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G7 countries: between trade openness and CO2 emissions

Mihai Mutascu
ESCE International Business School, and LEO, University of Orleans

Abstract

The paper analyses the causality between the trade openness and CO2 emissions in the G7 countries by using the bootstrap panel Granger causality. The panel includes seven countries (i.e. Canada, France, Germany, Italy, Japan, United Kingdom and United States of America) and covers the period 1995-2011. The main results show a strong heterogeneity between the G7 countries in terms of international trade and environmental issues. The CO2 emissions embodied in domestic final demand explains very well the trade openness, more precisely the imports. A higher propensity for social environmental responsibility characterizes the importers from EU countries comparing with the non-EU ones. Otherwise, the trade openness is a good proxy for the CO2 emissions generated by the sector of production. Curiously, the very big economies register an auto-regulatory mechanism of CO2 emissions related to trade, for both domestic consumption and production areas.

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Contact: Mihai Mutascu - mihai.mutascu@esce.fr.
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1. Introduction

The causality between trade openness and carbon dioxide (CO_2) emissions is intensively analysed over the last decades. The economic expansion under globalization process exerts a high pressure on the gas emissions especially in the Group of Seven (G7 - Canada, France, Germany, Italy, Japan, United Kingdom - UK and United States of America - US).

The paper explores the 'trade openness-CO_2 emissions' nexus in the G7 economies by using the bootstrap panel Granger causality. This area includes the first seven largest and advanced economies in the world.

The literature offers two theoretical resorts between trade openness and CO_2 emissions. Grossman and Krueger (1993) explain the first resort via three effects. The scale effect reveals that the openness has a positive impact on environment through the production and energy consumption but only at low level of revenues. The composition effect states that the openness generates pollution via changes in production. The technique effect attenuates the pollution as results of environmentally friendly technologies.

Copeland and Taylor (2004) describe the second resort. The authors argue that the gas emissions influence the trade openness via the 'pollution haven effect'. The pollution regulations control the plant location decisions influencing the international trade flows and, further, the degree of openness.

The empirical literature is prolific, Mutascu (2018) systematizes four main hypotheses: (i) 'trade openness leads CO_2 emissions' hypothesis, (ii) 'CO_2 emissions lead trade openness' hypothesis, (iii) 'synchronization' hypothesis, and (iv) 'neutral' hypothesis.

The 'trade openness leads CO_2 emissions' hypothesis assumes a one-way direction of causality driving from trade openness to CO_2 emissions with different signs (Grossman and Krueger, 1993). The 'CO_2 emissions lead trade openness' hypothesis also shows a one-way direction of causality but running from the CO_2 emissions to trade openness (Copeland and Taylor, 2004). The 'synchronization' hypothesis states that there is a bidirectional causality between trade openness and CO_2 emissions (Frankel and Rose, 2005). The 'neutral' hypothesis means no connection between the trade openness and CO_2 emissions (Birdsall and Wheeler, 1993).

Several papers analyses countries from the G7 group (e.g. Anderson and McKibbin, 2000; Dinda and Coondoo, 2006) but none of them are exclusively focused on this area.

The contribution of the paper for the literature is threefold. First, to the best of our knowledge, the study is a pioneering work exclusively focused on the G7 group. Second, the paper shows a strong heterogeneity in respect to environmental and trade policies between G7 countries. Third, it is one of the first investigations following the bootstrap panel Granger causality in the 'trade openness - CO_2 emissions' topic. As main limit, the paper tries to strictly explain in which measure the trade can be used to predict CO_2 emissions and vice-versa in the G7 group, offering also certain policy implications.

The rest of the paper is as follows: Section 2 describes the data and methodology, Section 3 shows the results, while Section 4 concludes.

2. Data and methodology

The empirical sequence follows the bootstrap panel Granger causality proposed by Kónya (2006) based on a panel with seven cross-sections (7 countries) and 26 years (1995-2011). The tool offers several advantages compared with the classical ones. Mutascu (2015, p. 2001) underlines that ”the methodology does not require testing the variables for unit root and cointegration, in this case the variables being used in their levels. Secondly, the tool considers the existence of contemporaneous correlations across countries and offers additional panel information (the equations composes a SUR system). Not at least, the procedure enforces for each country one-way, two-way or no Granger causality between variables.”

Two variables depict the connection between international trade and gas emissions: the trade openness and CO_2 emissions.

The *trade openness (O)* is the sum of the volume of imports *(Oi)* and exports *(Oe)*, in billions of US dollars, being taking from World Development Indicators (WDI), World Bank online 2018 database. Trade openness as share in Gross Domestic Product (GDP) is usually preferred in such empirical studies. Busse and Koeniger (2015, p. 2830) claim that the quality of rate is given by the elasticity of trade on GDP. Therefore, the ratio will fail to capture the trade openness intensity as it 'can either increase, decrease or stay the same due to an increase in trade and its corresponding changes in GDP' (p. 2830). Nevertheless, both volume of exports *(Oegdp)* and imports as share of GDP *(Oigdp)* are separately considered to investigate the implications of trade policy on CO_2 emissions. Cerdeiro and Nam (2018, p.4) argue that such indicators refer ”directly to policy barriers, and thus provide a better gauge of actionable policies than outcome-based measures”.

The *CO_2 emissions (E)* measures the volume of gas emissions as CO_2 equivalent, in millions of tonnes (Jamel and Derbali, 2016). At country level, these emissions are generated by domestic final demand and production. Therefore, two versions of CO_2 emissions are considered to discriminate between consumption and production: the CO_2 emissions embodied in domestic final demand *(Ed)* and the CO_2 emissions based on production *(Ep)*. Additionally, Environmental Policy Stringency Index *(Epsi)* is used to explore the implications of environmental policy on trade. The index measures the degree of environmental policies by putting an explicit or implicit price on polluting or environmentally harmful behavior. It goes from 0 (not stringent policy) to 6 (highest degree of stringency). The OECD.Stat online 2018 database represents the source of data for all variables.

In order to isolate the effect of interest variables and to fix the omitted variable bias, two other regressors are used (Kasman and Duman, 2015): Gross Domestic Product per capita *(G)* and energy use *(P)*. The *Gross Domestic Product per capita* is expressed in current US dollars, the *energy use* being measured in kilograms of oil equivalent per capita. The first variable control for economic size, while the second one is widely used as determinant for gas emissions in environmental context. Both control determinants are taken from World Development Indicators (WDI), World Bank online 2018 database.

All variables appear in natural logarithm form, excepting those ones already expressed as percentages/ratios (i.e. *Oigdp*, *Oegdp* and *Epsi*). Their levels of intensity augment by maximizing.

The cross-sectional dependence and cross-country heterogeneity are two required assumptions of bootstrap panel Granger causality. For these assumptions, following the core scenarios only, the variables are treated as stationary ones. The cross-sectional dependence is checked through the LM test, the CD test and the bias-adjusted LM test. The Pesaran and Yamagata’s (2008) test verifies the cross-country heterogeneity.

The Kónya’s (2006) proposal supposes to manage both cross-sectional dependence and country-specific heterogeneity based on the Seemingly Unrelated Regressions (SUR) systems and the Wald tests with country specific bootstrap critical values. As Cadavez and Henningsen (2012, p.

2-3) note, the efficiency of the SUR systems ”gains increase with increasing correlation among the error terms of the different equations (Judge *et al.*, 1988), as well as with larger sample size and higher multicollinearity between the regressors (Yahya *et al.*, 2008).”
By considering four variables, the SUR system is as follows:

$$O_{1,t} = \alpha_{1,1} + \sum_{l=1}^{mlO_1} \delta_{1,1,l}\, O_{1,t-l} + \sum_{l=1}^{mlE_1} \lambda_{1,1,l}\, E_{1,t-l} + \sum_{l=1}^{mlG_1} \zeta_{1,1,l}\, G_{1,t-l} + \sum_{l=1}^{mlP_1} \eta_{1,1,l}\, P_{1,t-l} + \varepsilon_{1,1,t}$$

$$O_{2,t} = \alpha_{1,2} + \sum_{l=1}^{mlO_1} \delta_{1,2,l}\, O_{2,t-l} + \sum_{l=1}^{mlE_1} \lambda_{1,2,l}\, E_{2,t-l} + \sum_{l=1}^{mlG_1} \zeta_{1,2,l}\, G_{2,t-l} + \sum_{l=1}^{mlP_1} \eta_{1,2,l}\, P_{2,t-l} + \varepsilon_{1,2,t}$$

....

$$O_{N,t} = \alpha_{1,N} + \sum_{l=1}^{mlO_1} \delta_{1,N,l}\, O_{N,t-l} + \sum_{l=1}^{mlE_1} \lambda_{1,N,l}\, E_{N,t-l} + \sum_{l=1}^{mlG_1} \zeta_{1,N,l}\, G_{N,t-l} + \sum_{l=1}^{mlP_1} \eta_{1,N,l}\, P_{N,t-l} + \varepsilon_{1,N,t} \tag{1}$$

and

$$E_{1,t} = \alpha_{2,1} + \sum_{l=1}^{mlO_2} \lambda_{2,1,l}\, O_{1,t-l} + \sum_{l=1}^{mlE_2} \delta_{2,1,l}\, E_{1,t-l} + \sum_{l=1}^{mlG_2} \zeta_{2,1,l}\, G_{1,t-l} + \sum_{l=1}^{mlP_2} \eta_{2,1,l}\, P_{1,t-l} + \varepsilon_{2,1,t}$$

$$E_{2,t} = \alpha_{2,2} + \sum_{l=1}^{mlO_2} \lambda_{2,2,l}\, O_{2,t-l} + \sum_{l=1}^{mlE_2} \delta_{2,2,l}\, E_{2,t-l} + \sum_{l=1}^{mlE_2} \zeta_{2,2,l}\, G_{2,t-l} + \sum_{l=1}^{mlE_2} \eta_{2,2,l}\, P_{2,t-l} + \varepsilon_{2,2,t}$$

....

$$E_{N,t} = \alpha_{2,N} + \sum_{l=1}^{mlO_2} \lambda_{2,N,l}\, O_{N,t-l} + \sum_{l=1}^{mlE_2} \delta_{2,N,l}\, E_{N,t-l} + \sum_{l=1}^{mlE_2} \zeta_{2,N,l}\, G_{N,t-l} + \sum_{l=1}^{mlE_2} \eta_{2,N,l}\, P_{N,t-l} + \varepsilon_{2,N,t} \tag{2}$$

where *O* mainly denotes the trade openness, but also its related versions as *Oi*, *Oe*, *Oigdp* and *Oegdp*, respectively; *E* is the CO_2 emissions as *Ed* or *Ep*, and environmental policy as *Epsi*, respectively; *G* reflects the Gross Domestic Product per capita, and *P* stands for the energy use. *N* represents the cross-section dimension (N=7, in our study), *t* is the time period (t =26, in our case), while *l* captures the lag length. The parameter α is the intercept. The slopes are λ, δ, ζ and η, while the error term is ε. For each system, there are the same maximal lags for *O*, *E, G* and *P* across equations. The optimal lag is given by the lag combinations, which minimize the Akaike Information Criterion (AIC) and Schwartz Criterion (SC).
Two scenarios represent the core of analysis. The first scenario shows the interaction between *O* and *Ed*, while the second one connects *O* with *Ep*. Complementary, two routines are employed to offer policy details. The first routine refers to the trade policy, showing the influence of *Oigdp* on Ed, and *Oegdp* on *Ep*, respectively. The second routine is related to the environmental policy. Herein, the impact of *Epsi* on *Oi* and *Oe,* respectively, is analysed. The *G* and *E* are used as controls in all SUR estimations.

3. Results

The Table A1, in Appendix, shows the results[1] of the cross-sectional dependence (LM test, CD test and LM_{adj} test) and slope homogeneity ($\tilde{\Delta}$ test and $\tilde{\Delta}_{adj}$ test), for both *Ed* and *Ep* core scenarios.

The top of the Table A1 clearly shows that the null hypothesis of cross-section independence is rejected by all tests, for both scenarios and all levels of significance. Consequently, there is a cross-sectional dependence in the G7 group. This means that any shock in a country is transmitted to another one suggesting also intensive trade flows between them. Additionally, the findings reveal that the SUR system approach is preferable to the country-by-country pooled OLS estimator.

At the bottom of the table, the results indicate that the null hypothesis of slope homogeneity is rejected for both scenarios and all levels of significance. Therefore, by using G and P as control determinants, the direction of causality between *O* and *E* varies across countries being exclusively driving by the country's own specific features. In other words, a specific economic process in one country is not replicated by the others.

Validating the cross-section dependence and slope heterogeneity, the bootstrap panel Granger causality estimations, for both *Ed* and *Ep* core scenarios, can be conducted[2]. In Appendix, the Tables A2 and A3 illustrate the main related outcomes. The coefficients of control variables ζ and η are reported in the Tables A4 and A5. Table A6 reports the findings of policy implications.

The *Ed scenario*, in the Table A2, evidences a one-way causality goes from *O* to *Ed* in Italy, with negative sign. Economic growth plays here a crucial role as Table A4 Table shows. More trade openness reduces the level of domestic CO_2 emissions. This highlights the special attention given by Italian importers for non-dirty goods. The propensity is additionally amplified by the import trade openness promoted by the Italian government, as the *Oigdp* negatively causes *Ed* (top left-side of Table A6).

Ed causes *O* with negative sign in France and UK. The pressure on demand for dirty goods compresses the related imports. It seems that the importers responsibly improve the quality of imported goods when the domestic consumption degrades the environment. Growth is an important factor in both countries, while the energy use influences the causality only in UK, as Table A4 Table reveals. The restrictive environmental policy existed in UK does not reduce the imports, as the *Epsi* causes *Oi* with the same sign (the bottom left-side of Table A6). This fact reinforces the aforementioned role of importers. No consistent environmental policy with trade implications is found in France.

The same direction of causality but with positive sign is registered in Canada. The consumption of dirty goods stimulates related imports. According to the Table A4 Table, the energy use shapes this causality. Herein, the importers neglect the social environmental responsibility in the absence of consistent environmental restrictions, as no causality is found between *Epsi* and *Oi* (bottom left-side of Table A6).

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[1] All variables are non-stationary in level, becoming stationary in their first difference. The unit root tests are available upon request. For both cross-sectional dependence and slope homogeneity tests, the variables are considered stationary (i.e. in their natural logarithm first difference).

[2] All variables are treated as non-stationary, being considered in their natural logarithm level. The estimations are performed by using a personal extended versions of the TSP codes for bootstrap panel Granger causality offered by the courtesy of Prof. Laszlo Kónya. The extended versions also follow the codes offered by Sen at al. (2018), and Acaravci and Erdogan (2017).

Two-way causality characterizes Germany and US, both directions having negative signs. The domestic consumption of imported non-dirty goods generates low-level of emissions, which falls by attracting new similar imported goods. Hence, both countries reveal a strong auto-regulatory mechanism of domestic CO_2 emissions related to trade. This mechanism is strongly supported in Germany on its environmental component, as the *Epsi* positively causes *Oi* (the bottom left-side of Table A6). In this country, those restrictive rules amplify the appetite for non-dirty imports. The top left-side of Table A6 reveals that the import openness policy of the US government is a good accelerator for non-dirty imports. Herein, *Oigdp* causes *Ed* with negative sign, the economic growth being important determinant, as the Table A4 reports. No causality between *O* to *Ed* is identified in Japan. In this country, both trade and environmental policy seem to be active at least especially as prevention (top and bottom left-sides of Table A6).

Table A3 illustrates the results for *Ep scenario*. *O* leads *Ep* with negative sign in Canada, Germany and UK meaning that the exports are generated by clean production capacities. Growth modulates causality only in Canada and UK, as the Table A5 shows. A special care for friendly technologies in respect to trade is shown in those countries. This fact seems to come from producers rather than government. Only UK registers efficient environmental policy to prevent exports based on dirty capacities, as the *Oegdp* causes *Ep* with negative sign (top right-side of Table A6).

Ep causes *O* with the same sign in Japan. Only the energy use is notable as determinant of causality, as the Table A5 illustrates. As the exports are sustained by unclean capacities, it seems that Japan sacrifices the environmental status for a good international trade position, fact also reinforced by the lack in consistence of environmental policy. Herein, there is no causality between *Epsi* and *Oe* (bottom right-side of Table A6).

Two-way causality is registered in France, Italy and US, with negative sign for both directions. The exports are obtained based on friendly technology and such clean production ensures a 'healthy environment' to produce new export units. In those countries, there is an auto-regulatory mechanism of CO_2 emissions based on production related to trade. Based on the Table A5, both the economic growth and energy use crucially shape the causality only in US. Additionally, the governments from Italy and US support this mechanism with a 'trade-environment' policy-mix, sustaining its functioning (top and bottom right-side of Table A6).

The 'trade openness leads CO_2 emissions' hypothesis is validated especially in the case of emissions based on production. The results are in accordance with the Grossman and Krueger's (1993) technique effect, reinforcing the role of environmentally friendly technologies in the attenuation of pollution. The 'CO_2 emissions lead trade openness' hypothesis characterizes the emissions generated by the domestic consumption. The findings are in contrast with the Copeland and Taylor's (2004) 'pollution haven effect', which refers to the production environmental regulations via the plant location decisions. For both domestic consumption and production scenarios, the 'synchronization' hypothesis of Frankel and Rose (2005) is generally validated for the biggest economies, while geographically isolated country (i.e. Japan) supports the 'neutrality hypothesis' of Birdsall and Wheeler (1993).

An important role in modelling the causality between trade openness and CO_2 emissions plays the economic growth, while the energy use has an isolated action.

4. Conclusions

The study of causality between the trade openness and CO_2 emissions by using the bootstrap panel Granger causality, evidences very interesting outcomes. A strong heterogeneity is found in respect to the international trade and environmental issues between countries, despite of a common environmental agreement. This document came into force on March 1994, as the United Nations Framework Convention on Climate Change[3], having as main target the reduction of CO_2 emissions between 1990 and 2008-2012.

The results show that the level of CO_2 emissions embodied in domestic final demand represents an important instrument to control the trade openness, more precisely the volume of imported goods. The domestic CO_2 emissions are a good predictor for imports. The environmental policies in domestic consumption seem to be appropriate to manage the trade openness in this case. Moreover, the importers from EU countries reveal a higher propensity for social environmental responsibility than the non-EU ones. In this sense, the Climate and Renewable Energy Package[4], adopted by European Parliament on December 2008, can play a crucial role for the EU group. Otherwise, the trade openness is important for the CO_2 emissions generated by the sector of production. Herein, the volume of exports can be a very useful instrument to control the level of CO_2 emissions. The trade is a good proxy for CO_2 emissions based on production. Therefore, the trade policies are suitable to regulate the CO_2 emissions in the production sector.

The very big economies (e.g. US) show an auto-regulatory mechanism of CO_2 emissions related to trade, for both domestic consumption and production areas. A monitoring policy approach can be taken into account for such situations. Generally, the economic growth seems to improve the effectiveness of policies in the big economies, while the energy use plays an important role only in specific contexts.

Regarding the policy implications, the policymakers in the G7 countries should consider environmental policies in domestic consumption to manage the trade openness, more precisely the volume of imports. Otherwise, for the production sector, it is recommended using of international trade, especially the exports, for adjustments in the level of CO_2 emissions. The monitoring policy approaches are appropriate for policymakers in the very big economies.

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Appendix

Table A1. Cross-sectional dependence and slope homogeneity test results

Method	*Ed scenario*		*Ep scenario*	
	Test statistics	p-value	Test statistics	p-value
Cross-sectional dependence tests				
LM test	147.1***	0.0000	118.2***	0.0000
CD test	35.23***	0.0000	26.97***	0.0000
LM_{adj} test	11.75***	0.0000	10.46***	0.0000
Slope homogeneity tests				
$\tilde{\Delta}$ test	2.892***	0.0020	3.981***	0.0000
$\tilde{\Delta}_{adj}$ test	3.168***	0.0010	4.361***	0.0000

Note:
(1) *, ** and *** are the significance for at 0.1, 0.05 and 0.01 levels;
(2) LM test, CD test and LM_{adj} test denote the cross-sectional dependence tests;
(3) $\tilde{\Delta}$ test and $\tilde{\Delta}_{adj}$ test represent the slope homogeneity test of Pesaran and Yamagata (2008).

Table A2. The bootstrap panel Granger causality results - *Ed scenario*

Country	H_0: *O* does not Granger causes *Ed*			H_0: *Ed* does not Granger causes *O*		
	Coefficient of trade openness *(O)*	Wald test	P-value	Coefficient of CO_2 emissions embodied in domestic final demand *(Ed)*	Wald test	P-value
Canada	-0.119	1.899	0.168	2.003***	15.01	0.000
France	0.059	1.310	0.252	-1.023***	13.97	0.000
Germany	-0.062*	2.913	0.088	-1.733***	11.81	0.001
Italy	-0.075***	7.887	0.005	-0. 472	0.245	0.620
Japan	0.014	0.376	0.846	-0.749	0.963	0.326
United Kingdom	-0.076	0.985	0.321	-1.007***	10.03	0.002
United States	-0.276***	32.65	0.000	-1.604***	18.38	0.000

Note: *, ** and *** denote the significance for at 0.1, 0.05 and 0.01 levels.

Table A3. The bootstrap panel Granger causality results - *Ep scenario*

Country	H_0: *O* does not Granger causes *Ep*			H_0: *Ep* does not Granger causes *O*		
	Coefficient of trade openness *(O)*	Wald test	P-value	Coefficient of CO_2 emissions based on production *(Ep)*	Wald test	P-value
Canada	-0.087**	4.616	0.032	-0.360	0.419	0.517
France	-0.120***	9.575	0.002	-0.953**	5.706	0.016
Germany	-0.070***	6.011	0.014	-1.437	2.531	0.112
Italy	-0.104***	18.75	0.000	-1.753*	3.499	0.061
Japan	-0.050	0.613	0.433	1.684*	3.344	0.067
United Kingdom	-0.166**	6.226	0.013	0.482	7.059	0.486
United States	-0.201***	29.26	0.000	-1.027***	7.095	0.008

Note: *, ** and *** denote the significance for at 0.1, 0.05 and 0.01 levels.

Table A4. Control determinants - *Ed scenario*

Country	*O* does not Granger causes *Ed*		*Ed* does not Granger causes *O*	
	ξ_2 - coefficient of GDP per capita *(G)*	η_2 - coefficient of energy use *(P)*	ξ_1 - coefficient of GDP per capita *(G)*	η_1 - coefficient of energy use *(P)*
Canada	3.423	-3.331	-1.129	-14.84***
France	4.821**	5.358**	8.794**	2.328
Germany	-3.152	0.101	-5.185	7.954
Italy	5.379*	7.678	5.366	1.666
Japan	-4.252	1.230	14.41	-15.04
United Kingdom	- 4.128	4.983*	11.25***	6.373*
United States	11.73***	0.002	29.34***	0.001

Note: *, ** and *** denote the significance for at 0.1, 0.05 and 0.01 levels.

Table A5. Control determinants - *Ep scenario*

Country	*O* does not Granger causes *Ep*		*Ep* does not Granger causes *O*	
	ξ_2 - coefficient of GDP per capita *(G)*	η_2 - coefficient of energy use *(P)*	ξ_1 - coefficient of GDP per capita *(G)*	η_1 - coefficient of energy use *(P)*
Canada	6.948***	-1.100	8.763	-3.260
France	2.808	1.445	11.33***	3.646
Germany	-1.255	-2.808	7.144	4.918
Italy	-0.359	8.457**	1.661	17.34
Japan	3.268	1.028	8.634	-26.18*
United Kingdom	4.081**	2.432	6.188*	-5.245
United States	8.059***	0.001	13.92**	0.001

Note: *, ** and *** denote the significance for at 0.1, 0.05 and 0.01 levels.

Table A6. The bootstrap panel Granger causality results - *policy estimations*

Country	Trade policy					
	H_0: *Oigdp* does not Granger causes *Ed*			H_0: *Oegdp* does not Granger causes *Ep*		
	Coefficient of volume of imports as share of GDP *(Oigdp)*	Wald test	P-value	Coefficient of volume of exports as share of GDP *(Oegdp)*	Wald test	P-value
Canada	-0.453*	3.742	0.053	0.083	0.531	0.466
France	-1.580*	6.594	0.010	0.545	1.003	0.316
Germany	-0.175	0.119	0.729	-0.229	0.579	0.446
Italy	-1.300***	11.94	0.000	-1.879***	20.63	0.000
Japan	-2.124***	10.14	0.001	-1.736**	6.456	0.01
United Kingdom	-1.205**	4.649	0.031	-0.947**	4.592	0.032
United States	-2.213 ***	30.83	0.000	-1.544***	19.23	0.000
	Environmental policy					
	H_0: *Epsi* does not Granger causes *Oi*			H_0: *Epsi* does not Granger causes *Oe*		
	Coefficient of Environmental Policy Stringency Index *(Epsi)*	Wald test	P-value	Coefficient of Environmental Policy Stringency Index *(Epsi)*	Wald test	P-value
Canada	0.863	0.166	0.683	0.015	0.517	0.471
France	0.010	0.101	0.750	0.034	1.753	0.185
Germany	0.217***	29.76	0.000	0.223***	25.81	0.000
Italy	0.065	1.355	0.244	0.109**	6.298	0.012
Japan	0.259**	4.802	0.028	0.097	1.027	0.310
United Kingdom	0. 080***	12.91	0.000	0.104***	27.10	0.000
United States	0.025	0.623	0.429	0.057*	3.245	0.071

Note: *, ** and *** denote the significance for at 0.1, 0.05 and 0.01 levels.