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The Relationship Between Economic Activities and Real Exchange Rate: The Case of Iran

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Abstract: exchange rate fluctuations have always been one of the most important macroeconomic issues. In this paper, the asymmetric effects of exchange rate shocks (decomposed to negative and positive shocks) on GDP have been investigated by co-integration analysis in Iran economy during the period 1960-2008. The results showed that the negative shocks have much more effects on output than positive ones. The major finding of this research is that during stagnation and low price period, depreciation of the domestic currency can have positive and significant effects on real GDP by little increase of prices. But depreciation of the domestic currency has insignificant effect on real GDP and results in significant increase in prices in economy, in high price level. Thus, in order to increase the efficiency of exchange policy it is necessary to consider the economic condition of the country

Key words: Economic activities · Asymmetric effects · Iran economy · Exchange rate · Fluctuations

INTRODUCTION

For decades the exchange rate was at the center of macroeconomic policy debates in the emerging markets. In many countries the nominal exchange rate was often used as a way of bringing down inflation. The experimental investigations indicate that exchange rate fluctuations show asymmetric effects. It means that depreciation of exchange rate effects on macroeconomic variables, such as GDP, are different from appreciation exchange rate effects. According to economic literature, currency depreciation or appreciation may cause increasing imported goods price. So that foreign goods will be more expensive than domestic goods. On the other hand, increasing the competitive power of domestic industries and with cost transferring of foreign goods to domestic goods, currency depreciation causes purchasing demand of domestic goods are more than foreign goods. In addition, currency depreciation will increase real export and nominal export. Currency depreciation has negative effects on economic performance in developing countries. Exchange rate depreciation diverts spending from foreign goods to domestic goods. Anticipated exchange rate movements determine the cost of the output produced, resulting in long-run effects. In contrast, unanticipated exchange rate movements determine economic conditions, in the short-run, in three directions: net exports, money demand and the output supplied. Both long-run and short-run effects matter to economic performance [1, 2]. Positive shocks to the exchange rate indicate unanticipated currency depreciation (devaluation) exchange rate depreciation increases the cost of imported intermediate goods, decreasing the output supplied in developing countries. The reduction in aggregate supply is consistent with a reduction in output growth and an increase in price inflation in the face of currency depreciation, both anticipated and unanticipated, in various developing countries. For countries in which energy is an input into the production function, energy price shifts, both anticipated and unanticipated, increase the cost of the output produced and, hence, prices. Supply has a direct positive relationship with output price surprises. Workers decide on labor supply based on their expectation of the aggregate price level. An increase in aggregate price relative to workers' expectations increases the demand for labor and, hence, the nominal wage [3].

Then, the important question is that how exchange rate fluctuations (symmetric or asymmetric) effects and evaluation effects of domestic and foreign exchange rate shocks affect production in economy of Iran. On the other

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hand, the main discussion is the effect of exchange rate decrease and increase on production that we try to find the answer. Knowing how and how much exchange rate increase or decrease affects the GDP is very important and results of this investigation can offer appropriate policy recommendation. This paper studies the Asymmetric Effects of Exchange Rate Fluctuations on Iran economic growth during 1960-2008 using cointegration tests. The paper is organized in five sections. The second part explains the theoretical literature; the third section will review the empirical literature. Section four presents the econometric model and empirical results. Finally section five concludes.

Theoretical Literature: Real exchange rate is a very important variable in foreign trade sector and as a major variable in the framework of macroeconomic policies is very important. Real exchange rate increase or decrease show strength and weakness of currency against foreign currency and is a criterion for demonstration of the competitiveness power of domestic manufactured goods in world markets. Deviation of this rate from equilibrium level, which indicates disorder in the relative prices, will have negative impact on resources allocation in society and finally, reduces the competitiveness power of domestically manufactured goods in world markets. Since the empirical model of research obtained on the base of theoretical models and empirical studies for output and prices, then explanation of theoretical literature of the exchange rate fluctuations effects on production is necessary. In fact unanticipated shocks can affect supply and demand from different channels; we need a series of fundamental assumptions for model presentation that economic agents behave rationally. According to the theory of rational expectations it can be expressed that anticipated variable do not affect real output and only unanticipated variable can affect real variables. Then we use only unanticipated variables of time series for analyzing in this study.

Our research model is based on macroeconomic equilibrium model and in this framework, exchange rate fluctuation impacts will be investigated on output and price. It is assumed that exchange rates fluctuate around the long-term equilibrium. Deviation of trend defines exchange rate fluctuation as uncertainty. Uncertainty affects economy from demand side through export, import and demand of money and from supply side through cost of imported intermediate goods. Consequent change in supply and demand will be reflected in change of output. As it is mentioned, economic agents behave rationally in reality, so supply and demand was under uncertain condition in reality and with this assumption; models based on certainty are less efficient. For this reason in theoretical discussions and research pattern bases, rational expectations enter the economics of supply and demand. So that exchange rate fluctuation will lead to demand and supply fluctuation and as a result affect real variables.

In defined framework, by currency depreciation, aggregate demand will be affected through change of net export and demand of local currency and aggregate supply will be affected through price of imported intermediate goods. Theoretically, exchange rate positive shocks lead to decrease real output growth (through decrease of supply), but the effects of these shocks on aggregate demand should be discussed and the resultant of these two factors depend on bases of economy [4-13].

The effects of real exchange rate fluctuations on the price level and output are complicated by demand and supply channels as follows:

In the goods market, an unexpected depreciation of the domestic currency will make exports less expensive and imports more expensive. As a result, the competition from foreign markets will increase the demand for domestic products, increasing domestic output and price.

in the money market, an unexpected depreciation of the domestic currency, relative to its anticipated future value, prompts agents to hold more domestic currency and increases the interest rate. This channel moderates the positive effect of the exchange rate shock on aggregate demand, output and price.

On the supply side, changes in the exchange rate, both anticipated and unanticipated, determine the cost of imported intermediate goods. As the domestic currency depreciates, producers are inclined to decrease imports of intermediate goods, decreasing domestic output and increasing the cost of production and, hence, the aggregate price level.

Thus, exchange rate positive and negative shocks affect both demand side and supply side. But consequent effects of these shocks depend on transition of supply and demand curves from one side and the initial conditions of economy from the other side (which is manifested mainly in the supply and demand curves slope) determining the change of the production level and price level. Since supply and demand of economy may show different behaviors in responding to these shocks, then it is possible that effects of exchange rate shocks be asymmetric.

Empirical Literature: Exchange rate fluctuation affects aggregate demand through import, export, money demand and aggregate supply through cost of imported intermediate goods and consequent of the two factors on output and price depend on economy conditions. Generally, in market exchange rate positive shocks cause imported goods be more expensive and exported goods be cheaper and as a result increase demand for domestic goods. On the other hand with depreciation of the domestic currency, firms' demand for liquidity increases and leads to increase demand of money.

Exchange rate positive shocks (depreciation) lead to increase of the cost of imported intermediate goods and causes imported intermediate goods be more expensive and lead to increase of the cost of production, that is called imported inflation. Thus, it leads to increase of production costs.

Tyers *et al.* (2006) found the links between growth shocks and the Chinese real exchange rate using a dynamic model of the global economy with open capital accounts and full demographic underpinnings to labour supply. The results suggest that, in the short run, the dominant force is financial capital inflows, which are appreciating. In the long run demographic forces prove to be weak relative to skill transformation and services sector productivity. These are both comparatively powerful and depreciating. While financial capital inflows driven by expected appreciation may be self-fulfilling in the short run, these results suggest that the fundamental forces are more likely to favour a trend toward real depreciation. [14]

Kandil (2007) examines the effects of exchange rate fluctuations on real output, the price level and the real value of components of aggregate demand in Turkey. The theoretical model decomposes movements in the exchange rate into anticipated and unanticipated components. The data under investigation are for Turkey over the sample period 1980–2004. Unanticipated currency fluctuations help to determine aggregate demand through exports, imports and the demand for domestic currency and aggregate supply through the cost of imported intermediate goods and producers' forecasts of relative competitiveness. Anticipated exchange rate appreciation has significant adverse effects, contracting the growth of real output and the demand for investment and exports, while raising price infiation. Unanticipated exchange rate fluctuations have asymmetric effects. Currency depreciation increases net exports and increases the cost of production. Similarly, currency appreciation decreases net exports and the cost of production. The combined effects of demand and supply channels determine the net results of exchange rate fluctuations on real output and price. She shows that the anticipated exchange rate appreciation has positive impact on inflation rate and negative impact on investment and unanticipated exchange rate appreciation raises price infiation [15].

Aghion *et al.* (2009) showed that real exchange rate volatility can have a significant impact on productivity growth. However, the effect depends critically on a country's level of financial development. The results appear robust to time window, alternative measures of financial development and exchange rate volatility and outliers. They also offer a simple monetary growth model in which real exchange rate uncertainty exacerbates the negative investment effects of domestic credit market constraints. [16].

Luo and Visaltanachoti (2010) analyzed develops a continuous-time two-country dynamic equilibrium model, in which the real exchange rates, asset prices and terms of trade are jointly determined in the presence of non-tradable goods. The model determines the relation between the financial markets and real goods markets in the world economy and their responses to various shocks under the home bias assumption. A positive domestic supply shock induces a positive return on the domestic asset markets and a deterioration of terms of trade that improves the foreign output and boosts the foreign asset markets. Demand shocks act in the opposite way. This model also analyses the impact of change in the relative price of non-tradable to tradable goods on the terms of trade and asset markets. A higher productivity growth in tradable goods than in non-tradable goods leads to a higher relative price of non-tradable to tradable goods, which appreciates the real exchange rate, deteriorates the terms of trade and depresses the domestic and foreign asset markets. A lower relative price of non-tradable goods depreciates the real exchange rate, improves the terms of trade and lifts both the domestic and foreign asset markets [17].

Christopher and Caglayan (2010) presented an empirical investigation of the hypotheses that exchange rate uncertainty may have an impact on both the volume and variability of trade flows by considering a broad set of industrial countries' bilateral real trade flows over the period1980–1998. Similar to the findings of earlier theoretical and empirical research, their first set of results show that the impact of exchange rate uncertainty on trade flows is indeterminate. Their second set of results provide new and novel findings that exchange rate uncertainty has a consistent positive and significant effect on the volatility of bilateral trade flows, helping a better understanding of macroeconomic volatility [18].

Hosseini pour and Moghaddasi (2010) investigated the impact of exchange rate volatility on aggregate and sectoral Iranian export flows to the rest of the world, as well as on agriculture and industry sectors export. The ARDL bounds testing procedures were employed on annual data for the period 1970 to 2006 and various measures of volatility such as ARCH and GARCH models and Moving Sample Standard Deviation were employed. The results suggest that, depending on the measure of volatility used, either there exist no statistically significant relationship between Iranian exports flows and exchange rate volatility or when a significant relationship exists, it is positive. However this study found a strong evidence of a stationary long run cointegrating aggregate, agriculture, minerals, transport means and fats and oils exports demand functions but no evidence of a long run chemical exports demand relations were found. These results are however not robust as they show great amount of sensitivity to different definitions of variable used. Finally they conclude that depending on the measure of volatility used, exchange rate volatility either does not have a significant impact on Iran's exports flows or it has a positive impact on agriculture, minerals, transport means and oils and fats exports and also on aggregate exports [19].

According to theoretical literature and empirical literature in previous section can express that exchange rate can be different effects (asymmetric) on output and price. It means that depreciation more than appreciation can affected price. Theoretically Depreciation effects less than appreciation effects on output can be. This problem is depending to initial condition of countries economy. Indeed how curve of supply determine symmetric or asymmetric effects of exchange rate fluctuations on real output. We will use of annual time series data the Iranian economy during the period 1338 to 1387.

David (2010) examines the impact of exchange rate fluctuations on the Nigerian manufacturing sector during a twenty (20) year period (1986 – 2005). The argument is that fluctuations in exchange rate adversely affect output of the manufacturing sector. This is because Nigerian manufacturing is highly dependent on import of inputs and capital goods. Fluctuations in exchange rate will cause instability in purchasing power and hence, negatively impact on investment in import of manufacturing inputs. Fluctuations in the rate of exchange are not favorable to economic activities in the manufacturing sector. It was discovered that the performance of the manufacturing sector was affected by factors such as high cost of foreign exchange for procuring raw materials and machineries required for production, availability of financial capital, technological underdevelopment, inadequate socio-economic infrastructure, shortage of technical manpower and foreign domination; following the implementation of exchange rate devaluation; the manufacturing sector has not performed any better because of the influence of the earlier mentioned factors which affect the manufacturing sector performance[20].

BahmaniOskooeea and Hanafiah (2011) analyzed the trade flows between Malaysia and the U.S. After showing that exchange rate volatility has neither short-run nor long-run effect on the trade flows between the two countries, they disaggregate the trade data by industry and consider the experience of 101 U.S. exporting industries to Malaysia and 17 U.S. importing industries from Malaysia. While exchange rate volatility seems to have significant short-run effects on the trade flows of most industries, short-run effects translate into the long run only in a limited number of small industries [21].

Syed Zahid Ali *et al.* (2011) examine the repercussions of induced currency depreciation. His model captures the impact of fluctuations in the exchange rate through three broad channels. On the demand side, the exchange rate affects net exports through changes in relative competitiveness. Similarly, exchange rate changes affect interest rate parity that in turn affects the aggregate demand for goods and services through a change in real interest rate. On the supply-side, exchange rate depreciation has a negative effect since domestic firms adjust their prices in response to changes in the effective prices of foreign firms. His simulation exercise shows that the effect of induced currency depreciation depends largely on supply-side effects. In most cases, he finds that currency depreciation results in (i) a fall in output, (ii) an increase in prices and (iii) an improvement in the balance of trade [22].

Olga Arratibel *et al.* (2011) analyzes the relation between nominal exchange rate volatility and several macroeconomic variables, namely real output growth, excess credit, foreign direct investment (FDI) and the current account balance, in the Central and Eastern European EU member states. Using panel estimations for the period between 1995 and 2008, he finds that lower exchange rate volatility is associated with higher growth, higher stocks of FDI, higher current account deficits and higher excess credit23[23].

RESULTS AND DISCUSSION

Model Estimation: In this section empirical model of asymmetric effects of exchange rate shocks on production, is specified and estimated. In production growth equation, in addition to positive and negative exchange rate shocks, the effect of other variables, including investment, real money supply and oil revenue are considered. In this study, growth equation is specified as follows:

$$\Delta \log y_t = \alpha_0 + \sum_{j=0}^{n} \delta_j pos_{t-j} + \sum_{j=0}^{n} \gamma_j neg_{t-j} + \beta X_t + \varepsilon_t$$

where Δ indicates the first difference, log is natural logarithm, Y_{it} is gross domestic output (without oil), pos is positive exchange rate shocks, neg is negative exchange rate shocks, X is explanatory variables and ε is error term. In addition, asymmetry hypothesis implies:

$$H_0 : \delta_j = \gamma_j \quad j = 1, \ldots n$$

In growth model, various variables are used as control variables in vector X. Some of these variables are: physical investment, human capital, free trade, inflation rate, population, government expenditures, geographical variables, foreign direct investment, abundant natural resources, institutions and the quality of macroeconomic policy. In this study, due to the limited sample size, availability of data and diagnostic test, in final specification the investment to GDP ratio ($\frac{inv}{y}$) or investment growth (Δ log inv) is used in X vector.

One of the important and considerable factors in this model is estimation method of positive and negative exchange rate shocks. The methodology of estimation of positive and negative exchange rate shocks is as follows.

Positive and Negative Exchange Rate Shocks: In empirical studies, any unanticipated change is considered as the shock. Researchers used different techniques for differentiation between positive and negative shocks. For example, Mishkin (1982), Cover (1992), Karras (1996) considered the residual of the money supply growth equation (M2) as monetary shocks [24, 25, 26]. In fact, in these studies money growth is divided into anticipated and unanticipated ones and the residual from the estimated equation of money growth is used as unanticipated monetary shock.

To analyze the asymmetric effects of exchange rate shocks on the relevant macroeconomic variables, kandil (2000) decomposed the exchange rate shock to its positive and negative components, as follows:

$$NEG_t = -\frac{1}{2}\{abs(D_{rs_t}) - D_{rs_t}\} \quad POS_t = \frac{1}{2}\{abs(D_{rs_t}) + D_{rs_t}$$

Where, D_{rs_t} is the exchange rate shock and NEG_t and POS_t are the negative and positive components of the shock or, to express it differently, unexpected depreciation and appreciation of the exchange rate [27].

The scaled and net specifications were developed by Lee *et al.* (1995), respectively, to account for the fact that oil price increases after a long period of price stability have more dramatic macroeconomic consequences than those that are merely corrections to greater oil price decreases during the previous quarter. In order to put this idea in practice, these authors use some transformation of the oil price variable. Lee *et al.* (1995) proposed the following AR (4)-GARCH (1,1) representation of oil prices:

$$O_t = \alpha_0 + \alpha_1 O_{t-1} + \alpha_2 O_{t-2} + \alpha_3 O_{t-3} + \alpha_4 O_{t-4} + e_t$$

$$e_t | I_{t-1} \approx N(0, h_t)$$

$$h_t = \gamma_0 + \gamma_1 e_{t-1}^2 + \gamma_2 h_{t-1}$$

$$SOPI_t = MAX(0, \hat{e}_t / \sqrt{\hat{h}_t})$$

$$SOPD_t = MIN(0, \hat{e}_t / \sqrt{\hat{h}_t})$$

Where $SOPI_t$ stands for scaled oil price increases, while $SOPD_t$ for scaled oil price decreases [28]. The scaled model builds on the asymmetric model, while it also employs a transformation of the oil price that standardizes the estimated residuals of the autoregressive model by its time-varying (conditional) variability. This transformation seems very plausible in light of the pattern of oil price changes over time, with most changes being rather small and being punctuated by occasional sizeable shocks.

Another method of decomposing positive and negative shocks is using univariate filtering of Hodrick-Prescott (1997) [29]. This smoothing filtering is widely used in real business cycle theory to separate the cyclical component of a time series from raw data. Let Xt denote the logarithms of a time series variable. The series Xt is made up of a trend component, denoted $\tau_{x,t}$ and a cyclical component given an adequately chosen, positive value of α, there is a trend component that will minimize

$$Min\sum_{t=1}^{T}(X_t-\tau_{x,t})^2+\alpha\sum_{t-2}^{T-1}[(\tau_{x,t+1}-\tau_{x,t})-(\tau_{x,t}-\tau_{x,t-1})]^2$$

The first term of the equation is the sum of the squared deviations which penalizes the cyclical component. The second term is a multiple α of the sum of the squares of the trend component's second differences. This second term penalizes variations in the growth rate of the trend component. The larger the value of α, the higher is the penalty. Hodrick and Prescott advise that, for annual data, a value of α= 100 is reasonable. Moreno (1999) estimates equations similar to those estimated by Agenor (1991) for a pooled sample of six East Asian economies[30, 8]. Using the Hodrick-Prescott filter to estimate trends in the variables and so to decompose each variable into anticipated and unanticipated components, Moreno finds that real depreciations reduce growth, though the size and significance of this effect is reduced in instrumental variable as opposed to OLS estimation. In this study we used Hodrick- Prescott filtering for differentiation between positive and negative shocks.

Data and Unit Root Tests: Time series data required to this research include non-oil GDP(Y), real oil revenue (OILREV), real exchange rate and fixed capital formation or investment to GDP ratio (INV/GDP), money supply (M2), aggregate price level (P) and government expenditure (G). The sources for data are balance sheets of the Central Bank of Iran during the period 1960-2008. The cointegration analysis is subject to the integration order of time series. The integration orders of variables are examined by Augmented Dickey – Fuller (ADF) and phillips-Perron (PP) unit root tests.

According to ADF and PP tests in Table (1), it can be seen that all variables except the investment to GDP ratio, INV/GDP, are integrated of order one so that when first differenced, all would be stationary.

Cointegration Test: As the level variables are non-stationary, the cointegration among the levels of the variables should be tested. According to the economic theories it is expected that the exchange rate, prices and GDP have a long run equilibrium relationship. If there is long run relationship between these variables, the residuals from the cointegrating relationship will be considered as imbalance affecting GDP symmetrically or asymmetrically. Therefore, the cointegration among these variables is tested by using the Johansson methodologies. The test results are presented in Table (2). As it can be seen in the table, Johansson test confirms one long run equilibrium relationship between these three variables. According to Granger representation theorem, a long run equilibrium relationship implies error correction mechanisms. The error correction mechanism ensures the long run relationship. Thus at least one variable in the relationship should react to disequilibrium or the residuals of long run relationship, namely ECM. In the next section we examine the importance of disequilibrium along with other variables on the production growth. Also, these imbalances may affect the production linearly (symmetric) or nonlinearly (asymmetric).

Table 1: PP and ADF test statistic variables in level and 1st difference

	ADFtest				PP test			
Variable	ADF test statistic	10% Critical Values	5% Critical Values	1% Critical Values	PP test statistic	10% Critical Values	5% Critical Values	1% Critical Values
log Y	-1.26	-2.60	-2.92	-3.57	-1.59	-2.60	-2.92	-3.57
log INV	-2.22	-2.60	-2.92	-3.57	-1.91	-2.60	-2.92	-3.57
log OIL	-2.58	-2.60	-2.92	-3.57	-2.48	-2.60	-2.92	-3.57
Log EX	-1.62	-2.60	-2.92	-3.57	-1.26	-2.60	-2.92	-3.57
Log M2	-1.58	-2.60	-2.92	-3.57	-1.44	-2.60	-2.92	-3.57
Log P	-2.01	-2.60	-2.92	-3.57	-2.13	-2.60	-2.92	-3.57
Log G	-2.02	-2.60	-2.92	-3.57	-2.37	-2.60	-2.92	-3.57
Dlog Y	-4.01***	-2.60	-2.92	-3.57	-4.05***	-2.60	-2.92	-3.57
DlogINV	-5.38***	-2.60	-2.92	-3.57	-5.22***	-2.60	-2.92	-3.57
Dlog OIL	-5.57***	-2.60	-2.92	-3.57	-5.56***	-2.60	-2.92	-3.57
Dlog EX	-5.03***	-2.60	-2.92	-3.57	-5.16***	-2.60	-2.92	-3.57
DLog M2	-4.59***	-2.60	-2.92	-3.57	-4.56***	-2.60	-2.92	-3.57
DLog P	-3.19**	-2.60	-2.92	-3.57	-3.29**	-2.60	-2.92	-3.57
DLog G	-4.45***	-2.60	-2.92	-3.57	-4.10***	-2.60	-2.92	-3.57

Notes:*** and** respectively show the significance in 1% and 5% level.

Table 2: Maximal eigenvalue and trace test for cointegration vectors

Variables in long-run relationship: ln(ex), ln(p), ln(y)							
A: cointegrating space							
Maximal eigenvalue test				Trace test			
Null	Alternative	LR statistic	95% critical value	Null	Alternative	LR statistic	95% critical value
0=r	1=r	19.38	18.17	0=r	r=1	25.87	23.28
r=1	2=r	10.89	12.52	r=1	r=2	10.11	12.51
r=2	3=r	0.31	9.24	r=2	r =3	0.31	9.24
B: cointegrating vector							
			lex		lp		ly
			Ecm	-1	0.91(3.22)		2.57(3.29)

Notes: t-ratios in parentheses.

Table 3: Estimation of model with different specification

variable	1	2	3	4	5	6	7	8	9	10	11	12	13
C	0.009	0.011	0.008	0.008	0.003	0.34	-0.017	0.011	0.012	0.006	0.003	0.008	0.006
	(-0.69)	(-0.80)	(-0.49)	(4.93)***	(2.45)**	(4.20)***	(0.25)	(1.21)	(1.44)	(0.37)	(0.25)	(0.64)	(0.66)
$\Delta\ln y_a^{(-1)}$	0.16	0.20	0.28	0.16	0.14	0.089	0.003	0.11	0.10	0.31	0.13	0.11	0.08
	(2.10)**	(1.94)**	(2.10)**	(2.16)**	(1.95)**	(1.04)	(0.53)	(1.42)	(1.43)	(2.15)**	(1.74) *	(1.46)	(1.01)
$\Delta\ln ex$	0.061	0.066	0.059	0.061	0.056								
	(1.95)**	(2.02)**	(1.44)**	(2.16)**	(1.92)**	-	-	-	-	-	-	-	-
pos	-	-	-	-	-	-0.11	-0.06	-0.049	-0.046	-0.05		-0.04	-0.02
						(-1.98)**	(-1.28)	(-0.96)	(-0.95)	(-0.77)		(-0.97)	(-0.44)
Pos(-1)	-	-	-	-	-			0.009		0.017			
								(0.20)		(0.26)			
neg	-	-	-	-	-	0.12	0.09	0.11	0.11	0.13	0.10	0.11	
						(1.99)**	(1.60)	(1.87)**	(1.88)**	(1.58)	(1.74) *	(1.90)**	
neg(-1)	-	-	-	-	-	-0.24	-0.21	-0.23	-0.22		-0.24	-0.22	-0.14
						(3.95)***	(3.30)***	(3.50)***	(3.64)***	(2.50)***	(3.51)***	(3.46)***	(2.96)***
Δin G	0.14	0.15	0.19	0.15	0.15	0.22	0.18	0.15	0.15	0.21	0.14	0.15	
	(2.87)***	(2.89)***	(3.11)***	(2.92)***	(3.15)***	(4.98)***	(3.54)***	(3.25)***	(3.28)***	(3.40)***	(3.19)***	(3.25)***	-
Δin G(-1)	-	0.036	0.06							-0.10			
		(0.61)	(0.79)	-	-					(-1.36)			
ΔIn *oilrev*	0.020	0.023	0.028	0.020		0.007		0.024	0.025	0.032	0.023	0.025	0.03
	(1.14)	(1.22)	(1.22)	(1.04)	-	(0.39)		(1.35)	(1.49)	(1.38)	(1.39)	(1.51)	(1.68)*
$\frac{INV}{GDP}$	0.20	0.20	0.39	0.21	0.21	0.19	0.25	0.24	0.24	0.51	0.24	0.23	0.26
	(6.63)***	(6.60)***	(3.83)***	(6.66)***	(6.83)***	(5.80)***	(8.29)***	(7.74)***	(7.89)***	(4.21)***	(7.63)***	(7.50)***	(7.82)***
Δin m^2	-	0.25	0.26	0.30						0.21	0.15	0.13	
		(3.60)***	(3.60)***	(3.27)***	-					(2.25)**	(2.24)**	(1.96)**	
Δ In P	-	-0.19	-0.20	-0.24						-0.19	-0.13	-0.11	
		(-2.88)***	(-2.89)***	(-2.68)***	-					(-2.13)**	(-2.20)**	(-1.78)**	
$\Delta\text{In}\,\frac{m^2}{p}$	-	-	-	0.21	0.21		0.13	0.12	0.11				0.25
				(3.56)***	(3.43)***		(2.12)**	(2.10)**	(2.10)**				(4.99)***
ecm(-1)			0.13	0.14	0.14								
			(3.89)***	(3.76)***	(4.19)***								
ecm^+										0.05	0.03	0.04	
										(1.33)	(1.65)	(1.39)	
ecm^-										0.19	0.20	0.20	0.21
										(3.49)***	(3.22)***	(3.99)***	(4.58)***
Asymmetric test statistic													
$H_0: \delta j=\gamma j$						6.67	6.29	6.88	7.78	7.03	7.34	7.08	9.48
						***	***	***	***	***	***	***	***
R^2	0.84	0.84	0.75	0.83	0.83	0.79	0.85	0.87	0.87	0.78	0.86	0.87	0.82
DW	2.05	2.05	1.99	1.98	1.99	2.04	2	2.03	2.02	2.13	2.12	2.04	2.03
AIC	-4.21	-4.18	-3.74	-4.23	-4.25	-4.05	-4.34	-4.35	-4.39	-3.75	-4.37	-4.35	-4.19
SIC	-3.90	-3.83	-3.39	-3.96	-4.01	-3.82	-4.03	-3.96	-4.04	-3.28	-4.02	-3.96	-3.91
ARX^2	0.58	3.29	0.14	0.16	0.18	0.69	1.26	2.28	1.38	1.17	0.73	1.45	1.27
RESET	1.26	3.01	1.29	1.33	1.23	2.3	1.05	2.23	2.29	2.28	1.31	2.27	2.33
HET	6.68***	6.99***	7.32***	8.53***	9.72***	7.86***	7.28***	7.34***	8.25***	6.83**	8.13***	7.27***	7.21***
NORM	3.28	3.32	3.16	2.07	2.12	1.35	1.08	1.32	1.7	1.8	1.7	0.93	0.37

Notes: t-ratios in parentheses and***,**and * respectively show the significance in 1%, 5% and 10% levels

Estimating the Short Run Non-oil GDP and Asymmetric Test: In this section, the effects of positive and negative exchange rate shocks as well as the supply and demand side factors on the production growth in Iran economy will be studied. For this purpose, we estimate various specifications according to the Table (3). The estimates in columns one to four are based on linear or symmetrical specifications. In other words, in these equations it is assumed that the effects of positive and negative exchange rate shocks on real production are symmetric so that the relationship is linear.

In all linear specifications, according to R^2, explanatory variables explain 75 to 83 percent of real non-oil GDP changes. The coefficients for Δln ex, in all the specifications are significant and of the expected sign (positive). The results show that exchange rate increase affects GDP growth with coefficient of 0.056 to 0.067. Δln P, as it is expected, decreases GDP growth with the coefficient of 0.19 to 0.24. Investment enters positive and significant in the real non-oil GDP growth equations with the size of coefficient changing between 0.19 to 0.22. Using the investment to GDP ratio instead of the, Δloginv, renders the similar results.

Oil revenue (Δln OILREV) was insignificant in some of the specifications and deleted. Government expenditure coefficient had significant and positive effect on GDP of the same period but its lag was insignificant in most specifications.

Error correction coefficient *ecm(-1)* reflects the adjustment speed of output with respect to the oil revenue disequilibrium. Considering the size of coefficient of error correction term (estimated between 0.13 to 0.14) it can be concluded that non-oil GDP responds significantly to its disequilibrium (*ecm(-1)*). Among the linear specifications, the fifth one outperforms the others based on the R2, Akaike (AIC) and Schwartz (SIC) information criteria.

Diagnostic test results are presented at the bottom of the Table (3) for each specification. x^2 AR (4) stand for the Lagrange multiplier test statistic for autocorrelation in error terms (with four lags), RESET is Ramsey's RESET test statistic for functional form misspecification based on the squares of fitted values, NORM is test statistic of normality of residuals based on the skewness and kurtosis and HET is Heteroscedasticity test statistic. As it can be seen, the obtained results are generally satisfactory especially for the fifth specifications (only the homoscedasticity is violated in the some specifications).

The first to fifth specifications reflect the symmetric effects of positive and negative exchange rate shocks on production. But if exchange rate effects are asymmetric, the results of these models may be misleading. As it was explained in previous section, to examine and test the asymmetric effects of exchange rate shocks on real production, exchange rate changes are divided into positive and negative ones and added as two explanatory variables to the growth model using Hodrick- Prescott filtering. Specifications 6 to 13 in Table (3) are estimated decomposition of exchange rate shocks to positive (pos) and negative (neg) ones. As it can be seen by adding positive and negative shocks to the growth equation, the coefficient of determination significantly increases (from76% to 87%).

In all cases, the negative exchange rate shocks are much more effective than the positive exchange rate shocks contemporaneously according to the size and statistical significance. Positive shocks in most cases are not significant or receive less importance than the negative exchange rate shocks. In addition, in all specifications positive exchange rate shocks (based on the coefficient $P^{os(-1)}$) affect GDP growth with a negative sign in the next period. Therefore, the lag of positive exchange rate shocks (based on the coefficient $P^{os(-1)}$) is insignificant and is removed to improve in some specification. Negative exchange rate shocks (based on the coefficient *neg*) had positive effect at first, but their lagged (based on the coefficient $n^{eg(-1)}$) effects are negative and their coefficient and more significant. Moreover, the symmetry hypothesis implying the equal effects of positive and negative exchange rate shocks is rejected based on Wald test.

The estimation results from equations10 to 18 indicate that disequilibrium also have asymmetric effects on economic growth. The size of coefficient of ecm^+, ranging from 0.03 to 0.05 is much less than the coefficient of ecm^- which is estimated at between 0.19 to 0.21. In addition, coefficient of positive disequilibrium is not significant in any equation, while the negative disequilibrium has important effects on (decreasing) economic growth. Among asymmetric specifications, equation 9 enjoys the minimum of Akaike (AIC) and Schwartz (SIC) criteria. In most of the equations, the coefficients of the variables of the investment to GDP ratio, government expenditures, money supply and inflation in addition to the key variables (exchange rate shocks) are significant and of correct sign. The estimated growth equation 9 passes through all

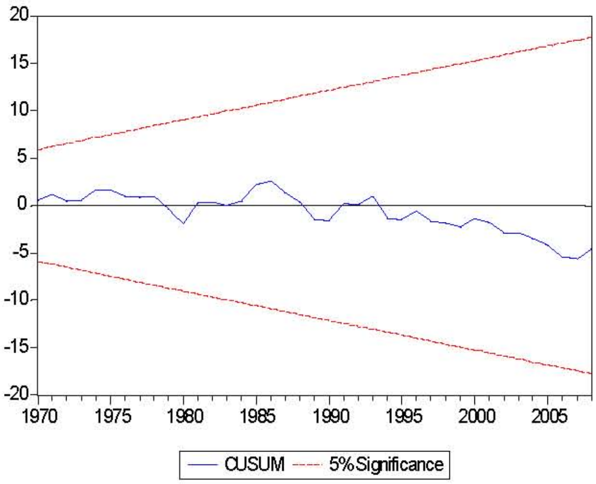

Fig. 1: CUSUM test for parameters stability in the growth equation

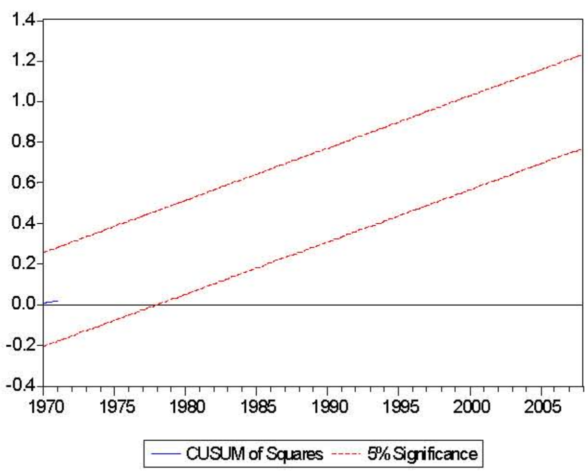

Fig. 2: CUSUMSQ test for parameters stability in the growth equation

diagnostic tests (Heteroscedasticity, Ramsey's RESET test, autocorrelation and normality). In addition, the preferred specification is able to explain 83% of changes in output growth. Thus 17 percent of production changes are yet attributable to factors that are not included in the model. Due to severe structural changes in the sample period (especially Iran-Iraq War and Islamic Revolution) stability of structural coefficients based on the plot of cumulative sum of recursive residuals (CUSUM) and plot of cumulative sum of squares of recursive residuals (CUSUMSQ) have been used. The plot of CUSUM and CUSUMSQ statistics together with the 5% critical lines shown in figures (1) and (2) clearly indicates stability in equation and residual variance during the sample period.

CONCLUSION

Exchange rate fluctuation affects country economy by two channels (aggregate demand and aggregate supply) and their consequences depend on initial economy condition. Thus investigation of effects on output and price is important and can present appropriate policy advice for economy demand management of country. In this research, asymmetric effects of exchange rate fluctuation on GDP of Iran by theoretical and experimental considerations are investigated. In experimental studies it is assumed that exchange rate fluctuation can have asymmetric effects on GDP. In this regard, symmetric effect between negative shocks (appreciation) and positive shocks (depreciation) cannot be valid any more. Generally, this research investigated asymmetric effects of exchange rate fluctuation on GDP, using annual time series data of Iran economy during 1960-2008. Results indicate that exchange rate fluctuation effects on GDP are asymmetric in this period so that implicit effects of negative shocks on real GDP are more than positive shocks.

In fact, the main result of this research indicates that in this period, firstly, anticipated and unanticipated exchange rate effects on real GDP were asymmetric. So that implicit of unanticipated exchange rate effects on macroeconomic variables were more than anticipated exchange rate effects. So it can be deduced that unanticipated exchange rate is more efficient than anticipated exchange rate for advancing major economy policies goals. In this regard, the advised policy for GDP growth, increasing employment and decreasing inflation rate is to use exchange rate surprise policy. Secondly, positive and negative exchange rate shocks effects on real GDP were asymmetric. So that during stagnation and low price level, depreciation can have significant positive effects on real GDP and employment by a little increase of the price level. But depreciation will have insignificant effects on real GDP in high price level. Depreciation leads to significant increase of price without having significant effect on GDP and employment. Then main advice policy of this research is that central bank must attend to economy condition for exchange rate appreciation policy.

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