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Application of the Threshold Vector Autoregression Model (TVAR) in Nonlinear Analysis of Exchange Rate Pass-through on Inflation in Iran

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Abstract

Considering nonlinearities in the exchange rate pass-through to domestic prices, this study analysis the Exchange Rate pass-through on Inflation in Iran by estimating a Threshold Vector auto-regression (TVAR) model. We estimate a Threshold Vector Auto-regression (TVAR) model on quarterly data over the period 1990Q2-2016Q3. The nonlinearity test for a TVAR model against a linear VAR model suggests the presence of two regimes with one threshold value of inflation. The threshold value of inflation is estimated endogenously. The quarterly rate inflation of 3.9 % select as a threshold level between two regimes. We find that domestic prices in Iran response strongly to a positive exchange rate shock in two regime of inflation. The rate of inflation below the threshold level constitutes a low inflation regime, and above the threshold level it constitutes a high inflation regime. The response of inflation is statistically significant in the two regimes and this result confirms the Taylor's theory. Also the calculation of the ERPT coefficient confirming this result and show that exchange rate pass-through is incomplete.

Keywords: Exchange rate pass-through, inflation, Output Gap, Threshold Vector Auto-regression Model (TVAR).

JEL Classification: C32, E31, F41.

1. Introduction

Exchange rate pass-through (ERPT) refers to the degree to which exchange rate changes are passed through to price level changes. The analysis of the ERPT is a key issue which has important macroeconomic implications. First, ERPT has an important impact on real variables such as imports, exports and investment. Second, ERPT affects the channel through which current account imbalances are adjusted. Third, ERPT also has relevant monetary policy implications given that monetary authorities consider exchange rates as one of the most important channels of the monetary trans-mission mechanism. Therefore, the knowledge of the extent and timing of ERPT is relevant to forecast inflation and, consequently, it is essential for monetary policy decision-makers. In fact, when the ERPT is

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low, the Central Bank is less concerned about the inflation impact of exchange rate changes on domestic prices and, consequently, the Central Bank may focus on other objectives such as economic growth. However, when the case the ERPT is high the Central Bank has to be more concerned about the inflation impact of exchange rate fluctuations, especially under an inflation targeting regime. In the latter case, the changes in exchange rates could be passed to domestic prices and from them to domestic nominal interest rates (Jiménez-Rodríguez & Morales-Zumaquero, 2016: 985). A large empirical literature has studied exchange rate pass through (ERPT) into import prices because this important topic in international macroeconomics relates to issues such as the movement of international relative prices, the adjustment of global imbalances, or business cycle co-movements (Auer & Schoenle, 2015: 60). In small open economy, the exchange rate pass-through has a considerable effect on inflation and output fluctuations. The exchange rate transmits the impact of any shock on the economy through its effect on import prices and relative prices. Under this circumstance, exchange rate channel plays a role as either shock absorber or amplifier in implementing the monetary policy, but how much it can absorb (or amplify) depends on the exchange rate pass-through. Therefore, the exchange rate pass-through is an important consideration with respect to the effectiveness of monetary policy (Buyandelger, 2015: 1185).

On the other hand, the exchange rate channel of monetary policy is important for many developing countries. When a central bank lowers the policy rates, it often results in a depreciation of that country's currency, which in turn makes imports more expensive while presumably enhancing the price competitiveness of that country's exports (Yanamandra, 2015: 57). In this paper, we estimate and test a threshold vector auto-regression (TVAR) to make inferences about nonlinearities in the exchange rate pass-through to domestic prices, this study analysis the Exchange Rate pass-through on Inflation in Iran.

2. Methodology

Considering nonlinearities in the exchange rate pass-through to domestic prices, this study analysis the Exchange Rate pass-through on Inflation in Iran by estimating a Threshold Vector Auto-regression (TVAR) model. We estimate a Threshold Vector Auto-regression (TVAR) model on quarterly data over the period 1990Q2-2016Q3. The nonlinearity test for a TVAR model against a linear VAR model suggests the presence of two regimes with one threshold value of inflation. The threshold value of inflation is estimated endogenously.

We estimate the following two regime TVAR model:

$$y_t = \begin{cases} \phi^{(1)} + \Phi^{(1)}(L) y_{t-1} + \varepsilon_t^{(1)} & if \quad q_t \le \gamma \\ \phi^{(2)} + \Phi^{(2)}(L) y_{t-1} + \varepsilon_t^{(2)} & if \quad q_t > \gamma \end{cases} \tag{1}$$

Where the vector of variables (y_t) consists of the rate of inflation (π), the output gap, the nominal effective exchange rate (NEER) and an indicator of the stance of monetary policy (M). The output gap captures the effects of the real sector on exchange rate pass-through. We include an indicator of the stance of monetary policy in the vector of variables to take into account the effects of the monetary policy on exchange rate pass-through.

$$y_t = [\pi, ER, M, outputgap] \tag{2}$$

We define a shock to the exchange rate as a positive variation of the exchange rate. Thus, a positive variation of the exchange rate represents an appreciation of the domestic currency. The rate of inflation is measured by the consumer price index (CPI). It is a widely used indicator by both financial analysts and policy makers to examine developing price trends and is generally considered as an indicator of the inflationary process in the economy. The exchange rate affects import prices which in turn affect production costs and consequently the CPI. The volume of liquidity is the sum of money and pseudo-money in terms of billion Rials (M). Finally, the output gap is created by taking the deviations of the logarithm of real GDP from the trend estimates. Then, Statistics and data variables on quarterly basis of parameters set of by Central Bank reports and publications Statistical Center of Iran.

3. Discussion and Results

Before performing the necessary tests and estimating the model, be sure to output gap as one of the important variables in the model used, can be extracted. The output gap is created by taking the deviations of the logarithm of real GDP from the trend estimates. This corresponds to the difference between annual percentage growth rate of GDP at market prices based on constant local currency (aggregates are based on constant 1997) and the potential output (Hodrick-Prescott filter). As suggested by An and Wang (2012), the inclusion of the output gap is necessary to take into account business cycle fluctuations in the model (Mendonça & Tiberto, 2017: 205). The consideration of this variable is important because the exchange rate pass-through effect may vary depending on macroeconomics conditions (fig.1).

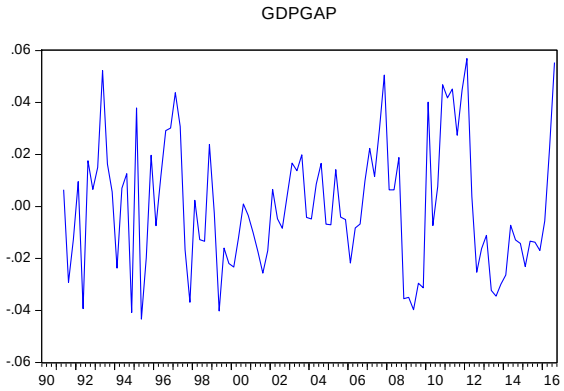

Fig 1: Time series of output gaps in Iran over the period 1991-2016

In time-series analyzes, before considering the model's estimation, it is necessary to test the statics variables of the research. ADF test results show that output gaps variable is integrated at order zero I(0) with trend and intercept only but not with intercept. all other variables are not stationary at the level in both cases. However, the all other variables become integrated at order one I(1). The choice of a specification in first differences instead of levels is important because non-stationarity may induce spurious non-linearity in the estimated system (particularly when it affects the variable underlying the threshold indicator) and may also affect the regularity conditions required for the application of Hansen's (1996) simulation technique (Calza and Sousa, 2005:11) . Therefore, the variables entered in the model are DLCPI, DLER, DLM and GDPGAP, all of which are static (table.1).

Table 1: Static test results of variables using Generalized Dickey Fuller Test (ADF)

1st difference		level		Variable name
Trend and Intercept	Intercept	Trend and Intercept	Intercept	
---	---	-5/96 (0/00)	-6/00 (0/00)	GDPGAP
-3/62 (0/03)	-3/36 (0/01)	-3/02 (0/13)	-1/79 (0/38)	LCPI
-8/35 (0/00)	-8/39 (0/00)	-1/38 (0/86)	-0/72 (0/83)	LER
-7/42 (0/00)	-7/46 (0/00)	-2/47 (0/34)	-0/04 (0/95)	LM

Before testing for thresholds in the vector auto-regression representation of the data, we select the optimal lag order by estimating the linear VAR model. The optimal lag order is determined by using the Akaike Information Criterion (AIC) which is the most widely used information criterion in the empirical

literature of model selection. The AIC selects 1 as the optimal lag for the TVAR model (table.2).

Table 2: Results of tests of the threshold auto regression model (TVAR)

The entered variables: DLCPI (INF), DLER, DLM, GDPGAP						
AIC	**Exp-Wald**	**Avg-Wald**	**Sup-Wald**	**lag order for VAR model**	**Threshold value**	**Threshold variable**
-19/106	278/06 (0/00)	278/49 (0/00)	315/05 (0/00)	4	3/905	$INF_{(t-1)}$
-18/941	257/55 (0/00)	258/44 (0/00)	306/77 (0/00)	4	2/351	$DLER_{(t-1)}$

Table (Appendix 1): reports the results of the TVAR model with the rate of inflation (π) acting as a threshold variable. The quarterly rate inflation of 3.9 % select as a threshold level between two regimes. We find that domestic prices in Iran response strongly to a positive exchange rate shock in two regime of inflation. The rate of inflation below the threshold level constitutes a low inflation regime, and above the threshold level it constitutes a high inflation regime. The response of inflation is statistically significant in the two regimes.

Fig. 2 to 5 depicts the accumulated impulse responses of inflation rate, exchange rate, Liquidity and output gap to a positive one unit exchange rate shock in Low regime.

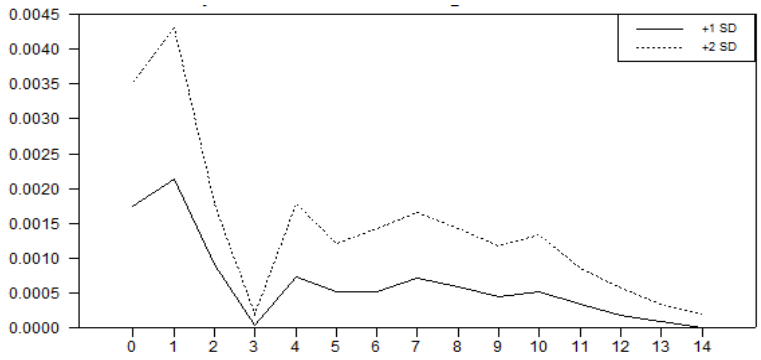

Fig 2: the impulse response of inflation rate to a positive shock exchange rate (Devaluation of national currency)
1 and 2 standard deviation - low regime

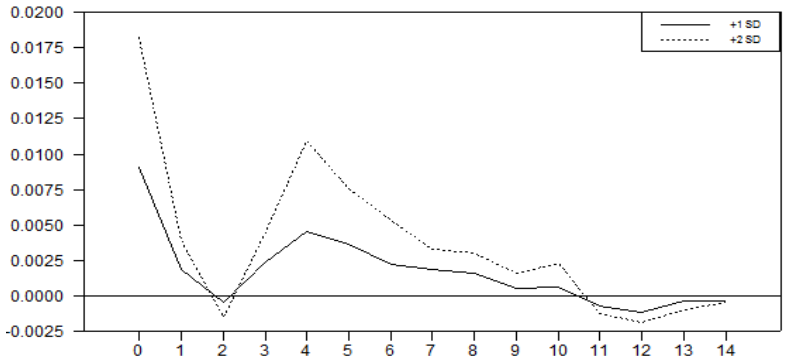

Fig 3: the impulse response of exchange rate to a positive shock exchange rate (Devaluation of national currency) 1 and 2 standard deviation - low regime

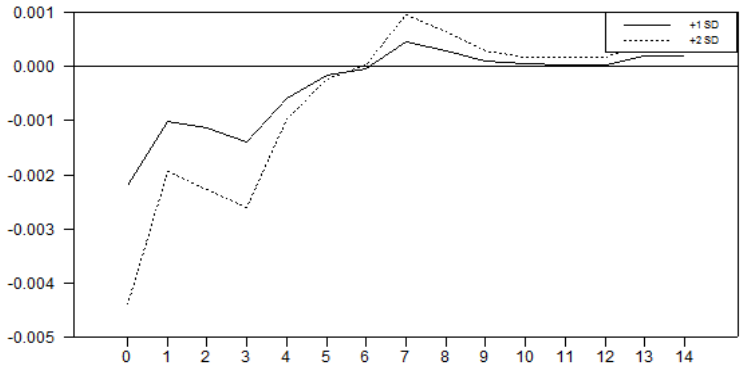

Fig 4: the impulse response of liquidity to a positive shock exchange rate (Devaluation of national currency) 1 and 2 standard deviation - low regime

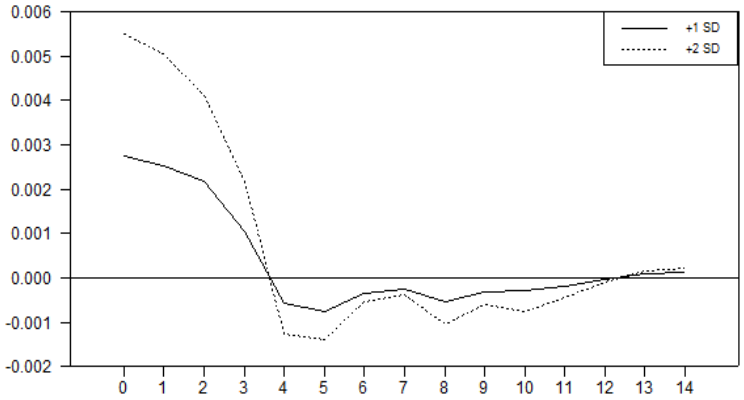

Fig 5: the impulse response of output gap to a positive shock exchange rate (Devaluation of national currency) 1 and 2 standard deviation - low regime

Fig. 6 to 9 depicts the accumulated impulse responses of inflation rate, exchange rate, Liquidity and output gap to a positive one unit exchange rate shock in high regime.

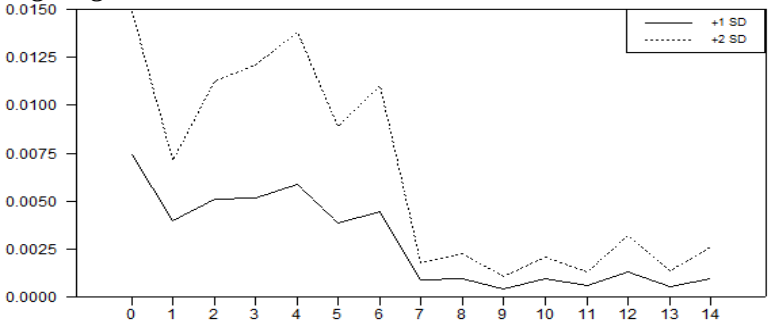

Fig 6: the impulse response of inflation rate to a positive shock exchange rate (Devaluation of national currency) 1 and 2 standard deviation - high regime

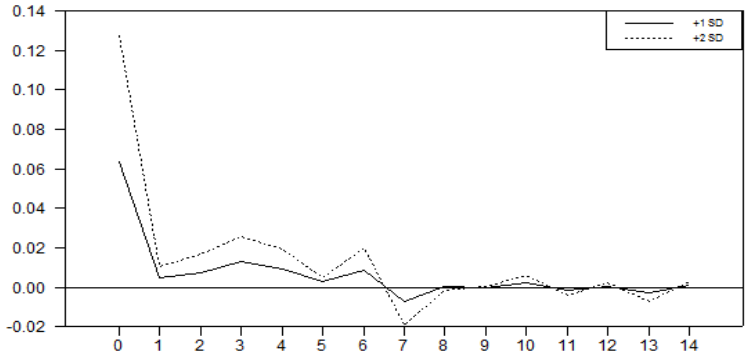

Fig 7: the impulse response of exchange rate to a positive shock exchange rate (Devaluation of national currency)
1 and 2 standard deviation - high regime

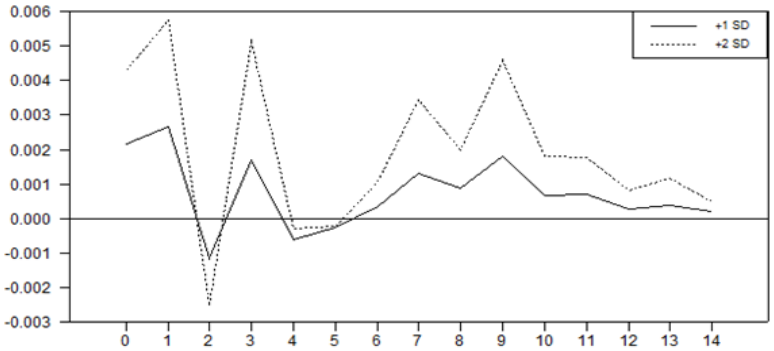

Figure 8: the impulse response of liquidity to a positive shock exchange rate (Devaluation of national currency)
1 and 2 standard deviation - high regime

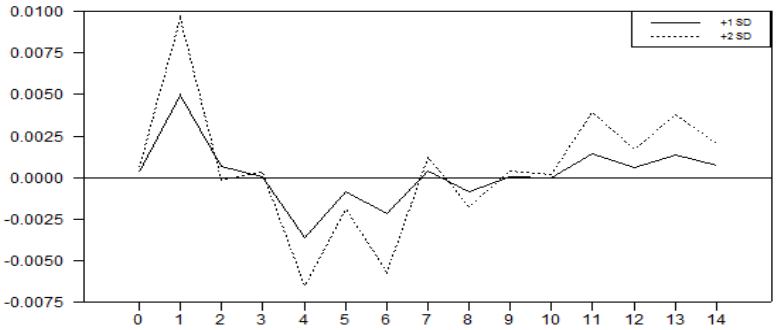

Figure 9: the impulse response of output gap to a positive shock exchange rate (Devaluation of national currency)
1 and 2 standard deviation - high regime

Impulse response functions show a positive one unit exchange rate shock leads to a increase in inflation rate and over time, its positive effect on inflation decreases and at the end of the course it almost disappears. Also, Impulse response functions show when the rate of inflation is above the threshold level, the exchange rate pass-through is significant, and when the rate of inflation is below the threshold level, the exchange rate pass-through is insignificant.

4. Conclusions

We examine the exchange rate pass-through to domestic prices in Iran by estimating a threshold vector auto-regression (TVAR) model. The nonlinearity test for a TVAR model against a linear VAR model suggests the presence of three regimes with two threshold values of inflation. The threshold values of inflation are estimated endogenously. we find that domestic prices in Iran response strongly to a positive exchange rate shock in two regime of inflation. The quarterly rate inflation of 3.9 % select as a threshold level between two regimes. The rate of inflation below the threshold level constitutes a low inflation regime, and above the threshold level it constitutes a high inflation regime. The response of inflation is statistically significant in the two regimes and this result confirms the Taylor's theory. Also the calculation of the ERPT coefficient confirming this result and show that exchange rate pass-through is incomplete.

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