Acta Technica 62 (2017), No. 5A, 437–448

The Influence of Relative CO_2 Emission Regulation Intensity on Trade Competitiveness of China

Li Fangmin[2], Lu Wenyi[3]

Abstract. Chinese government has promised to reduce CO_2 emission by 40%-45% with per unit GDP by 2020; under such circumstances, this paper studies the influence of relative CO_2 emission regulation intensity on trade competitiveness of China. The bilateral data of China with 77 major trading partners during 1992 and 2013 are adopted to tackle the issue in this study. Based on the multivariate panel data, a framework of cointegration and Granger causality test is constructed to empirically analyze the problem. This research find that intensity of relative CO_2 emission is a significant factor in influencing Chinese trade competitiveness. Meanwhile, the influence of CO_2 regulation on Chinese trade competitiveness, which positively promotes Chinese trade competitiveness, is in conformity with the "Porter Hypothesis". Therefore, the policy of CO_2 emission reduction implemented by Chinese government contributes to the export competitiveness improvement of China at the current stage.

Key words. Relative CO_2 emission regulation intensity, bilateral trade, export competitiveness, Cointegrating Regression..

1. Introduction

With the expansion of international trade, the advance of trade freedom and the increasing severity of environmental pollution, the interaction between stringent environment regulation and international trade competitiveness has been widely discussed and studied by politicians and scholars during the recent 20 years[1,2]. Throughout time, developing countries obtained comparative from pollution-intensive industries, and eventually transformed into the "Haven" of polluting industries. The "Pollution Haven Hypothesis", as a representative viewpoint, posits that under the circumstances of free trade, enterprises in industrialized countries relocate their pro-

[1]Acknowledgement - This research was partly supported by the following funding institutions/projects:Zhejiang Philosophy and Social Sciences Planning Project 18NDJC210YB.

[2]Workshop 1 - College of Economics and Management, Zhejiang University of Technology, Hangzhou, 310023, China

[3]The Graduate Center, CUNY365 Fifth Av, New York, NY 10016

duction of pollution-intensive products to developing countries with less stringent environmental regulations[3]. The difference of environmental regulations would lead to the improvement of export competitiveness and increase of trade volume in those countries with lower regulation standards or weaker enforcement[4]. The "Porter hypothesis" is a different viewpoint proposed by Porter and Linde (1995). Scholars, who support such hypothesis, point out that discussion about interaction between environmental regulation and international trade competitiveness should be placed in a dynamic analyzing framework. Given the production technologies available, products and production process are improved under the change of environmental regulations. Hence, a causal relationship exists between stringent environmental regulation and improved industrial international competitiveness[5]. High environmental regulation standard benefits the export of developing countries. Combining a country's income level with its stringent level of environmental regulation, Copeland and Taylor(1994) prove that when only the difference of human capital level is considered, the "Pollution Haven Hypothesis" could be valid. Antweiler, construct a 2by2 small country trade model to conduct theoretical derivation, with evidences to support the existence of the "Pollution Haven Hypothesis" in both theoretical and empirical aspects. Cole and Elliott(2003), Levinson and Taylor (2008) and Dean and Lovely (2010) have reached similar conclusions, while some other scholars gathered opposing conclusions. Through comparing the differences of environmental policies among various countries, Spatareanu (2007) analyzed whether the stringent level of environmental regulations would influence enterprises' international competitiveness, and observed that a positive correlation is present[6]. Grehter and Mel (2003) determined that polluting industries generally suffer from higher trade barriers, and their empirical study does not support the idea that developed countries would transfer their polluting industries to developing countries[7]. Other scholars, such as Sinclair-Desgaen? (1999)and Alpay (2001), note that whether or not environmental regulation improves international development depends on the join force of both environmental cost and technological innovation mechanisms. Many scholars in China have conducted studies on the relation between environmental regulations and trade structure in the Chinese context. Zhang Xiuqin(2012), Chi,YY &Guo, ZQ(2014)[8],demonstrate that, with the government intensifying environmental regulations, export competitiveness of environment-sensitive products shows an improving trend in China. Based on the Chinese data from 1996 to 2004, Fu Jinyan &Li Lisha(2010),Guo, ZQ & Liu, HB(2016)[9] analyzed the environmental regulation effect, the factor endowment effect and the functional effect of industrial competitiveness, and finally reach the conclusion that China is not a "Pollution Refuge" for developed countries. By empirically studying the trade data between China and major developed countries such as G7 and OECD member countries, Li Xiaoping and Lu Xianxiang (2010)find that China does not become the "Polluting Industry Haven" of developed countries through international trade[10].

Existing literatures mainly discuss the influence of overall environmental regulation on trade competitiveness. However, few have studied specially on the influence of CO_2emission. Under the circumstances that China has promised to reduce CO_2emission by 40%-45% with per unit GDP by 2020, it is significant to focus research on studying the influence of CO_2emission regulation on trade competitiveness, Cheng Huifang, Li Fangmin(2015)[11] In addition, the majority of empirical studies are based on multilateral trade, while the relationship of bilateral trade is infrequently studied. According to the theory of comparative advantage, study of a country's trade competitiveness under bilateral conditions is more compelling. Therefore, selecting "the influence of relative CO_2 emission regulation on Chinese trade competitiveness using bilateral trade data" as the main focus in this paper is not only insightful but also worth further investigating.

2. Literature Review

In current existing literature, few have studied the impact of CO_2 emission regulation on trade competitiveness particularly. However, CO_2 emission regulation is a specific type of environmental regulation. Therefore, some related literatures on general environmental regulations can be referred to in our study.

2.1. Frameworks of Empirical Study

During the process of studying the relation between environmental regulation and trade competitiveness, this research find that domestic and foreign scholars adopt different analyzing frameworks to conduct empirical analysis. There are mainly three methods used in these empirical studies. The first method is the regression testing based on the Heckscher-Ohlin-Vanek ("HOV") model. The detail of such method is to add the environmental regulation variable into the HOV model, which is applied by Copeland and Taylor(2001), Cole & Elliott(2003) and Edington and Minier(2003). The equation is as follows:

$$TC_{it}^{j} = f(K_{it}^{j}, L_{it}^{j}, EG_{it}^{j}, D_{it}^{j}) + \varepsilon_{it}^{j}.$$

Innovation and further studies are often based on the selection of trade flow indicator, "TC", and confirmation of control variable, "D". Let i denotes the industry, j denotes the country and t denotes the time, included in the function are K as the physical capital, L as the labor force(human capital)EG as the environmental regulations and D as the other control variables, such as R&D and tariff. ε is the error term.

Another method is to add environmental regulation variable into the Gravity model framework. Van Beers and Van den Bergh(1997) are the earliest scholars who applied the Gravity Model to analyzing environment and trade issues. Based on the data of 14 OECD member countries and 9 developing countries in 1975 and 21 OECD member countries in 1992, examined with the Gravity model, they discovered that the stringent level of environmental regulation and export performance in 1975 were in positive correlation. However, the stringent level of environmental regulation in OECD countries poses minor influence on trade competitiveness of polluting industries. Based on Van's study, Xu(2000) adds a tariff indicator into the independent variables. The result of the study shows that environmental regulation benefits the overall export, but the export competitiveness of environment-sensitive products is unaffected. Grether and Melo(2003)add Revealed Comparative Advantage("RCA") into the Gravity model framework, and discovered that environmental regulations have only minor influence on the international trade flow of pollution-intensive industries. Lu Jing (2007) adds the factors of ever-changing environmental cooperation among international governments and different measuring standards of environmental regulation into the environmental regulation variable; thereby further developing the Gravity model.

The third method is the Leontief Method, which is based on the Input-Output model("I-O") of Leontief. In this method, the pollution abatement cost contained in the trade is estimated and used for comparison. Leontief and Ford (1972)incorporate contaminants as unhealthy output into the input model. Later, inspired by their ideas, more scholars conducted studies in this area. Using I-O model, Dietzenbacher and Mukhopadhyay (2007) examine the influence of trade between India and European countries on the environment, as well as the influence of trade between India and other countries on environment. Gale(1995)examines the influence of NAFTA on CO_2emissions on Mexico with the I-O model, and finds that trade liberalization contributes to both economic growth and CO_2emissions in Mexico. They came to the conclusion that trade leads to the reduction of pollution emissions in India, which overturns the "Pollution Haven Hypothesis" in the nation of India. Peng Shuijun and Liu Anping(2010) adopt an environmental I-O model in an open economic system, and prove that exported products of China is "cleaner" than imported products. Participating in international trade contributes to the reduction of pollution emission in China. Dong Mingjie(2011) utilizes the I-O model to illustrate the influence of environmental regulation on Chinese export competitiveness, noting that it is unnecessary to worry about the international competitiveness impairment of Chinese products posed by environmental regulation.

The advantage of the Gravity model lies in its scientific analysis of the relation between bilateral trade flow and environmental regulation. Its disadvantage is that it fails to control well the factors such as physical capital and human capital while discussing the influence of emission regulation on trade competitiveness. In this paper, regression testing of the HOV model is adopted for necessary study

2.2. Measurement of CO_2Emission Regulation Intensity

The variable of CO_2emission regulation intensity in studying economic development is rarely seen in existing literature. One of the major reasons is that it's quite difficult to measure the intensity of CO_2emission regulation. CO_2emission regulation belongs to environmental regulation. Therefore, measurement of environmental regulation intensity in the literature can be referred to in measuring the intensity of CO_2emission regulation. There are three most frequently applied methods measuring the intensity of environmental regulation in previous studies:

(??)1)Pollution Abatement and Control Expenditure("PACE") in unit of output is used in many studies to measure the intensity of environmental regulation. This method is frequently employed in the studies of developing countries, and several Chinese scholars have also adopted this method. However, the disadvantage of the

PACE method lies in its limitation of data credibility and effectiveness.

(??)2)Per capita income level is adopted as a substitute variable for environmental regulation intensity. Lu Yang(2009) is one representative that utilizes this method. Taking per capita income level as the only consideration in measuring the intensity of CO_2emission regulation is simply one means, which processes weak accuracy and representativeness.

(??)3)Emission of per unit industrial output is adopted to measure the environmental regulation intensity. Hettige, Huq, Pargal, and Wheeler (1996) point out in their study that pollution emissions are to be regarded as an additionally input "environmental service" in the industrial production function. Cole, Elliott and Shimamoto (2005) take pollution emissions as "environmental service," and conduct general equilibrium analysis on the supply and demand of such "environmental service." Finally, they examine the feasibility of measuring the environmental regulation intensity with emissions of per unit industrial output. In this paper, this research focus on CO_2emission regulation, and adopt CO_2emission per unit industrial output to measure its regulation intensity, which is in line with the requirements of this study. Meanwhile, the data are readily available.

3. Variables and Methodology

In our study, the method written by Cole and Elliott(2003), is referred to[23] . The detail is as follows:

$$SPEC_{it} = \alpha + \gamma_i + \tau_t + \beta_1 relPAOCva_{it} + \beta_2 relPCI_{it} + \beta_3 (relPCI_{it})^2 + \beta_4 HCI_{it} (1)$$

Based on the equation (1), this research make some modifications, and thus get equation (2):

$$\ln CCP_t = \alpha + \beta_1 \ln relCR_t + \beta_2 \ln relK_t + \beta_3 \ln(relK_{it})^2 + \beta_4 \ln relH_t + \beta_5 \ln relT_t + \varepsilon_t (2)$$

In equation (2), this research substitute CCP (the ratio of Chinese export volume toward target country and the consumption in the target country) for export competitiveness index in equation (1). Since CCP is determined by export competitiveness, after the above substitution, the equation still holds true and conforms to the requirement of bilateral trade data analysis. relCR, relK, relH and relT represent the ratio of CO_2emission regulation intensity, the ratio of physical capita intensity, the ratio of human capita intensity and the ratio of tariff intensity in China and target country respectively. $(relK)^2$ is the quadratic term of relative physical intensity, and all variables are evaluated in logarithm. Through improvement on models such as Cole model, this research incorporate bilateral trade data between China and target countries into our model based on HOV theory.

The Ratio of Chinese export volume toward target country and the consumption in the target country is demonstrated in this equation:$CCP_c^j = \frac{EXP_c^j}{VAD^j + IM_w^j - EXP_j^w}$, in which$CCP_c^j$equals to the ratio of Chinese export volume to the target country divided by industrial added value plus total import volume minus total export volume in target country. c stands for Chinaj stands for the target country w stands for the whole world.

4. Data sources and data processing

Data of Chinese industrial value added and capital stock in this paper are extracted form "China Statistical Yearbook" and "China Industrial Economy Statistical Yearbook" in relevant year. Data of employment rate at the end of year, average labor compensation and labor hours are from the "China Labor Statistical Yearbook," where the employment rate is replaced by the rate of urban employees. In addition to the host country, China, 77 target counties such as America, Britain, Japan, German, Mexico, Zambia and India are selected as sample countries in this study. The time range of the data is 1992-2013. In 2013, export volume of China to the above 77 countries accounts for 50.89% of Chinese total export volume. Therefore, these countries selected as sample countries are fairly representative, and the data are comparatively complete.

Import and export data of all countries are from UNComtrade (UN Commodity Trade Statistics Database); Industrial CO_2 emissions data come from the International Energy Agency (IEA) statistics database. Data of national industrial added value, capital stock, exchange rates, and the price index of manufacturing industry of all countries except for China are from the OECD database, World Bank WDI database and each countries' national Statistical Yearbook. Employment rate at the end of each year, labor compensation, labor hours and other data are from the International Labour Organization (ILO database), in which the average labor remuneration of industry is equal to remuneration divided by employment rate by the end of year of the total industry. National data of all countries (including China) are unified in terms of dollars, and standardized by using 2005 constant prices. The statistical description of the data is shown in table 1:

Table 1.statistical description of the data

	LNRELK	LNRELH	LNRELT	LNRELCR
Mean	0.611069	-0.907605	0.771894	-1.450061
Median	0.6	-1.08	0.87	-1.56
Maximum	2.85	2.77	8.7	0.85
Minimum	-0.69	-2.81	-2.53	-3.51
Std. Dev.	0.292544	1.051381	1.116456	0.868859
Observations	1682	1682	1682	1682
Cross sections	77	77	77	77

5. Empirical Results

In this paper, the method of multivariate panel regression is adopted to estimate the 22-year panel data of 77 countries from 1992 and 2013. The detailed regression model is illustrated in equation (2). To avoid potential “spurious regression” problem in analyzing our panel dataset, this research conduct unit root test before estimating regression coefficients. The result of multivariate unit root tests showed that the dependent variable lnCCP and the independent variable lnrelH are non-stationary series but integrated; while the other independent variable lnrelK, lnrelH and lnrelCR are stationary series. Since OLS could provide consistent estimates only if integrated dependent and independent variables are cointegrated, this research proceed to check whether there exist a cointegrating relationship between the dependent variable lnCCP and the independent variable lnrelH. Through the Pedroni Residual Cointegration Test, this research find that within the 5% confidence interval, a cointegrating relationship dose in fact exist between them. According to the recent literatures on cointegration test, when most independent variables are stationary series while the rest are cointegrated with dependent variable, cointegrating regression estimated by the OLS can generate consistent results. Here, this research employ FMOLS model, select the detrend method and choose the AIC automatic selection in lagging period. The regression results can be seen in table 2.

The method of step wise regression is adopted in this study. Regression of group (a)-(g) is used to estimate the relationship between Chinese export competitiveness $\text{lnCCP}_t$and relative CO_2emission regulation intensity lnrelCR_{t-i}(i=0,1,2). In the regression of (a), this research estimate the cointegrating coefficient of lnrelCR_t at current period. The coefficient is positive and significant at 1%, which means that, in the long term, the relative CO_2 emission regulation intensity at current period contributes to the enhancement of Chinese trade competitiveness. In the regression of (b), after the control variable lnrelK_t is added, the coefficient of $\text{lnrelCR}_{t,}$ remains notably positive and significant at 1%, but declines greatly to 0.95; the coefficient of lnrelK_t is also notably positive. The standard error of regression has been reduced with control variable lnrelK_tadded, from 2.828 to 2.207, confirming that the relative physical capital is a variable required to be controlled.

In the regression of (c), this research continue to add the control variable lnrelH_tinto the model. The result shows that the coefficient of lnrelCR_t, significant at 1%, continues declining, but remains notably positive. The coefficient of lnrelH_t is notably positive, significant at 1%, which illustrates that the addition of variable relative human capital intensity optimizes the model. Group (d) observes the influence of both relative tariff intensity ("LnrelTt") and the quadratic term of relative physical capital ("$(\text{LnrelKt})^2$") on the model. This research find that both of them poses influence on the model; with these two additional control variables, regression deviation of the model has been further reduced. However, the coefficient of relative tariff intensity is not significant. The reason for the insignificance could be due to the lack of relevant data, and thus the regression results are affected. The coefficient of the quadratic term of relative physical capital is also notably positive, which is consistent with the result in literatures, such as Cole(2003), that there is parabola correlation between physical capital and export competitiveness.

Table 2. The Regression Results of the Model

Dependent Variable: $\ln CCP_t$							
	(a)	(b)	(c)	(d)	(e)		(f)
$LnrelK_t$		5.199276	5.048632	5.099857	$LnrelK_{t-1}$	7.157345	$LnrelK_{t-1}$
		(14.76956)	(14.30913)	13.73151		(10.93298)	
$LnrelH_t$			0.86136	0.978703	$LnrelH_{t-1}$	0.735036	$LnrelH_{t-1}$
			(6.433628)	5.952		(4.934424)	
$LnrelT_t$				0.129643	$LnrelT_{t-1}$	0.06015	$LnrelT_{t-1}$
				(0.803180)		(0.408477)	
$LnrelCR_t$	3.036002	0.952154	0.434848	0.409084	$LnrelCR_{t-1}$	0.261748	$LnrelCR_{t-2}$
	17.43879	(6.707326)	(2.827289)	(2.503822)		(1.657483)	
$(LnrelK_t)^2$				2.219158	$(LnrelK_{t-1})^2$	2.282115	$(LnrelK_{t-1})^2$
				(4.133415)		(1.657483)	
S.E. of regression	2.827983	2.207059	1.945131	1.952201		1.905386	
Included observations	1682	1680	1664	1615		1614	

Illustration: In the table, ***, significant at 1%, is notable; **, significant at 5%, is notable; *, significant at 10%, is notable. Value of Hausman is the value of Prob>chi2. The value in the brackets is t value.

The regression of group (a)-(d) are based on the data at current period. However, in the real economy, the influence of CO_2 emission regulation, physical capital, human capital and tariff on trade competitiveness is usually not instant but lagging. This research examine such lagged effects in our model through the regression of group (e)-(g). In the regression of group (e), this research analyze the influence of all independent variables and control variables with one-period lag, denoted as "t-1", on the dependent variables at the current period. More details could be seen in model (3).

$$\ln CCP_t = \alpha + \beta_1 \ln relCR_{t-1} + \beta_2 \ln relK_{t-1} + \beta_3 \ln(relK_{t-1})^2 + \beta_4 \ln relH_{t-1} (3)$$

Except for the coefficient of relative tariff intensity, which is not significant, the coefficients of $\ln relK_{t-1}$, $(\ln relK_{t-1})^2$ and $\ln relH_{t-1}$, significant at 1%, are all notable positive, and the coefficient of $\ln relCR_{t-1}$, significant at 10%, is also notable positive. The regression deviation is more optimized than the regression of all current factor groups, which means that regression model with one-lag period fits our data better. The difference between group (f) and (e) regression is that relative CO_2 emission regulation("$\ln relCR_{t-2}$")in group (f) lagged by two-period. From the results of group (f), this research find that the influence of relative CO_2 emission regulation, lagged by two-period, on trade competitiveness is greater than that, lagged by one-period, in the regression of group (e). The coefficient, significant at 5%, is notable and contains smaller regression deviation.

Based on group (f) and (e) regression, this research alter the influence of relative tariff intensity into the current period, and find that the influence of relative CO_2 emission regulations, lagged by two-period, further increases to 0.408, which is highly significant at 1% and contains much smaller regression deviation. Therefore, it is the regression of group (g) that is the most optimized in this paper. This research then conduct residual unit root test on group (g), and the series turn out to be stationary. Granger Causality Test is further taken on the independent variable $\ln relCR_t$ and $\ln relCR_{t-1}$ and the dependent variable $\ln CCP_t$, and the result shows that $\ln relCR_t$, $\ln relCR_{t-1}$and $\ln relCR_{t-2}$ granger cause $\ln CCP_t$ at 1% significance level. Finally, we construct an error correction model (**??**)4), according to the results in the regression of group (g).

$$\ln CCP_t = \alpha + \lambda resid_{t-1} + \beta_1 \Delta \ln relCR_{t-2} + \beta_2 \Delta \ln relK_{t-1} + \beta_3 \Delta \ln (relK_{t-1})^2 \quad (4)$$

If the residual coefficient (λ) is between -2 and 0 ($-2 \leq \lambda \leq 0$), the original cointegration model is convergent, and the cointegration relation exists in the long run.

As for the model (4), this research conduct a least square regression, and getλ= -0.426, which satisfies the convergence condition. Therefore, this research can prove that there exists a stable long-run influence of relative CO_2 emission regulations on Chinese trade competitiveness. All in all, this research find that relative CO_2 emission regulations has a notable positive impact on Chinese trade competitiveness, which is consistent with the "Porter Hypothesis". The influence coefficient remains at about 0.4, and the best-fit model to our panel dataset is the one with relative CO_2 emission regulations lagged 2-period. Relative physical capital and relative human capital are both important control variables. Though the coefficient of relative tariff is not statistically significant, the addition of such factor in the model contributes to the goodness of fit.

6. Conclusion and Policy Suggestions

In this paper, this research empirically investigate the influence of CO_2emission regulation intensity on export competitiveness in China. Data on bilateral trade between China and 77 countries are adopted, including import and export trade data, relative physical capital, relative human capital, relative tariff and relative CO_2emission regulation intensity; and methods such as multivariate cointegrating regression, Granger-causality test and Error Correction Model analysis are applied in our empirical study. Relative physical capital, relative human capital and relative tariff intensity are regarded as control variables to test the influence of relative CO_2emission regulation intensity of both the present period and the lagging periods on current trade competitiveness in China. This research find that the regression results are fairly stationary. Additionally, the current and lagged impact of the relative CO_2 emissions constraint on China's trade competitiveness are both positive, that is, CO_2 emissions constraint enhanced China's trade competitiveness to our trade target countries relatively. Also, our results suggest that in China, the role of CO_2 emissions constraints in our Technical Promoting Effect is stronger than "Pollution Heaven Effect."

Based on our results, the implementation of following policy suggestions will be advantageous for the trade competitiveness of China: Firstly, the relative CO_2 emission constraints is in favor of enhancing China's trade competitiveness; therefore, China should reinforce the opening-door policy, actively participate in international greenhouse gas control, enhance CO_2 emission constraints, alleviate the negative externalities of CO_2 emissions, and reduce greenhouse gas emissions while accepting emission reduction requirements within a reasonable range for higher international status and concessions in other trade areas. Secondly, the main impact of the relative CO_2 emission constraints on the competitiveness of exports is its technical promoting effect and extrusion effect of excess capacity; therefore, it will enhance the technical promoting effect of CO_2 emission constraints to strengthen the institutional improvement of China and create a favorable economic atmosphere.

References

[1] M. Arouri, G. M: *Environmental Regulation and Competitiveness: Evidence from Romania.*Ecological Economics *81*, (2012), 130–139.

[2] M. Busse, M. Silberberger: *Trade in pollutive industries and the stringency of environmental regulations.* Applied Economics *18* (2013), No. 2, 589–597.

[3] L. Antonio, Z. Enrique: *Parcelling virtual Carbon in the Pollution Haven Hypothesis.* Energy Economics *78* (2013), No. 4, 585–590.

[4] C. Elgin, O. Oztunali: *Pollution and informal economy.* Economic Systems *27* (2014), No. 2, 189–203.

[5] G. Felix: *Determinants of trade with solar energy technology components: evidence on the porter hypothesis.* Applied Economic *29* (2014), No. 24, 3087–3097.

[6] R. Sascha, R. Christian: *Environmental Innovations and Firm Profitability: Unmasking the Porter Hypothesis.* Environmental & Resource Economics *114* (2014), Nos. 3–4, 233–247.

[7] B. Thomas M. Per-Olov: *Testing the Porter hypothesis: the effects of environmental investments on efficiency in Swedish industry.*Journal of Productivity Analysis *167* (2013), No. 1, 183–191.

[8] Y. Y. Chi, Z. Q. Guo: *Scenarios Analysis of the Energies' Consumption and Carbon Emissions in China Based on a Dynamic CGE Model.*Sustainability *1* (2014), No. 5, 357–365.

[9] Z. Q. Guo, H. B. Liu: *The impact of carbon tax policy on energy consumption and CO2 emission in China.* Energy Sources Part B-Economics Planning and Policy. *2* (2017), No. 7, 40–52.

[10] Z.G. Wen, et al: *Low-carbon policy options and scenario analysis on CO2 mitigation potential in China's transportation sector.* Greenhouse Gases-Science and Technology. *2* (2017), No. 7, 40–52.

[11] H.F. Cheng , F.M. Li: *The Empirical Analysis on the Influence of CO2 Emis-*

sion Regulation on the Export Transformation of Chinese Manufacturing Industries. Journal of Coastal Research. *73* (2015) 209–215.

Received November 16, 2017