Trade, Environment Quality and Income in MENA Region

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Abstract: This paper investigates the causal relationship between environmental quality, GDP and trade for MENA region countries by using panel unit root tests and panel cointegration analysis for the period 1970-2011. The results show a strong causality from GDP and trade to environmental quality in these countries. Yet, Trade and environmental quality does not have any significant effects on GDP in short- and long-run. It means that it is the trade and GDP that drives environmental quality in mentioned countries, not vice versa. So the findings of this paper support the point of view that the cost of higher trade and economic growth is paid in terms of poorer environment.

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

JEL classifications: Q00, F1, F18

1. Introduction

Globalization has multiple implications for environmental sustainability. The interactions are so numerous and Complicated that it would be simplistic to confirm that the two are in conflictIn fact, there are not theoretical reasons or empirical evidence to show that the relationship between globalization and environmental sustainability is unidirectional or unidimensional. It is true that both positive and negative effects on environment have come about because of globalization. According to Bhagwati (2004) globalisation is playing the important role of enhancing economic Welfare by offering new hope to developing countries. Gangopadhyay and Chatterji (2005) saying that globalisation has been characterised as a reduction in trade barriers such as free flow of goods, services and labour from one country to another. Richardson (2000) contends with these views as, the impact of this is increasing the trade which turn into increased income for developing countries and serves as an opportunity to stabilise their economies by taking the advantages of trade. This statement is true and has been proving by (Richardson, 2000) that globalisation has greatly reduced the trade barriers between countries through adjustment of tariffs and import duties. Chan and Scarritt (2001) noted that the large capital inflows were caused by the appreciation of exchange rates and inflationary pressures that effect on the country's current account. Indeed, trade liberalization in improving the countries' economy could actually stop the progress of the economy unless the host countries' balance of payment focuses on the foreign plant where the export is more than import. The adjustment in trade barriers has led to the progression of specialization to developing countries because they are able to focus on the production of commodities which can be produced at the least cost. Developing countries fully use the advantage of globalisation to enhance their income through trading goods which they can produce most effectively.

The focus of the paper is, therefore, to examine the relationship between Income, environmental quality and trade in MENA region for 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

Economic theory suggests that the free market may be expected to produce an efficient and welfare-enhancing surface of resource use, production, consumption, and environmental protection if the prices of resources, goods and services capture all of the social expenditures and benefits of their use. When private costs – which are the basis for market decisions – fail to include social expenditures, market failures occur, resulting in allocative inefficiency in the form of suboptimal resource use and air Pollution. Market failures are a mark of the environmental domain. A lot of critical resources such as timber, fish, water, coal, and oil tend to be under-priced. Ecosystem services such as flood prevention, carbon sequestration, water retention, and oxygen provision often go entirely un-priced. Because under-priced and un-priced resources are overexploited, economic actors are often able to ignore part or all of the environmental expenditures they generate. Trade liberalization may magnify the problem of mis-priced resources and the consequent environmental problems. The Initial impressions of a world community provides citizens with a basis for demanding that those with whom they trade meet certain baseline moral standards, including a commitment to environmental stewardship. As economic integration extends and deepens, and information about one's associates becomes more readily available, what national's feel should be encompassed within the set of baseline standards tends to grow. Increased access to information and data on environmental and economic performance allows for faster problem identification, better issue analysis, and quicker trend spotting. It may also aid the identification of leaders and laggards in the international arena relative to various environmental or social criteria and spur competition among nations. Information in and of itself is not, however, necessarily beneficial. Information overload could lead to a cacophony of voices in the policy realm and result in paralysis instead of action. This risks need to be kept in mind as the volume of internationally shared information continues to increase and appropriate devices for examining through and filtering accurate and related information become necessary.

An appearance at data across countries or across time allows some rough generalization as to the usual outcome of these conflicting impacts. For several vital environmental measures, a U-shaped relationship appears: at relatively low levels of income per capita, growth leads to greater environmental injury, until it levels off at an intermediate level of income, after which further growth leads to improvements in the environment. Such empirical relationship is known as the Environmental Kuznets Curve. The label is by analogy with the original Kuznets curve, which was a U-shaped relationship between inequality and average income. The idea behind the Environmental Kuznets curve is that growth is bad for air and water pollution at the initial stages of industrialization, but later on reduces pollution, as countries become rich enough to pay to clean up their environments. The dominant theoretical explanation is that production technology makes some pollution unavoidable, but that demand for environmental quality increases with income. The standard rationale is thus that, at higher levels of income per capita, growth raises the public's demand for environmental quality, which can translate into environmental regulation. Agras and Chapman (1999) and Suri and Chapman (1998) studied the composition of international trade and detect that manufacturing goods exporting countries tend to have higher energy consumption. They found the poor and rich countries to be net exporters and net importers of pollution-intensive goods, respectively. Thus, the inverted U-shaped EKC curve might partly be the result of changes in international specialization under which poor countries engage in dirty and energy concentrate production while rich countries specialize in clean and service intensive production, without effectively any change in the consumption patterns. On the contrary the PHH, the factor endowment hypothesis (FEH) asserts that in free trade the differences in endowments determine trade between two countries. The FEH suggests that the capital abundant country exports the capital intensive goods that stimulate its production and thereby raising pollution in the capital abundant country. The impacts of trade on the environment depend on the comparative advantages enjoying a country. Under this view capital-abundant countries tend to export capital-intensive goods, regardless of differences in environmental policy (Copeland and Taylor 2004). According to the FEH3 polluting industries will concentrate in affluent countries, which also tend to be capital abundant. This is because polluting industries are typically also capital intensive and thus affluent capital-abundant countries have a comparative advantage in these industries (Copeland and Taylor 2004). In this context, it should be noted that the differences in environmental policy and differences in factor endowments might jointly determine the comparative advantage in trade. It is clear that impacts of trade liberalization on environmental quality depend on, among other factors, jointly by differences in pollution policy and differences in factor endowments, which leads to two competing theories in question.Lucas, et al. (1992), study the toxic intensity implied by the composition of manufacturing output in a sample of 80 countries, and find that a high degree of trade distorting policies increases pollution in rapidly growing countries. Harbaugh et al. (2002) analyzed report in passing a beneficial impact of trade on the environment, after controlling for income. Dean (2002) found a detrimental direct of liberalization for a given level of income, via the terms of trade, though this is outweighed by a beneficial indirect impact via income.

3. Data and empirical results

We apply a three variable model to examine the causal relationship between environment quality, GDP and trade. Environment quality is proxied by CO2 and SO2 emissions per capita. We apply the principle component approach to merge the proxies into one measurement (EMI). The data were obtained from world development indicators. Data used in the analysis are panel of annual time series during the period 1970-2011 on the proxy of quality environment, real GDP per capita (GDP) and trade, defined as the ratio of the value of total trade to GDP (T) for MENA region countries. All variables are in terms of logarithm. The choice of the starting period was constrained by the availability of data.

To test the nature of association between the variables while avoiding any spurious correlation, the empirical investigation in this paper follows the three steps: We begin by testing for non-stationarity in the three variables of EMI, GDP and T. Prompted by the existence of unit roots in the time series, we test for long run cointegrating relation between three variables at the second step of estimation using the panel cointegration technique developed by Pedroni (1995, 1999). Granted the long run relationship, we explore the causal link between the variables by testing for granger causality at the final step.

3.1. Panel Unit Roots Results

The panel data technique referred above has appealed to the researchers because of its weak restrictions. It captures country specific effects and allows for heterogeneity in the direction and magnitude of the parameters across the panel. In addition, it provides a great degree of flexibility in model selection. Following the methodology used in earlier works in the literature we test for trend stationarity of the three variables of EMI, GDP and T. With a null of non-stationary, the test is a residual based test that explores the performance of four different statistics. Together, these four statistics reflect a combination of the tests used by Levin-Lin (1993) and Im, Pesaran and Shin (1997). While the first two statistics are non-parametric rho-statistics, the last two are parametric ADF t-statistics. Sets of these four statistics have been reported in Table 1.

The first three rows report the panel unit root statistics for EMI, GDP and T at the levels. As we can see in the table, we cannot reject the unit-root hypothesis when the variables are taken in levels and thus any causal inferences from the three series in levels are invalid. The last three rows report the panel unit root statistics for first differences of EMI, GDP and T. The large negative values for the statistics indicate rejection of the null of non-stationary at 1% level for all variables. It may, therefore be concluded that the three variables of EMI, GDP and T are unit root variables of order one, or, I (1) for short.

Table 1: Test of Unit Roots for EMI, GDP and T

variables	Levin-Lin Rho-stat	Levin-Lin t-Rho-stat	Levin-Lin ADF stat	IPS ADF stat
EMI	0.34	-0.29	-0.81	-1.81
GDP	-1.23	-1.78	-1.51	-0.50
T	-0.41	-0.62	-0.82	-1.91
ΔEMI	-12.41***	-7.90***	-8.81***	-11.61***
ΔGDP	-12.55***	-7.19***	-10.68***	-16.61***
ΔT	-10.60***	-9.51***	-7.91***	-14.56***

***Significant at 1%

3.2. Panel Cointegration Results

At the second step of our estimation, we look for a long run relationship among EMI, GDP and T using the panel cointegration technique developed by Pedroni (1995, 1999). This technique is a significant improvement over conventional cointegration tests applied on a single country series. While pooling data to determine the common long run relationship, it allows the cointegrating vectors to vary across the members of the panel. The cointegration relationship we estimate is specified as follows:

$$EMI_{it} = \alpha_i + \delta_t + \beta_i GDP_{it} + \gamma_i T_{it} + \varepsilon_{it} \qquad (1)$$

Where α_i refers to country effects and δ_t refers to trend effects. ε_{it} is the estimated residual indicating deviations from the long run relationship. With a null of no cointegration, the panel cointegration test is essentially a test of unit roots in the estimated residuals of the panel. Pedroni (1999) refers to seven different statistics for this test. Of these seven statistics, the first four are known as panel cointegration statistics; the last three are group mean panel cointegration statistics. In the presence of a cointegrating relation, the residuals are expected to be stationary. These tests reject the null of no cointegration when they have large negative values except for the panel-v test which reject the null of cointegration when it has a large positive value. All of these seven statistics under different model specifications are reported in Table 2. The statistics for all different model specifications suggest rejection of the null of no cointegration for all tests except the panel and group $\rho -$tests. However, according to Perdroni (2004), ρ and PP tests tend to under-reject the null in the case of small samples. We, therefore, conclude that the three unit root variables EMI, GDP and T are cointegrated in the long run.

Table 2: Results of Panel Cointegration test

Statistics	
Panel v-stat	7.51***
Panel Rho-stat	-2.71
Panel PP-stat	-6.61***
Panel ADF-stat	-2.89**
Group Rho-stat	-0.61
Group PP-stat	-7.51***
Group ADF-stat	-9.55***

***Significant at 1%
** Significant at 5%

The estimated long run relationship is of the form:

$$EMI = 2.02GDP + 0.13T$$
$$t \quad (6.72) \quad (6.63)$$

The results show a positive long-run relationship between emissions and per capita income, suggesting that environmental quality get worse as the income increases. Also, the findings indicate a positive long-run relationship between emissions and openness, implying that air pollution tends to increase as the trade and exposure to international markets increases

3.3. Panel Causality Results

Cointegration implies that causality exists between the series but it does not indicate the direction of the causal relationship. With an affirmation of a long run relationship among EMI, GDP and T, we test for Granger causality in the long run relationship at the third and final step of estimation. Granger causality itself is a two-step procedure. The first step relates to the estimation of the residual from the long run relationship. Incorporating the residual as a right hand side variable, the short run error correction model is estimated at the second step. Defining the error term from equation (1) to be ECT_{it}, the dynamic error correction model of our interest by focusing on emissions (EMI) and GDP is specified as follows:

$$\Delta GDP_{it} = \alpha_{yi} + \beta_{yi} ECT_{i\,t-1} + \gamma_{y1i}\Delta EMI_{i\,t-1} + \gamma_{y2i}\Delta EMI_{i\,t-2} + \delta_{y1i}\Delta GDP_{i\,t-1} + \delta_{y2i}\Delta GDP_{i\,t-1} + \lambda_{y1i}\Delta T_{i\,t-1} + \lambda_{y2i}\Delta T_{i\,t-2} + \varepsilon_{yit} \quad (2)$$

$$\Delta EMI_{it} = \alpha_{ei} + \beta_{ei} ECT_{i\,t-1} + \gamma_{e1i}\Delta EMI_{i\,t-1} + \gamma_{e2i}\Delta EMI_{i\,t-2} + \delta_{e1i}\Delta GDP_{i\,t-1} + \delta_{e2i}\Delta GDP_{i\,t-1} + \lambda_{e1i}\Delta T_{i\,t-1} + \lambda_{e2i}\Delta T_{i\,t-2} + \varepsilon_{eit} \quad (3)$$

Where Δ is a difference operator; ECT is the lagged error-correction term derived from the long-run cointegrating relationship; the β_y and β_e are adjustment coefficients and the ε_{yit} and ε_{hit} are disturbance terms assumed to be uncorrelated with mean zero.

Sources of causation can be identified by testing for significance of the coefficients on the lagged variables in Eqs (2) and (3). First, by testing $H_0 : \gamma_{y1i} = \gamma_{y2i} = 0$ for all i in Eq. (2) or $H_0 : \delta_{e1i} = \delta_{e2i} = 0$ for all i in Eq. (3), we evaluate Granger weak causality. Masih and Masih (1996) and Asafu-Adjaye (2000) interpreted the weak Granger causality as 'short run' causality in the sense that the dependent variable responds only to short-term shocks to the stochastic environment.

Another possible source of causation is the ECT in Eqs. (2) and (3). In other words, through the ECT, an error correction model offers an alternative test of causality (or weak exogeneity of the dependent variable). The coefficients on the ECTs represent how fast deviations from the long run equilibrium are eliminated following changes in each variable. If, for example, β_{yi} is zero, then GDP does not respond to a deviation from the long run equilibrium in the previous period. Indeed $\beta_{yi} = 0$ or $\beta_{ei} = 0$ for all i is equivalent to both the Granger non-causality in the long run and the weak exogeneity (Hatanaka, 1996).

It is also desirable to check whether the two sources of causation are jointly significant, in order to test Granger causality. This can be done by testing the joint hypotheses $H_0 : \beta_{yi} = 0$ and $\gamma_{y1i} = \gamma_{y2i} = 0$ for all i in Eq. (2) or $H_0 : \beta_{ei} = 0$ and $\delta_{e1i} = \delta_{e2i} = 0$ for all i in Eq. (3). This is referred to as a strong Granger causality test. The joint test indicates which variable(s) bear the burden of short run adjustment to re-establish long run equilibrium, following a shock to the system (Asafu-Adjaye, 2000).

The results of the F test for both long run and short run causality are reported in Table 3. As is apparent from the Table, the coefficients of the ECT, GDP and T are significant in the EMI equation which indicates that long-run and short-run causality run from GDP and T to environmental quality. So, GDP and trade strongly Granger-causes environmental quality. Trade does Granger cause GDP at short run at 1% level, without any significant effect on output in long run. Weak exogeneity of GDP and trade indicate that this variable does not adjust towards long-run equilibrium.

Moreover, the interaction terms in the EMI equation are significant at 1% level. These results imply that, there is Granger causality running from GDP and trade to environmental quality in the long-run and short run, while environmental quality have a neutral effect on GDP and trade in both the short- and long-run. In other words, GDP and trade are weakly exogenous and whenever a shock occurs in the system, environmental quality would make short-run adjustments to restore long-run equilibrium.

Table 3:Result of Panel causality tests

	Source of causation(independent variable)						
Dependent Variable	Short-run			Long-run	Joint (short-run/long-run)		
	ΔGDP	ΔEMI	ΔT	ECT(-1)	ΔGDP, ECT(-1)	ΔEMI, ECT(-1)	ΔT, ECT(-1)
ΔGDP	-	F=0.87	F=8.98***	F=0.94	-	F=0.81	F=6.16***
ΔEMI	F=7.29***	-	F=5.80***	F=8.61***	F=8.94***	-	F=9.81***
ΔT	F=1.85	F=0.33	-	F=0.20	F=0.71	F=0.60	-

***Significant at 1%

4. Conclusion

The objective of this study is to examine Granger causality between environmental quality (measured by CO2 and SO2 emissions), income and trade for MENA region countries over the period 1970-2011. The panel integration and cointegration techniques are employed to investigate the relationship between the three variables: emissions, GDP, and trade. 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 a positive long-run relationship between emissions and per capita income, suggesting that environmental quality deteriorate when income increases. Also, the findings indicate a positive long-run relationship between emissions and trade, implying that air pollution tends to increase as the trade and exposure to international markets increases. Utilizing Granger Causality within the framework of a panel cointegration model, the results suggest that there is strong causality running from GDP and trade to emissions with no feedback effects from emissions to GDP and trade for MENA countries. It means that it is the trade and GDP that drives emissions in mentioned countries, not vice versa. So the findings of this paper support the point of view that it is higher trade and economic growth that leads to higher emissions.

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