CO_2 emissions has resisted effect, because of the stock market is an important to obtain funding pipeline for companies, enterprises in order to maintain good price and a good social image ,will try to reduce pollution for the production process. Similarly bank development also have the same effect, the enterprise is able to successfully borrow money from banks, measures for environmental protection is also very important index.

Overall, the energy consumption increase then the CO_2 emissions will increase, on the other hand ,the higher the economic development of the country, can resist the effect of CO_2 emissions addition. The relationship between labor and CO2 emissions of trade off correlation, we believe that when labor input to a certain extent, the same as economic development, promote national income, people will emphasis the importance of the living environment and environmental protection.

As mentioned above, OECD countries in addition to advocacy to reduce CO_2 emissions, as well as input costs to control CO_2 emissions, there is a better way, through good of trade measures, and the management of stock market development, bank development to guide the industry initiative to reduce CO_2 emissions and the development of key technologies to reduce dependence on energy consumption.

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