Exchange rate pass-through to inflation in Mongolia

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EXCHANGE RATE PASS-THROUGH TO INFLATION IN MONGOLIA

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ABSTRACT

This paper examines the impact of exchange rates on the domestic consumer prices in Mongolia by analyzing data from January 1998 to January 2008. The empirical model is a recursive VAR, suggested by McCarthy (2000). Impulse responses and variance decompositions are used to measure the exchange rate pass-through to consumer price inflation. The paper finds high pass-through of exchange rate to inflation and low persistence and volatility of the exchange rate. The major findings of this paper are: (i) the impact of exchange rate on consumer prices is over after about a year months, but is mostly felt in the 6-7 months. (ii) Exchange rate pass-through to consumer prices rises from about 10 percent in the fifth month of the shock to about 55 percent in ninth months. (iii) Exchange rate explains about 7-8 percent of the variation in consumer price inflation.

1. INTRODUCTION

The pass-through of exchange rate to domestic consumer price is an important link in the process of monetary policy transmission. Mongolia's economy has a considerable degree of openness to foreign trade; domestic price level cannot remain immune to external price shocks that are exchange rate depreciation/appreciation and changes in import prices. Any depreciation or appreciation of the exchange rate will not only result in significant changes in the prices of imported finished goods but also imported inputs that affect the cost of the finished goods and services. So exchange rate movements can affect domestic prices through changes in the price of the imported finished goods and imported inputs. In other side, the exchange rate depreciation affects the net exports which in turn influence the domestic prices through the changes in aggregate demand, putting upward pressure on domestic prices.

This paper examines the impact of exchange rate on the inflation in Mongolia by analyzing data from January 1998 to January 2008. The empirical model is a recursive VAR, suggested by McCarthy (2000). Impulse responses and variance decompositions are used to measure the exchange rate pass-through to inflation.

This paper is organized as follows. The next section describes the methodology adopted for the analysis and the data coverage, its sources and preliminary statistical properties. The results from the impulse responses and variance decompositions are presented in section 3, and section 4 concludes.

II. METHODOLOGY AND DATA

To examine the pass-through of exchange rate to consumer prices, this paper utilizes a recursive VAR approach proposed by McCarthy (2000). The model is based on five variables in the following order: $\Pi^{oil} \rightarrow \Delta y \rightarrow \Delta e \rightarrow \Pi^{CPI} \rightarrow \Delta M1$ and the structural shocks are recovered from the VAR residuals using the Cholesky decomposition of variance-covariance matrix.

The VAR considers the following set of variables:

[1] $$x_t = \left(\Pi_t^{oil}, \Delta y_t, \Delta e, \Pi_t^{CPI}, \Delta M1\right)$$

where all variables are expressed in coefficients. Π_t^{oil} is oil price inflation, which is used as a proxy for supply shock; Δy_t is growth in monthly GDP[1] (seasonal adjusted), which is used as a proxy of demand shock; Δe_t is change in nominal exchange rate; Π_t^{CPI} is consumer price inflation, $\Delta M1_t$ is growth in narrow money.

Shocks in the VAR system are identified in accordance with a recursive VAR specification in the following manner:

[1] The monthly GDP is calculated from quarterly GDP using Kalman filter (State Space Model).

[2] $$\Pi_t^{oil} = E_{t-1}[\Pi_t^{oil}] + \varepsilon_t^{oil}$$

[3] $$\Delta y_t = E_{t-1}[\Delta y_t] + \alpha_1 \varepsilon^{oil} + \varepsilon^{\Delta y}$$

[4] $$\Delta e_t = E_{t-1}[\Delta e_t] + \lambda_1 \varepsilon_t^{oil} + \lambda_2 \varepsilon_t^{\Delta y} + \varepsilon_t^{\Delta e}$$

[5] $$\Pi_t^{CPI} = E_{t-1}[\Pi_t^{CPI}] + \gamma_1 \varepsilon_t^{oil} + \gamma_2 \varepsilon_t^{\Delta y} + \gamma_3 \varepsilon_t^{\Delta e} + \varepsilon_t^{CPI}$$

[6] $$\Delta M1_t = E_{t-1}[\Delta M1_t] + \beta_1 \varepsilon_t^{oil} + \beta_2 \varepsilon_t^{\Delta y} + \beta_3 \varepsilon_t^{\Delta e} + \beta_4 \varepsilon_t^{CPI} + \varepsilon^{\Delta M1}$$

Where ε_t^{oil}, $\varepsilon^{\Delta y}$ and $\varepsilon_t^{\Delta e}$ are the supply, demand and exchange rate shocks respectively; ε_t^{CPI} and $\varepsilon^{\Delta M1}$ are the consumer price inflation and money supply shocks; the time period t corresponds to one month; and $E_{t-1}[\cdot]$ is the expectation of a variable based on information set at the end of period t-1. The conditional expectation in equations [2] through [6] which can be replaced by linear projections based on lags of the five endogenous variables. Also the shocks are assumed serially uncorrelated as well as uncorrelated with one another within a period.

Data used in this study is monthly from January 1998 to January 2009, thus giving me a total 108 observations. The sources of the data for all variables except international oil prices is the statistical bulletin of the Bank of Mongolia and National Statistical Office, while international oil prices are taken from Official Energy Statistics from the U.S. Government[2].

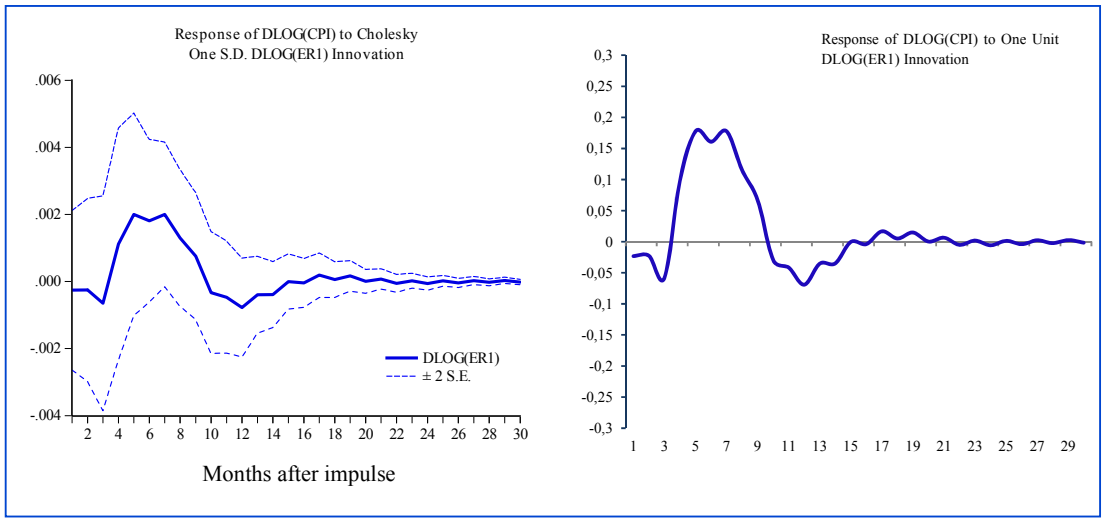
Before estimate of recursive VAR, it is important to establish the order of integration of the series involved and then select the optimal lag length of the VAR model. The ADF unit root test is used to determine stationary of variables in the system, which suggests that all variables have I(0) order of integration at 5% significance level (see Appendix 1). The reduced-form VAR is estimated with 3 lags, which is based on VAR lag exclusion Wald tests (see Appendix 2).

III. EMPIRICAL RESULTS: IMPULSE RESPONSES AND VARIANCE DECOMPOSITION

The result of impulse response functions are described in the Figure 1, from wich it may be seen that the exchange rate pass-through to inflation is relatively high which is consistent with estimates reported in other studies of the pass-through in Mongolia (L.Davaajargal (2005); and A.Khulan (2005)). The consumer prices (CPI) respond rising for 4-9 months after a depreciation shock to exchange rate. The inflation impulse response is significantly different from zero at the 5% significance level for the 6-7 months. Also the impulse response function indicates that 1% monthly depreciation of exchange rate increases monthly inflation by 0.2 percentage points after 5-7 months.

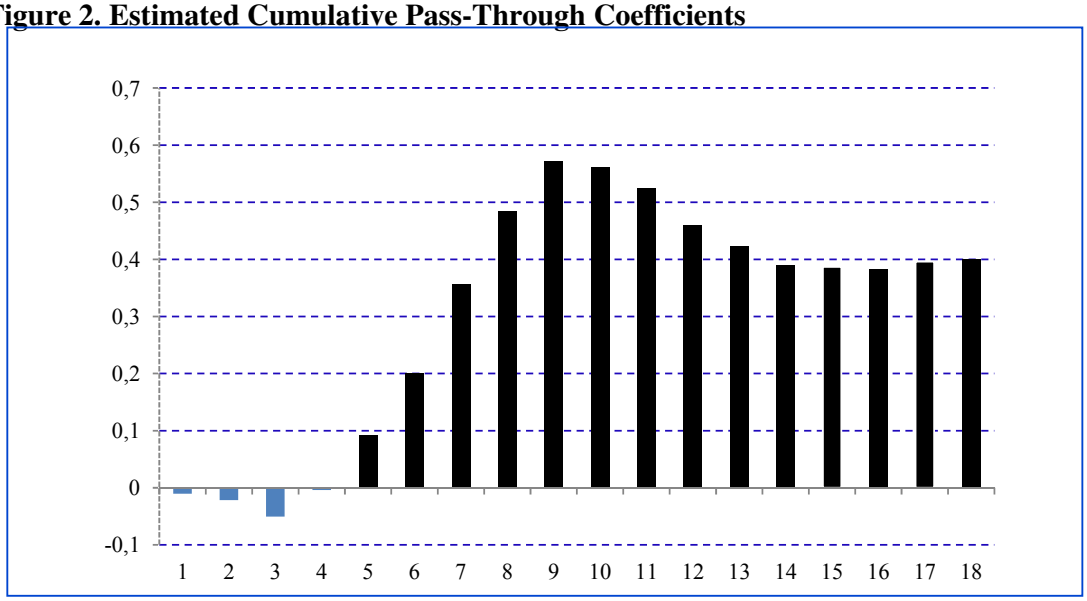
[2] Official web site of Energy Information Administration of USA (www.eia.doe.gov).

Figure 1. Impulse Responce of Consumer Prices to Innovation in Exchange Rate



Cumulative pass-through coefficients are obtained by dividing the cumulative impulse responses of CPI after j months by the cumulative response of the exchange rate shock after j months[3]. The model estimates suggest that the exchange rate shock has a relatively slow effect on consumer prices (after 4 months). By the end of the fifth month after the shock, consumer price has risen by 10 percent of the exchange rate depreciation shock. The impact of exchange rate shock on consumer price increases untill the ninth month, by which time 55.0 percent of the depreciation shock seems to have passed through to consumer price (Figure 2).

Figure 2. Estimated Cumulative Pass-Through Coefficients



[3] $PT_{t,t+j} = P_{t,t+j} / E_{t,t+j}$, where P_{t+j} is the cumulative change in the price level and E_{t+j} is the cumulative change in the nominal exchange rate between months t and t+j.

Impulse responses of consumer price and exchange rate to other shocks are presented in the Appendix 3 and Appendix 4, respectively.

The pass-through coefficients provide information on the impact of the exchange rate on the levels of the CPI, they do not indicate haw important exchange rate shocks have been in inflation fluctuations. The variance decomposition decomposes variation in CPI inflation into the shocks to the endogenous variables in the VAR model.

Figure 3. Variance Decomposition of Monthly Inflation: Percentage of Forecast error variance[4]

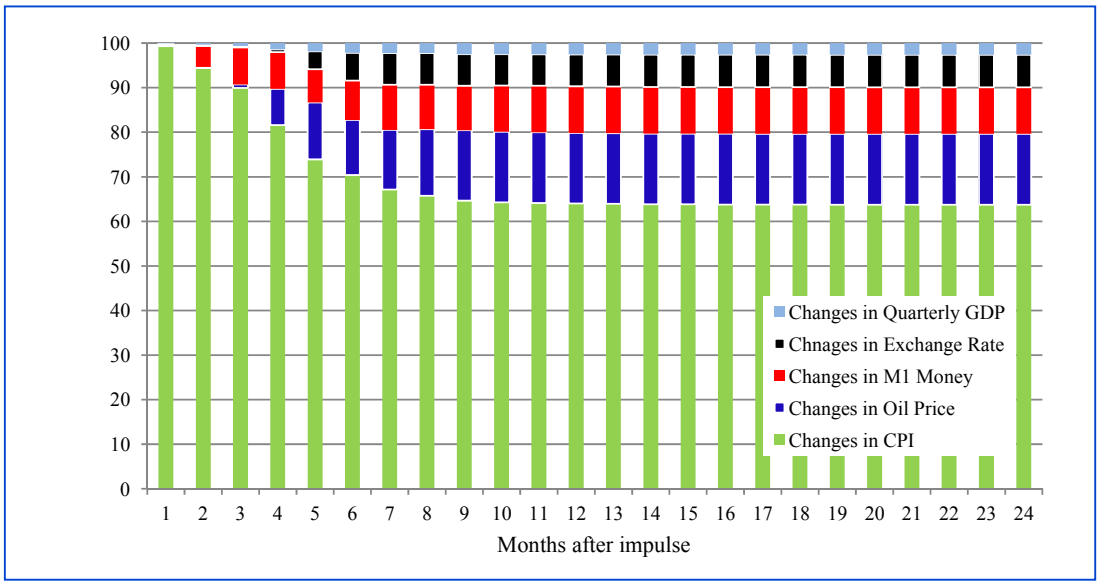


Figure 3 presents the percentage of the monthly inflation forecast variance attributed to the various shocks. Variance decompoposition of monthly inflation show that the exchange rate shocks explain 7.0-8.0 percent of monthly inflation after 8-9 months. The remainder of the variance of monthly inflation is explained by its own innvations (about 60.0-70.0 percent) and innovations to petrol price (13.0-16.0 percent), and to the other variables.

IV. CONCLUSIONS

Using impulse response functions and variance decompositions derived from a recursive VAR model, the paper finds that exchange rate pass-through to consumer prices rises from about 10 percent in the fifth month of the shock to about 55 percent in ninth months. The exchange rate shocks explain a relatively high percentage of the variation in monthly inflation and other domestic shocks likely play a significant role on inflation. These results, which show a high exchange rate pass-through to inflation, has a complication for monetary policy implementation.

[4] The following Cholesky ordering was used in the variance decomposition: DLOG(WOIL_P) DLOG(GDP_SA) DLOG(ER1) DLOG(CPI) DLOG(M1), Standard Errors: Monte Carlo (100 repetitions).

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Appendix 1. Unit Root Test: ADF test

	Level			1st difference		
	Lags	t-Statistic	Prob.*	Lags	t-Statistic	Prob*
log (CPI)	1	-3.17	0.09	0	-5.93	0.00#
log $(M1)$	12	-3.05	0.12	11	-2.82	0.05##
log (GDP_SA)	2	-4.16	0.01#	3	-33.7	0.00#
$log(WOIL\_P)$	1	-2.30	0.49	0	-8.90	0.00#
log $(ER1)$	1	-2.20	0.19	1	-4.86	0.00#

Note: *MacKinnon (1996) one-sided p-values. #, ## indicates that H0 hypothesis (unit root) is rejected at 1%, 5% significance level, respectively.

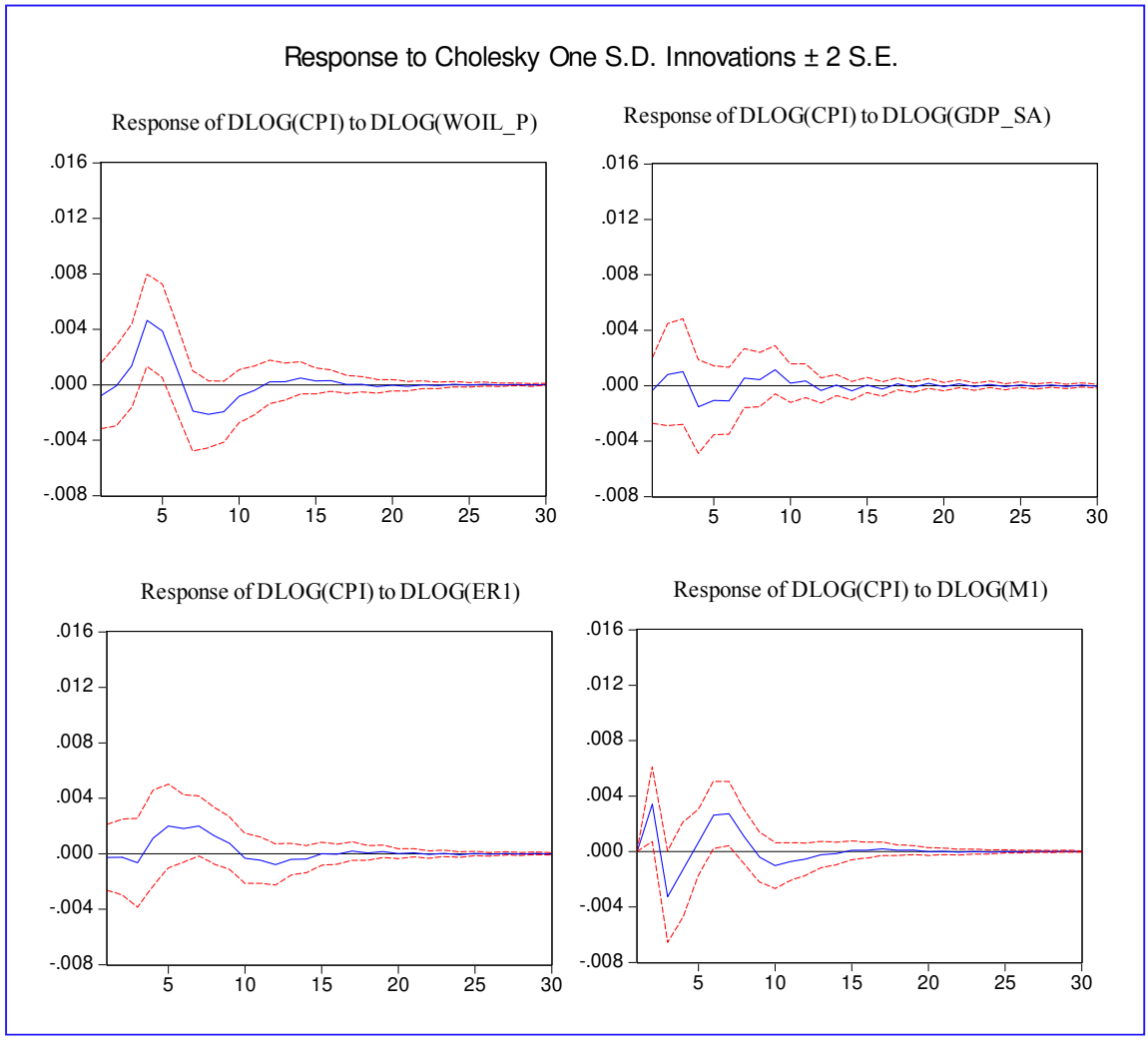
Appendix 2. VAR Lag Exclusion Wald Tests

VAR Lag Exclusion Wald Tests
Date: 02/28/09 Time: 12:33
Sample: 1998M01 2009M01
Included observations: 128

Chi-squared test statistics for lag exclusion:
Numbers in [ ] are p-values

	DLOG(WOIL_P)	DLOG(GDP_SA)	DLOG(ER1)	DLOG(CPI)	DLOG(M1)	Joint
Lag 1	**12.33038**	**51.77727**	**42.98962**	**27.71592**	**9.283988**	**131.5989**
	[0.030531]	**[5.99e-10]**	**[3.71e-08]**	**[4.14e-05]**	**[0.098259]**	**[2.22e-16]**
Lag 2	**8.470158**	**16.60839**	**7.339481**	**8.664617**	**3.286822**	**49.24150**
	[0.132157]	**[0.005306]**	**[0.196592]**	**[0.123213]**	**[0.655860]**	**[0.002640]**
Lag 3	**8.346772**	**2.900195**	**5.677544**	**19.50927**	**2.864226**	**38.75977**
	[0.138132]	**[0.715370]**	**[0.338870]**	**[0.001544]**	**[0.720908]**	**[0.038933]**
Lag 4	0.920195	16.18467	1.512118	4.898104	7.536462	30.38485
	[0.968742]	[0.006336]	[0.911667]	[0.428442]	[0.183700]	[0.210202]
df	5	5	5	5	5	25

Appendix 3. Impulse Responce of Consumer Prices to Other Shocks



Appendix 4. Impulse Responce of Exchange Rate to Other Shocks