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INFLATION TARGETING IN MONGOLIA: A VAR MODEL ANALYSIS

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ANALYSIS

by

Anujin Nergui

B.A., Gazi University, 2013

A Thesis
Submitted in Partial Fulfillment of the Requirements for the
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THESIS APPROVAL

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ANALYSIS

by

Anujin Nergui

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Master of Science

in the field of Economics

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AN ABSTRACT OF THE THESIS OF

Anujin Nergui, for the Master of Science degree in Economics, presented on November 2, 2022, at Southern Illinois University Carbondale.

TITLE: INFLATION TARGETING IN MONGOLIA: A VAR MODEL ANALYSIS

MAJOR PROFESSOR: Dr. Scott Gilbert

This study aims to conduct a descriptive analysis of inflation targeting in Mongolia. In this context, I will assess whether the current inflation targeting practice of Mongolia is classified as a fully-fledged, eclectic, or inflation targeting lite regime. Then I will verify that Mongolia validates the prerequisites necessary for the implementation of fully fledged inflation targeting. Finally, I will proceed to a VAR model analysis aiming to describe the determinants of inflation.

The results show that the inflation targeting practice of Mongolia falls in inflation targeting lite countries categorization and most of the prerequisites to adopt fully fledged inflation targeting have not been fulfilled. It would require significant improvement in the independence of the Bank of Mongolia's operation and monetary policy decision making, modeling capabilities within the Bank of Mongolia, and financial stability. Finally, the VAR model results show a relationship among the variables, CPI, money supply, exchange rate, and GDP in Mongolia. The principal finding is that the money supply and exchange rate are more important in explaining variation in CPI than GDP in Mongolia.

ACKNOWLEDGMENTS

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CHAPTER 1

INTRODUCTION

According to Bernanke et al.(1999) inflation targeting (IT) is a framework for monetary policy characterized by the public announcement of official quantitative targets or target ranges for the inflation rate over one or more time horizons, and by an explicit acknowledgment that low, stable inflation is monetary policy's primary long run goal. Simply the central bank forecasts the inflation and compares it to the target inflation rate and their difference guides the central bankers in making monetary policy decisions. If the actual inflation rate falls below the target rate consistently, firms and agents expect inflation to be on target for the coming periods. It helps central bankers to react to shocks effectively. During the 1990's several countries adopted a new monetary policy regime, IT, including New Zealand, Canada, Australia, and Sweden. Its popularity increased over time even though the effectiveness of the regime is still controversial. In 2020, 74[1] central banks announced their inflation target rate[2]. One of them was the Bank of Mongolia (BoM).

In this paper, I will examine the inflation targeting regime in Mongolia, and the inflation determinants with VAR model analysis. First, I will analyze the prerequisites and the necessary steps for the implementation of the IT regime and verify that Mongolia validates those prerequisites. To analyze the impact of the inflation targeting regime on the economy of Mongolia, I will proceed to a VAR model analysis aiming to identify the most significant macroeconomic variables that lead to changes in inflation in Mongolia.

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[1] http://www.centralbanknews.info/p/inflation-targets.html

[2] Some of them are considered as eclectic inflation and fully fledged inflation targeters, others as inflation targeting lite. Detailed definitions and difference samong inflation targeting regimes can be found in Carare and Stone (2003).

Rapid political changes of 1990–1992 marked the beginning of Mongolia's efforts to adopt a democratic regime and shift from a centrally planned economy to a market-based economy. Like other transition economies, during the first years of reform, Mongolia suffered triple-digit inflation, rising unemployment, and shortages of basic goods and food rationing.

Under the market-based regime, the economy has maintained 5.3 percent on the average in terms of real GDP (1993-2021).

Figure 1. Real GDP and GDP growth (1990-2021)
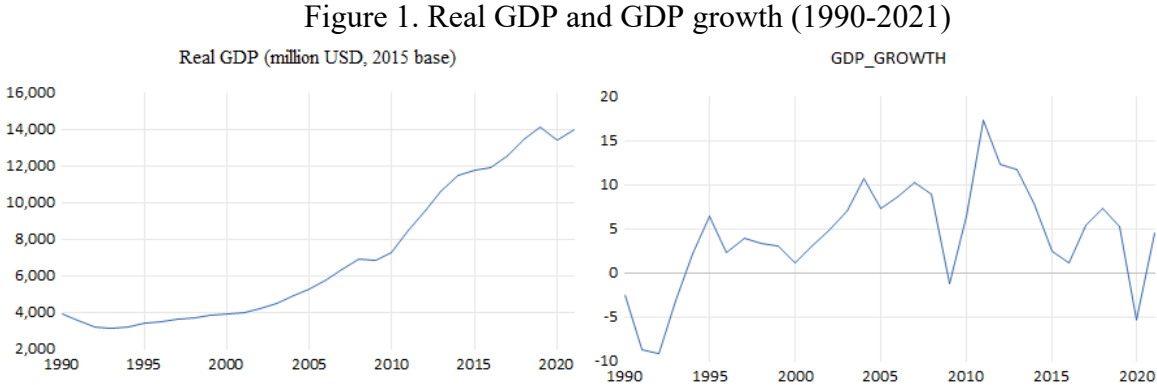
Source: National Statistical Office

Through the growth process, Mongolia has graded up its economic status from low income to lower-middle income in 2007, to upper middle-income in 2014 as the GNI per capita crossed the threshold between lower and upper middle-income countries according to the World Bank Classifications[3]. Annual growth exceeded 15% in the period 2011–2012. Large foreign direct investment (FDI) in the mining sector helped this rapid growth. Foreign FDI averaged 40 percent[4] of GDP during that period. However, in 2015, Mongolia was re-designated as the lower middle-income country because the economy has faced sharp declines in FDI and coal exports

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[3] See the website https://datatopics.worldbank.org/world-development-indicators/the-world-by-income-and-region.html

[4] Data from World Bank

since 2014. During the years of low FDI and coal exports, the Mongolian government expenditure increased with large fiscal deficits and external borrowing. As a result, public debt has risen sharply. For instance, public debt reached 77.4% of GDP in 2020 and, given ongoing deficits, it is expected at 81.5% of GDP in 2021 (IMF 2021).

The Mongolian economy also suffered from serious inflation. During the transition period, 1991 to 1994 the rate of the annual increase in consumer prices reached its peak of 420[5] percent. Even after the transition period, the inflation rate was mostly recorded in double digit percentage.

Figure 2. Inflation rate

Source: National Statistical Office

To stabilize inflation the Government of Mongolia and the BoM made several efforts. The BoM had a monetary aggregate targeting framework from 1995 to 2006 with reserve money as the operating target and M2 as the intermediate target. Difficulties were raised in conducting monetary aggregate targeting due to the volatility of the money multiplier, so the BoM needed

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[5] January 1993

another nominal anchor and started announcing the inflation target rate publicly in 2002. The ultimate intention was to shift to an inflation targeting framework in the future. Under the new framework, the BoM introduced the policy rate in 2007 and stopped targeting the monetary aggregate. However, after being hit by the global financial crisis in 2009, BoM accepted the IMF Stand-By Program to safeguard the foreign exchange reserves. The program required the BoM to temporarily target monetary aggregate until 2011, the completion year of the program. Since 2011, the BOM has been considering moving toward an IT regime as the guiding framework for monetary policy. BoM is trying to meet several initial conditions in support of a move to inflation targeting, such as pursuing a phased medium- and long-term program to improve monetary policy implementations, and adopting a formal forecasting framework, Forecasting and Policy Analysis System (FPAS), to reinforce the link between the policy rate and the inflation expectation. But it is not an easy task for BOM to maneuver the longer-term inflation rate in the desired direction, and it often misses the inflation target, and every time it misses its credibility decreases as well.

Figure 3. Inflation and Inflation target rates (January 2002- August 2022)
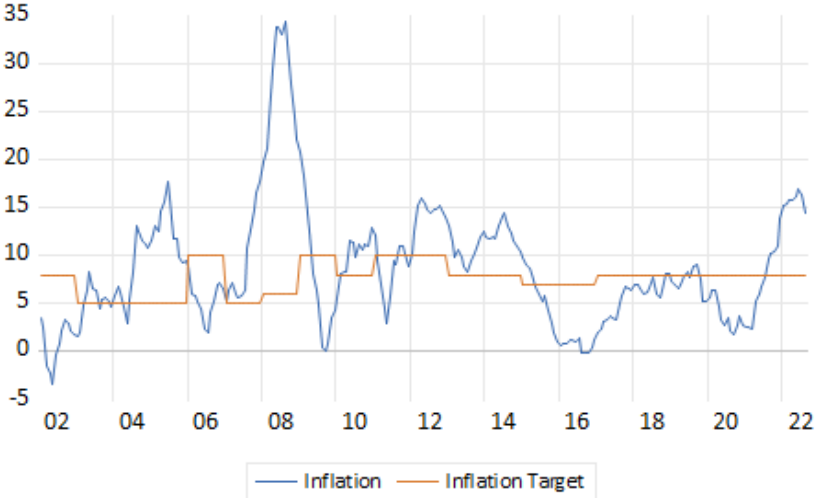
Source: National Statistical Office

Figure 4. Deviation from target inflation rate
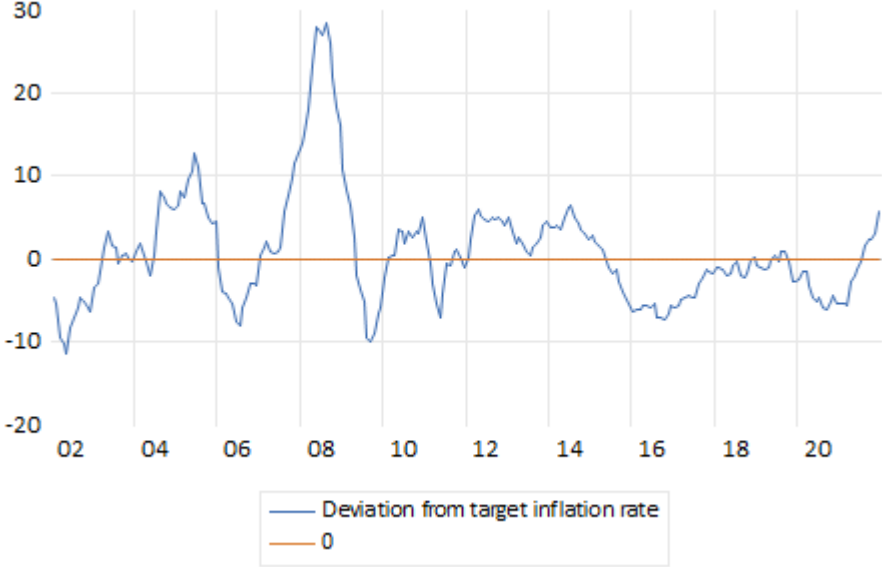
Source: National Statistical Office

CHAPTER 2

LITERATURE REVIEW

This section reviews previous studies on inflation targeting regime, and its performance in other countries, and in Mongolia.

Since its inception three decades ago, the IT regime and its performance have been examined by a significant number of academics and economists. The main questions were how IT regime countries have performed compared to non IT regime countries and whether IT has made a significant difference in macroeconomic performances such as actual inflation, its volatility, and economic growth. One of the earliest studies, Svensson (1998) compared targeting of CPI and domestic inflation, strict and flexible inflation targeting, and inflation targeting reaction functions and the Taylor rule and concluded that flexible. He concluded that CPI-inflation targeting works better in limiting the variability of CPI inflation, output gap, and exchange rate in a small open economy. Carare and Stone, (2005) classified countries that define their monetary policy regimes as IT into fully fledged, eclectic, and inflation targeting lite regimes. This paper is useful to assess where Mongolia belongs and get fundamental insights into the appropriate design of monetary policy conditional on the country's circumstances. Another important literature that includes fundamental concepts of IT regime, case studies of 9 countries, and empirical evidence is conducted by Bernanke et al. (1999). The result of the case studies showed that IT was successful in reducing both inflation and private sector inflation expectations. Like these literatures, previous research on IT has focused on high-income countries and emerging market economies' performances. However, there are not many studies conducted on the effect of IT regime in Low Income Countries.

Studies focusing on advanced economies mainly found insignificant and small effects of

inflation targeting and use various approaches to evaluate the performances. Neumann and Hagen (2002) compared six advanced IT countries and three advanced non IT countries' data from 1978 to 1998. They used difference in difference approach and concluded: IT has proven a useful strategy for reducing the level and volatility of inflation. Ball and Sheridan (2005) measured the effects of inflation targeting on macroeconomic performance in twenty OECD countries seven that adopted inflation targeting during the 1990s and thirteen that did not and concluded that there was no evidence that inflation targeting improves performance as measured by the behavior of inflation, output, or interest rates. They used difference-in-differences approach. In their words, "Just as short people on average have children who are taller than they are, countries with unusually high and unstable inflation tend to see these problems diminish, regardless of whether they adopt inflation targeting." Alvaro and Philip (2006) applied intervention analysis to structural time series models in the case of 10 high income countries and concluded that inflation targeting strategy in terms of its initial impact on inflation was not supported by the empirical evidence and they said that in most cases, inflation had already entered a downward trend before inflation targeting was introduced. Gonçalves and Carvalho (2009) concluded that IT regime countries had been able to "disinflate" less costly after investigating OECD economies that experienced at least one disinflationary episode during the 1970-2004 period.

Studies focusing on emerging economies mainly found that adopting IT significantly reduced average inflation. Mishkin and Schmidt-Hebbel (2007) used Ordinary Least Squares and instrumental variables estimation techniques and examined 21 inflation targeting and 13 non targeting countries' data covering 1989-2004. The selected countries include both advanced and emerging countries. They did not find a significant impact of IT on inflation from their sample of

7

advanced economies. However, they found that emerging countries gained better inflation, inflation volatility, and output volatility performance if compared to their own pre-targeting performance. Based on a detailed survey of 31 central banks, Batini and Laxton (2006) found that inflation targeting in emerging-market countries brings significant benefits to the countries that adopt it relative to other strategies, such as money or exchange rate targeting. They also used difference in difference approach. There are only a few studies that have assessed the performance of IT during the global economic crisis in 2009. Filho (2010) analyzed a sample of 84 countries' performances during crises and found that IT countries dealt with the crisis better than non-IT countries.

Studies focusing on the IT performance of Low-Income Countries (LIC) are less than advanced and emerging countries' studies. Gemayel et al., (2011) found that inflation targeting was associated with lower inflation and inflation volatility in three LIC[6] that had adopted IT. He also stated preconditions for the adoption of inflation targeting. The recent work by Morozumi et al. (2020) is another paper that discusses inflation targeting within LIC. They studied 185 countries' data for the 1980–2016 period and found that IT was not as effective in reducing inflation in LICs as in EMEs due to the relatively low central banks' instrument independence in LICs, associated with weak restrictions limiting a central bank's lending to the government.

Since the adoption of the IT regime of Mongolia is not categorized as a fully-fledged, none of the above literature included data on Mongolia. However, there are several studies conducted by the Bank of Mongolia's economists on the relationship between macroeconomic variables and inflation. Ulziideleg (2016) studied data from 1994-2004 and modeled the

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[6] According to Gemayel et al., 2011 IMF's Monetary and Capital Market Department (MCM) classification there were only three LICs worldwide that adopted IT– Ghana, Armenia, and Albania in 2011.

relationship between money supply, exchange rate, and inflation via CPI in Mongolia. The result showed that both money supply and exchange rate have highly effective on inflation. Doojav (2011) studied quarterly data from 2000 to 2011 and found that the exchange rate acts as a shock absorber in the economy rather than a source of shocks by using a Structural Vector Autoregression model. This study helped to conclude that adopting flexible exchange rate policy in Mongolia will promote monetary policy independence to control and stabilize inflation.

CHAPTER 3

INFLATION TARGETING FRAMEWORK OF MONGOLIA

In this section, I will assess which type of IT regime Mongolia belongs to using Carare and Stone's (2003) method. Knowing this will help us to appropriately design the monetary policy conditional on the country's circumstances. And then verify whether Mongolia meets the prerequisites to adopt fully fledged IT.

Carare and Stone, (2003) have classified inflation targeting countries into three separate regimes: fully fledged inflation targeting (FFIT), eclectic inflation targeting, and inflation targeting lite. They made a presumption that countries with a floating exchange rate make a commitment to an inflation target. So, they excluded countries that are small and less developed (the countries with GDP under 4 billion USD in 2000) from their study because they tend to choose fixed exchange rate or adopt the currency of their largest trading partner. Mongolia's GDP was under 4 billion USD in 2000, so it was excluded from the classification. However, since 2019[7] Mongolia has been reclassified as a country that has a floating exchange rate by IMF. So, I assume that Mongolia has met the presumption and I will use their classification method to see where Mongolia belongs today. The regimes are classified by the clarity and credibility of the central bank's commitment to the inflation target. According to their method, Mongolia classifies as an Inflation Target Lite regime country.

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[7] The IMF's 2021 Annual Report on Exchange Arrangements and Exchange Restrictions

Table 1. Assessment of IT regime classification

1.Clarity of commitment to inflation target		
Separation	Characteristics	Mongolia: Characteristic
Countries with clear commitment	Make an explicit commitment to an inflation target and implement a transparent framework to ensure that the central bank is accountable for the target. They have numerical inflation targets expressed as a point target or as a range defined.	
Countries without clear commitment	Do not explicitly commit to an inflation target and some have other stated objectives as well. They announce some sort of inflation objective or intention to aim at general price stability. Many explicitly specify other objectives, such as the nominal exchange rate, real exchange rate, and international reserves.	"Monetary Policy Guidelines" is approved by the Parliament annually. The inflation target has been specified in this guideline every year since 2002. However, other objectives such as exchange rate and foreign reserves are still applicable in Monetary Policy decision making.[8]
2.Credibility of the inflation targeting regime		
Separation	Characteristics	Mongolia: Characteristic
High credibility	First actual rate of inflation was low[9] (1999-2002). Second the Standard and Poor's long term local currency government debt rating for 2001 was high.	

[8] "Although the BOM has adopted inflation as the de facto nominal anchor for the last decade, de jure it is the MNT/US$ exchange rate which serves as the nominal anchor because of concerns about financial dollarization and a disorderly depreciation in thin markets." (IMF 2021)

[9] EIT countries average inflation was 1.2 and the rating average was 2, for FFIT counties average inflation was 4.4 and the rating average was 7.2, for ITL counties average inflation was 10 and the rating average was 14.7.

Low Credibility	Actual Inflation rate was high (1999-2002), government debt rating was low.	The actual inflation rate average (1999-2021) is 8.4, which is like IT Lite countries' performance. In July 2022, S&P Global Ratings affirmed its 'B' long- and short-term sovereign credit ratings of Mongolia with gross general government debt/GPD 77 percent, which is high as IT Lite countries in 2001.

Carare and Stone (2003) also studied data on structural and policy changes that FFIT countries chose to make before adopting FFIT. The result showed that FFIT emerging market countries reduced inflation, consolidated their fiscal position[10], and experienced significant financial deepening[11] before adopting FFIT.

The preconditions for the adoption of IT discussed in previous studies are similar to each other. (for instance Carare and Stone, 2003, and Bernanke et al.,1999) The most recent study by Gemayel et al.(2011) focused on Low-Income Countries' preconditions. I summarized the prerequisites discussed in those papers and verified the completion of those conditions of Mongolia[12].

The first precondition is that the central bank maintains independence, including the absence of quasi fiscal roles, the presence of operational independence, and a low likelihood of

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[10] Such as government debt to GDP decreased.

[11] Such as stock market capitalization increase.

[12] Mongolia is categorized as a Lower Middle-Income country, which is close to Lower Income Country category. The other studies focus on emerging market economies and advanced economies.

fiscal pressures given moderate public debt and fiscal balance conditions. According to the Law on Central bank[13], the Central bank's activities shall be independent from the Government, price and financial stability are the central bank's mandate, and decisions on monetary policy and financial supervision are made collectively in committee. The law aims to strengthen the central bank's independence. However, it is specified that the amount of Central bank loans issued to the Government shall not exceed 10 percent of the average of the past 3 years' budget revenue in the law. This condition is burdening the process of the financing being accumulated without any inflationary pressures. According to Morozumi et al. (2020), where fiscally driven inflationary pressure is present, the central bank lacks the ability to adjust instruments, eventually failing to anchor actual inflation to the target. As mandated in the Anti-Pandemic Law of 2020, the BoM has resumed quasi-fiscal activities including purchasing a public enterprise bond to finance a debt relief scheme, resuming a subsidized mortgage program, and extending concessional loans to gold miners in 2020−2021 to support the economy during the pandemic. These quasi fiscal activities are expected to be extended till 2023 under the draft post-pandemic economic recovery law. Limited operational independence undermines the BoM's credibility and effectiveness, holding back its ability to control inflation and financial stability. Moreover, the general government's debt is 79.8 percent and the account balance is -12.8 percent of GDP[14] in 2021. The sovereign ratings of 'B'[15] is affirmed and underpinned by these indicators. The debt burden is above the median of 65.9 percent for the 'B' rating category countries.

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[13] Approved first in 1996, revised in 1998, 1999, 2003, 2010, 2011, 2013, 2015, 2017, 2018, and 2019.

[14] IMF WEO

[15] July 2022, S&P Global Ratings

The second precondition is that the inflation forecasting and modeling capabilities in the central bank, including good data availability should be present. Since 2011 BoM has been working on a more forward-looking monetary policy framework, Forecasting, and Policy Analysis System (FPAS). Bayarsaikhan. B et al. (2015) studied to determine the macroeconomic effects of monetary policy shock and its transmission mechanism. Bayarsaikhan and his colleagues stated that the BoM lacks a well-defined operational target and anchor for inflation expectations.

The third precondition is that for effective inflation control, prices must be fully deregulated, the economy should not be overly sensitive to commodity prices and exchange rates, and dollarization should be minimal. According to Doojav's (2009) study based on the data from January 1998 to January 2008, the exchange rate pass-through into inflation is about 55 percent in short term. The dollarization of the banking system's liabilities was 28.6 percent in January 2021[16]. There is no specific annual inflation rate target stated in accordance with the Law on Central Bank. The target inflation rate proposed by the Bank of Mongolia is officially approved only after being discussed at the Parliament of Mongolia. To effectively control inflation the Central Bank's ability to sustain market confidence and manage its expectations is crucial. The Bank of Mongolia publishes the Inflation Report each quarter to inform the public on the performance and forecasts of macroeconomic indicators, inflation, near term economic outlook, and factors that influence overall economic outlooks since 2015. the BoM's inflation target was 8 percent, which is high relative to other inflation targeting countries until 2021. The target rate has changed to 6 percent with the +/-2 range in 2021 according to the "Monetary

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[16] Inflation report 2021 March Bank of Mongolia

Policy Guidelines" approved by the Parliament. Even though BoM maintained a high inflation target rate, the inflation escalated and remained above the central bank's target for the past 16 consecutive months[17].

The final precondition is minimal potential for conflict with financial stability objectives, given a sound banking system and a reasonable development of local capital markets conditions. According to the Law on the Central Bank, it is stated that "The main objective of Bank of Mongolia is to sustain the stability of national currency tugrug (MNT)" and this statement can be interpreted in two manners. For instance, the stability of MNT in the external market refers to the stability of exchange rate of MNT in foreign currencies, whereas the stability of MNT in the domestic market refers to the stability of the Consumer Price Index.[18] Since price stability objective co-exists with exchange rate stability objective, which is unavoidable for Mongolian economy, which is small and open, the benefits of inflation targeting will be diminished. (Gemayel et.al 2011). According to the Asian Development Bank report[19] Mongolia's banking system is fairly well developed even though there are some critical problems in this sector, such as highly concentrated bank structure and recurring financial scandals. The domestic credit to to private sector was 45.8 percent of GDP which is comparable to the region's more developed economies.

Clearly, Mongolia appears to fall short of meeting several of the above preconditions.

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[17] Before August 2022

[18] https://www.mongolbank.mn/eng/listmonetarypolicy.aspx?id=0101

[19] Mongolia's Economic Prospects: Resource-Rich and Landlocked Between Two Giants

CHAPTER 4

DATA AND METHODOLOGY

The sample includes 28 annual observations from 1994 to 2021. EViews10 was used in further analysis. Variables used in the estimation are obtained from the National Statistical Office. Variables:

p- Natural logarithm of the CPI, base year 2015

y- Natural logarithm of the real GDP, base year 2015

m- Natural logarithm of the real money supply, (m2/CPI)

e- Natural logarithm of the exchange rate (MNT per U.S. Dollar, period average)

I estimated a vector autoregressive (VAR) model of the CPI to evaluate the feasibility of using inflation targeting. VAR model shows which causal factors are the most important sources of continuing inflation and thus the feasibility of reducing inflation by means of monetary policy. Before estimating the VAR model, unit roots, stationarity, cointegration, residual serial correlation, and heteroscedasticity were checked.

First, Augmented Dickey-Fuller (ADF) test is used for testing unit roots and stationarity of these variables. Regressing two nonstationary variables on each other may create a problem of spurious regression, which refers to the situation where correlation is found to be present between the ratios of variables even though the original variables are uncorrelated or random. Therefore, the variables need to be examined.

Table 2. Stationarity test result

Indicators	No difference				1 level			
	t-Statistic	Test critical value		Y/N	t-Statistic	Test critical value		Y/N
		1 %	5%			1 %	5%	
p	-1.9	-3.6	-2.9	N	-5.58	-3.6	-2.9	Y*
y	0.09	-3.6	-2.9	N	-5.12	-3.6	-2.9	Y*
m	-0.58	-3.6	-2.9	N	-4.29	-3.6	-2.9	Y*
e	-3.16	-3.6	-2.9	Y*				

The variables e was stationary at a 5 percent significance level, and p, y and m were not stationary. When the first order difference was used for variables p, y and m, the result showed that they are stationary at a 1 percent significance level. So, in this study, the first order differences were used.

Figure 5.

Inverse Roots of AR Characteristic Polynomial
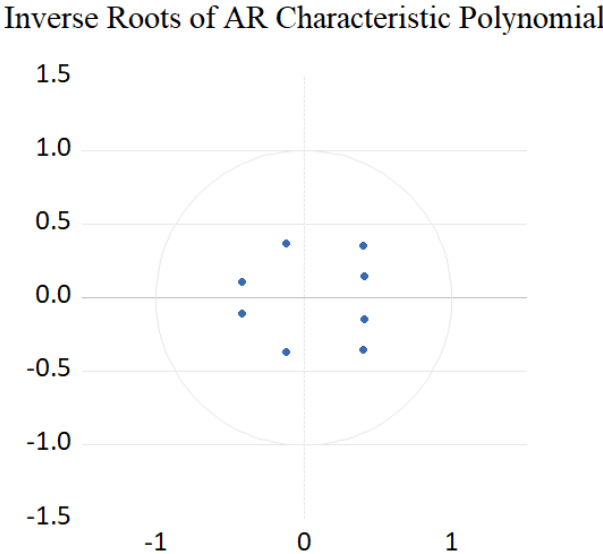
If all the inverse roots of the characteristic AR polynomial have modules less than one and lie inside the unit circle, the VAR estimate is stable. The stability of the VAR model implies stationarity. Figure 5 shows that all the inverse roots of the characteristic polynomial are inside the circle. So, the stationarity condition was satisfied.

VAR residual serial correlation LM test has been done to investigate which lag is appropriate to use. Serial correlation LM is a test for autocorrelation in the errors in a regression model. The null hypothesis is that there is no serial correlation of any order up to p (lag). The test result showed that the null hypothesis is rejected at lag 1 (p-value=0.01) and failed to reject at lag 2 (p-value=0.20). So, I concluded that there is no serial correlation at lag 2. The result is attached in Appendix A.

I also tested for heteroscedasticity. An important assumption of the classic linear regression model is that the variance of each disturbance term is some constant number equal to sigma square. It means that the model is homoscedasticity and OLS will be the best linear unbiased estimator (BLUE). The null hypothesis is that the model is homoscedasticity. If the null hypothesis is rejected, the model will be heteroscedasticity which means that OLS will not be the BLUE. The test result showed that I failed to reject the null hypothesis (p-value=0.58) at lag 2. So, I concluded that the model is homoscedasticity. The result is attached in Appendix B.

The EViews offers several other useful tools to investigate the lag structure. The most used is the lag length criteria. The result is attached in Appendix C. In this study, I estimated the VAR model with two lags because the tests could not reject the null hypothesis of no serial correlation and homoscedasticity at lag 2.

Cointegration between the variables in the VAR(2) model is tested using Johansen Cointegration Test.

Table 3. Johansen cointegration test result

Ho: number of CE(s)	Eigenvalue	Trace statistic	Critical Value (5%)	Prob
None	0.89	85.7	47.8	0.00
At most 1	0.38	25.1	29.7	0.15
At most 2	0.25	12.1	15.4	0.14
At most 3	0.14	4.1	3.8	0.04

The trace and Eigen-value test have Ho: r=a versus Ha: r>=a+1 where r is the number of cointegration equations and a is set from zero to three sequentially. The result showed that there are at most two cointegrated equations in this model.

In this study, I would like to know whether changes in money supply, exchange rate, and GDP will have an impact on changes in Inflation. I used the Granger causality test to test the causal relationship between the variables.

Table 4. Granger causality test result

Dependent variable: d(p)	P-value	Dependent variable: d(m)	P-value	Dependent variable: d(e)	P-value	Dependent variable: d(y)	P-value
Regressors:							
d(m)	0.00	d(p)	0.10	d(p)	0.14	d(m)	0.87
d(e)	0.00	d(e)	0.00	d(m)	0.27	d(e)	0.61
d(y)	0.67	d(y)	0.65	d(y)	0.51	d(y)	0.78
Jointly	0.00	Jointly	0.00	Jointly	0.26	Jointly	0.95

The result showed the null hypothesis (change in money supply does not cause a change in CPI) is rejected at a 1 percent significance level. In other words, the Granger causality test says that the changes in the money supply cause changes in the CPI in Mongolia. Similarly, the null hypothesis has been rejected for the exchange rate and the test shows that the changes in the

exchange rate cause changes in the CPI. However, for GDP (p-value=0.67), I can conclude that changes in GDP do not cause changes in CPI because I failed to reject the null hypothesis.

Stock and Watson (2001) assessed how well VARs have addressed the four macroeconomic tasks; data description, forecasting, structural inference, and policy analysis, and concluded that for describing data and forecasting, VARs have proven to be powerful and reliable tools. So, VAR will be a useful and reliable tool in this study to describe the inflation determinants.

A VAR is an n-equation n-variable linear model in which each variable is in turn explained by its own lagged values, plus current and past values of the remaining n-1 variables. (Stock and Watson 2001). The general form of a VAR model is given by the following unrestricted (reduced form) system.

$$Y_t = a + \sum_{i=1}^{p} B_i Y_{t-i} + u_t$$

Where:

$$Yt = \begin{bmatrix} P_t \\ M_t \\ E_t \\ Y_t \end{bmatrix} \quad a = \begin{bmatrix} a_1 \\ a_2 \\ a_3 \\ a_4 \end{bmatrix} \quad B_i = \begin{bmatrix} \beta_{11,i} & \beta_{12,i} & \beta_{13,i} & \beta_{14,i} \\ \beta_{21,i} & \beta_{22,i} & \beta_{23,i} & \beta_{24,i} \\ \beta_{31,i} & \beta_{32,i} & \beta_{33,i} & \beta_{34,i} \\ \beta_{41,i} & \beta_{42,i} & \beta_{43,i} & \beta_{44,i} \end{bmatrix} \quad u_t = \begin{bmatrix} u_{1,t} \\ u_{2,t} \\ u_{3,t} \\ u_{4,t} \end{bmatrix}$$

I estimated the VAR model in this study with two lags, so p=2. The result showed that lag 1 and lag 2 of CPI, and lag 1 of money supply are statistically significant and have a positive effect on CPI in Mongolia. Also, lag 2 of the exchange rate is statistically significant and has a negative effect on CPI in Mongolia. The impulse responses for the VAR, ordered p, m, e, and y are plotted in Appendix D. The first row shows the response of CPI to an unexpected 1 percentage point increase in money supply, exchange rate, and GDP accordingly. According to

the impulse response plots, all these unexpected rises in variables slowly fades away over time.

The model estimation result is shown below.

Table 5. Vector Autoregression Estimates

	d(p)	d(m)	d(e)	d(y)
Sample:1994-2021				
Included observations: 28				
t-statistics in ()				
d(p(-1))	0.68	-0.65	0.63	-0.36
	(2.84)	(-1.23)	(1.79)	(-0.46)
d(p(-2))	0.23	-0.27	0.01	0.14
	(2.25)	(-1.17)	(0.09)	(0.41)
d(m(-1))	0.44	-0.01	-0.07	-0.33
	(4.29)	(-0.04)	(-0.49)	(-0.97)
d(m(-2))	-0.17	0.15	-0.30	0.07
	(-1.12)	(0.45)	(-1.32)	(0.14)
d(e(-1))	0.22	-0.09	-0.18	0.18
	(1.71)	(-0.32)	(-0.96)	(0.42)
d(e(-2))	-0.42	0.55	-0.32	-0.07
	(-4.07)	(2.40)	(-2.11)	(-0.20)
d(y(-1))	0.01	0.13	-0.12	0.08
	(0.13)	(0.74)	(-1.01)	(0.32)
d(y(-2))	-0.06	-0.07	0.05	0.12
	(-0.85)	(-0.44)	(0.42)	(0.48)
c	-0.01	0.16	0.09	0.12
	(-0.30)	(2.29)	(2.06)	(1.20)
R-squared	0.93	0.61	0.47	0.08
F-statistic	34.01	3.68	2.13	0.20
Log likelihood	43.71	21.59	32.81	10.34

CHAPTER 5

CONCLUSION

The IT regime in Mongolia can be categorized as an Inflation Targeting Lite according to

Carare and Stone (2003). The regimes are classified by the clarity and credibility of the central

bank's commitment to the inflation target. Due to having other stated objectives (exchange rate

stability), inflation performance (inflation rate average is 8.4[20]), government S&P Global Ratings

(affirmed its 'B' long- and short-term sovereign credit ratings), and with gross general

government debt of 77 percent on GPD, Mongolia falls into Inflation Targeting Lite countries,

characterized as countries without a clear commitment to the inflation targeting and with low

credibility. This result suggests that before adopting FFIT Mongolia should focus on reducing

inflation, consolidating its fiscal position[21], and committing to significant financial deepening[22].

After assessing the prerequisites stated in the literature (Carare and Stone, 2003,

Bernanke et al,.1999, Gemayel et al,.2011) Mongolia falls short of meeting several of them. For

instance, even though the Law on Central Bank has been revised several times to strengthen the

central bank's independence the BoM is still performing quasi-fiscal operations such as

subsidized mortgage programs. Limited operational independence undermines the BOM's

credibility and effectiveness, holding back its ability to control inflation. Having high general

government debt and account deficit for several years is decreasing the credibility of the

Government and the Central Bank which makes it hard to implement FFIT. While Mongolia's

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[20] During 1999-2021 (Carare and Stone, (2003) categorized countries based on data from 1999-2002)

[21] Such as government debt to GDP decreased.

[22] Such as stock market capitalization increase.

fear of floating the exchange rate is understandable given its import dependence and high

passthrough to inflation, meeting the precondition of stating inflation targeting as the only

objective is hard to achieve. As a result, Mongolia has not met most of the prerequisites to adopt

an explicit inflation targeting regime (FFIT). It would require independence of BoM operation

and monetary policy decision making, a significant upgrade in modeling capabilities within the

BoM, and financial stability.

Finally, the VAR model results show a relationship among the variables, CPI, money

supply, exchange rate, and GDP in Mongolia. The principal finding is that the money supply and

exchange rate are more important in explaining variation in CPI than GDP in Mongolia.

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VAR RESIDUAL SERIAL CORRELATION LM TEST RESULT

VAR Residual Serial Correlation LM Tests
Date: 10/28/22   Time: 14:33
Sample: 1970 2021
Included observations: 28

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	31.51427	16	0.0116	2.417075	(16, 37.3)	0.0133
2	20.65886	16	0.1920	1.385113	(16, 37.3)	0.2019

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	31.51427	16	0.0116	2.417075	(16, 37.3)	0.0133
2	51.62475	32	0.0154	2.006330	(32, 31.1)	0.0277

*Edgeworth expansion corrected likelihood ratio statistic.

APPENDIX B

VAR RESIDUAL HETEROSCEDASTICITY TESTS RESULT

VAR Residual Heteroskedasticity Tests (Levels and Squares)
Date: 10/28/22   Time: 14:33
Sample: 1970 2021
Included observations: 28

Joint test:

Chi-sq	df	Prob.
155.5876	160	0.5838

Individual components:

Dependent	R-squared	F(16,11)	Prob.	Chi-sq(16)	Prob.
res1*res1	0.638708	1.215394	0.3787	17.88383	0.3307
res2*res2	0.361072	0.388520	0.9580	10.11000	0.8608
res3*res3	0.653934	1.299114	0.3355	18.31015	0.3061
res4*res4	0.492175	0.666312	0.7765	13.78089	0.6150
res2*res1	0.546749	0.829319	0.6435	15.30897	0.5021
res3*res1	0.881762	5.127035	0.0045	24.68933	0.0755
res3*res2	0.587050	0.977350	0.5300	16.43740	0.4229
res4*res1	0.334921	0.346212	0.9734	9.377796	0.8970
res4*res2	0.469773	0.609113	0.8217	13.15363	0.6615
res4*res3	0.401162	0.460558	0.9228	11.23255	0.7949

APPENDIX C

VAR LAG ORDER SELECTION CRITERIA RESULT

VAR Lag Order Selection Criteria
Endogenous variables: D(P) D(M) D(E) D(Y)
Exogenous variables: C
Date: 10/28/22   Time: 14:40
Sample: 1970 2021
Included observations: 28

| Lag	LogL	LR	FPE	AIC	SC	HQ
0	75.58766	NA	7.07e-08	-5.113404	-4.923089	-5.055223
1	114.1946	63.42567*	1.43e-08*	-6.728185*	-5.776610*	-6.437279*
2	129.6849	21.02261	1.60e-08	-6.691781	-4.978947	-6.168151

* 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

APPENDIX D

IMPULSE RESPONSE

Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

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