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The Relationship among Trade, Income and Environment in Iran

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ABSTRACT

This paper examines causal relationships between environment, GDP and trade for Iran using annual data over the period 1970-201, applying the techniques of the long–run Granger non–causality test proposed by Toda and Yamamoto (1995). The results suggest that there is a long-run relationship between these variables. CO2 emissions have a positive long-run relationship with per capita income, indicating economic growth tends to worsen environmental quality. In addition, CO2 emissions have a positive long-run relationship with openness, supporting for the so-called race-to-the bottom hypothesis for developing countries. The Granger Causality test indicates strong unidirectional effects from GDP to CO2 emissions.

Key words: Unit root, Cointegration, Granger Causality, Environmental quality, Trade, Economic Growth

1. INTRODUCTION

Globalization and development are among the highest policy priorities in many developing countries. Trade liberalization can be good for the environment, since it increases trade and increases real income, which creates demand for stringent environmental protection standards and forces firms to invest in cleaner and more environmentally friendly technologies. Trade also leads to an expansion of the economy, which rises environmental degradation since the production of goods in the economy makes pollution as a joint product. However, trade has contradictory impacts on the environment, since it increases pollution but also motivates its reduction. Trade entails the movement of goods produced in one country for consumption to another country. This implies that pollution generated in the production of these goods is related to consumption in another country. Thus, it is vital to examine the impact of the international movement of goods that generate pollution as part of their production processes (Dellachiesa, 2010). Globalization offers a mixed blessing for the environment. It creates economic opportunities but also gives rise to new problems and tensions. By increasing the volume and decreasing the cost of information, data, and communications, globalization also offers expanded access to knowledge, new mechanisms for participation in policymaking, and

the promise of more refined and effective modes of governance. Understanding this array of effects – economic, regulatory, information, and pluralization – is essential if one is to make sense of globalization's impact on the environment.
The focus of the paper is, therefore, to examine the relationship between CO2 emissions, GDP and trade for Iran using annual data over the period 1970-2011. The direction of causality between these variables is examined by utilizing a cointegration and error correction modeling framework. The paper is organized in four sections. Section 2 reviews the relevant literature. Section 3 discusses the methodology, data and empirical results of the study. Section 4 concludes.

2. LITERATURE REVIEW

The relationship between environmental quality and economic development evoked much discussion in the last decade .Trade liberalization contains of policies aimed at opening up the economy to foreign investment and lowering trade barriers in the form of tariff reduction. Anyway, while trade may stimulate growth it may concurrently lead to more pollution either as a result of relocation of polluting industries from countries with strict environmental policy or owing to increased production in dirty industries. According to potential benefits of trade liberalization policies, it is important to examine whether such policies are in fact in conflict with the environment as they expand production and accelerate economic growth. Therefore what happens to the environment when international trade is liberalized is a matter of debate .
Trade liberalization and economic development are among the top policy priorities in most developing countries. Trade has potentially mixed effects on the environment, since it may increase pollution but also motivate its reduction. According to Jones and Rodolfo (1995) and Lee and Roland-Holst (1997) trade leads to an increase in economic growth and may exacerbate environmental degradation, but many economists have long argued that trade is not the root cause of environmental damage. Liddle (2001) suggested that trade liberalization can be good for the environment because it increases real incomes, which may in turn create demand for tighter environmental regulations .
Trade liberalization will lead to increased pollution in developing countries, as free trade will raise environmental degradation in developing countries. Among environmentalists, one common concern is that liberalized trade regimes and market-driven exchange rates, by increasing the incentive for export, will lead to a greater exploitation of natural resources. Then, trade liberalization will increase industrial pollution in developing countries, through the displacement of dirty industries from developed countries with stricter environmental regulations, and through competitive pressure on developing countries to reduce further their environmental standards .
There has recently accrued statistical evidence on how trade liberalization and growth tend to affect environmental aims on average, even without multilateral institutions. Looking for Models in the data across countries in recent decades can help us answer some important questions. Increased international trade turns out to have been beneficial for some environmental measures, such as SO2 pollution. There is little evidence to support the contrary fear that international competition in practice works to lower environmental standards overall. Rather, globalization can aid the process whereby economic growth enables people to demand higher environmental quality. To be sure, effective government regulation is probably required

if this demand is ever be translated into actual improvement; the environment cannot take care of itself. But the statistical evidence says that high-income countries do indeed eventually tend to use some of their wealth to clean up the environment, on average, for measures such as SO2 pollution. For the increasingly important category of global environmental externalities, however, such as emission of greenhouse gases, regulation at the national level is not enough . According to Komen (1997); wealthier nations can afford to spend more on research and development, generating cleaner technology that improves environmental quality, than poorer nations. As a result, environmental degradation will increase as the structure of the economy changes from rural to urban or agricultural to industrial, but will start to fall when the economy changes from energy intensive industry to services and cleaner technologies. This generates the inverted U-shaped curve when pollution indicators are plotted against per capita income. Grossman and Krueger (1995) estimated an EKC for 42 countries. They suggested that the downward sloping and inverted U-shaped patterns might arise due to citizens' demand for more attention paid to noneconomic aspects of their living conditions via induced policy responses and the development of technology that is cleaner than before.

3. DATA AND METHODOLOGY

In this study, the relationships among logarithm of real GDP per capita (GDP), trade liberalization, defined as the ratio of the value of total trade to GDP (TRADE) and environmental quality have been examined for the Iran case during the period 1970-2011. To measure the environmental quality, we use logarithm of Per capita carbon dioxide (CO2).

Before conducting any econometric analysis, the time series properties of the data must be investigated. So, we first conduct augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests to establish the order of integration for GDP per capita (GDP), TRADE and CO2. Table 1 shows the results of the tests for presence of a unit root in levels and first differences. The results of both tests do not provide evidence against the unit root in the levels. Meanwhile, the test for a unit root in the first difference series indicates strong rejection of the null hypothesis in all the cases. As a result, these data series can be characterized as I(1) for period of analysis.

Table 1: Unit-root tests

	Augmented Dickey-Fuller(ADF)		Phillips-Perron(PP)	
variable	Levels	First differences	Levels	First differences
TRADE	-2.11	-3.98	-2.01	-3.99
GDP	-2.04	-7.23	-2.32	-7.90
CO2	-2.01	-4.90	-2.02	-4.87

Notes: The lag lengths for the ADF and PP tests are chosen by using Akaike's information criterion and Newey and West (1987) method respectively.

As pointed out by Toda and Yamamoto (1995) and Zapata and Rambaldi (1997), the power of unit roots and cointegration tests are very low against the alternative hypothesis of (trend) stationarity. Moreover, these tests are cumbersome and sensitive to the values of the nuisance parameters in finite samples and therefore their results may be unreliable. Hence, the method we apply in our empirical investigation to test for Granger causality is Toda and Yamamoto (1995) methodology. This procedure provides the possibility of testing for causality between integrated variables based on asymptotic theory. In order to clarify the test method of Toda and Yamamoto (1995) augmented Granger Causality; let us consider the simple example of a bivariate model with k lag, based on the following equations:

$$Y = \alpha_y + \sum_{i=1}^{k+d} \theta_{yi} X_{t-i} + \sum_{i=1}^{k+d} \phi_{yi} Y_{t-i} + \varepsilon_{yt} \quad (1)$$

$$X = \alpha_x + \sum_{i=1}^{k+d} \theta_{xi} X_{t-i} + \sum_{i=1}^{k+d} \phi_{xi} Y_{t-i} + \varepsilon_{xi} \quad (2)$$

where d is the maximal order of integration order of the variables in the system, k is correct optimal lag order and $\varepsilon_{it}s$ are error terms that are assumed to be white noise with zero mean, constant variance and no autocorrelation. Indeed, all one needs to do is to determine the maximal order of integration d, which we expect to occur in the model and construct a (augmented) VAR in their levels with a total of (k + d) lags. In equation (1) X "does not Granger-causes" Y if it is $\theta_{yi} = 0 \quad for \quad i \leq k$. Similarly, in equation (2), Y "does not Granger-causes" X if it is $\phi_{xi} = 0 \quad for \quad i \leq k$. Notice that the additional lags (d) are unrestricted. Their function is to ensure that the asymptotical critical values can be applied when test for causality between integrated variables are conducted, according to Toda and Yamamoto (1995). The zero restrictions are tested by computing the modified Wald (MWALD) test statistic. This method is applicable whether the VAR's are stationary (around a deterministic trend), integrated of an arbitrary order, or cointegrated of an arbitrary order.

4. EMPIRICAL RESULTS

Given that all of the variables are integrated of the same order, the next step was to test for cointegration using Johansen's multivariate maximum likelihood procedure as well as Engle-Granger (1987) approach. The test results from Johansen procedure are reported in Table 2, where r presents the number of cointegrating vectors. It can be seen that, for Iran, the null hypothesis of no cointegration relationships is rejected against the alternative of one cointegrating relationship at the 1% level. Moreover, the ADF cointegration test for residuals shows the value of -3.93, which is significant at the 5% level.

Table2: Results of Johansen's maximum likelihood tests for multiple cointegrating relationships

	trace		maximum eigenvalue	
Null hypothesis	Statistics	p-value	Statistics	p-value
r=0	42.69	0.00	39.54	0.00
r≤1	24.36	0.23	19.36	0.18
r≤2	15.36	0.69	14.36	0.59

The estimated long run relationship is of the form:

$$CO2 = 1.12 + 1.52GDP + 2.64TRADE - 0.004trend$$

$$t \quad (5.45)(5.42) \quad (4.55) \quad (6.65)$$

The results show a positive long-run relationship between CO2 emissions and per capita income, suggesting that pollution levels tend to increase as a country's economy grows. Also, the findings indicate a positive long-run relationship between CO2 emissions and openness, implying that air pollution tends to increase as the oil revenues and exposure to international markets increases.

The unit root tests presented in the earlier section, suggest that the variables are all characterized as integrated of order 1. Having determined that $d_{\max} = 1$, we then proceed in estimating the lag structure of a system of VAR in levels and our results indicate that the optimal lag length based on Schwarz Information Criterion(SIC) is one, that is, k=1. We then estimate a system of VAR in levels with a total of $(d_{\max} + k = 2)$ lags.

$$\begin{bmatrix} CO2 \\ GDP \\ TRADE \end{bmatrix} = A_0 + \sum_{i=1}^{2} A_i \begin{bmatrix} CO2_{t-i} \\ GDP_{t-i} \\ TRADE_{t-i} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} \quad (3)$$

The system of equations is jointly estimated as a "Seemingly Unrelated Regression Equations" (SURE) model by Maximum Likelihood and computes the MWALD test statistic. The MWALD statistic will be asymptotically distributed as a Chi Square, with degrees of freedom equal to the number of "zero restrictions", irrespective of whether the variables are I (0), I (1) or I (2), non-cointegrated or cointegrated of an arbitrary order. The results of the MWALD test statistic as well as its p-values are presented in Table 3.

Table 3: Results of long run Causality due to Toda-Yamamoto (1995)

Null Hypothesis	MWALD Statistics	p-values
GDP does not Granger cause CO2	4.21	0.00
CO2 does not Granger cause GDP	12.35	0.52
TRADE does not Granger cause CO2	2.21	0.00
CO2 does not Granger cause TRADE	8.31	0.34
GDP does not Granger cause TRADE	1.73	0.48
TRADE does not Granger cause GDP	8.05	0.02

The test results in Table 3 suggest that past GDP and TRADE significantly cause current change in CO2 at less than the 5% level. In other words, the results suggest that these two macro variables lead CO2. Moreover, we fail to reject the null hypothesis of Granger non-causality from GDP and TRADE to CO2 emmisions at 5% level of significance. So, it seems that there is a unidirectional long-run causality from GDP and TRADE to CO2 emission for Iran.

5. CONCLUSION

This paper applies the cointegration analysis and the long–run Granger non–causality test proposed by Toda and Yamamoto (1995 in order to test causal relationship between CO2 emision, GDP and openness in Iran based on annual data from 1970 to 2011. Prior to cointegration analysis, the unit root tests have been applied to test the stationarity of the variables. The empirical results indicate that we cannot find enough evidence against the null hypothesis of unit root. However, for the first difference of the variables, we rejected the null hypothesis of unit root. It means that the variables are I(1). The results show that there is one long-run relationship between CO2 emission, GDP and openness.

It is found a positive long-run relationship between CO2 emissions and income for Iran. Moreover, we find that, trade liberalization has a detrimental effect on environmental quality.

The main results in this paper confirm that there is a unidirectional causal link running from GDP and trade to CO2 emission. This further entails that, if Iran attempt to control the emission rate, there will be a corresponding reduction in the GDP growth rate and trade. As such, this country may have to accept a decrease of their existing GDP levels and degree of trade openness if it has to decrease permanently the emission level from what it is at present

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REFERENCES

[1] Dellachiesa, Alejandro E., "Trade, Pollution and the Environment: An Examination of Economic Growth and Greenhouse Emissions from Different Sources." PhD diss., University of Tennessee, 2010. http://trace.tennessee.edu/utk_graddiss/789.

[2] Engle R.F. and Granger C.W.J., 1987. Cointegration and error correction: Representation, esti- mation and testing. Econometrica, 55:251-276.

[3] Grossman GM, Krueger AB (1995) Economic growth and theenvironment. Q J Econ 110:353–377.

[4] Johansen, S. (1991). “Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models,” Econometrica, 59,1551-1580.

[5] Jones, Larry E. and Rodolfo E.Manuelli. 1995. "Growth and the effects of inflation," Journal of Economic Dynamics and Control, Elsevier, 19(8): 1405-1428.

[6] Komen, R., S. Gerking and H. Folmer. 1997. “Income and environmental R&D: empirical evidence from OECD countries”. Environment and Development Economics, 2: 505- 515.

[7] Lee, Hiro and David Roland-Holst. 1997. “The environment and welfare implications of trade and tax policy" *Journal of Development Economics*, 52(1): 65-82.

[8] Liddle, Brantley. 2001. “Free trade and the environmental-development system” *Ecological Economics,* 39(1): 21-36.

[9] Newey, W. and K. West (1987), "A simple, positive semi-definite, heteroskedasticity and autocorrelation-consistent covariance matrix," Econometrica 55(3): 703-8.

[10] Toda, H.Y. and T. Yamamoto. (1995). “Statistical Inference in Vector Autoregressions with Possibly Integrated Processes,” Journal of Econometrics, 66, 225-250.

[11] Zapata, H.O. and A.N. Rambaldi, 1997, Monte Carlo evidence on cointegration and causation, Oxford Bulletin of Economics and Statistics 59, 285-298