Does Export Product Quality Matter for CO2 Emissions? Evidence from China

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9 June 2016

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Abstract

This paper re-estimates the environmental Kuznets curve over the period 1971–2010 in China. To this end, it uses the unit root tests with one structural break and the autoregressive-distributed lag (ARDL) estimations. The special role is given to the impacts of export product quality and energy consumption on CO_2 emissions in the empirical models. The paper finds that the environmental Kuznets curve hypothesis is valid in China. It also observes the positive effect from energy consumption to CO_2 emissions. In addition, it finds that the export product quality is negatively associated with CO_2 emissions. The paper also argues potential implications.

Keywords: environmental Kuznets curve; energy consumption; export product quality; ARDL estimation; structural break

JEL Codes: Q56; O13; L15; C32

1. Introduction

Developing countries are striving to ensure a balance between energy consumption and sustainable development (Saboori and Sulaiman, 2013). This is mainly due to the problem of global warming, which is one of the most significant problems that humanity faces today. It is well known that environmental pollution brings out various economic, social, and health problems; and therefore, scientists have increased interest in the subject of environmental degradation (Zhang et al., 2014). In this context, recent studies have particularly focused on the relationship between environmental degradation and income level (Narayan and Narayan, 2010). Although the topic is important for policy implications, environmental degradation is of secondary importance in the developing countries in general (Wang et al., 2016b). It is also important to note that environmental degradation threatens not only sustainable development in developing countries (Managi and Jena, 2008), but also other countries at different levels of development.

One of the most significant factors that increases environmental degradation is adopted production techniques and output levels (Kang et al., 2016). In this regard, increased economic activity in the country systematically leads to a surge in CO_2 emissions. However, individuals and societies will be more sensitive to environmental degradation as per capita income increases in the country. This sensitivity will affect the production techniques used, which leads to a significant decline in CO_2 emissions. This process is known as the environmental Kuznets curve (EKC) in the literature (Jayanthakumaran and Liu, 2012). The EKC hypothesis, which was firstly put forward by Grossman and Krueger (1995), suggests that a rise in domestic output leads to an increase in CO_2 emissions until the economy reaches a certain level, and decreases thereafter (Kearsley and Riddel, 2010). In other words, the EKC hypothesis proposes that there is an *inverted U-shape* relation between CO_2 emissions and per capita income (Jalil and Mahmud, 2009). Our paper tests the validity of the EKC hypothesis in China over the period 1971–2010.

Indeed, several papers address the relationship among environmental degradation, economic growth, and energy consumption in the literature. In addition, different control variables were also used in these studies.[1] It can be said that papers on the environmental degradation in China can be categorized into three main categories.

[1] Financial development, foreign direct investment (FDI), population, tourism, trade openness, and urbanization are used as control variables for testing the validity of the EKC hypothesis. (e.g., Al-Mulali et al., 2015; Al-Mulali and Ozturk, 2015; Bento and Mountinho, 2016; Dogan and Turkekul, 2016; Javid and Sharif, 2016; Jebli et al., 2016; Katircioglu, 2014; Lau et al., 2014; Liddle, 2015; Tang and Tan, 2015).

First, scholars analyze the factors that affecting environmental degradation in China at the sectoral level (e.g., Ouyang and Lin, 2015; Ren et al., 2014; Steenhof, 2007; Tian et al., 2013; Xu et al., 2012).

Second, scholars investigate the factors that affecting environmental degradation in China at the regional level. (e.g., Diao et al., 2009; Du et al., 2012; Fei et al., 2011; He and Wang, 2012; Jayanthakumaran and Liu, 2012; Kang et al., 2016; Li et al., 2016; Liu et al., 2015; Shen, 2006; Song et al., 2008; Wang and Liu, 2015; Wang et al., 2011; Wang et al., 2016a; Wang et al., 2016b; Zhang and Lin, 2012; Zhang and Zhou, 2016; Zhou et al., 2015).

Third, scholars test the validity of the EKC hypothesis in controlling the macroeconomic indicators at the macro level. For instance, Jalil and Mahmud (2009) examined the effects of per capita income, energy consumption, and trade openness on CO_2 emissions using the ARDL approach for the period between 1975 and 2005. They found that the EKC hypothesis is valid, and there is an *inverted U* relationship between per capita income and CO_2 emissions in China. Moreover, they observed that the most significant determinants of CO_2 are per capita income and energy consumption, respectively. The effect of trade openness on CO_2 emissions was positive, but its coefficient was not found as statistically significant. Jalil and Feridun (2011) investigated the effects of financial development, trade openness, and energy consumption on CO_2 emissions using the ARDL approach over the period 1953–2006. They observed that the EKC hypothesis is valid in the long run. Plus, income per capita, energy consumption, and trade openness yield higher CO_2 emissions, while financial development decreases CO_2 emissions in China. Jayanthakumaran et al. (2012) investigated the effects of per capita income, trade openness, and energy consumption on CO_2 emissions over the period 1971–2007 by using the ARDL approach. They found that the EKC hypothesis is valid, and the most important determinants of CO_2 emissions are income per capita and energy consumption in the long run. Govindaraju and Tang (2013) investigated the impact of coal consumption upon CO_2 emissions over the period 1965–2009. They used the cointegration approach of Bayer and Hanck, and observed that the series are significantly cointegrated. Ertugrul et al. (2016) analyzed the impacts of income, energy consumption, and trade openness on CO_2 emissions over the period 1971–2011 using an ARDL approach. They observed that the EKC hypothesis is valid, and there is an *inverted U* relationship between the income per capita and CO_2 emissions. Besides this, they concluded that both energy consumption and trade openness positively affected CO_2 emissions in the long run.[2]

[2] There are also studies that focus on the relationship between the sub-elements of CO_2 emissions and per capita income in China (e.g., Aslan and Gozbasi, 2016).

Our paper belongs to the studies categorized in the third group, but it considers export product quality as an explanatory variable, rather than trade openness.[3] Scholars have recently focused on trade openness in their studies regarding their effects on CO_2 emissions. However, recent papers in the international trade literature have emphasized the significance of different aspects of globalization than trade openness (or export volume),[4] and the role of export quality upgrading is often underlined. In other words, scholars have stressed that *what you export matters,* rather than the volume of exports alone (Hausmann et al., 2007; Rodrik, 2006).[5] Indeed, upgrading the quality of export products leads to faster economic growth (International Monetary Fund (IMF), 2014). The quality of exports is also related to structural transformation, particularly in countries at the middle stages of economic development (Harding and Javorcik, 2012). These findings imply that export upgrading is a key policy issue, and the most telling examples are developing East Asian countries, which have succeeded in achieving structural transformation through the upgrading of export quality. Starting in the 1970s, the Asian Tigers, including China, have changed their development strategy from agriculture-based to manufacturing-oriented growth (Papageorgiou and Spatafora, 2012).

Our paper considers the new export quality index developed by Henn et al. (2015). Henn et al. (2015) measure export product quality as the unobservable quality of the product, the income level of the exporting country, and the distance between importing- and exporting countries.[6] In this context, the purpose of our paper is to investigate the effects of per capita income, energy consumption, and export product quality on CO_2 emissions in China, i.e., the world's largest exporter. To the best of our knowledge, our paper is the first in the literature to investigate the dynamic relationships among export product quality, per capita GDP, energy consumption, and CO_2 emissions within the context of the EKC hypothesis.

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[3] Papers on the determinants of export quality observe that FDI is an important determinant of the export quality (e.g., Harding and Javorcik, 2012; Henn et al., 2015). The studies for testing the validity of the EKC hypothesis also underline that FDI is an important determinant of CO_2 emissions (e.g., List and Co, 2000; Tang and Tan, 2015; Zhang and Zhou, 2016. Therefore, export quality can be used as a control variable in the EKC hypothesis not only instead of trade openness, but also for FDI as the benchmark indicator of globalization.

[4] These new variables for globalization aspects can be listed as the economic complexity, export diversification, and export quality upgrading (see, e.g., Agosin et al., 2012; Gozgor and Can, 2016b; Hausmann et al., 2007 and 2011; Henn et al., 2013 and 2015).

[5] It is observed that new variables for globalization are used in the studies investigating the relationship between international trade and CO_2 emissions. For example, Gozgor and Can (2016a) analyzed the effects of export product diversification on CO_2 emissions in Turkey, while Can and Gozgor (2016) investigated the effects of economic complexity on CO_2 emissions in France within the context of the EKC hypothesis.

[6] Export product quality is mainly measured by the unit price in the literature (e.g., Feenstra and Romalis, 2014; Hallak, 2006; Hallak and Schott, 2011; Hummels and Klenow, 2005; Khandelwal, 2010; Martin and Mejean, 2014; Schott, 2004). However, according to Henn et al. (2013 and 2015), the unit price does not completely reflect the export product quality, and they propose the new index for measuring export product quality.

China's economic reforms, initiated in 1978, have led to a rapid economic growth of the country in the 1990s and the 2000s, thanks to the decline in trade- and investment barriers (Jayanthakumaran and Liu, 2012). Especially from the 1980s to the present day, the average annual growth rate of China has been around 10% (Song et al., 2008; Wang et al., 2014). High growth rates have also enabled the Chinese economy to become the second largest economy in the world (Wang et al., 2013). Rapid economic growth also resulted in the rise of living standards and welfare (Song et al. 2008) as well as a significant increase in urbanization (Liu et al., 2015). China's solid macroeconomic performance has supported the emergence of new job opportunities for many people and has helped to improve health, education, and other social standards in the country (Rodrik, 2006). At this process, the Chinese government implemented various policies to upgrade the export product quality. For instance, high-tech industrial zones and export processing zones have a significant role in the growth of export volume and in upgrading export product quality. At this point, their total share of China's exports, which was 6% in 1995, increased to 25% in 2005 (Wang and Wei, 2010).

This structural transformation has also led to a significant increase in energy consumption in China, making it the world's largest energy consumer (Wang et al., 2013). However, this sharp rise in energy consumption has resulted in a significant increase in CO_2 emissions in the country (Zhang, 2011). Higher economic activity as well as a higher demand for energy inputs have caused a higher emission of pollutants and worsened environmental conditions in the country (Onafowora and Owoye, 2014). Therefore, policies on economic growth and protection of environmental quality are highly related in China (Song et al., 2008), due to the fact that China is the country that discharges the most CO_2 emissions in the world (Chang, 2010). However, the Chinese government has been under tremendous pressure from international organizations since the early 2000s; therefore, it has taken various measures to reduce the level of CO_2 emissions (Wang et al., 2016a). At this point, the Chinese government aims to gradually meet the carbon intensity target for reducing CO_2 emissions in 2020 (Zhang, 2011). Plus, the government also demonstrates several targets to improve environmental quality within the "twelfth five-year plan" (Liu et al., 2015). All in all, China is probably the most appropriate country to analyze the effects of increased export quality, rapid growth rate, and high-energy consumption on CO_2 emissions—which are targeted for reduction. At this juncture, our paper reveals that not only per capita income and energy consumption but also export product quality matter for CO_2 emissions in China over the period 1971–2010. Our findings indicate that a higher level of export product quality reduces CO_2 emissions in the Chinese economy.

The remainder of the paper is organized as follows. Section 2 explains the data and the econometric methodology, and sets the empirical model. Section 3 provides the empirical results. Section 4 discusses the empirical results and argues the potential implications. Section 5 concludes.

2. Data, Empirical Model, and Econometric Methodology

2.1. Data and Empirical Model

The paper focuses on CO_2 emissions (metric tons per capita) over the period 1971–2010 in China as the dependent variable. The real per capita GDP (constant USD price in 2005) and the real per capita GDP squared represent the linear and nonlinear impacts of income on CO_2 emissions, respectively. Energy consumption per capita (kilogram of oil equivalent) is also included in the dynamic empirical models. All variables are considered in logarithmic form in the empirical examination. The data are obtained from the World Development Indicators (WDI) of the World Bank. The frequency of the data is annual. Plus, the data on export quality are obtained from the database of the IMF, and a higher value on the index means a higher product quality in the export basket. The export quality index is also used in logarithmic form since the benchmark model is defined in logarithmic form. In addition, a summary of the descriptive statistics is provided in Appendix I.

Our paper considers a standard EKC model in the literature (e.g., Gozgor and Can, 2016a; Saboori and Sulaiman, 2013); i.e., the per capita income, per capita income squared, and energy consumption are considered the main determinants of CO_2 emissions. Our paper also proposes that export quality is a significant determinant of CO_2 emissions. Therefore, the following empirical model for the EKC hypothesis is written:

$$CO_{2t} = f(RGDP_t^{\alpha_1}, SRGDP_t^{\alpha_2}, ENC_t^{\alpha_3}, EXPQUA_t^{\alpha_4}) \tag{1}$$

The empirical model in Eq. (1) can be defined in logarithmic form as such:

$$\log CO_{2t} = \alpha_0 + \alpha_1 \log RGDP_t + \alpha_2 \log SRGDP_t + \alpha_3 \log ENC_t + \alpha_4 \log EXPQUA_t + \varepsilon_t \tag{2}$$

In Eq. (1) and Eq. (2), $\log CO_{2t}$ is CO_2 emissions in logarithmic form at time *t*, $\log RGDP_t$ is the real per capita GDP in logarithmic form at time *t*, $\log SRGDP_t$ is the real per capita GDP squared in logarithmic form at time *t*, $\log ENC_t$ is the per capita energy consumption in logarithmic form at time *t*, $\log EXPQUA_t$ is the export quality index in logarithmic form at time *t*. The error term is represented by ε_t.

According to the main hypothesis of the paper, it is expected that α_1 >0, α_2 <0, and α_3 > 0. The EKC hypothesis proposes that α_1 >0 is elastic, as well as α_2 <0, and both coefficients should be obtained as statistically significant. Otherwise, there is no valid CO_2 emission function in the country; that is, there is a no significant inference for environmental pollution (Gozgor and Can, 2016a). In addition, it is expected that higher energy consumption leads to higher CO_2 emissions in a developing economy (α_3 > 0).

On the other hand, the impact of export quality on CO_2 emissions can be negative (α_4 <0). This is due to the fact that the export basket of a developing country consists of pollution-intensive goods at first place, but as a country develops, it starts to exclude these goods from the export basket. Moreover, the main environmental policy will be to import pollution-intensive goods from less developed countries, which have "less-restrictive environmental protection laws." Therefore, as a developing country upgrades the quality of its export basket, CO_2 emissions will be reduced. Of course, we need to observe a statistically significant (long-run) coefficient for α_4.

2.2. Econometric Methodology

First, following Ertugrul et al. (2016), the paper applies the unit root test of Zivot and Andrews (1992) that accounts for one endogenous structural break. To check the robustness of the findings of the unit root test of Zivot and Andrews (1992), following Jayanthakumaran et al. (2012), we also consider the unit root test of Lee and Strazicich (2003) that accounts for two endogenous structural breaks in the time-series.

Second, following the results of unit root tests, we use the bounds tests for cointegration analysis. At this stage, the model with constant term is considered in the cointegration analysis. The optimal lag length is selected using the Akaike Criteria (AIC). The null hypothesis of the bounds test is that "there is no cointegration among variables." We report both the original critical values, provided in Pesaran et al. (2001), as well as the critical values corrected for small samples in Narayan (2005) in the cointegration analysis.

Third, both the short-run and the long-run coefficients in Eq. (2) are estimated by the ARDL model of Pesaran and Shin (1999). Therefore, we estimate the following unrestricted error correction regression, in which the level of per capita CO_2 emission is the dependent variable in China:

$$\Delta \log CO_{2t} = \alpha_0 + \sum_{i=1}^{n} \alpha_1 \Delta \log CO_{2t-k} + \sum_{i=0}^{n} \alpha_2 \Delta \log RGDP_{t-k} + \sum_{i=0}^{n} \alpha_3 \Delta \log SRGDP_{t-k}$$
$$+ \sum_{i=0}^{n} \alpha_4 \Delta \log ENC_{t-k} + \sum_{i=0}^{n} \alpha_5 \Delta \log EXPQUA_{t-k} + \beta_1 \log CO_{2t-1} + \beta_2 \log RGDP_{t-1} \quad (3)$$
$$\beta_3 \log SRGDP_{t-1} + \beta_4 \log ENC_{t-1} + \beta_5 \log EXPQUA_{t-1} + \beta_6 D2006 + \varepsilon_{1t}$$

In Eq. (3), Δ represents the change in both dependent and independent variables, and ε_{1t} is the error term. The parameters for α (i=1, 2, 3, 4, and 5) are the corresponding long-run multipliers; and the parameters for β (i=1, 2, 3, 4, 5, and 6) are the short-run dynamic coefficients of the underlying ARDL model in China (Jayanthakumaran et al., 2012). In addition, the dummy variable (*D*) of one break date (2006) is also considered in the estimation, and the selection is based on the results of the unit root test of Zivot and Andrews (1992) (Ertugrul et al., 2016). We also provide the following diagnostic tests on the ARDL estimations:

i.) Breusch-Godfrey serial correlation test (the null hypothesis: there is no residual serial correlation, and the alternative hypothesis: there is a serial correlation up to order 4).

ii.) Ramsey-Reset specification test for the specification of the model (the null hypothesis: specification (functional form) is correct in the model).

iii.) Jarque-Bera normality test for the normality assumption of residuals (the null hypothesis: the error terms are normally distributed).

iv.) Breusch-Pagan-Godfrey heteroscedasticity test for the homoscedasticity of variance (the null hypothesis: the variance is homoscedastic).

Finally, we consider the long-run Granger causality / Vector Error Correction Model (VECM) test. The t-statistics of the lagged error correction term (ECT_{t-1}) are also provided in the empirical analysis.

3. Empirical Results

First, the results of the unit root test of Zivot and Andrews (1992) are provided in Table 1 for each variable. The results are based on the break in the level.

[Insert Table 1 around here]

The results in Table 1 show that log squared per capita real GDP, log CO_2 emissions per capita, and log energy consumption per capita contain a unit root at a statistical significance level of 5%, and the difference among them is stationary. However, log per capita real GDP and log export product quality are stationary in the level form. In other words, all variables are not defined as I(1) process, and the stochastic properties of variables are not appropriate for the cointegration analysis. At this stage, following the previous papers in the literature, we also consider the unit root test that considers two breaks, and the results of the unit root test of Lee and Strazicich (2013) are provided in Table 2.

[Insert Table 2 around here]

The results in Table 2 indicate that log per capita real GDP, log squared per capita real GDP, log CO_2 emissions per capita, and log energy consumption per capita contain a unit root at a statistical significance level of 1%, and the difference among them is found as stationary. However, log export product quality is still stationary in the level form. In other words, all variables are not still defined as I(1) process, and the empirical model is still not appropriate for the cointegration analysis. At this stage, following Narayan and Smyth (2006), we implement the bounds test for cointegration analysis and the ARDL estimations.

The results of the bounds test for cointegration analysis are provided in Table 3. The F-statistic is greater than both the critical values of Pesaran et al. (2001) and Narayan (2005); therefore, the results indicate that there is a statistically significant (at the 1% level) cointegration among variables (CO_2 emissions, GDP per capita, squared GDP per capita, energy consumption, export quality).

[Insert Table 3 around here]

The results of the ARDL estimations for long-run coefficients are provided in Table 4. The long-run coefficients of the log real GDP per capita are positive and elastic (1.42), and the long-run coefficients of the log squared real GDP per capita are negative and inelastic (–0.25) as expected. Furthermore the long-run coefficients of the log energy consumption per capita are also positive and elastic (1.31), as expected. The impacts of related variables are found as statistically significant at the 1% level; plus, the coefficients of the structural break date (dummy variable for 2006) are statistically significant at the 5% level. Table 4 also provides that there is no problem in the diagnostics (serial correlation, model misspecification, non-normality, heteroscedasticity, and instability test) in the ARDL estimations.

[Insert Table 4 around here]

Moreover, the impact of the log export product quality of the log CO_2 emissions is negative and elastic (–1.26), and that means a higher export quality leads to lower CO_2 emissions. The long-run coefficient of the log export quality is obtained as statistically significant at the 1% level. The long-run results in Table 4 also show that one percentage increases in the export quality index, which leads to a 1.27 percentage decrease in CO_2 emissions (1.83 metric tons per capita) in China. The results of the short-run coefficients for the ARDL estimations are also reported in Appendix II. However, the short-run coefficients for the export quality are statistically insignificant. The coefficient of the lagged error correction term (ECT_{t-1}) is −1.616, and it is found to be statistically significant at the 1% level. Following, Narayan and Smyth (2006), and Gozgor and Can (2016a), the negative sign and elastic coefficient mean that CO_2 emissions in China gradually converge to its long-run equilibrium path by a speed of adjustment through the channels of the real GDP per capita, squared real GDP per capita, energy consumption per capita, and export quality. In addition, the results of the long-run Granger causality / VECM tests are provided in Table 5.

[Insert Table 5 around here]

The results in Table 5 indicate that the overall chi-square test statistics for the causality relationship of the log CO_2 emissions are only statistically significant. These results are in line with the results of the ARDL estimations for long-run coefficients.

4. Discussion on Findings and Implications

Our empirical findings are as follows. First, the EKC hypothesis is valid in China, and there is an *inverted U* relationship between per capita income and per capita CO_2 emissions in China; that is, the level of CO_2 emissions escalates with income at first until they reach stabilization, and they decrease in the long run.

Second, per capita income is the most substantial variable in determining CO_2 emissions in China, since its coefficient has the greatest absolute value in the long run. However, it is well known that rapid economic growth yields higher environmental pollutants at the first stage of the development process. It is also well known that sustained and rapid economic growth is crucial for any developing economy, not only to achieve convergence with developing countries, but also for creating new job opportunities, better infrastructure, health care systems, etc. (Gozgor and Can, 2016a). In other words, as per capita income increases, CO_2 emissions systematically increase as well in developing economies, as we do observe in China.

Third, energy consumption yields higher CO_2 emissions in China, as expected in any case of a low-, lower-middle-, and upper-middle income economy. China is the net energy importer, and it is one of the largest energy consumers in the world. Given that there is a positive correlation between per capita income and the level of energy consumption, decreasing the level of energy consumption in order to suppress CO_2 emissions would not be a rational policy. At this stage, policy implications should promote more efficient use of renewable energy in China, and investments in technologies for renewable energy can be a significant policy tool. Indeed, energy consumption in China heavily depends on coal consumption (Govindaraju and Tang, 2013). At this point, nuclear and renewable energy (biofuels, geothermal, solar, and wind) can decrease the consumption of fossil energy sources (coal in particular), thereby reducing the level of CO_2 emissions in China. These findings imply that forecasting future CO_2 emissions from past levels of energy consumption, export quality, and per capita income is possible for the Chinese economy. The results for the impacts of income and energy consumption on CO_2 emissions are in line with previous empirical results of studies on developing Asian countries: China (Chang, 2010; Fei et al., 2011; Jalil and Mahmud, 2009; Jayanthakumaran and Liu, 2012; Jayanthakumaran et al., 2012; Li et al., 2016); India (Jayanthakumaran et al., 2012; Managi and Jena, 2008); Malaysia (Lau et al., 2014); Pakistan (Javid and Sharif, 2016); Thailand (Saboori and Sulaiman, 2013); and Vietnam (Tang and Tan, 2015).

Fourth, higher quality exports decrease CO_2 emissions in China in the long run. To the best of our knowledge, this is the first empirical finding on the impact of export quality on CO_2 emissions in the current literature. Indeed, export quality can accelerate not only the rate of economic growth, but can also reduce CO_2 emissions. At this stage, policy-makers can force Chinese firms to produce goods that do not cause high levels of CO_2 emissions. This issue should also be evaluated in upgrading the export basket; goods with high CO_2 emissions should probably be imported. Finally, we need to emphasize that all these implications necessitate an exhaustive knowledge of the scale of environmental pollutants for each sector in China.

5. Conclusion

This paper investigates the dynamic relationships among CO_2 emissions, energy consumption, export quality, and per capita income in China, where the export-led growth strategy has been adopted during the last four decades. In other words, the paper analyzes the validity of the EKC hypothesis over the period 1971–2010 in China. To this end, it uses the unit root tests of Zivot and Andrews (1992) and Lee and Strazicich (2003), as well as the bounds test for cointegration and the ARDL estimations of Pesaran and Shin (1999) and Pesaran et al. (2001). A special role is given to the impact of export product quality on CO_2 emissions in the empirical model, and to the best of our knowledge, this is the first study that investigates the impacts of export quality within the context of the EKC hypothesis.

The findings of the paper are as follows: First, the EKC hypothesis is valid in China. Second, we observed the positive and elastic effects of energy consumption on CO_2 emissions. Third, we found that export quality is negatively associated with CO_2 emissions; this is the novel contribution of the paper to the current literature.

Future research on the impacts of export quality on CO_2 emissions and energy consumption can be implemented in other developing and developed economies. Moreover, future papers can focus on the sectoral and regional data sets in various developing and developed countries.

At this stage, not only the impacts of the overall index, but also the subindexes of the export quality index of Henn et al. (2013, 2015) (one, two, three, four, five, and six digit data) can be used within this context with different econometric techniques.

References

[1] Agosin, M.R., Alvarez, R., and Bravo–Ortega, C. (2012). Determinants of Export Diversification around the World: 1962–2000. *World Economy*, 35 (3), 295–315.

[2] Al-Mulali, U., and Ozturk, I. (2015). The Effect of Energy Consumption, Urbanization, Trade Openness, Industrial Output, and the Political Stability on the Environmental Degradation in the MENA (Middle East and North African) Region. *Energy*, 84, 382–389.

[3] Al-Mulali, U., Tang, C.F., and Ozturk, I. (2015). Does Financial Development Reduce Environmental Degradation? Evidence from a Panel Study of 129 Countries. *Environmental Science Pollution Research*, 22 (19), 14891–14900.

[4] Aslan, A., and Gozbasi, O. (2016). Environmental Kuznets Curve Hypothesis for Sub-elements of the Carbon Emissions in China. *Natural Hazards*, 82 (2), 1327–1340.

[5] Bento, J.P.C., and Moutinho, V. (2016). CO_2 Emissions, Non-Renewable and Renewable Electricity Production, Economic Growth and International Trade in Italy. *Renewable and Sustainable Energy Reviews*, 55, 142–155.

[6] Can, M., and Gozgor, G. (2016). Dynamic Relationships among CO_2 Emissions, Energy Consumption, Economic Growth, and Economic Complexity in France. *Munich Personal RePEc Archive*, No. 70373.

[7] Chang, C-C. (2010). A Multivariate Causality Test of Carbon Dioxide Emissions, Energy Consumption and Economic Growth in China. *Applied Energy*, 87 (11), 3533–3537.

[8] Diao, X.D., Zeng, S.X., Tam, C.M., and Tam, V.W.Y. (2009). EKC Analysis for Studying Economic Growth and Environmental Quality: A Case Study in China. *Journal of Cleaner Production*, 17 (5), 541–548.

[9] Dogan, E., and Turkekul, B. (2016). CO_2 Emissions, Real Output, Energy Consumption, Trade, Urbanization and Financial Development: Testing the EKC Hypothesis for the USA *Environmental Science and Pollution Research*, 23 (2), 1203–1213.

[10] Du, L., Wei, C., and Cai, S. (2012). Economic Development and Carbon Dioxide Emissions in China: Provincial Panel Data Analysis. *China Economic Review*, 23 (2), 371–384.

[11] Ertugrul, H.M., Cetin, M., Seker, F., and Dogan, E. (2016). The Impact of Trade Openness on Global Carbon Dioxide Emissions: Evidence from the Top Ten Emitters among Developing Countries. *Ecological Indicators*, 67, 543–555.

[12] Feenstra, R.C., and Romalis, J. (2014). International Prices and Endogenous Quality. *Quarterly Journal of Economics*, 129 (2), 477–527.

[13] Fei, L., Dong, S., Xue, L., Liang, Q., and Yang, W. (2011). Energy Consumption-Economic Growth Relationship and Carbon Dioxide Emissions in China. *Energy Policy*, 39 (2), 568–574.

[14] Govindaraju, V.G.R.C., and Tang, C.F. (2013). The Dynamic Links between Co_2 Emissions, Economic Growth and Coal Consumption in China and India. *Applied Energy*, 104, 310–318.

[15] Gozgor, G., and Can, M. (2016a). Export Product Diversification and the Environmental Kuznets Curve: Evidence from Turkey. *Munich Personal RePEc Archive*, No. 69761.

[16] Gozgor, G., and Can, M. (2016b). Effects of the Product Diversification of Exports on Income at Different Stages of Economic Development. *Eurasian Business Review*, 6 (2), 215–235.

[17] Grossman, G., and Krueger, A. (1995). Economic Growth and the Environment. *Quarterly Journal of Economics*, 110 (2), 353–377.
[18] Hallak, J.C., and Schott, P.K. (2011). Estimating Cross-Country Differences in Product Quality. *Quarterly Journal of Economics*, 126 (1), 417–474.
[19] Hallak, J.C. (2006). Product Quality and the Direction of Trade. *Journal of International Economics*, 68 (1), 238–265.
[20] Harding, T., and Javorcik, B.S. (2012). Foreign Direct Investment and Export Upgrading. *Review of Economics and Statistics*, 94 (4), 964–980.
[21] Hausmann, R., Hidalgo, C.A, Bustos, S., Coscia, M., Chung, S., Jimenez, J., Simoes, A., and Yildirim, M. (2011*). The Atlas of Economic Complexity*. Puritan Press: Cambridge, MA.
[22] Hausmann, R., Hwang, J., and Rodrik, D. (2007). What You Export Matters. *Journal of Economic Growth*, 12 (1), 1–25.
[23] He, J., and Wang, H. (2012). Economic Structure, Development Policy and Environmental Quality: An Empirical Analysis of Environmental Kuznets Curves with Chinese Municipal Data. *Ecological Economics*, 76, 49–59.
[24] Henn, C., Papageorgiou, C., and Spatafora, N. (2013). Export Quality in Developing Countries. *IMF Working Paper Series*, No. WP/13/108. Washington, D.C.: International Monetary Fund.
[25] Henn, C., Papageorgiou, C., and Spatafora, N. (2015). Export Quality in Advanced and Developing Economies: Evidence from a New Dataset. *WTO Working Paper*, No. ERSD-2015–02, Geneva: World Trade Organization.
[26] Hummels, D., and Klenow, P.J. (2005). The Variety and Quality of a Nation's Exports. *American Economic Review*, 95 (3), 704–723.
[27] International Monetary Fund (2014). Sustaining Long–Run Growth and Macroeconomic Stability in Low–Income Countries–the Role of Structural Transformation and Diversification. *IMF Policy Paper*, March 2014, Washington, D.C.: International Monetary Fund.
[28] Jalil, A., and Feridun, M. (2011). The Impact of Growth, Energy and Financial Development on the Environment in China: A Cointegration Analysis. *Energy Economics*, 33 (2), 284–291.
[29] Jalil, A., and Mahmud, S.F. (2009). Environment Kuznets Curve for CO_2 Emissions: A Cointegration Analysis for China. *Energy Policy*, 37 (12), 5167–5172.
[30] Javid, M., and Sharif, F. (2016). Environmental Kuznets Curve and Financial Development in Pakistan. *Renewable and Sustainable Energy Reviews*, 54, 406–414.
[31] Jayanthakumaran, K., and Liu, Y. (2012). Openness and the Environmental Kuznets Curve: Evidence from China. *Economic Modelling*, 29 (3), 566–576.
[32] Jayanthakumaran, K., Verma, R., and Liu, Y. (2012). CO_2 Emissions, Energy Consumption, Trade and Income: A Comparative Analysis of China and India. *Energy Policy*, 42, 450–460.
[33] Jebli, M.B., Youssef, S.B., and Ozturk, I. (2016). Testing Environmental Kuznets Curve Hypothesis: The Role of Renewable and Non-Renewable Energy Consumption and Trade in OECD Countries. *Ecological Indicators*, 60, 824–831.
[34] Kang, Y-Q., Zhao, T., and Yang, Y-Y. (2016). Environmental Kuznets Curve for CO_2 Emissions in China: A Spatial Panel Data Approach. *Ecological Indicators*, 63, 231–239.
[35] Katircioglu, S.T. (2014). Testing the Tourism-Induced EKC Hypothesis: The Case of Singapore. *Economic Modelling*, 41, 383–391.
[36] Kearsley, A., and Riddel, M. (2010). A Further Inquiry into the Pollution Haven Hypothesis and the Environmental Kuznets Curve. *Ecological Economics*, 69 (4), 905–919.

[37] Khandelwal, A. (2010). The Long and Short (of) Quality Ladders. *Review of Economic Studies*, 77 (4), 1450–1476.
[38] Lau, L-S., Choong, C-K., and Eng, Y-K (2014). Investigation of the Environmental Kuznets Curve for Carbon Emissions in Malaysia: Do Foreign Direct Investment and Trade Matter?, *Energy Policy*, 68, 490–497.
[39] Lee, J., and Strazicich, C. (2003). Minimum Lagrange Multiplier Unit Root Test with Two Structural Breaks. *Review of Economics and Statistics*, 85 (4), 1082–1089.
[40] Li, T., Wang, Y., and Zhao, D. (2016). Environmental Kuznets Curve in China: New Evidence from Dynamic Panel Analysis. *Energy Policy*, 91, 138–147.
[41] Liddle, B. (2015). What are the Carbon Emissions Elasticities for Income and Population? Bridging STIRPAT and EKC via Robust Heterogeneous Panel Estimates. *Global Environmental Change*, 31, 62–73.
[42] List, J.A., and Co, C.Y. (2000). The Effects of Environmental Regulations on Foreign Direct Investment. *Journal of Environmental Economics and Management*, 40 (1), 1–20.
[43] Liu, Y., Zhou, Y., and Wu, W. (2015). Assessing the Impact of Population, Income and Technology on Energy Consumption and Industrial Pollutant Emissions in China. *Applied Energy*, 155, 904–917.
[44] Managi, S., and Jena, P.R. (2008). Environmental Productivity and Kuznets Curve in India. *Ecological Economics*, 65 (2), 432–440.
[45] Martin, J., and Mejean I. (2014). Low-Wage Country Competition, and the Quality Content of High-wage Country Exports. *Journal of International Economics*, 93 (1), 140–152.
[46] Narayan, P.K. (2005). The Saving and Investment Nexus for China: Evidence from Cointegration Tests. *Applied Economics*, 37 (17), 1979–1990.
[47] Narayan, P.K., and Smyth, R. (2006). What Determines Migration Flows from Low-Income to High-Income Countries? An Empirical Investigation of Fiji-U.S. Migration 1972–2001. *Contemporary Economic Policy*, 24 (2), 332–342.
[48] Narayan, P.K., and Narayan, S. (2010). Carbon Dioxide Emission and Economic Growth: Panel Data Evidence from Developing Countries. *Energy Policy*, 38 (1), 661–666.
[49] Onafowora, O.A., and Owoye, O. (2014). Bound Testing Approach to Analysis of the Environment Kuznets Curve Hypothesis. *Energy Economics*, 44, 47–62.
[50] Ouyang, X., and Lin, B. (2015). An Analysis of the Driving Forces of Energy-Related Carbon Dioxide Emissions in China's Industrial Sector. *Renewable and Sustainable Energy Reviews*, 45, 838–849.
[51] Papageorgiou, C., and Spatafora, N. (2012). Economic Diversification in LICs: Stylized Facts and Macroeconomic Implication. *IMF Staff Discussion Notes*, No. 12/13, Washington, D.C.: International Monetary Fund.
[52] Pesaran, M.H., and Shin, Y. (1999). An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis, S. Strom (Eds.), Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium, Cambridge.
[53] Pesaran, M.H., Shin, Y., and Smith, R.J. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics*, 16 (3), 289–326.
[54] Ren, S., Yuan, B., Ma, X., and Chen, X. (2014). International Trade, FDI (Foreign Direct Investment) and Embodied CO_2 Emissions: A Case Study of Chinas Industrial Sectors. *China Economic Review*, 28, 123–134.
[55] Rodrik, D. (2006). What's So Special about China's Export? *China & World Economy*, 14 (5), 1–19.
[56] Saboori, B., and Sulaiman, J. (2013). CO_2 Emissions, Energy Consumption and Economic Growth in Association of Southeast Asian Nations (ASEAN) Countries: A Cointegration Approach. *Energy*, 55, 813–822.

[57] Schott, P. (2004). Across-Product versus Within-Product Specialization in International Trade. *Quarterly Journal of Economics*, 119 (2), 647–678.
[58] Shen, J. (2006). A Simultaneous estimation of Environmental Kuznets Curve: Evidence from China. *China Economic Review*, 17 (4), 383–394.
[59] Song, T., Zheng, T., and Tong, L. (2008). An Empirical Test of the Environmental Kuznets Curve in China: A Panel Cointegration Approach. *China Economic Review*, 19 (3), 381–392.
[60] Steenhof, P.A. (2007). Decomposition for Emission Baseline Setting in China's Electricity Sector. *Energy Policy*, 35 (1), 280–294.
[61] Tang, C.F., and Tan, B.W. (2015). The Impact of Energy Consumption, Income and Foreign Direct Investment on Carbon Dioxide Emissions in Vietnam. *Energy*, 79, 447–454.
[62] Tian Y.H., Zhu, Q.H., and Geng, Y. (2013). An Analysis of Energy-Related Greenhouse Gas Emissions in the Chinese Iron and Steel Industry. *Energy Policy*, 56, 352–361.
[63] Wang, Z., and Wei, S-J. (2010). What Accounts for the Rising Sophistication of China's Exports? R.C. Feenstra and S-J Wei (Eds.), In *China's Growing Role in World Trade*, (pp. 63–104), Chicago, IL: University of Chicago Press.
[64] Wang, S.S., Zhou, D.Q., Zhou, P., and Wang, Q.W. (2011). CO_2 Emissions, Energy Consumption and Economic Growth in China: A Panel Data Analysis. *Energy Policy*, 39 (9), 4870–4875.
[65] Wang, Q.W., Zhou, P., Shen, N., and Wang, S.S. (2013). Measuring Carbon Dioxide Emission Performance in Chinese Provinces: A Parametric Approach. *Renewable and Sustainable Energy Reviews*, 21, 324–330.
[66] Wang, S., Zhou, C., Li, G., and Feng, K. (2016a). CO_2, Economic Growth, and Energy Consumption in China's Provinces: Investigating the Spatiotemporal and Econometric Characteristics of China's CO_2 Emissions. *Ecological Indicators*, 69, 184–195.
[67] Wang, S.J., Fang, C.L., Ma, H.T., Wang, Y., and Qin, J. (2014). Spatial Differences and Multi-Mechanism of Carbon Footprint Based on GWR Model in Provincial China. *Journal of Geographical Sciences*, 24 (4), 612–630.
[68] Wang, Y., Han, R., and Kubota, J. (2016b). Is There an Environmental Kuznets Curve for SO_2 emissions? A Semi-Parametric Panel Data Analysis for China. *Renewable and Sustainable Energy Reviews*, 54, 1182–1188.
[69] Wang, Z., and Liu, W. (2015). Determinants of CO_2 Emissions from Household Daily Travel in Beijing, China: Individual Travel Characteristic Perspectives. *Applied Energy*, 158, 292–299.
[70] Xu, J-H., Fleiter, T., Eichhammer, W., and Fan, Y. (2012). Energy Consumption and CO_2 Emissions in China's Cement Industry: A Perspective from LMDI Decomposition Analysis. *Energy Policy*, 50, 821–832.
[71] Zhang, C., and Lin, Y. (2012). Panel Estimation for Urbanization, Energy Consumption and CO_2 Emissions: A Regional Analysis in China. *Energy Policy*, 49, 488–498.
[72] Zhang, C., and Zhou, X. (2016). Does Foreign Direct Investment Lead to Lower CO_2 Emissions? Evidence from a Regional Analysis in China. *Renewable and Sustainable Energy Reviews*, 58, 943–951.
[73] Zhang, Y-J. (2011). The Impact of Financial Development on Carbon Emissions: An Empirical Analysis in China. *Energy Policy*, 39 (4), 2197–2203.
[74] Zhang, Y-J., Liu, Z., Zhang, H., and Tan, T-D. (2014). The Impact of Economic Growth, Industrial Structure and Urbanization on Carbon Emission Intensity in China. *Natural Hazards*, 73 (2), 579–595.
[75] Zhou, Y., Liu, Y., Wu, W., and Li, Y. (2015). Effects of Rural-Urban Development Transformation on Energy Consumption and CO_2 Emissions: A Regional Analysis in China. *Renewable and Sustainable Energy Reviews*, 52, 863–875.

[76] Zivot, E., and Andrews, D.W.K. (1992). Further Evidence on the Great Crash, the Oil Price Shock and the Unit Root Hypothesis. *Journal of Business and Economic Statistics*, 10 (3), 251–270.

Table 1
Results of the Unit Root Test of Zivot and Andrews (1992)

Variables	LM	CV (1%)	CV (5%)	CV (10%)	Lag	Variables	LM	Lag	Break Dates	Result
Log Real GDP per Capita	–4.949**	–5.340	–4.800	–4.580	3	Δ Log Real GDP per Capita	–	–	2004	I(0)
Log Squared Real GDP per Capita	–3.348	–4.545	–3.842	–3.504	1	Δ Log Squared Real GDP per Capita	–4.723***	3	2003	I(1)
Log CO_2 Emissions per Capita	–3.553*	–4.545	–3.842	–3.504	3	Δ Log CO_2 Emissions per Capita	–6.928***	3	2006	I(1)
Log Energy Consumption per Capita	–3.329	–4.545	–3.842	–3.504	1	Δ Log Energy Consumption per Capita	–6.464***	0	2001	I(1)
Log Export Product Quality	–6.077***	–4.545	–3.842	–3.504	3	Δ Log Export Product Diversification	–	–	1992	I(0)

Notes: The table shows the results of the unit root test of Zivot and Andrews (1992), and the results include break on the level. Null hypothesis: the series have unit root. The optimal number of lags is selected by the Akaike Information Criteria (AIC). The maximum number of lags is 3. Trimmer rate is defined as 0.10. CV: Critical Values. *** indicates the rejection of the null hypothesis at the 1% significance level.

Table 2
Results of the Unit Root Test of Lee and Strazicich (2003)

Variables	LM	CV (1%)	CV (5%)	CV (10%)	Lag	Variables	LM	Lag	Break Dates	Result
Log Real GDP per Capita	–1.847	–4.545	–3.842	–3.504	1	Δ Log Real GDP per Capita	–5.049***	0	1977, 1985	I(1)
Log Squared Real GDP per Capita	–1.440	–4.545	–3.842	–3.504	1	Δ Log Squared Real GDP per Capita	–5.002***	0	1977, 1985	I(1)
Log CO_2 Emissions per Capita	–2.741	–4.545	–3.842	–3.504	1	Δ Log CO_2 Emissions per Capita	–5.233***	3	2003, 2005	I(1)
Log Energy Consumption per Capita	–1.628	–4.545	–3.842	–3.504	1	Δ Log Energy Consumption per Capita	–5.252***	0	1990, 2003	I(1)
Log Export Product Quality	–4.011**	–4.545	–3.842	–3.504	3	Δ Log Export Product Diversification	–5.450***	2	1976, 1993	I(0)

Notes: The table shows the results of the unit root test of Lee and Strazicich (2003), and the results include two breaks on the level. Null hypothesis: the series have unit root. The optimal number of lags is selected by the Akaike Information Criteria (AIC). The maximum number of lags is 3. Trimmer rate is defined as 0.10. CV: Critical Values. *** and **indicate the rejection of the null hypothesis at the 1% and the 5% significance levels, respectively.

Table 3
Results of the Bounds Tests for Cointegration Analysis
CO_2 Emissions – GDP per Capita – Squared GDP per Capita – Energy Consumption – Export Quality

Panel A: Bounds Tests for Cointegration	F-statistic	Optimal Lag	Structural Break
China	6.837***	4	2006
Panel B: Critical value bounds of the F-statistic in Pesaran et al. (2001)	**Lower bounds, I(0)**	**Upper bounds, I(1)**	**Cointegration**
1% Significance Level	3.74	5.06	Yes
5% Significance Level	2.86	4.01	
10% Significance Level	2.45	3.52	
Panel C: Critical value bounds of the F-statistic in Narayan (2005)	**Lower bounds, I(0)**	**Upper bounds, I(1)**	**Cointegration**
1% Significance Level	4.42	6.25	Yes
5% Significance Level	3.20	4.54	
10% Significance Level	2.66	3.83	

Notes: The model with the constant term is used in the cointegration analysis. The optimal lag length is selected by using the AIC. The null hypothesis is that there is no cointegration among variables. The critical values are given in Pesaran et al. (2001) and Narayan (2005). *** indicates the rejection of the null hypothesis at the 1% significance.

Table 4
Results of the Long Run Coefficients for ARDL Model Estimations

	China	Log CO_2 Emissions per Capita
Long Run ARDL Models (2, 2, 3, 3, 3)	Log Real GDP per Capita	1.416 (0.100)***
	Log Squared Real GDP per Capita	–0.247 (0.023)***
	Log Energy Consumption per Capita	1.306 (0.074)***
	Log Export Product Quality	–1.266 (0.267)***
	Dummy 2006	–0.025 (0.011)**
R^2	Overall	0.998
F-statistic	Overall	1004.41
Breusch-Godfrey Serial Correlation	F-statistic	2.102 [0.1750]
Ramsey-Reset	F-statistic	0.488 [0.4991]
Jarque-Bera Normality	Chi Square-statistic	0.382 [0.826]
Breusch-Pagan-Godfrey Heteroskedasticity	F-statistic	1.411 [0.2718]
Stability Tests	CUSUM	Stable at 5% level
Stability Tests	CUSUM of Squares	Stable at 5% level
Stability Tests	Chow Test	Stable at 5% level

Notes: The table reports the results of the long run coefficients in the ARDL model of Pesaran and Shin (1999). Serial Correlation has the null hypothesis is that there is no residual serial correlation, and the alternative hypothesis is that there is a serial correlation up to order 4. The Ramsey-Reset tests the specification of the model, and the test statistics has the null hypothesis is that specification (functional form) is correct in the models. Normality refers to the Jarque-Bera test, and the null hypothesis is that the error term are normally distributed. Heteroskedasticity has the null hypothesis is that the variance is homoscedastic. The standard errors are given in parentheses, and the probability values are given in brackets. *** and ** indicate the rejection of the null hypothesis at the 1% and the 5% significance level, respectively.

Table 5
Results of the Long-run Granger Causality / VECM Tests

Dependent Variable:	ECT_{t-1} (t-statistics)
ΔLog CO_2 Emissions:	13.48*** [0.0092]
ΔLog GDP per Capita:	5.691 [0.2234]
ΔLog Squared GDP per Capita:	7.499 [0.1123]
ΔLog Energy Consumption:	1.348 [0.7419]
ΔLog Export Quality:	3.629 [0.5138]

Notes: The optimal number of lag length is selected by the Schwarz Information Criteria (SIC). The probability values are in brackets. *** and ** indicate the rejection of the null hypothesis at the 1% and the 5% significance level, respectively.

Appendix Table I.
Descriptive Summary Statistics and the Description of Variables: 1971–2010

Variable	Unit	Data Source	Mean	Standard Deviation	Skewness	Kurtosis
Real per Capita GDP (constant $ price in 2005)	Logarithmic Form	World Bank, WDI	2.735	0.404	0.186	1.764
Squared Real per Capita GDP (constant $ price in 2005)	Logarithmic Form	World Bank, WDI	7.643	2.244	0.345	1.884
CO_2 Emissions (metric tons per capita)	Logarithmic Form	World Bank, WDI	0.355	0.213	0.339	2.332
Energy Consumption (kilogram of oil equivalent per capita)	Logarithmic Form	World Bank, WDI	2.902	0.162	0.699	2.686
Export Product Quality (index)	Logarithmic Form	International Monetary Fund	–0.117	0.050	–0.058	1.773

Appendix Table II.
Results of the Short-run Coefficients for ARDL Model Estimations

Short Run ARDL Models (4, 4, 4, 3, 3)	Log CO_2 Emissions per Capita
ΔLog CO_2 Emissions $_{t-1}$	0.017 (0.313)
ΔLog CO_2 Emissions $_{t-2}$	–0.583 (0.272)*
ΔLog CO_2 Emissions $_{t-3}$	–0.040 (0.289)
ΔLog CO_2 Emissions $_{t-4}$	–0.307 (0.148)*
ΔLog GDP per Capita $_{t}$	–1.109 (1.513)
ΔLog GDP per Capita $_{t-1}$	0.550 (2.607)
ΔLog GDP per Capita $_{t-2}$	0.014 (2.498)
ΔLog GDP per Capita $_{t-3}$	–5.647 (3.099)*
ΔLog GDP per Capita $_{t-4}$	9.070 (3.055)**
ΔLog Squared GDP per Capita $_{t}$	0.287 (0.298)
ΔLog Squared GDP per Capita $_{t-1}$	–0.112 (0.517)
ΔLog Squared GDP per Capita $_{t-2}$	–0.012 (0.516)
ΔLog Squared GDP per Capita $_{t-3}$	1.151 (0.647)
ΔLog Squared GDP per Capita $_{t-4}$	–1.832 (0.621)**
ΔLog Energy Consumption $_{t}$	0.869 (0.202)***
ΔLog Energy Consumption $_{t-1}$	0.233 (0.274)
ΔLog Energy Consumption $_{t-2}$	0.549 (0.310)
ΔLog Energy Consumption $_{t-3}$	0.793 (0.366)*
ΔLog Export Quality $_{t}$	–0.290 (0.366)
ΔLog Export Quality $_{t-1}$	–0.533 (0.404)
ΔLog Export Quality $_{t-2}$	–0.153 (0.422)
ΔLog Export Quality $_{t-3}$	–0.558 (0.431)
ΔDummy 2003	0.014 (0.023)
ΔDummy 2005	–0.033 (0.019)
ΔConstant Term	–10.59 (2.231)***
Lagged Error Correction Term (ECT_{t-1})	–1.616 (0.241)***
R^2	0.998

F-statistic	830.19
Durbin-Watson Statistic	2.161