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THE CAUSALITY BETWEEN NON-OIL EXPORTS AND GDP IN PETROLEUM EXPORTING COUNTRIES

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Abstract: *This paper investigates the causal relationship between non-oil exports and the GDP in a panel of 11 selected oil exporting countries by using panel unit root tests and panel cointegration analysis. A three-variable model is formulated with oil exports as the third variable. The results show a strong causality from oil exports and economic growth to non-oil exports in the oil exporting countries. Yet, non-oil export does not have any significant effects on GDP in short- and long-run. It means that it is the oil and GDP that drives the non-oil exports in mentioned countries, not vice versa. So, the results in this paper support the GLE (Growth-led Export) hypothesis.*

JEL classifications: *C33;F13; F43*

Keywords: *Panel Unit Root, Panel Cointegration, Granger Causality, Oil Exporting Countries, Export-led Growth (ELG), Growth-led Export (GEL)*

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1. INTRODUCTION

The question that whether international trade will lead to higher economic growth is an old question which has been discussed among exports supporters and protectionists. Theorists of both sides have affected policymaking in different countries with different levels of development from the time of Adam Smith, John Stuart Mill, and Keynes up to now. The supporters of trade liberalization encourage the gains resulted from specialized production of goods with comparative advantage and claim that international trade growth causes technological change and innovation which result in economic growth. But protectionists believe that trade liberalization is dreadful for growth and claim that economic openness in some countries makes economic growth and development worse. They believe in the strategy of supporting infant industries with tariffs and non-tariff laws. So it is not surprising that some countries are wary of the amount of trade liberalization.

There are a lot of theories of development which suggest that export expansion accelerate economic growth through efficient allocation of recources, efficient management and production techniques, specialization, and improved scale. This strategy is known as ELG hypothesis (Feder, 1963; Balassa, 1978, 1982, 1985). Endogenous growth models use a similar opinion to explain the effect of export on economy. However, they also consider the role of imports. In fact, we can say that according to the theory of endogenous growth, the main factors of economic growth are physical and human capital, and expansion of import and export of capital and intermediate goods.

According to the above, many studies have been conducted using time series data for different countries, and cross-sectional and panel data for different combinations of countries, to find whether export growth increases economic growth or not. Different results are obtained from different studies. These studies can be divided into four categories:

1. Older studies have mostly examined the simple correlation between export growth and economic growth. These studies have generally found that exports and economic growth have strongly significant correlation with each other.

2. Some other studies estimate the economic growth using neoclassical methods and considering export or export growth as the independent variable, and examine the question that whether export causes an increased economic growth or not.
3. The studies in third category focus on causality between export growth and economic growth. These studies generally use Granger or Sims tests to find causality. The main shortcoming of this group is that the tests are valid only if the time series are co-integrated. So co-integration should be tested before the causality tests.
4. There are some new studies which have used co-integration technique and ECM models. These studies do not have the shortcomings of previous studies.

The focus of the paper is, therefore, to examine the relationship between export and economic growth in petroleum exporting countries for the period 1970-2009 The direction of causality between these two variables is examined by utilizing a co-integration and error correction modeling framework. The paper is organized in four sections. Section 2 provides a review of the empirical literature. Section 3 discusses the methodology and data. Section 4 shows the empirical results of the study. Section 5 concludes.

2. EMPIRICAL LITERATURE REVIEW

Safdari, et al. (2011) investigated the causality relationship between export and economic growth in thirteen Asian developing countries over the 1988 to 2008 years, by employing Panel-VECM causality based on Wald's test. Empirical analyzes have presented a unidirectional causality from economic growth to export. They studied the causality between the two variables by using a bi-variate vector autoregressive (VAR) model and employing Wald test.

Ekanayake (1999) has used cointegration and error-correction models to analyze the causal relationship between export growth and economic growth in eight Asian developing countries using annual data from 1960 to 1997. This study has provided strong evidence supporting the export-led growth hypothesis. The empirical results in Ekanayake's research show that bi-directional causality exists between export growth and economic growth in India, Indonesia, Korea, Pakistan, Philippines, Sri Lanka and Thailand. According to this study, there is also evidence for export-led growth in Malaysia. Furthermore, there is evidence for short-run Granger causality running from economic growth to export growth in all cases except Sri Lanka. However, there is no strong evidence for short-run causality running from export growth to economic growth.

Jun (2007) has explored the relationship between international trade and economic growth, employing cutting-edge panel co-integration testing and estimation techniques. Annual panel data on 81 countries' macroeconomic variables over the period 1960-2003 have been exploited in empirical analysis. Various panel unit root tests demonstrate that the data variables have been integrated processes with unit roots. Three distinct panel co-integration techniques have been used to estimate the regression equation. A positive bi-directional interactive relationship between exports and output growth has been found and the positive impact of output on exports is a bit stronger than the reverse. The positive association between investment share and exports and the negative correlation between labor and exports has been confirmed. The results of the research suggest that the exports of high income, high export, and high investment countries have somewhat larger output enhancement effects than those of low income, low export, and low investment nations.

Lee and Huang (2002) have used the two-regime multivariate TAR model to investigate the causal relationships between export growth and output growth for five countries. They have found that, except for Hong Kong, the relationship whereby exports lead output prevails in at least one regime for each of four of the countries being studied. Among them, they could not find any export-led growth relationships for Korea, Japan (at least in the short-run) and the Philippines using the conventional one-regime model.

Pop-Silaghi (2009) has examined the export-led growth hypothesis (ELG) and growth-led export hypothesis (GLE) for the Central and Eastern European Countries (Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia, Slovakia) through co-integration and causality tests. Empirical evidence from Granger causality tests using VARL, DVAR or VECM models indicates that, causality from exports to GDP is obtained for Bulgaria, the Czech Republic, Estonia, Latvia and Lithuania. Causality from GDP to exports is found for Bulgaria, the Czech Republic, Estonia, Hungary, Lithuania, Romania and Slovenia. He also has investigated if the above results still hold when including the other relevant component of the foreign trade, i.e. imports. He has concluded that in trivariate systems, ELG remains valid in the Czech Republic only and becomes valid in Lithuania while GLE is validated in Hungary, Romania and Slovenia.

Pandhi(2007)has analyzed the theories behind the role that exports play in growth, and has used regression analysis for four African nations namely the Democratic Republic of the Congo, Guinea Bissau, Malawi, and Nigeria during the period 1981-2003,. By following Foster's model and using the first-difference form of the variables, the regression results have shown a mostly positive relationship between exports and growth and mixed results for the other independent variables, investment and population.

Anwerand Sampath(1997) utilizing unit root and co-integration techniques and Granger causality, for the period of 1960 to 1992, have found that out of 96 countries only 8 show unidirectional or bidirectional causality from exports to GDP with positive relationship between the two variables. According to the evidence of the study, causality from GDP to exports with positive relationship between the two variables has been found for only 9 countries.

3. METHODOLOGY AND DATA

We apply a three variable model to examine the causal relationship between non-oil exports and GDP with oil exports included in model as conditioning variable. Data used in the analysis include (logarithm of real) non-oil exports (EX), Gross Domestic Product (GDP), and oil exports (OIL). We use annual data for the period of 1970-2009 for the selected oil exporting countries, gathered from World Development Indicators.

As can be seen, this study uses panel data for estimation. A panel unit root and co-integration approach, unlike the conventional time series one, has several benefits. First, by pooling time series and cross sections, finite sample power of test is significantly improved. Levin and Lin (1992), Levin, Lin, and Chu (2002), and Im, Pesaran, and Shin (1997, 2003) among others argue that power of panel unit root tests is considerably improved over univariate testing procedures. Mark and Sul (2001), Oh (1996), and Pedroni (1997, 1999, 2004) also indicate that the power of the panel co-integration approach is improved. Second, panel data analysis may provide more useful information on the nature of the economic system of equations for a group of countries compared to time series or cross sectional one.

To test the causal relationship between the variables while avoiding any spurious correlation, this paper follows three steps: We begin by testing for non-stationarity in the three variables of EX, GDP and OIL. Prompted by the existence of unit roots in the time series, we test for long-run co-integrating relation between three variables at the second step of estimation using the panel co-integration technique developed by Pedroni (1995, 1999). Granted the long-run relationship, we explore the direction of the causal link between the variables using Granger causality test at the third step.

3.1. Unit Root Test

First of all, it is important to know if the variables are stationary. For this purpose, we should conduct unit root tests for the data of the variables of EX, GDP, and OIL. Therefore, following the methodology used in earlier works in the literature, we test for trend stationarity of the three variables. The null hypothesis of the test is the existence of unit root or being non-stationary. The test is a residual based test that explores the performance of four different statistics. 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. The results of these four tests are shown in Table 1. The first three rows report the panel unit root statistics for EX, GDP and OIL at the levels. As it can be seen in the Table, the results fail to 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 show the panel unit root statistics for first differences of EX, GDP and OIL. According to the results in the Table, the null of non-stationary at 1% level is rejected for all variables. Hence we can conclude that all the variables of EX, GDP and OIL are unit root variables of order one, or, I (1).

Table 1: Test of Unit Roots for HE, GDP and OIL

variables	Levin-Lin Rho-stat	Levin-Lin t-Rho-stat	Levin-Lin ADF stat	IPS ADF stat
EX	0.22	-0.41	-0.82	-1.41
GDP	-1.03	-1.16	-1.22	-0.82
OIL	-0.76	-1.84	-0.27	-0.22
ΔEX	-12.72***	-6.89***	-10.31***	-21.58***
ΔGDP	-11.24***	-6.63***	-8.11***	-18.62***
ΔOIL	-6.57***	-9.28***	-11.39***	-.18.43***

***significant at 1%

3.2. Panel Co-integration Tests

After conducting the unit root tests, it is time to apply panel co-integration tests to explore the long-run relationship between the three variables. Panel co-integration techniques have been developed in early 1980s and there is a lot of research in 1990s which has used these techniques.

Here, we apply panel co-integration technique developed by Pedroni (1995, 1999) in order to look for a long-run relationship between EX, GDP, and OIL. This technique is a significant improvement compared to conventional co-integration tests applied on a single country series. While pooling data to determine the common long-run relationship, it allows the co-integrating vectors to vary across the members of the panel. After including OIL as an additional variable, the co-integration relationship is specified as follows:

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

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. The null hypothesis of the panel co-integration test is not having co-integration. Pedroni (1999) refers to seven different statistics for this test. The first four ones are known as panel co-integration statistics, and the last three are group mean panel co-integration ones. In the presence of a co-integrating relation, the residuals are expected to be stationary. These tests reject the null of no co-integration when they have large negative values except for the panel-v test which reject the null of co-integration when it has a large positive value. All of these seven statistics under different model specifications are reported in Table 2. According to the statistics for all different model specifications, we reject the null hypothesis of no cointegration for all tests except the panel and group $\rho-$tests. However, according to Pedroni(2004), ρ and pp tests generally under-reject the null hypothesis in the case of small samples. So it can be concluded that all the three variables of EX, GDP, and OIL are cointegrated in the long run.

Table 2: Results of Panel Cointegration test

Statistics	
Panel v-stat	4.41***
Panel Rho-stat	-0.59
Panel PP-stat	-2.12**
Panel ADF-stat	-3.34***
Group Rho-stat	-0.30
Group PP-stat	-4.92***
Group ADF-stat	-7.11***

***significant at 1%

** significant at 5%

3.3. Panel Causality Tests

As Granger (1988, 1969) has noted, co-integration implies that causality exists between the series at least in one direction, but it does not indicate the direction of the causal relationship. Knowing there is a long-run relationship among EX, GDP and OIL, we conduct Granger causality test at the 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 EX and GDP is specified as follows:

$$\Delta GDP_{it} = \alpha_{yi} + \beta_{yi} ECT_{i\ t-1} + \sum_{j=1}^{n} \gamma_{yji} \Delta EX_{it-j} + \sum_{j=1}^{n} \delta_{yji} \Delta GDP_{i\ t-j} + \sum_{j=1}^{n} \lambda_{yji} \Delta OIL_{i\ t-j} + \varepsilon_{yit} \tag{2}$$

$$\Delta EX_{it} = \alpha_{hi} + \beta_{hi} ECT_{i\ t-1} + \sum_{j=1}^{n} \gamma_{hji} \Delta EX_{i\ t-j} + \sum_{j=1}^{n} \delta_{hji} \Delta GDP_{i\ t-j} + \sum_{j=1}^{n} \lambda_{hji} \Delta OIL_{i\ t-j} + \varepsilon_{hit} \tag{3}$$

Where Δ is a difference operator; ECT is the lagged error-correction term derived from the long-run co-integrating relationship; β_y and β_h are adjustment coefficients and 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 $H_0: \delta_{h1i} = \delta_{h2i} = ... = 0$ 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 $\beta_{hi} = 0$ 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 $H_0: \beta_{hi} = 0$ and $\delta_{h1i} = \delta_{h2i} = ... = 0$ 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 it can be seen in the Table, the coefficients of the ECT, GDP and OIL are significant in the Exports equation which indicates that long-run and short-run causality run from GDP and OIL to EX. Therefore GDP and OIL strongly Granger causes EX. In addition, OIL does Granger cause GDP at short run at 5% level, without any significant effect on output in long-run. Weak exogeneity of GDP indicates that this variable does not adjust towards long-run equilibrium.

Moreover, the interaction terms in the Exports equation are significant at 1% level. These results show that there is Granger causality running from GDP and Oil to EX in the long-run and short-run, while non-oil exports has a neutral effect on GDP in both the short- and long-run. In other words, GDP is strongly exogenous and whenever a shock occurs in the system, non-oil exports 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	ΔEX	ΔOIL	ECT(-1)	ΔGDP, ECT(-1)	ΔEX, ECT(-1)	ΔOIL, ECT(-1)
ΔGDP	-	F=0.88	F=5.41***	F=0.51	-	F=0.55	F=4.26***
ΔEX	F=2.77**	-	F=4.71***	F=4.98***	F=5.36***	-	F=6.81***

***significant at 1%

** significant at 5%

4. CONCLUSION

The objective of this study was to examine Granger causality between non-oil exports and income for oil-exporting developing countries over the period 1970-2009. Oil exports are also included in the model along with these two variables. The panel integration and cointegration techniques are employed to investigate the relationship between the three variables: non-oil exports, GDP, and oil exports. Utilizing Granger Causality within the framework of a panel cointegration model, the results suggest that there is strong causality running from GDP and oil exports to non-oil exports with no feedback effects from non-oil exports to GDP for oil exporting countries. Moreover, oil exports have significant effects on GDP just in short-run. It means that it is the oil and GDP that drives the non-oil exports in mentioned countries, not vice versa. So, the results in this paper support the GLE (Growth-led Export) hypothesis. Our findings challenge the empirical literature regarding the ELG (export-led growth hypothesis) hypothesis and expresses serious doubts with regard to promoting exports as a comprehensive development strategy. The ELG is possibly favorable only for a limited number of developing countries, and only to a certain extent.

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