"Asymmetric effects of real exchange rate misalignment on the economic growth of Iran"

After the collapse of the Bretton Woods system, the biggest challenge facing the foreign exchange market was the deviation of the real exchange rate from its equilibrium level which is known as exchange rate misalignment, and ultimately led to macroeconomic imbalances, whether domestic or foreign.

In this regard, what is important from the point of view of policy makers is the effect of these misalignments on major variables such as exports, balance of payments, domestic price levels and other variables, however the economics growth is one of the most important macro indicators which is affected by long-term exchange rate misalignments.

After the 1979 revolution, the Iranian economy was exposed to economic shocks, which led to a series of structural changes and a phenomenon of exchange rate misalignment. Among the factors that led to these changes, the war and government intervention in the foreign exchange market, along with sanctions, can be highlighted. Policies that in the country's foreign exchange system cause inappropriate regulation of the real exchange rate and its misalignments, could affect through mechanisms such as reducing the country's competitiveness in global markets, the non-specific allocation of inputs for production and the prevalence of mercantilism, can stop the economic movement and slow down its growth.

In the beginning, most studies were limited to the effects of the real exchange rate misalignment on macro variables, regardless of the nature of misalignments. In this case, the conclusion was that the exchange rate misalignment has a negative effect on economic growth. Recently, attention has been focused on the nature of misalignments, which may appear as "over-valuation " or "under-valuation". The most important question raised in this regard is whether the effects of undervaluation of currency and over-valuation of currency on economic growth are the same or not.

This study analyzes the asymmetric effects of real exchange rate misalignment on the economic growth of Iran in period 1979-2016 For this purpose, after measuring the misalignment of the real exchange rate in the Iranian economy, this misalignment was split into two variables of positive misalignment and negative misalignment, and along with other variables such as terms of trade, the ratio of the gross fixed capital formation to gross domestic product entered the GDP model and then it was estimated through simple OLS approach. The results of the estimation of the model and a simple Wald test will show that whether the effects are the same or not.

In "Part A" I use Python to create three visualizations of data related to this topic.

in "Part B" I use Python as well to estimate a baseline econometric model.

Part 1

Investigating Iran's Real Exchange rate Trend During the Years of 1979 and 2016

Mathematically, the real exchange rate is equal to the nominal exchange rate times the domestic price of the GDP divided by the foreign price of the item. According to the chart, the real exchange rate has been declining up to year 1992 and has seen a huge jump in year 1991(about 20 times). Then again, it had a steady decline until year 2002, and by year 2003 it had reached another peak. The main reason for the fluctuations so far has been the negative consequence of economic adjustment policies and the implementation of the government's exchange rate policy.

The downward trend continued until year 2012 due to rising domestic prices relative to foreign prices (US) but again rising from year 2013.


Real Exchange Rate of Iran 1979-2016
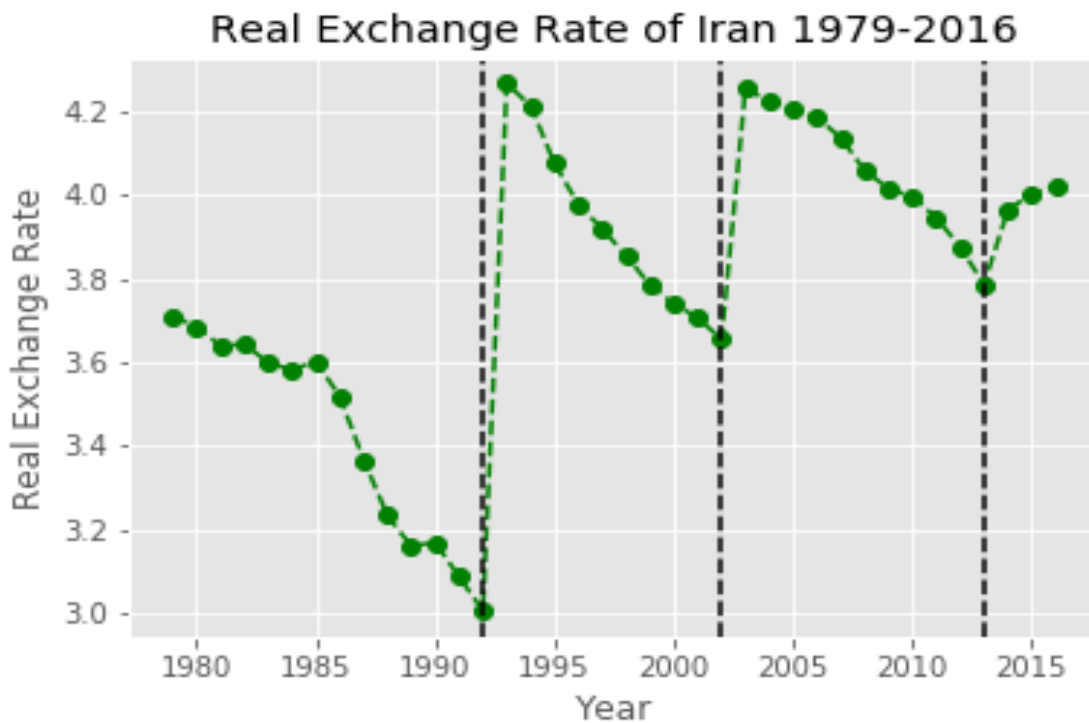
Investigating the Trend of terms of trade of Iran during Years 1979-2016

The terms of trade were first coined by Alfred Marshall to determine the interests of the parties to the trade. From the point of view of modern economists, terms of trades are one of the most important tools for analyzing macroeconomic issues, so that changes in the terms of trade of countries have a direct impact on their welfare.
Improving the terms of trades enables countries to buy more commodities at the same income level. Reducing the terms of trades reduces countries' purchasing power in world markets.
As the diagram shows, the terms of trades of Iran was stable until year 1987, but during the imposed war it fluctuated so much that
it continued until year 1999. The terms of trade have been on a downward trend from year 1999 to year 2010 and has been on an upward trend since year 2012, with high growth rates.


Terms of Trade of Iran 1979-2016
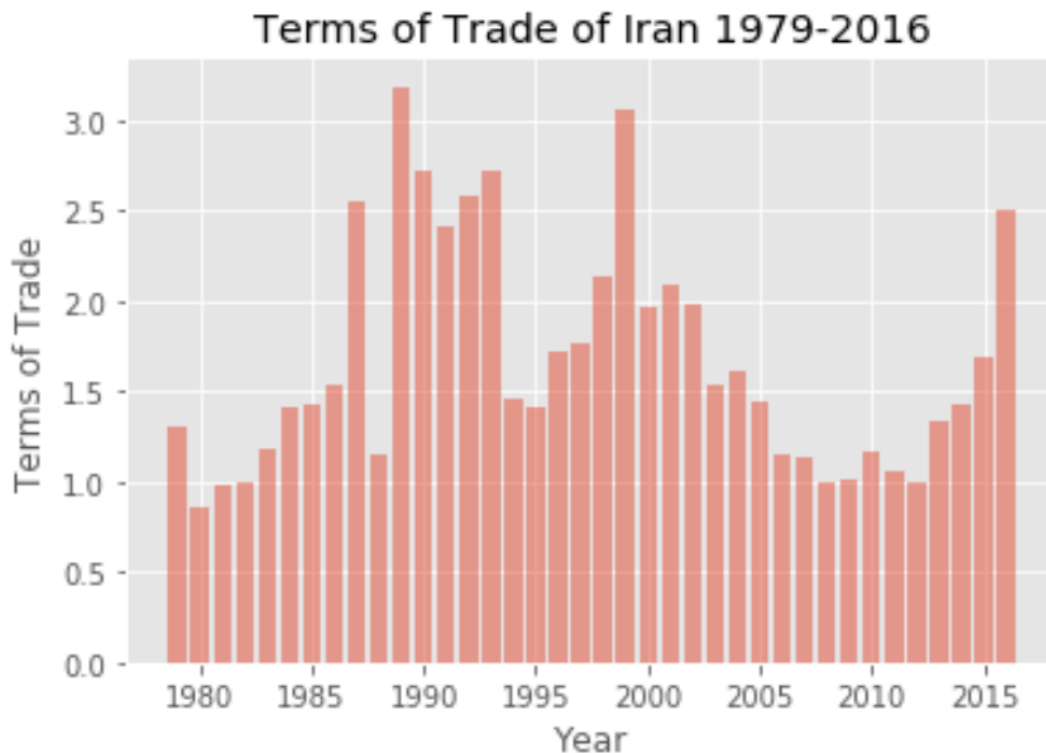
Investigating of the official exchange rate trend and the non-official exchange rate trend over the years 1979-2016

During the post-revolutionary years, factors such as the decline in oil revenues(in USD Dollars), even a decline in oil prices at constant prices, strong dependence on oil revenues, population growth, capital flight, Rising demand for imported goods, war, and other political factors, have led to a sharp decline in the value of the Rial against other currencies.

According to the chart, the informal market rate trend has been stable and steady up to year 2010 but has been fluctuating since the beginning of the decade, so that with the entry of year 2011 and the start of sanctions, oil exports decline and the blocking of some of resources have also inflamed the market.

Overall, it can be concluded that over the past decades, the approach taken by central bank officials to exchange rate policy has shown a strong tendency to keep the official exchange rate close to the informal exchange rate.

Official and Non Official Exchange Rate
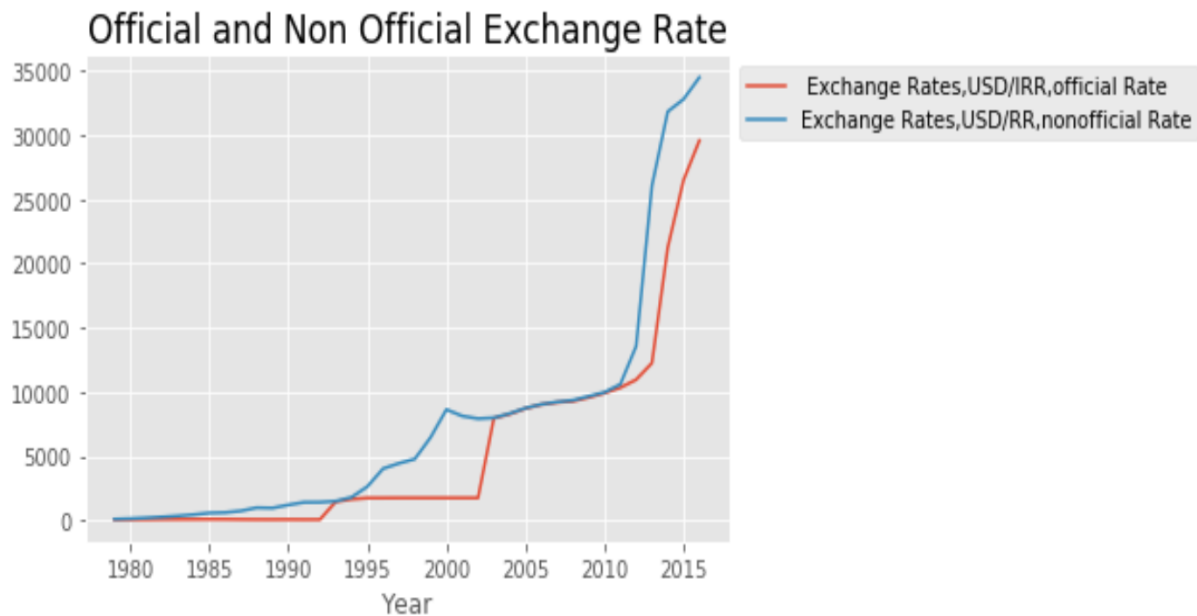
investigating the Relationship Between Real Exchange Rate Misalignment and Iranian Gross Domestic Product

In this section, the relationship between two variables of GDP and real exchange rate misalignment is investigated using time series and distribution charts.
As can be seen, assuming the other variables are constant, the relationship between these two variables is positive. In other words, with the increase in Iran's GDP, the real exchange rate misalignment will increase.
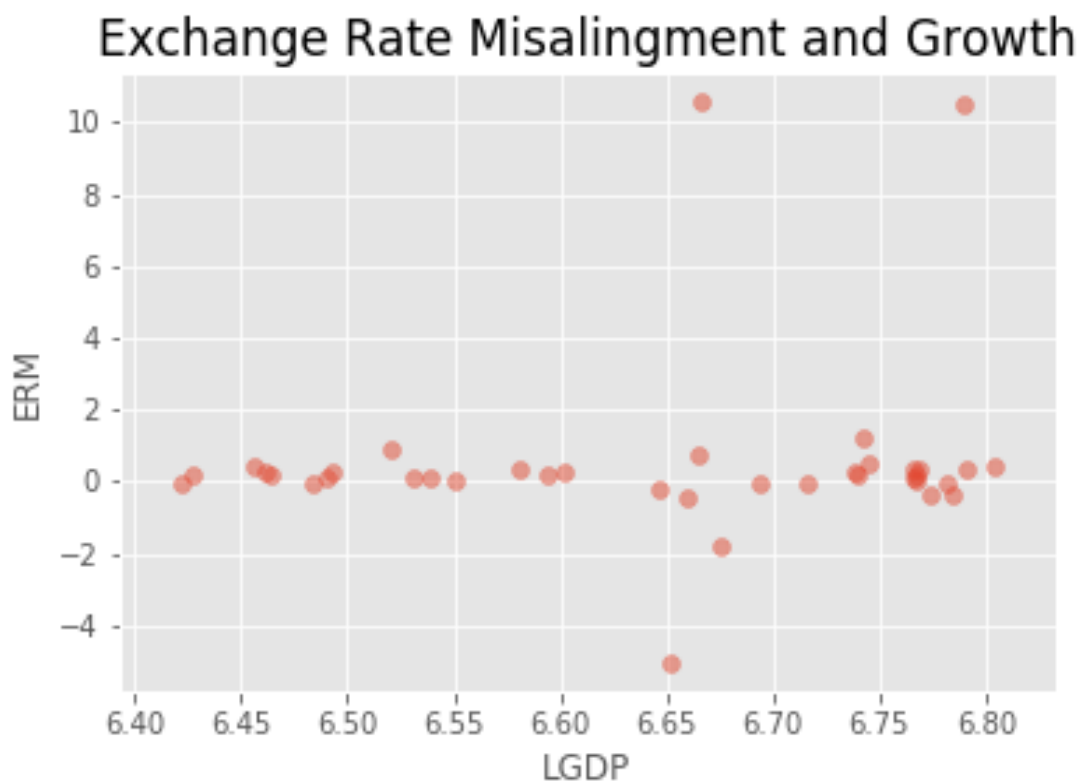
Part 2

The underlying question is:

are the effects of the deviation of the real exchange rate from their long-term equilibrium on Iran's economic growth asymmetric?

Research methodology
The real exchange rate misalignment which is derived from Wong (2013) studies on the Malaysian economy is equal to:

$$MIS_t = \log RER_t - \log ERER_t \quad (1)$$

MIS_t Misalignment

$\log RER_t$ Real Exchange Rate

$\log ERER_t$ Equilibrium Real Exchange Rate

If this difference is positive, we will encounter "under-valuation" (positive misalignment), and if the result is negative, we will encounter "over-valuation" (negative misalignment). The real exchange rate is derived from the ratio of foreign prices to domestic prices in terms of currency:

$$RER_i = (NER_i \times CPI_i)/CPIIR \quad (2)$$

NER_i : The nominal exchange rate which is defined as the value of currency of the country i in terms of the Iranian Rials, which can be derived from The unofficial nominal exchange rate of Iran (the value of one dollar of the United States in Iranian riyals) corresponds to the nominal exchange rate of the country i (the value of one US dollar in the currency of the i-th country). (The data source of the unofficial nominal exchange rate of Iran and the nominal exchange rate of the United States of America are World Bank Development Indicators).

CPI_i : Consumer price index of United States. (the source of data is World Bank Development Indicators)

$CPIIR$: Consumer price index of Iran. (the source of data is World Bank Development Indicators)

To estimate the equilibrium exchange rate, I use the following model, which is a generalization of the Edwards model (1998):

$$LRER_t = \beta_0 + \beta_1 LOPN_t + \beta_2 LOIL_t + \beta_3 LESUB_t + U_t \quad (3)$$

$LRER_t$: The logarithm of equilibrium real exchange rate

$LOPN_t$: The logarithm of the degree of openness of the economy, which is obtained from the logarithm of the sum of the value of exports and imports on gross domestic product. (Data on GDP, exports and imports in Billion Rials, Source: Time series data of the Central Bank of Iran).

$LOIL_t$: The logarithm of oil revenue relative to GDP (data on oil revenue and gross domestic product in terms of billions of Rials (Source: Time series data of the Central Bank of Iran, 2011).

$LESUB_t$: Exchange rate premium equivalent to;
(official exchange rate / official exchange rate - free market exchange rate) = exchange rate premium

To obtain the equilibrium exchange rate and calculate the real exchange rate Misalignment, I estimate the equation (3) by the OLS method for the annual data of 1979-2016, then using equation (1), I obtain the real exchange rate misalignment and I place it in the following model which is modification form of Wong (2013)'s model in his studies:

$$LPGDP_t = \beta_0 + \beta_1 LI_t + \beta_2 LTOT_t + \beta_3 PO_t + \beta_4 NE_t + U_t \quad (4)$$

$LPGDPt$: Logarithm of gross domestic product per capita (GDP data in billion Rials, Source: Central Bank of Iran).

LI_t: Logarithm of the ratio of the gross fixed capital formation to gross domestic product (data on the gross fixed capital formation and gross domestic product in billion Rials, (Source: Time series data of the Central Bank of Iran)).

$LTOT_t$: The logarithm of the terms of trade, which is obtained from the ratio of the price index of the product to the price index of the imported products (data on the price index of the products of the export and the price index of the imported products (Source: Time series data of the Central Bank of Iran, 1397)

PO_t: Positive real exchange rate misalignment

NE_t: Positive real exchange rate misalignment

Finally, I study the asymmetry of these misalignments using the Wald test in equation:

$$H_0: \beta_3 - \beta_4 = 0$$
$$H_1: \beta_3 - \beta_4 \neq 0$$

If the H_0 assumption is rejected, this means that the real exchange rate misalignments are asymmetric.

Results

Here is the result of the estimation of the equation (3) :

$$LRER_t = \mathbf{3.54} + \mathbf{0.18}LOPN_t + \mathbf{0.05}LOIL_t - \mathbf{0.19}LESUB_t + U_t$$

Variable	Coefficient	P-Value	t-statistic
$LOPN_t$	0.18	0.007	1.037
$LOIL_t$	0.05	0.046	1.489
$LESUB_t$	-0.19	0.000	-6.539

As can be seen in Table above, all coefficients are significant, and their signs are consistent with the economic theories. With regard to the significance and the positivity of the openness coefficient of the economy, it can be concluded that with a one percent increase in the interaction with the global economy, the real exchange rate is up by 18 percent. Oil revenues also have a positive and significant effect on the real exchange rate, so that with a percentage increase in oil revenues, the real exchange rate increase by 5 percent. Increasing oil revenues will increase the demand for commercial and noncommercial goods and, assuming the other economic conditions are stable, the real exchange rate will increase.
Regarding the amount of the premium exchange rate, it can be concluded that it has a significant effect on the real exchange rate and with a 1% increase in this gap the real exchange rate will decrease by 19 percent.

Here is the result of the estimation of the equation (4) :

$$LPGDP_t = \mathbf{3.81} + \mathbf{0.38}\ LI_t + \mathbf{0.60}\ LTOT_t - \mathbf{0.02}\ PO_t - \mathbf{0.02}\ NE_t + U_t$$

Variable	Coefficient	P-Value	t-statistic
LI_t	0.38	0.056	0.575
$LTOT_t$	0.60	0.048	2.470
PO_t	$-\,0.02$	0.321	-1.185
NE_t	$-\,0.02$	0.007	-0.574

Based on the results of the estimation, the variables terms of trade, the negative real exchange rate misalignment and the ratio of the gross fixed capital formation to gross domestic product have a significant effect on the country's GDP per capita.
The positive misalignment of the real exchange rate on economic growth, which has a negative coefficient, is not statistically significant, but the negative misalignment of the real exchange rate on economic growth, which has a negative coefficient too, is statistically significant.

Wald Test Results

To test the symmetric or asymmetric effects of positive and negative real exchange real rate misalignments on economic growth, the Wald test is used (I used Stata for this).

Table (12): Wald Test Results

χ^2 **Statistics**	0.14
Null Hypothesis	the effects of the real exchange rate misalignment on economic growth are symmetric

Based on the results of the Wald test, presented in Table above it can be stated that in the study period, the positive and negative exchange rate misalignments have a symmetrical effect on Iran's economic growth. In general, the effects of the real exchange rate misalignment on economic growth are symmetric and negative.

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