

Relationship between Mongolian Tugriks Depreciation against US Dollar and Inflation

Battamir Batbayar¹

¹(Master's student, Management School, Shanghai University, China)

Abstract: *Main idea behind this paper is to examine exchange rate depreciation against US dollar as determining inflation rate in the domestic economy. Mongolia is small landlocked country therefore it is vulnerable to the both internal and external shocks created by exchange rate. Under such circumstance, exchange rate depreciation could play significant role of national income, exporting competence and moreover. As of Mongolia implies dirty flexible exchange rate system currently, it promotes monetary policy influence to control and stabilize inflation in Mongolia. The article idea is to check whether there is any noticeable relationship between these 2 variables in Mongolia thus especially inflation rate cause exchange rate depreciation since currencies in other commodity dependent country depreciates as faster than those who produce and supply domestic product in the market as dominated. Using the time series data of exchange rate of USD/MNT and inflation; the current status of depreciating domestic currency has tried to be explained by the inflation rate. The main argument for this discussion can be justified by part of exchange rate depreciation caused by inflation. In doing so, macroeconomic issues of Mongolia related to the depreciation of real exchange rate and also theoretical background of role of exchange rate studied. As overall, it has concluded the inflation rate has been affecting to the exchange rate depreciation partially but very small.*

Background: *Mongolia is one of the countries that has flexible exchange rate system. Unfortunately, it has been depreciating against US dollar ever since. The most of the importing countries like Mongolia, unable to adopt the right policies as their government budget deficits are too high over time, lack of central bank independence, following there is a high inflation and exchange rate volatilities which became a very common case. Among these economic issues, it is more crucial that adopting the right internal policies in the economy underlined on research basis.*

Materials and Methods: *The article employed 2 models; VAR and OLS, however during the double lagged VAR estimation, it has not presenting significance of relationship between variables. Therefore, author takes result from OLS method. Time series ranges from 2007 to 2020 including its 159 observations.*

Results: *The result of methodology has concluded the main two variables are statistically significant with negative correlated. When all of error terms and unenclosed variables except of Inflation are constant, relationship between Exchange rate and Inflation are negative. Increases of 1% in Inflation will cause 0.02% of decrease in USD MNT exchange rate.*

Conclusion: *Explanations in macroeconomic models have stated the current circumstances of the proportional changes in exchange rates in the short-run by relative price increases in trade volumes have certain amount of effects to exchange rate. Responses from the regression model on dependent variable exchange rate has negative relation between the independent variable inflation rates that also having considerable rate of explanation percentage recorded at 29%.*

Key Word: *Exchange rate; Inflation; Mongolia*

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I. Introduction

Mongolian economy is small open economy yet it's very vulnerable to the exchange rate. As its free market economy, Mongolian imported goods and inputs of the domestic productions are imported from abroad are accounted over 85% of total GDP. At the retail level, foreign distribution businesses are dominated. Hereof, both the domestic and foreign shocks fluctuate exchange rate more frequently. Even though, Mongolia has been continuously invested and issued bonds by/to the developed countries as using the world class natural resource. There still is high currency fluctuation even though there are an external supply of US dollar created by bonds. The reason is that US dollars are not digesting through domestic market as well as satisfies US dollar demand. Meanwhile, this large flow of USD has been sinking into unnecessary investments which have no returns to scale such as infrastructures, social welfare included one-time cash handout, all students' monthly stipend and shares of state owned mining company for all etc., thus added raw materials price drop in the international market has pushed Mongolian economy to fall several times and consequence was economic crisis with two

digit inflation rate and continuously depreciation against USD. To addressing it clearly, sudden changes in economic variables are not preferable in any country, but in 2011, Mongolian economic boomed with GDP growth rate of 17.3% however average growth rate of the Mongolian economy was about 7%. Furthermore, inflation rate was 32% once in Q4 2008 but decreased to 4.2% in Q4 2009 then turned -0.1% in Q2 2016 is surely demonstrating Mongolian economy is not stable. Therefore, Mongolia needs to ensure macroeconomic stability which is steady growth rate without too ascending or big variance in its main aggregates which are government spending, consumption and imports. Otherwise, increasing import price would cause high pressure on CPI (inflation) in Mongolian economy. In the other hand, role of central bank of Mongolia has challenging issue of inflation and exchange rate targets through the monetary policy regime. Therefore, examining the correlations of these two variables, exchange rate and inflation is important to be studied to aware monetary policy further macroeconomics of Mongolia.

II. Literature Review

The Mundell-Fleming model is a very useful tool when dealing with the analysis of open economies. The model shows that the effectiveness of national macroeconomic policy depends on the exchange rate system. This is because in open economy the real exchange rates influence net export national income and more. An appropriate monetary policy is most likely to arise when two conditions are satisfied. First, the central bank, and the decisions it makes, must be independent of the national government which makes government spending decisions. If it is not, governments have always been inclined to print money to finance government spending projects. This has been the primary source of high inflation in most countries. The second condition is the central bank's objective must be clear that monetary policy will satisfy the demands of a growing economy while maintaining sufficiently low inflation. When these 2 conditions are satisfied, and with independent central bank; exchange rate system will function well.

Inflation can be the factor affected by the exchange rate but it also may be the factor affecting the exchange rate. Inflation is an increment in the aggregate or the general price level in the economy. Also, it means there is increase in living cost. There is widespread agreement that high and volatile inflation can be damaging both to individual businesses and consumers and also to the economy as a whole. However, the inflation rate is used to measure the price stability in the economy. A low inflation rate scenario will exhibit a rising currency rate, as the purchasing power of the currency will increase as compared to other currencies. The relative prices of currency between two countries are worth as much as we can expect. Exchange rate flexibility in alignment is macroeconomic fundamentals to support domestic production, exports and overall competitiveness of the economy. Aside from factor inflation, the exchange rate is one of the most important determinants of a country's relative level of economic health as mentioned as small economies' macroeconomic fundament which is it can play a vital role in a country's level of trade. For this reason, exchange rates are the most watched analyzed and governmentally manipulated economic measures. But exchange rates matter on a smaller scale as well: they impact the real return of an investor's portfolio (Gudmundsson, 2012). Moreover, the exchange rate influences income factors such as interest rates, inflation and even capital gains from domestic securities. While exchange rates are determined by numerous complex factors that often leave even the most experienced economists flummoxed, investors should still have some understanding of how currency values.

Theoretical reason behind the exchange rate depreciation could simply connect with the foreign exchange rates market of foreign currency in return for domestic currency by domestic residents. When the government purchases foreign exchange reserves with domestic currency on the international market it increases the money supply. On the other hand, government can control or target exchange rate within foreign reserves by buying its currency for foreign currency in international market and inflation for Tailors rule etc. When the economy is operating with full employment output, then money supply will increase eventually and put upward pressure on price. Therefore, in the long-run, aggregate price level will rise and economy will experience inflation in the transition. Long-run effects of an increase in the money supply need to be described as using an AA-DD model.

- AA- It shows all combinations of exchange rate and output that are consistent with equilibrium in the domestic money market and the foreign exchange market.
- DD - it shows all combinations of output and the exchange rate for which the output market is in short-run equilibrium (aggregate demand = aggregate output). It slopes upward because a rise in the exchange rate causes output to rise.

The current account in the DD-AA model has assumed that nominal exchange rate changes cause proportional changes in the real exchange rates in the short run. Degree of Pass-through is the percentage by which import prices rise when the home currency depreciates by 1%. In the DD-AA model, the degree of pass-through is 1. Exchange rate pass-through can be incomplete because of international market segmentation. Currency movements have less than proportional effects on the relative prices determining trade volumes.

In case of exchange rate and inflation, the most well-known subject called pass-through effect of exchange rates on domestic prices. Two scholars Choudri and Hakura (2001) worked on large amount of data which contain 71 countries, between in 1979 to 2000. They have found pass-through effects from exchange rate to prices. Countries that have high inflation have more pass-through effect. Their findings are consistent with Taylor's (2000) paper, which inspired them. Further, Edwards (2006) analyzed the pass-through subject from an "inflation targeting" perspective. Edwards studied the relationship between the pass-through and the effectiveness of nominal exchange rates in regimes, which have inflation targeting. The results showed that countries with inflation targeting experienced decreasing pass-through effects of exchange rate changes to inflation.

For Mongolian case, Oyu-Erdene Buyandelger, lecturer in Economics Department, The Institute of Finance and Economics Mongolia 2015, examined this effect on exchange rate pass through in case of Mongolia. She accomplished the analysis by comparing impulse responses for four different degrees of pass-through under the three shocks such as domestic productivity shock, domestic demand shock, and foreign demand shock. Based on the results, she made three main conclusions. First, the exchange rate pass-through into import price is incomplete in Mongolian economy and the degree of pass-through has considerable impact on the economic fluctuations in terms of inflation and output gap variability. Stabilizing inflation becomes more costly in terms of output when the pass-through is sufficiently low. Therefore, to distinguish complete or incomplete pass-through is a significant effect on the implementing monetary policy. Second, the monetary policy reactions to shocks depend on considerably what shock hits the economy, in turn how the role of exchange rate changes in case of different shocks, and eventually whether the pass-through is complete or incomplete (high or low). Particularly, the BoM (Bank of Mongolia) may needs to adjust the nominal interest rate more under the productivity shock where the exchange rate act as a shock absorber and the pass-through is incomplete. Third, the incomplete pass-through changes the performance of the monetary policy rule. Therefore, considering incomplete pass-through in the conduct of monetary policy is significant to improve the effectiveness of the monetary policy.

Exchange rate manipulation under flexible exchange rate

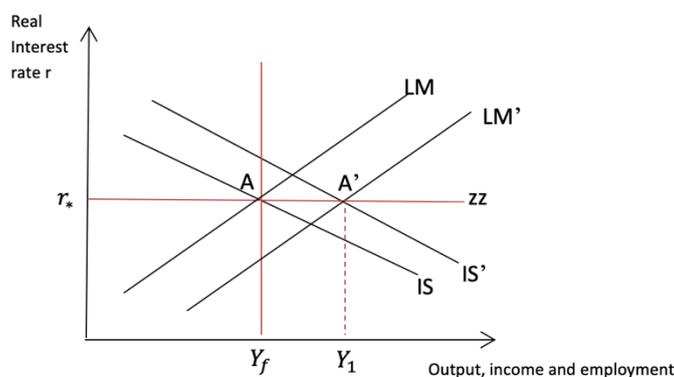


Figure 1. Exchange rate manipulation under flexible exchange rates

When government purchase of foreign currency, it will LM to shift right and monetary expansion cause LM to down. On the other hand, associated exchange rate devaluation will cause IS to shift right and domestic fiscal expansion cause IS curve move to the right. Effect of the exchange rate is temporary due to the sales of foreign currency in return for domestic currency will act immediately by populace. In other word, government purchases foreign exchange reserves with domestic currency for increase money supply but when government sells bonds of equivalent amount then it decreases money supply by same amount of money. Excessive supply of domestic asset on the international market will cause domestic interest rate to be increased slightly. For the demand side, when exchange rate is fixed but real interest rate increased then the exchange rate demand will also increase. There might seems temporary depreciation in the exchange rate.

Long-run effects of a money supply using AA-DD model

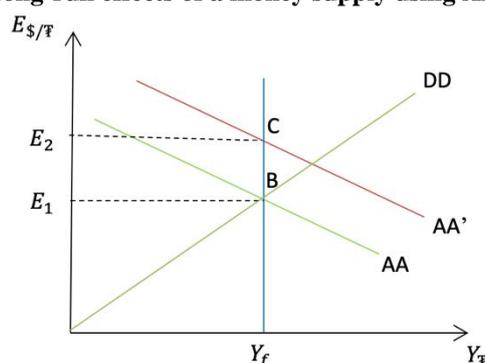


Figure 2. In the long run, expansionary monetary policy with the floating exchange rates

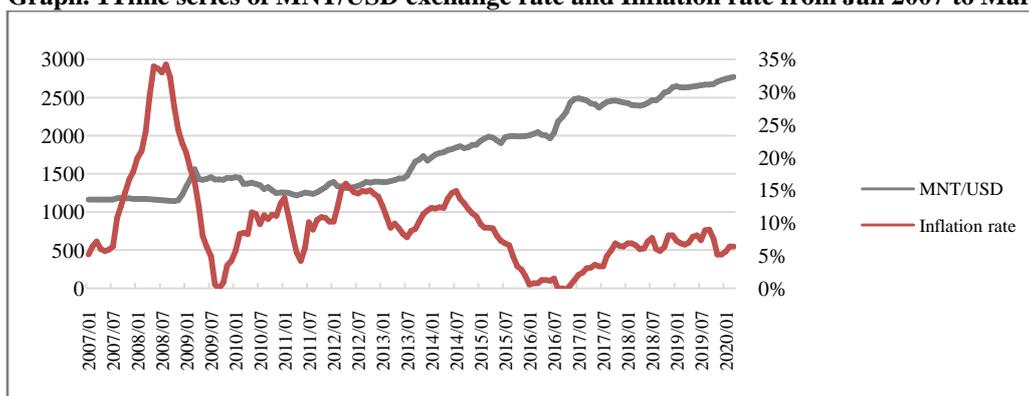
The figure above will describe the long-run effects of an increase in the money supply using an AA-DD model. In the long-run, we allow the effects of price level to be risen. Suppose that market economy is in equilibrium and F in the adjoining diagram. The GNP level is Y_f , exchange rate is E_1 . It represents the full-employment level of output and also it can imply natural rate of unemployment prevails. Movement of economy to the right of Y_f will cause increase of price level. And left side movement will represent decrease in price level. If suppose that Mongolian central bank decides to expand money supply, it will cause a shift in the AA curve. And increase in money supply will lead AA to shift up from AA to AA'. Since the exchange rates adjust much more rapidly than GNP, the economy adjusts to the new AA' curve before any changes in GNP occur. That means the first adjustment will start from B to C directly. Then the exchange rate will increase from E_1 to E_2 , representing a depreciation of the Mongolian tugrik.

III. Discussion of Mongolian tugriks and inflation review

Mongolia is one of the countries that has flexible exchange rate system. Unfortunately, it has been depreciating against US dollar ever since it has transit from fixed exchange rate to flexible exchange rate. The most of the importing countries like Mongolia, unable to adopt the right policies as their government budget deficits are too high over time, lack of central bank independence, high inflation and exchange rate volatilities are very common cases. Among these economic issues, it is more crucial that adopting the right internal policies in the economy. In the case of Mongolian economy, when imported goods price' increases, core inflation has begun to gradually accelerate to the two digits in late 2013. The import price converted to local currency values has represented inflationary pressure from foreign inflation and also imported intermediate goods for domestic production. Following this action, price of goods in constitute of CPI basket has rose dramatically which leads industries indicate how the price domestically produced goods are broadly affecting to the consumer price. In 2015, core inflation has slowed down within moderate path of slower exchange rate depreciation against US dollar.

Furthermore, foreign commodity price shocks in the world market, especially Chinese demand shock (Mongolian main export destination is China) increase the exchange rate fluctuations due to the Mongolian economy is very much dependent on main trade partner China. The 80% of Mongolian exports are made of mineral commodities such as coal, gold and copper. Therefore, Mongolian economy is vulnerable for exchange rate that affected by importing and exporting goods price level and demand level as much. When imported goods price' increases, core inflation has begun to gradually accelerate. The import price converted to local currency values has represented inflationary pressure from foreign inflation and also imported intermediate goods for domestic production. Following this action, price of goods in constitute of CPI basket has rose dramatically which leads industries indicate how the price domestically produced goods are broadly affecting to the consumer price.

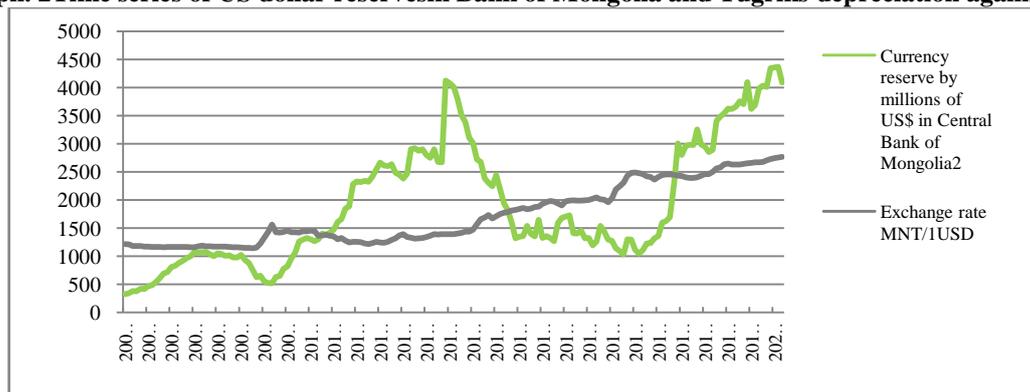
Graph. 1 Time series of MNT/USD exchange rate and Inflation rate from Jan 2007 to Mar 2020



Graph 2. Nominal exchange rate MNT/USD and Inflation rate
Source: Mongol Bank

While Mongolian tugriks has been continuously depreciating against US dollar, inflation rate of Mongolia was fluctuating over time. Bank of Mongolia is committed and subjected to achieve low and stable inflation. However, in 2008, accompanied with Global Financial Crisis, Mongolian domestic inflation rate has reached over 30%. This is the result of the Central bank inadvertently exacerbate price volatility by mistakenly responding to a supply shock and not responding to price pressures stemming from excess demand. This has led to a period of protracted high inflation since monetary policy works with a lag of six months or more, it took a whole year to fix and sterilize real time inflation rate. Moreover, the Mongolian economy is subject to large supply and demand shocks. Due to external shocks, inflation rate has been fluctuating frequently displaying “roller coaster-like trend”. In Q1 of 2016, inflation rate reached minus term which could undermine central banks credibility and taking actions of potential monetary policy to stabilize inflation rate. Moreover, prices in Mongolia differs every months of year, inflation is very short-lived. Exchange rate of MNT against USD depreciates 57.9% over time.

Graph. 2 Time series of US dollar reserves in Bank of Mongolia and Tugriks depreciation against USD



Graph 3. Nominal exchange rate MNT/USD and US\$ reserve central bank holds
Source: Mongol Bank

The graph shows that Mongolian tugriks exchange rate has been steadily depreciating against US dollar, while foreign reserve in the central bank fluctuated heavily. As describing the trend, US dollar depreciation has a potential correlation with central bank’s US dollar reserve. As much as domestic currency has been weakening, US dollar reserve has been increasing in the general view. Few of exceptional increases shown in currency reserve such as Feb 2013 and Jan 2018. This leads to the assumption of influence of a big sum of FDI as well as its inflow of potential amount of US dollar in the market. The central bank has been trying to absorb the shocks as intervening US dollar market in domestic market within the reserve in several times as biggest in Oct 2013 and Jul 2017 as noticeable in the graph. Shocks affected to the exchange rate is a lot. Therefore, interventions are crucial to protect domestic currency and controlling inflation to maintain market fundamentals. If not, it is likely to unsustain inflations underlined on huge pressure to the domestic currency and lead to weak balance of payment within overall continual deficits in external trade balances.

IV. Methodology

In order to find the relationship between exchange rate and inflation in Mongolia, monthly time series data from Jan 2007 to Mar 2020. Data of inflation and exchange rates are found from Mongol Bank (Central Bank of Mongolia) at their official website www.mongolbank.mn since inflation rate of Mongolia is affected by many factors and fluctuates frequently, 2 level of lag form has adjusted to be more accurate.

VAR Lag Order Selection Criteria
 Endogenous variables: INF MNT_USD
 Sample: 2007M01 2020M03
 Included observations: 159

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1639.322	NA	9469682.	21.73936	21.77932	21.75560
1	-1032.970	1188.611	3246.854	13.76119	13.88108	13.80989
2	-990.3741	82.36997*	1947.462	13.24999	13.44981*	13.33116*

* indicates lag order selected by the criterion
 LR: sequential modified LR test statistic (each test at 5% level)
 FPE: Final prediction error
 AIC: Akaike information criterion
 SC: Schwarz information criterion
 HQ: Hannan-Quinn information criterion

VAR Granger Causality/Block Exogeneity Wald Tests
 Sample: 2007M01 2020M03
 Included observations: 157

Dependent variable: INF

Excluded	Chi-sq	df	Prob.
MNT_USD	3.225675	2	0.1993
All	3.225675	2	0.1993

Dependent variable: MNT_USD

Excluded	Chi-sq	df	Prob.
INF	3.108483	2	0.2113
All	3.108483	2	0.2113

Sample (adjusted): 2007M04 2020M03
 Included observations: 156 after adjustments
 Trend assumption: No deterministic trend
 Series: INF MNT_USD
 Lags interval (in first differences): 1 to 2

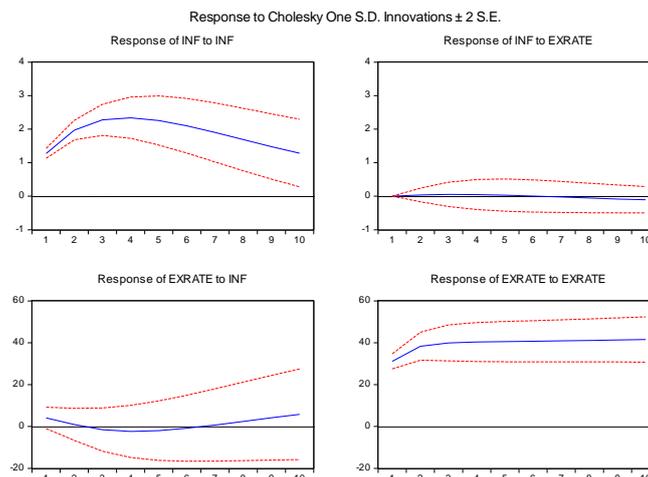
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.040791	10.91259	12.32090	0.0851
At most 1 *	0.027909	4.415705	4.129906	0.0423

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Trace test indicates no cointegration at the 0.05 level
 * denotes rejection of the hypothesis at the 0.05 level
 **MacKinnon-Haug-Michelis (1999) p-values

	INF	MNT_USD
INF(-1)	1.518619 (0.06615) [22.9572]	-3.087771 (1.75586) [-1.75855]
INF(-2)	-0.573944 (0.06576) [-8.72840]	3.020941 (1.74540) [1.73080]
MNT_USD(-1)	0.000452 (0.00286) [0.15791]	1.328166 (0.07591) [17.4960]
MNT_USD(-2)	-0.000861 (0.00288) [-0.29893]	-0.327175 (0.07647) [-4.27824]
C	1.253555 (0.52063) [2.40774]	5.828331 (13.8196) [0.42174]
R-squared	0.967281	0.996082
Adj. R-squared	0.966420	0.995979
Sum sq. resids	244.9027	172550.2
S.E. equation	1.269331	33.69271
F-statistic	1123.414	9660.191
Log likelihood	-257.6756	-772.4459
Akaike AIC	3.346186	9.903769
Schwarz SC	3.443519	10.00110
Mean dependent	9.799363	1778.936
S.D. dependent	6.926857	531.3113
Determinant resid covariance (dof adj.)		1818.915
Determinant resid covariance		1704.906
Log likelihood		-1029.686
Akaike information criterion		13.24441
Schwarz criterion		13.43907



In order to find detailed relationship as of double lagged regression of inflation to the exchange rate using VAR model, the two variables were not significantly correlated nor explained. Therefore, I have employed OLS model in order to explain or prove the relationship between two variables. Apart from theoretical relationship, there are certain purposes to suspect there would some influence between these two variables. First, Mongolia imports a large share of final and intermediate goods and services, and deals made with US dollar which causes the depreciation of MN tugriks depends on the foreign goods and services demand. Second reason is that Mongolia is not a manufacturing country, therefore foreign goods and services demand is very high in all time. Third reason is, no matter how much foreign currency inflow to Mongolian economy, the sectors receiving those inflows are non-profitable; those inflows spend through infrastructure, public welfare or strategic developments. Therefore, challenges face to the central bank is a massive that much of the period central bank has to manage tightly the protecting domestic currency against US dollar and limiting its variability.

To determine whether there is any responsiveness of relationship between Inflation to Exchange rate, I employed simple linear OLS model with possible residual of economic conditions below:

$$\text{Log}(\text{exchange rate}) = \beta_0 + \beta_1(\text{inflation}) + u$$

Table 4.1

Summary table

Variable	Mean	Std. Dev	Min	Max	Sum	P>chi2	Skewness	Kurtosis
lnEXR	7.435	0.294	7.04	7.92	1182.2	0.000	0.196	0.000
Inflation%	0.097	0.068	-.002	0.342	121.83	0.000	0.000	0.000

Source: Writer's Own Calculation, Calculated by STATA

Hypothesis and Expected relationship of variables

The study addresses a straightforward question that is "Does inflation have a relationship with the exchange rate of MN tugriks against US dollars in Mongolia?". The expected answer is "Inflation rate has negative effect on the exchange rate of Mongolian tugriks". Where either exchange rate depreciation or the inflation rate increases, it has influence to each other directly. An increase of growth rate of Exchange rate means that Mongolian tugriks has been depreciating against US dollar. Since the exchange rate increment means depreciation of MN tugriks against US dollars, the potential outcome of relationship would be negative.

Table 4.2
Expected signs

Variable name	Proxy or definition	Expected sign
lnEXR	Growth rate of MN tugriks/US dollar	
InflationRate	Inflation rate	-

Source: Writer's Own Expectations

4.3 Empirical results and interpretations

To estimate the parameters corresponding to variables of interest from the data under consideration, I employ an empirical exposition of which is provided in the main model. Independent variable expected to have negative relationship and expected to be consistent with the theoretical relationship between these two variables.

Table 4.3

Regression Result

Number of observation	159
F (1, 157)	65.36
Prob > F	0.0000
R squared	0.2939
Adj R squared	0.2894
Root MSE	0.05814
DW	.0282973
<hr/>	
Dependent variable - lnGDP	

Variables	Estimates	Std.err	t	P > t	95% Confidence intervals	
Inflationrate	-2.317327	0.2866361	-8.08	0.000	-2.883487	-1.751166
const	7.661587	0.0341955	224.05	0.000	7.594045	7.72913

Source: Writers own calculation, Calculated by STATA

Changes in the exchange rate is possible to affect inflation rate, however the determination rate is small as 30%. The correlation between the two variables were significant in overall and negative which is consistent with the expectation or the hypothesis. Interception of LogExchange rate is recorded as negative 2.3 in the equation. When all of error terms and unenclosed variables except of Inflation are constant, relationship between *Exchange rate* and *Inflation* are negative. Increases of 1% in Inflation will cause 0.02% of decrease in USD MNT exchange rate. Inflation rate increases would cause negative effect on exchange rate as expected. The results shown in the above table reveals a strong negative relation between inflation and exchange rate. On the regression, R squared, determination coefficient has pointed at 0.29 which is the independent variable is explaining dependent variable based on total 159 observations. To checking significance of single variable inflation using t test; t stat has pointed at -8.08 which isn't included in the 95% confidence interval which means coefficient of inflation is statistically significant. On behalf of above-mentioned results, it can be said that inflation has partial influence to determine the exchange rate in Mongolian market scenario if it is compared with US Dollar. It means that if inflation rate increases then there would depreciation in domestic currency for exchanging to US dollar.

V. Result conclusion

The main objective of this robust work is to find the impact of inflation on the exchange rate. Within 13 years of data collection from 2007 to 2020, following results are found which can reject null hypothesis of there is no relationship between exchange rate and inflation. Results shown:

- There is a significant and a negative relationship between inflation and exchange rate of US dollar and Mongolian tugriks.

This suggests that the argument of imported inflation is valid in case of Mongolia, which means that there is depreciation in Mongolian tugriks from consumer prices in the economy. Therefore, inflationary consequences of devaluation in Mongolia have proven to be existed. Stability of nominal exchange rate against USD explained by many reasons, but it's proven that there are currency fluctuations caused by the inflationary cost on the economy. Furthermore, these results are taken from one foreign currency which is the US dollar; exchange rate variation to the other countries' currency can be differed.

VI. Conclusion

Mongolia has its own uniqueness for its economy. Within an open economy that imports most of the products from foreign countries could take risks for inflation and exchange rates depreciation to other trade partner countries. The article idea is to check whether there is any noticeable relationship between these 2 variables in Mongolia thus especially inflation rate cause exchange rate depreciation since currencies in other commodity dependent country depreciates as faster than those who produce and supply domestic product in the market as dominated. Due to the exchange rate depreciation, Mongolian economy has suffered way more than only high inflation rate but also recession in the economy that took indulgence by Central Bank of Mongolia.

Explanations in macroeconomic models have stated the current circumstances of the proportional changes in exchange rates in the short-run by relative price increases in trade volumes have certain amount of effects to exchange rate. Responses from the regression model on dependent variable exchange rate has negative relation between the independent variable inflation rates that also having considerable rate of explanation percentage recorded at 29%. A high short-run association has shown there is devaluation of the exchange rate determined by general price level increment in the Mongolian market scenario. Therefore, Mongolia could establish a price risk protection fund for neutralize domestic price increases of imported commodities, reduce import consumption against domestic price increases and develop domestic import substitutes. Whether the exchange rate stayed on a depreciation trend as the external inflation rate or began to appreciation against USD could be partially solved by when government of Mongolia implement monetary policy to reach targeted inflation rate. In the residuals there could be trade balances, bond issues, foreign reserves, government spending and economic performance so on. It is crucial to work on other factors simultaneously combating with inflation rate that are affecting exchange rate as establishing domestic currency exchanges, increase FDI, improve effectiveness of the policies and promote exports etc.

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