Research Article
Volume 10:5, 2021

International Journal of Economics & Management Sciences

ISSN: 2162-6359 Open Access

The Effect of Oil Real Price on the Real Exchange Rate: A Case Study of OPEC Member Countries

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Abstract

Varying price ratio of tradable and non-tradable goods can change the bilateral exchange rates and the value of the national currency in accordance with the country's economic structure. Increase of the oil price as a strategic commodity without replacement leads to enhancing of the national currency value of the major Petroleum Exporting Countries against the universal currencies such dollar.

The aim of the current study was to evaluate the effect of oil price on the real exchange rate of the Petroleum Exporting Countries OPEC using dynamic pooled mean group patterns (PMG) and mean group (MG). Based on these patterns results, the long-term positive relationship between real oil prices and the value of the national currency of Petroleum Exporting Countries against the dollar was approved; on the other hands, sensitivity of the real exchange rate against the real oil prices depending on the model used was estimated between -0.01 and -0.02, respectively. Also in the current study, the effect of increasing productivity of the tradable sector on the surveyed countries national currency was not significant in less developed countries compared to the developed countries (Balassa and Samuelson effect).

Keywords: Real rate • Panel data • Dynamic patterns • Mean group • Pooled mean group

Introduction

The number of each country currency exchange rate against a unit of foreign currency is called exchange rate which is the same as direct definition of exchange rate. According to the direct definition, increase of exchange rate would mean weakening and eroding the purchasing power of the domestic currency against the currencies of the country. Since the exchange rate reflects the relative prices, its fluctuations have always been of interest to the policy makers and economic actors. Due to importance of the mentioned variable in determining the relative prices and the effect of it's on the market changes, the money officials and decision makers in the money and economic in order to provide and retain have always controlled the exchange rate and tried to advisably prevent its excessive changes and limit its fluctuations with the fundamental variables of the domestic economy and all the macroeconomic conditions in a specified range. It is interesting to note that in practice control of exchange rate fluctuations cannot be obtained only through the policy makers' will and decisions; however, the exchange rate, as noted, to a large extent depends on the production structure, productivity of the production factors in tradable and non-tradable sectors, composition and quality of the imported and exported goods in comparison with business partners. As the result, fluctuations of this variable are strongly correlated with changes in macroeconomic conditions and the economy's fundamental variables.

In the economy of developing countries where export of natural resources and raw materials forms a large part of their foreign exchange earnings and for, depending on the level of exports, GDP growth, inflation rate, and other economic and institutional conditions in those countries, the exchange rate will be influenced by global price of exported goods. In other words, the real exchange rate of these countries is sensitive to changes in the terms of trade in which is defined as the ratio of export to import goods prices and will react [1].

Petroleum as a commodity with low substitution plays a strategic and important role in the global economy and its fluctuation will affect on macroeconomic variables such as economic growth rate, unemployment rate, inflation, stock market etc. Dollar as a universal currency which often allocated the dominant share of the currencies used in the financial markets and foreign exchange reserves to it is often used to determine value of the country's currency or comparing

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Received: April 19, 2021; **Accepted:** May 03, 2021; **Published:** May 10, 2021

purchasing power at the global level. Accordingly given the importance of variables discussed in the global economy in spite of similar studies in this area, the authors are wishing to study the effect of rising oil prices on the bilateral value of currencies of APEC 12 members against the US dollar using the dynamic panel Patterns. In the present article in addition, the effects of productivity differences (APEC member economies and productivity of the United States) on the exchange rate effect which is known as the Balassa Samuelson effect was studies. The study period was from 1982 to 2013 annually.

The impact of oil real price on the real exchange rate assuming other conditions are calculated and analyzed in the current study, based on behavioral equilibrium exchange rate without directly using of any of the exchange rate determining models, using the accumulated dynamic models and specifically using the pooled mean group (PMG).

Titles and contents of the present study are classified as follows. After the introduction, the theoretical basis and estimation method are expressed in the second part. In the third part, a review of studies carried out is presented; and in the fourth part, the model variables are introduced and the estimation results will be analyzed. In the fifth part, the summary and conclusions are presented.

Theoretical foundations

The relationship between changes in oil prices and exchange rates in the early eighties was stated after Bretton Woods, there was a strong consensus among researchers on the relationship between real oil prices on the non-stationary behavior of exchange rate [2,3]. Results of some studied showed that there was a co-integration relationship between real exchange rate and real oil price, and oil price changes also was as the dominant factor in sustainable shocks and dollar real rate non- stationary after Bretton Woods. Moreover, other studies have assessed the effect of oil prices on the real exchange rate, the mentioned effect have studied the effect of oil price on the real exchange rate in three major oil exporting countries of Russia, Norway, and Saudi Arabia. In all studies, the positive relationship between real oil prices and the strengthening of the real exchange rate of these countries was confirmed [4,5].

Introducing two variables of the sources and costs studied the relationship between changes in natural resources prices and exchange rate. Rise in energy prices (oil in this case) increases the demand for goods and capital in the energy sector unless energy supply is perfectly inelastic. Wage increases and higher yields of investment in the energy sector lead the labor and capital to move to this sector which may decrease supply in other sectors such as services. If this section demand does not change, supply decrease causes the price of services and non-tradable sector to increase. Therefore, price of non-tradable goods increases in relation to tradable goods that results in strengthening real exchange rate and the exchange rate changes have been appeared through the sources effect [6].

In the debate of expenditures effect, increase in energy prices will lead to wage increases and profitability of the given sector that increases aggregate demand. If even part of the demand increase in the market moves toward non-tradable goods and services, this increase the prices of goods and services is that sector which cause the price of tradable goods to decrease in relation to the non-tradable goods price which means strengthening real exchange rate. Also, if the government increases it's spending through tax revenue increase, the expenses effect may occur in the public sector.

In addition to the above cases, there is more analysis to support the relationship between the dollar value and oil prices; for example, some believe that the petroleum exporting countries are interested in financial investments in dollars [4]. Thus, oil prices rising increase the producing countries income and consequently the demand for dollar assets and keeping that will raise. On the other hand, the relationship between trade and net foreign assets was presented as explanatory variables of exchange rate fluctuations that has repeatedly been used in other studies and their effects has been confirmed. Taking into consideration the obvious effect of oil prices on the terms of trade and net assets; therefore, the indirect effect of oil prices on the exchange rate is confirmed from this point of view [7].

One of the other important factors affecting the exchange rate equilibrium is of productivity differences effect known as the Balassa Samuelson effect which was believes that the long-term equilibrium exchange rate can be achieved from the balance macroeconomic where policy and exogenous variables are sustainable in the long-term. He in this study introduced and analyzed the effects of different economics productivity on national currency, namely Balassa-Samuelson effect. In the following with more details, the impact of commodity price changes and productivity growth on national currency will be examined.

Balassa Samuelsson effect

Balassa- Samuelson's effect default is that the application of the theory of purchasing power parity for tradable goods and tradable and non-tradable goods price ratio may change in different style for different countries. This theory focuses on the tradable goods, and based on the theory, higher economic growth due to higher productivity of tradable and non-tradable sector enhances the value of the countries national currencies against other countries with lower growth rate. The main emphasis of this theory is that the difference in productivity between two countries in the tradable sector leads the value of the national currency of more productive countries to enhance. Thus, according to this hypothesis, it is expected that in developing and less developed countries where productivity is more likely to increase of the national currency value is more intuitive.

Balassa taking into account the traditional world of the two countries and two commodities in international trade has divided the economy into tradable (industry and agriculture) and non-trade (services) sectors. He suggested that if the productivity international differences in the production of tradable goods greater are than non-tradable goods production, the country with higher efficiency will enjoy national currency value increase in terms of purchasing power parity. If per capita Gross Domestic Product is considered as an indicator of productivity, the portion of purchasing power parity to exchange rates will be an increasing function of price levels.

In general, Balassa Samuelson model has several basic premises as follows. First, economy is divided into tradable (economy) and non-trade (economy) sectors. Second, it is possible to transfer the capital between sectors and between countries. Third, labor force is possible to be transferred between sectors but cannot be transferred between countries. This assumption leads to wage equality between

segments within a country. Finally, purchasing power parity is established only in the tradable sector.

According to Balassa – Samuelson theory, productivity increase in tradable sector will increase wages of labor force in this section in the case that in tradable sector wages will be determined on the basis of productivity. Assuming pricing of the producer countries in tradable commodity (tradable commodity prices is equal to the world price and fixed), in the meantime due to higher level of wages in the tradable sector and free movement of labor between sectors, the work resources will be transferred to the tradable sector. This leads to decrease of the labor force and accordingly raising of wages and production costs in non-tradable sector. Now assuming the non-tradable sector demand as fixed, the cost of non- tradable commodity will increase and therefore the portion of tradable to non- tradable goods decline which indicates increase of the currency value of the more productive country.

Theoretical principles of used model for estimates of Mean Group (MG) and Pooled Mean Group (PMG)

Based on the theoretical basis of combined data patterns, different assumptions about the effects of variables on each other have been considered during the temporal period and in between sections depending on the model used. Hence, the authors use specific estimation methods depending on their goals, theoretical foundations, and limitations of each the model.

Based on the theoretical basis of panel data models, intercept and the slope are assumed equal for all countries in order to estimate the classic least combined squares models (multi-country). In the fixed effects and random effects models, intercepts and slope are more likely to be different between countries. But in this method, long-term and short-term coefficients are assumed equal. In other words, it is assumed that the communication and interaction between variables is the same in a long and short term. In order to distinguish between short-term and long-term behavior of the variables introduced regression patterns with distributed-lag. The other problem of combined patterns is disregarding the dynamism. Although this problem can be removed using methods such as GMM (GMM), these models do not consider the heterogeneity between sections and misleading results may be created after their using. Thus, pooled mean group patterns, which consider the subject of dynamism in addition to distinguishing between short-term and long-term behavior of variables, enjoy higher priority [8].

In addition to the above cases, since the economic variables used in the models may have varying degree of non-stationary (accumulation), thus the use of pooled mean group method which allows the stationary and non-stationary variables to be estimated together is another advantage of this method. In this method somehow to estimate short-term and long-term coefficients, ARDL pattern and VECM broderie error correction pattern is used in the form of panel data.

In the method of mean group models estimation, estimates are done according to the number of sections (countries), and then the results will be averaged. Based on the theoretical foundations of the models, the possibility to take advantage of regression models with distributed-lag, different duration and frequency, and different regions are provided. In distributed-lag regression approach, short-term and long-term coefficients are different among groups or countries presented more flexible approach called pooled mean and argued that different states (levels) though may be homogeneous in the long term, this is not true in the short term and heterogeneity will occur between them. In other words, these models assumed that the long-term coefficients and error variance are the same in all cases and only short-term coefficients differ.

In the present paper, the target countries are the OPEC petroleum exporting countries, and it seems the economic, political, and institutional structure of any country are among the special and unique characteristics of that country which can cause heterogeneity in the variables relationships and similar economic policies in them. In the current study despite accepting all differences in economic structure of the APEC member countries due to similar business model and oil structure of these economies, it is assumed that the key variables behavior in these countries have no significant difference in long term; however, differences in short term are tangible and accepted. Therefore, in the current paper, the long-term effect of oil real price changes on the countries real exchange rate were assumed the same and dynamic pooled patterns data and the mean group were used.

Literature review: Previous studied the effect of long-term relationship between real oil prices, real interest rate, and real exchange rate. Their research study period was from 1983 to 2012 in the form of panel data. The obtained results showed a significant positive relationship between real oil prices and changes in the real exchange rate in the sense that increase of the oil real price leads to an increase in the real exchange rate.

Panel model studied the Balassa Samuelson effect in Central and Eastern Europe. He in his study revaluated Balassa-Samuelson effects in explanatory of inflation and real exchange rate using panel data for 9 countries of central and Eastern Europe since the mid 90's to 2010. The results of his study showed that the above effect was describing less than 1.5% of the mean difference in relative inflation in Europe and about 1% of total inflation within the studied countries [9].

The effect of Balassa-Samuelson model. He in his research investigates real and nominal economic convergence for the countries in East Europe in a certain period of time. Real convergence refers to the real economic performance of a country which is usually associated with the growth rate of GDP and productivity level. Another one of those who studied Balassa-Samuelson effect in the Romanian economy was Vasyli Dede. His goal was to show the extent that difference between tradable and non-traded goods productivity explains the differences in inflation between Romania and the euro zone. His research showed that Balassa-Samuelson effect only explained final inflation differences [10].

Balassa-Samuelson effect in the period of economic transition using panel data. He in his research dealt with differences in relation prices on the economy of Europe in the 2000s. The results of his study hypothesis were confirmed [11].

The effects of productivity differences and economic demand differences on real exchange rate in major oil exporting countries (Norway, Iran, Venezuela, Kuwait, Nigeria Valjzayr). Hashem pour's

estimation results in the form of an unbalanced panel data with annual frequency over the period of 2005-1970 signifies that one percent increase in real oil prices on the value of the national currency of the world first eight oil exporting countries including three major oil exporting countries with fixed exchange rate regime and five major oil exporting countries with managed floating exchange rate regime or floating led to exchange rate regime rise respectively equivalent to 0/13, 0/15, and 0/15 per cent [12].

Balassa-Samuelson effect test studied the effect of sector productivity on effective real effective exchange rate in the economy of Iran. They examined short-term and long-term effects of sector productivity on the real effective exchange rate using the annual statistics and major trading partners of Iran in the period of 1980-2008 and come to the conclusion that Balassa- Samuelson effect using the self-explanatory method with wide lag, relative productivity in the tradable sector has a significant positive coefficient at the level of 5% in long-term, and relative productivity in non-tradable sector at the same significance level in the long and short term has negative coefficient [13-15].

The purchasing power parity and production efficiency with the approach of Balassa-Samuelson model in selected countries using co- integration analysis method and FMOLS estimates. Their results confirmed Balassa-Samuelson effect in these countries, so that the increase in tradable sector productivity ends in increase their effective exchange rate increase. The results also indicated a negative effect of decline in the real exchange rate on the purchasing power in Iran during the years under investigation [16].

Materials and Methods

Introduction of the variables used

Real exchange rate: This variable is defined as multiplication of the nominal exchange rate (the number of the state currency i to US dollars) in the US consumer price index on the i-country consumer price index.

$rert = e_{ti} * cpi_{tus}/cpi_{ti}$

Where e_{ti} is the nominal exchange rate of the currency and is consumer price index in the i country.

Real oil prices (Roil): This variable is realized using the US Consumer Price Index.

Gross Domestic Production (GDP): in order to evaluate Balassa-Samuelson effect in economics of the selected countries, the economic growth rate of any country productivity has been used as a successor productivity variable.

All required data of OPEC member countries excluding Iran has been extracted from the World Bank WDI, and Iran required statistics is according to the Central Bank of the Islamic Republic of Iran. It should be noted that the model used is a log-line model.

Unit root tests and co-co-integration

Various tests have been presented for investigating presence of a unit root in panel data that some of them included Levin, Lin and Chu (LLC), Pesaran and Shin (IPS), ADF-Fisher and PP-Fisher. The panel unit root is classified into two types: the first category includes common unit root tests such as LLC and Hodder, and the second is the sectional unit root which contrasts the previous state and considers different sections. Sectional unit root test results in Table 1 were carried out on variables of the model (Table 1).

Degree of co-integration	ADF test with one difference	ADF statistics on the surface	Statistics	Variables
I (0)	-	36.8711 (0.0244) *	ADF - Fisher Chi-square	LnFER
I (1)	-13.1398 (0.0000) *	-1.57904 (0.0572)	ADF - Choi Z-stat	
I (0)	-	233.257 (0.0000) *	ADF - Fisher Chi-square	RGDP
I (0)	-	-9.37446 (0.0000) *	ADF - Choi Z-stat	
I (0)	-	151.722 (0.0000) *	ADF - Fisher Chi-square	Roil
I (0)	-	-10.2380 (0.0000) *	ADF - Choi Z-stat	

* Significant at the level of 90% or higher

Table 1. Panel unit root test.

Since some variables are at the stationary level and some get to the stationary level differences with one time of difference, the pooled mean group estimates methods therefore are preferred to others.

Results

In this section using the mean group and pooled mean group patterns, the effect of real oil prices and economic growth on the real exchange rate to the APEC member economies was estimated. After the model estimate and before its interpretation, Hausman test first was carried out to test the hypothesis of selecting between the two mean group and pooled mean group models. The calculated statistics of the software and probability of the test (0.2) show that the hypothesis of preferring pooled mean group pattern cannot be rejected, and accordingly, results of estimating pooled mean group model parameters with the assumption of consolidated long-term coefficients be interpreted as follows (Table 2).

	Non-trending model	Trending model
	PMG	MG
Template adjustment speed	-.033 ** (0.000)	0.26** (0.000)
Roil	-.0116591 **(0.023)	-0.00128
Rgdp	0.0130 (0.33)	-0.19 (0.52)
Possibility of Hausman test for	Prob (0.2)	Prob (0.01)
Selected models based on hypothesis test:	PMG	MG

Note: The numbers in parentheses are the percent chance.

* Coefficient significance at the confidence level of 90% or higher.

Table 2. The estimation results of both trending and non-trending pattern.

Based on the results of the pooled mean group in Table 2, the Petroleum Exporting Countries, increases of OPEC oil basket real price is inversely related with real exchange rate; in other words, an increase in real oil prices reduced the real exchange rate and raise of the exporting countries currency value against the US dollar. The confirmed direct and positive relationship between real oil prices and the value of the national currency of Petroleum Exporting countries statistically in this model is according to theoretical basis and in line with the results of other studies on this issue [17].

According to the pooled mean group model, real prices coefficient of oil is equal to 0.011, and the said coefficient is significant at a confidence interval of 0.95 percent. In other words, the ten-unit increase in real oil prices increases the value of the national currency at the rate of 0.1 percent. In this model also, it is expected, according to the theory of Balassa-Samuelson, the relationship between exporting countries economic growth rate difference of real growth rate of the United States with real exchange rate is negative. But in this model, the mentioned variable was not statistically significant, and Balassa-Samuelson hypothesis was not confirmed. Also based on the results of error correction of pooled group mean model, errors and disequilibria correction speed and achieving long-term equilibrium was equal to 0.032 that are consistent with the expected sign and statistically significant. However, the adjustment speed according to coefficient value of the error correction model was low and time period of shock modification was long pattern.

The relationship between real exchange rate and oil real price and oil-exporting countries' economic growth rate difference by adding the time trending is re-estimated. Also, in order to select the proper fit model Hausman test was used. Based on the software output, the possibility reported in above table shows that the null hypothesis of pooled mean group pattern fit was rejected.

The pooled mean group pattern results show that the oil real price coefficient in the model is equal to -0.02 which in terms of sensitivity and symptoms was consistent with theoretical expectations and confirmed the results of the pooled mean group pattern in non-trending state. Also, error correction coefficient in this model was equal to -0.26 and statistically significant [18,19].

The empirical results show that the average real price of oil in the model coefficient is equal to 0.02- In terms of sensitivity and symptoms consistent with theoretical expectations and confirmed the results of the pooled mean group in the absence of the time. In this model, error correction coefficient was about -0.26 and statistically significant.

Discussion

According to estimate results of this model, the value of the national currency rate increases to 0.2% for every increase of ten units of real oil prices. In fact, based on the estimate results of the trending pooled mean group and non-trending mean group, real oil price coefficient was between -0.01 to -0.02 that is for each ten unit increase of oil real price the currency value in Petroleum Exporting Countries will increase between 0. 1 to 0. 2 percent.

Comparing adjustment of two models show that in the mean group model compared with the pooled mean group model short-term imbalances will be corrected more quickly, and the period to reach for long-term equilibrium is shorter in this model. No evidence was provided to confirm Balassa-Samuelson theory in both models; in other words, no significant relationship was observed between economic growth and real exchange rate in target countries during the studied period. Therefore, with appropriate caution in interpreting the estimate results and assuming other conditions and factors affecting the real exchange rate, due to the investigated economies high dependence on oil and the lack of efficient allocation of its resulted resources, growth and development conditions other for economic sectors are not provided in these countries. Thus, increase of economic growth rate cannot lead to considerable changes in the value of national currency of the studied countries.

Conclusion

In the current study, the effect of real oil prices increase on the real exchange rate were studied among the 12 APEC member countries using dynamic mean panel models. Results of the mean group and pooled mean group showed that the real exchange rate sensitivity against the oil price respectively in pooled mean group and mean group was equal to-0.01 and -0.02. The adjustment speed also in these patterns respectively was equal to 0.03 and -0.26. Comparison of the models' results show that the sensitivity of the real exchange rate against the real price of oil and the speed of reaching long-term equilibrium in mean group model was higher than that in pooled mean group model.

Based on the estimate results, the economic growth rate of APEC member economies compared to US economic growth rate in any one of these patterns had no significant effect on the real exchange rate; in other words, no evidence was observed in the present study on the Balassa-Samuelson effect. Therefore, with appropriate caution in interpreting the estimate results and assuming other conditions and factors affecting the real exchange rate, due to the investigated economies high dependence on oil and the lack of efficient allocation of its resulted resources, growth and development conditions other for economic sectors are not provided in these countries. Thus, increase of economic growth rate cannot lead to considerable changes in the value of national currency of the studied countries.

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How to cite this article: Torki, Leila, Ameneh Khoshbakht and Hossein Khandaniand. "The Effect of Oil Real Price on the Real Exchange Rate: A Case Study of OPEC Member Countries." *Int J Econ Mang* 10 (2021) : 593