MEASURING EXCHANGE MARKET PRESSURE IN MONGOLIA: EMP index*

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Abstract

The study estimates the exchange market pressure (EMP) in Mongolia over the period 2000-2010. EMP index measured as Siregar&Pontines (2007) methodology as the sum of exchange rate changes, reserve changes and policy rate changes. The study also, examined a threshold level for signal of currency crisis and macroeconomic fundamentals to determine EMP in Mongolia.

The results obtained suggest that (i) EMP index based on central bank's intervention in domestic FX market observes more pressure comparing to EMP index calculated by standard methodology, (ii) threshold level estimated by 3 sigma-rule and extreme value theory suggest that there was 5 signals of exchange market pressure during the study period, 3 of which were real currency crisis signal (end of 2008), (iii) the result of single-equation and structural vector auto-regression models (SVAR) provides evidence that exchange market pressure is consistent with Girton & Roper (1997) model which explained by change in domestic credit, government expenditure, real income, inflation and real interest rate differentiation.

JEL classification: F31, F41

Key words: Exchange market pressure index, exchange rate, currency crisis

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*The views expressed in this paper are those of the staffs and to not necessarily represent position of Bank of Mongolia. Thus any error or mistakes belong to the staffs.

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I. INTRODUCTION

Mongolia is expecting the world highest economic growth in coming decade. Its vast mineral deposits and stable investment opportunities are attracting massive foreign capital inflows in mineral sector and creating long lasting economic prosperity. As of 2010, net flow of FDI increased 2.8 times reaching USD 1.6 billion, portfolio investments rose 13.4 times amounting to USD758.4 million, and the outstanding of private sector debt doubled reaching USD 1.1 billion.

This influx of capital flows may increase our economic vulnerabilities to external shocks. Many empirical studies suggest that it has substantial risks to lead to unfavorable consequences such as further real exchange rate appreciation, loosened competitiveness of national producers in foreign and domestic markets, increased vulnerability of banking and financial sector, bubble price of real estate, increased inflation, and instability of nominal exchange rate due to the difference in productivity.

In this circumstances, it is required to implement sound macroeconomic policy that creates sustainable economic growth in medium and long run. In this framework, one of issues needed to examine and implement is to determine exchange market pressure with numerical values and to review opportunity to use it in exchange rate policy.

In international experience, pressure on domestic currency is expressed by "exchange market pressure (hereinafter "EMP") index". Griton&Roper (1977) calculated EMP index based on the balance of money market for the first time for Canada as the change in nominal exchange rate cannot fully demonstrate surplus supply and demand of exchange market for countries with high intervention of central bank in domestic exchange market. This monetary approach considers that decision makers regulate exchange market pressure through either the change in nominal exchange rate, or official foreign reserves of central bank, or the change in monetary policy of central bank, or combination of these.

The calculation of EMP index has following benefits. *Firstly*, to determine exchange market real pressure, to develop monetary and exchange rate policy that absorbs in economy at minimum cost, and to evaluate outcome of policy implementation. *Secondly*, to create opportunity to prevent currency crisis. *Lastly*, to study sustainability of regional macro-economy and negative impact of exchange market pressure of neighboring countries on the exchange rate of national currency.

This paper has three main objectives: (i) to calculate EMP index, (ii) to determine critical level of EMP index to prevent currency crisis, and (iii) to determine macro factors that explain EMP index. In other words, to calculate EMP index of Mongolia by the methodology as same as in member countries of SEACEN, to determine whether the index is below or higher than critical level that leads to crisis, and to look for opportunity to assume this criterion using main variables of macro economy in the future.

This approach is done in Mongolia for the first time. The paper does not cover other issues such as comparison of methods to calculate EMP index, its impact on monetary policy, methodology to make short term assumption, and impact on macro economy.

Next chapter of the paper presents research background of the topic; third chapter explains calculation of EMP index; fourth chapter explains the results of study on criticial level to prevent currency crisis; last chapter determines macro-economic factors that determine EMP econometrics methodology, and the paper ends by conclusion and recommendation.

II. THEORITICAL BACKGROUND

Economists calculate EMP index, which shows tendency of national currency to depreciate/appreciate and the equilibrium of domestic money market, because the change in exchange rate of national currency cannot fully demonstrate exchange market pressure. This index explains if exchange market pressure is absorbed either as appreciation/depreciation of nominal exchange rate, or increase/decrease in official foreign reserves, or increase/decrease in interest rate.

Exchange market pressure is absorbed by only the change of nominal exchange rate in countries with flexible exchange rate regime, by only the change of official reserves in countries with fixed exchange rate system, and by the changes of exchange rate and reserves in countries with managed floating regime.

As stated in the previous chapter, Griton&Roper (1977) calculated EMP for the first time based on monetary model of exchange rate as the sum of the changes in official foreign reserves and nominal exchange rate as follows.

$$\boldsymbol{EMP_t = e_t + r_t} \quad (1)$$

Where, e_t-change in nominal exchange rate,

r_t - change in official foreign reserves of central bank

Weymark (1997) included the criterion of the change in reserves into calculation of EMP index based on the model of small and open economy with price rigidity as follows.

$$\boldsymbol{EMP_t = \Delta e_t + \varphi \Delta r_t} \quad (2)$$

where, $\Delta e_t$is change in nominal exchange rate, Δr_t is change in official foreign reserves of central bank, $\varphi = -\frac{\partial \Delta e_t}{\partial \Delta r_t}$ is elasticity.

Following studies expanded above models by including response of monetary policy in EMP index calculation thus reflected the change in policy interest rate of central bank.

Table 1. List of recent studies by chronological order

Research	Exchange rate	Official foreign reserve	Interest rate difference
Griton & Roper (1977)	*	*	
Kaminsky & Reinhart (1999)	*	*	
Glick & Hutchison (2000)	*	*	
Edison (2003)	*	*	
Khawaja (2007)	*	*	
Eichengreen (1995)	*	*	*
Nitithanprapas&Willett (2000)	*	*	*
Bordo (2001)	*	*	*
Bussiere & Fratzscher (2002)	*	*	*
Siregar & Pontines (2007	*	*	*

Specifically, Eichengreen (1995) emphasized the need to reflect significance of response of monetary policy during crisis and inserted policy interest rate into EMP index calculation. In other words, central bank can intervene directly through selling and buying foreign currency in the market, or indirectly through changing interest rate. EMP index is formulated in this approach as follows.

$$\boldsymbol{EMP_t} = \Delta \boldsymbol{e_t} + \boldsymbol{w_r} \Delta \boldsymbol{r_t} + \boldsymbol{w_i} \Delta \boldsymbol{i_t} \tag{3}$$

Where, w_r is ratio of change in reserves in EMP index,

w_i- ratio of change in interest rate in EMP index $w_r > 0, w_i > 0$

Above ratios are calculated by two methods. First method is based on structure model; specifically it applies estimation results of monetary approach of Girton&Roper (1977) and Weymark (1995) to determine exchange rate. The advantage of this method is the ratio of the indicator is well explained by economic theory.

Another method is method of the ratio to decrease variance used by Eichengreen (1996). This approach is widely used in the practice because of its advantage that each indicator does not overweigh in terms of variance and is easily calculated as it compares the variance of changes in reserves and interest rate to the variance of exchange rate. For instance, EMP calculation used in this paper is based on following formula of Kaminsky, Lizondo, and Reinhart (1999).

$$\boldsymbol{EMP_t} = \frac{\Delta \boldsymbol{e_t}}{\boldsymbol{e_t}} - \frac{\sigma_e}{\sigma_r} \frac{\Delta \boldsymbol{r_t}}{\boldsymbol{r_t}} \tag{4}$$

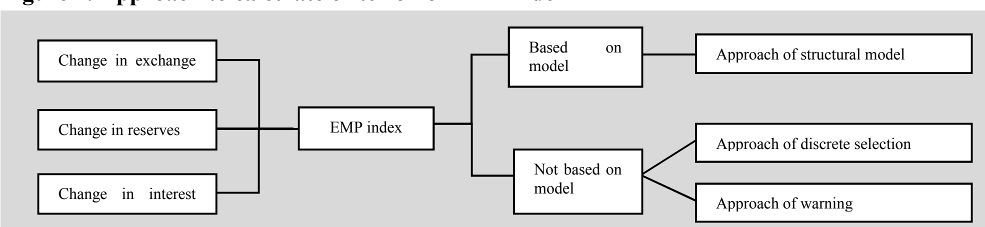
where, σ_e- standard deviation of exchange rate, σ_r-standard deviation of reserves

Regarding application of EMP index, it is significant to calculate the criterion that can lead to currency crisis. Researches done in this regard can be divided into two groups: based on model and not based on model, in general.

Previously explained formula of EMP index of Griton& Roper (1977) and Eichengreen (1996) is approach based on structural model. It is criticized for the fact that it cannot explain short term trend of exchange rate.

One way of another approach aims to determine probability of crisis, potential expenses and duration using econometrics method (Logit, Probit, VAR model) based on discrete data. Another way determines macro factors that can lead to currency crisis, and studies opportunity to prevent the crisis through calculation of their critical value.

Figure 1. Approach to calculate criterion of EMP index



Source:Chui (2002)

In Mongolia, it is first research on EMP index. However, studies that calculated sharp floating, which expresses instability in foreign currency market, taking only change in nominal exchange rate as exchange market pressure have been carried out in the past.

Ts. Munhbayar (2010) determined sharp floating as ±0.6 in consecutive three days by calculating maximum floating using data for the period of 2006/01-2010/04 assuming announced exchange rate of togrog versus USD has Normal distribution. In other words, he considered that the condition for central bank to intervene exchange market will be created if daily floating of nominal exchange rate exceeds above limit.

S. Bilguun (2010) calculated critical value for the period of 2003/01-2010/08 using Extreme value theory as floating of nominal exchange rate of togrog against USD tends to have non-standard distribution. He concluded: (i) tails of distribution of floating follow Frenchent distribution, and (ii) emergency comes in the market when nominal exchange rate appreciates by 0.5% or depreciates by 0.4%.

III. EMP INDEX CALCULATION

This paper uses following index of Siregar&Pontines (2007), which is calculated with three variables, in the calculation of EMP index.

$$\boldsymbol{EMP_t} = \frac{\Delta e_t}{e_t} - \frac{\sigma_e}{\sigma_{nir}}\left(\frac{\Delta res_t}{res_t}\right) + \frac{\sigma_e}{\sigma_r}(\Delta \boldsymbol{i_t}) \quad (5)$$

where: EMP_t – exchange market pressure index

e_t nominal exchange rate of national currency against USD

res_t foreign official reserves deducted by monetary gold

i_t policy interest rate

σ_e standard deviation of change in nominal exchange rate of togrog against USD

σ_{nir} standard deviation of change in official foreign reserves

σ_r standard deviation of change in policy interest rate

As seen in Equation (5), an increase of EMP index demonstrates the depreciation of nominal exchange rate of national currency, the decrease of official foreign reserves, or the increase of domestic interest rate. In other words, increased index will raise pressure of national currency to be sold.

Following data for 2000-2010 is used in the calculation of EMP index:

Nominal exchange rate [e_t]: end-of-month nominal exchange rate of togrog/USD announced by Bank of Mongolia. Data is taken from monthly bulletin of Bank of Mongolia.

Policy interest rate [r_t]: Bank of Mongolia has made interest rate of 7 day-bill of central bank as policy interest rate since July 2007. Therefore, dynamics of this criterion for 2000-2010 is represented by weighted mean of interest rate of 7 day-bill of central bank. Data is taken from monthly bulletin of Bank of Mongolia.

Official foreign reserves 1 [$res1_t$]: Data on intervention in exchange market is missing in most countries. Therefore, number of intervention is represented by the change in official foreign reserves. Data is also missing in Mongolia. So, it is represented by the change in reserves. ($res1_t$ is calculated as official foreign reserves minus monetary gold).

Official foreign reserves2 [$res2_t$]: As report on flows of official foreign reserves shows, change in official foreign reserves differs from intervention amount by USD2.9 billion during 2000-2010 (Figure 2). Therefore, in order to make EMP index calculation realistic, the balance[§] of official foreign reserves at the end of 1999 or beginning of 2000 is taken as USD1,700 million, and balances of following years adjusted by deducting or adding intervention amount. Dynamics of official foreign reserves reflected intervention is shown in Figure 3.

Figure 2. Official foreign reserves /OFR/

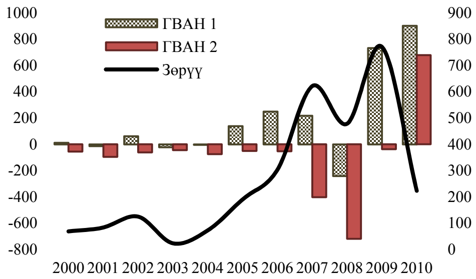
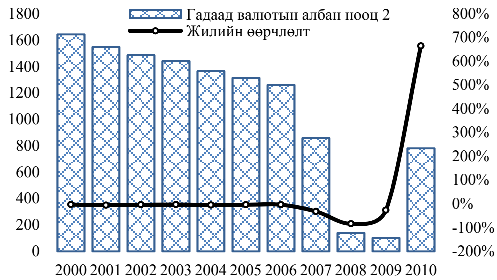


Figure 3. Official foreign reserves 2



Intervention amount of Bank of Mongolia is represented by USD spot trades done with commercial banks by Bank of Mongolia. In order to calculate data, statement of commercial accounts of foreign currency of Bank of Mongolia is taken from the system, and FX trade amount is consolidated.

When EMP index is calculated separately by two criteria of official foreign reserves, it turns out the result shown in Figure 4. As seen from Figure 4, statistics (Table 2) and distribution (Figure 5, 6) of EMP indices, EMP2 calculated by intervention is more stable in 2000-2008, and swung up during crisis of 2008/2009 and down during large flows of foreign currency in 2009-2010. In other words, EMP2 index better determines exchange market pressure. Therefore, EMP index is further represented by EMP2 index.

Figure 4. EMP1, EMP2 calculation

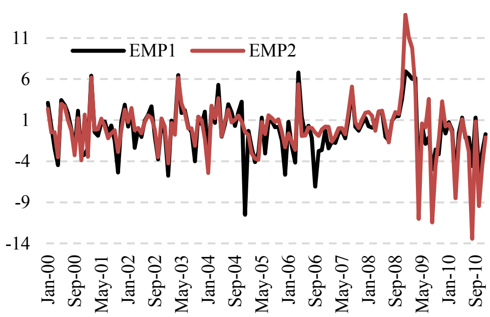


Table 2. Statistics

	EMP1	EMP2
Mean	-0.182576	0.069536
Median	0.110000	0.125689
Maximum	6.940000	13.84258
Minimum	-10.52	-13.43006
Std. Dev.	2.960940	3.487162
Skewness	-0.143313	-0.292796
Kurtosis	3.938486	7.754218
Jarque-Bera	5.296002	126.2003
Probability	0.070793	0.000000
Sum Sq. Dev.	1148.499	1592.999
Observations	132	132

[§]Official foreign reserves flow consist of monetary gold, revenue, expense and financing of loan and aid of Government programs, transaction of Bank of Mongolia, and nostro replenishment of banks. So, beginning balance is taken at large amount and official foreign reserves are considered to be positive in terms of time series.

Figure 5. EMP1

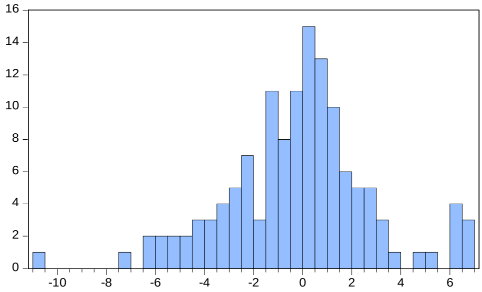
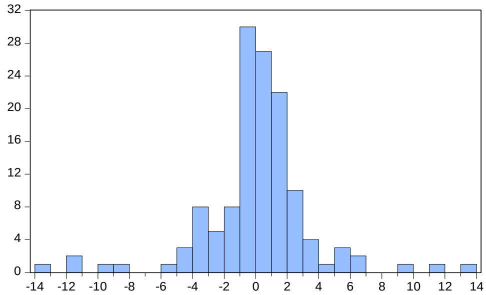


Figure 6. EMP2



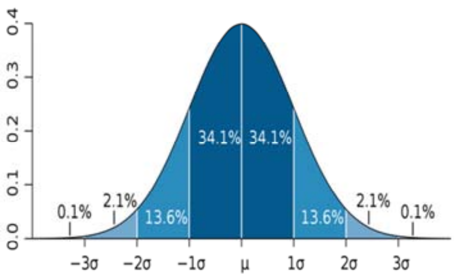
IV. MEASURING EMP INDEX THRESHOLD LEVEL

An application of EMP index is using it as early warning signal to prevent currency crisis. Therefore, this chapter estimates critical value of EMP index that leads to currency crisis using Three sigma rule and Extreme value theory.

4.1 Three-sigma rule

The simplest way to answer this question is following statistical rule of Three-sigma (Figure 7). For instance, probability of 2 out of 7 days in daily series to fall within standard deviation from mean variable of that sample is 68%.

Figure 7. Three-sigma rule



$\mu \pm \sigma$ or 68.26% of distribution is within 1 standard deviation from the mean,

$\mu \pm 2\sigma$ or 95.44% of distribution is within 2 standard deviations from the mean,

$\mu \pm 3\sigma$ or 99.73% of distribution is within 3 standard deviations from the mean,

Currency crisis is defined as "*when value of EMP index becomes larger than the mean of the sample plus standard deviation*δ", based on above rule of Knedlik (2006). In other words:

$$\text{Crisis} = \begin{cases} \mathbf{1}, \text{if} \boldsymbol{EMP_{t,i} > \mu_{EMP} + \delta \cdot \sigma_{EMP}} \\ \mathbf{0}, \text{otherwise} \end{cases} \quad (6)$$

where: μ_{EMP} – mean value of the sample of EMP index

σ_{EMP}- standard deviation of the sample of EMP index

In international practice, the critical value of EMP index that leads to the crisis has been mainly calculated by 1-3 standard deviations (Table 3). Some researchers propose sharp depreciation of nominal exchange rate in addition to EMP index; for instance, Frankel &

Rose (1996) suggest additional condition of "nominal exchange rate to depreciate by 25% or more".

Table 3. Researches done on the topic

Sigma	Research papers
1.500	Eichengreen, Rose&Wyplosz (1996); Aziz, Caramazza&Salgado (2000) Ahluwalia (2000); Bordo (2001)
1.645	Caramaza, Ricci&Salgado (2000); Bhundia&Ricci (2005)
1.700	Kamin, Schindler&Samuel (2001)
2.000	Eichengreen, Rose, Wyplosz (1994); Glick&Hutchinson (2001)
2.500	Edison (2000)
3.000	Kaminsky&Reinhart (1999); Berg and Patillo (1999); Bubula&Otker-Robe (2003)

Following results turned out when crisis signal or EMP index exceeded the criterion is calculated for 2000-2010 by three-sigma rule.

Table 4. Calculation of crisis criterion

Sigma	EMP	Signal	Date	crisis or not
1.500	5.30	6 times	2001/02 ; 2003/04; 2006/04; 2008/12; 2009/01; 2009/02	3/6 case (50%)
1.645	5.81	5 times	2001/02 ; 2003/04; 2008/12; 2009/01; 2009/02	3/5 case (60%)
1.700	6.00	5 times	2001/02 ; 2003/04; 2008/12; 2009/01; 2009/02	3/5 case (60%)
2.000	7.04	3times	2008/12; 2009/01; 2009/02	3/3 case (100%)
3.000	10.53	2 times	2008/12; 2009/01	2/2 case (100%)

Source: Estimation by researchers

First three signals in Feb 2001, Apr 2003, and Apr 2006 are associated with the change in interest rate of Central bank bill; remaining one demonstrates crisis of 2008.

Table 5. Results of currency crisis

№	Date	EMP index	Annual change in nominal exchange rate, %	Annual change in reserves, %	Change in interest rate, monthly	Inflation, annual	crisis or not
1	Feb-01	6.2	0.5	10.5	6.44	13.2	No
2	Apr-03	6.2	2.7	36.8	6.91	6.4	No
3	Apr-06	5.4	1.4	-1.3	3.9	4.3	No
4	Dec-08	13.8	8.3	-30.0	-0.26	23.2	Yes
5	Jan-09	11.1	17.9	-33.9	-2.71	21.0	Yes
6	Feb-09	9.8	25.5	-40.4	-0.93	17.2	Yes

Source: Estimation by researchers

Therefore, the critical value of EMP index should be taken at 7.04 for $\delta = 2.0$.

Additional criterion for the depreciation of nominal exchange rate of national currency over 25% annually is applied to check whether currency crisis occurred or not. The result shows that the crisis occurred in Mongolia in Feb 2009.

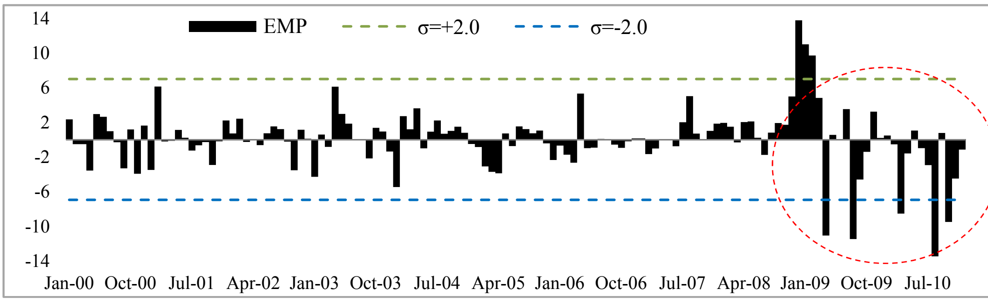
Table 6. Annual change in nominal exchange rate of togrog against USD, %

	02/2001	04/2003	12/2008	01/2009	02/2009
Annual change in nominal exchange rate	0.5	2.7	8.3	17.9	25.5

Source: Calculation based on reference rate of the Bank of Mongolia, *www.Bank of Mongolia.mn*

If the criterion of EMP index is taken as asymmetry, value of $\delta = 2.0$ goes below the criterion in Apr, Aug 2009 and Mar, Aug, Oct 2010, creating pressure for exchange rate of togrog against USD to sharply appreciate (Figure 9).

Figure 8. Criterion of EMP index



The long run trend of EMP index is represented by HP filter of Eviews-7 program, and there are stability or slight depreciation during 2000-2003, appreciation during 2003-2005, substantial depreciation during 2005-2008, and increasing pressure of appreciation since the later 2008. Therefore, when we calculated criterion of EMP index, we divided it into two groups by its trend to depreciate and appreciate: 2000/01-2009/06 and 2009/07-2010/12.

Figure 9. HP filter of EMP index

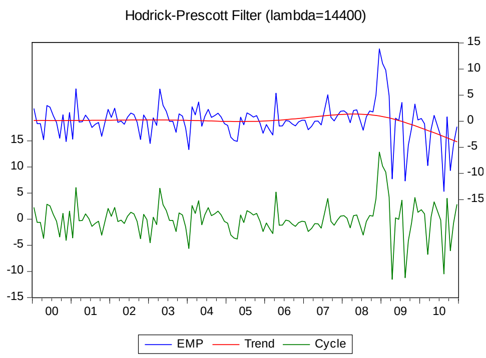
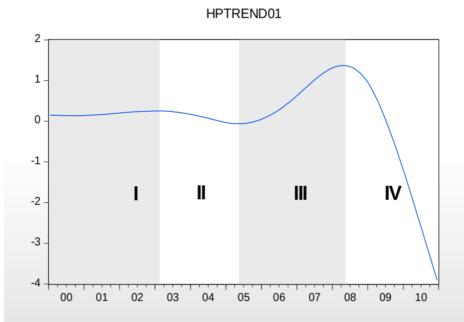


Figure 10. HP trend of EMP index



There is value of $\delta = 1.5$ gives crisis signal 8 times when EMP index criterion is calculated for 2000/01-2009/06, the first or depreciation period trend. It can be said that crisis occurred in Aug 2007 and Nov 2008.

Table 7. Calculation of crisis criterion

Sigma	EMP	Signal	Date
1.500	5.30	8 times	2001/02 ; 2003/04; 2006/04;2007/08; 2008/11; 2008/12; 2009/01; 2009/02
1.645	5.81	5 times	2001/02 ; 2003/04; 2008/12; 2009/01; 2009/02
1.700	6.00	5 times	2001/02 ; 2003/04; 2008/12; 2009/01; 2009/02
2.000	7.04	3times	2008/12; 2009/01; 2009/02
3.000	10.53	3times	2008/12; 2009/01; 2009/02

Source: Estimation by researchers

Newly arised signal of Aug 2007 is related to the depreciation of nominal exchange rate of togrog and increase of interest rate. In this summer time with international flight overload, demand for cash in FX market sharply increased due to interrupt of cash replenishment of foreign currency.

Nominal exchange rate of togrog against USD had depreciated by 16.7 togrog or 0.24% daily on average during 2007.08.06-13. Second signal was given in Nov 2008, the first month of currency crisis.

Therefore, threshold level of EMP index during depreciation trend turns out to be same with the criterion calculated for total period.

Figure 11. Criterion of EMP index (01/00-06.09)

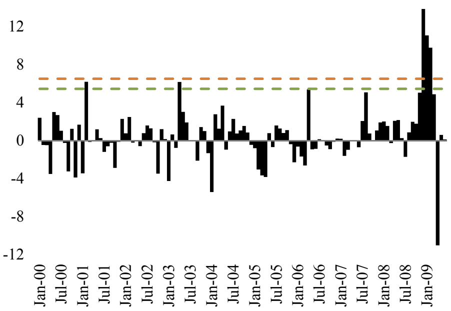
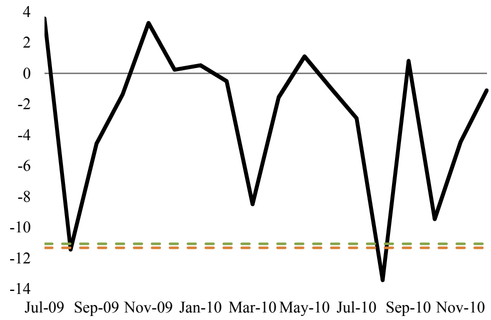


Figure 12. Criterion of EMP index (07/09-12/10)



Second criterion of EMP index for the period of appreciation trend turns out over (-10.4) for value of $\delta = 1.5$ twice and within the criterion for other values (Table 8).

Table 8.Criterion of EMP index (2009.07-2010.12)

Date	EMP criterion	EMP	Monthly change in exchange rate	Intervention	Currency flow
2009.08	-10.4	-11.4	-1.8%	$41.5 M	-4.6 M
2010.08	-10.4	-13.4	-3.8%	$157.7 M	196.5 M

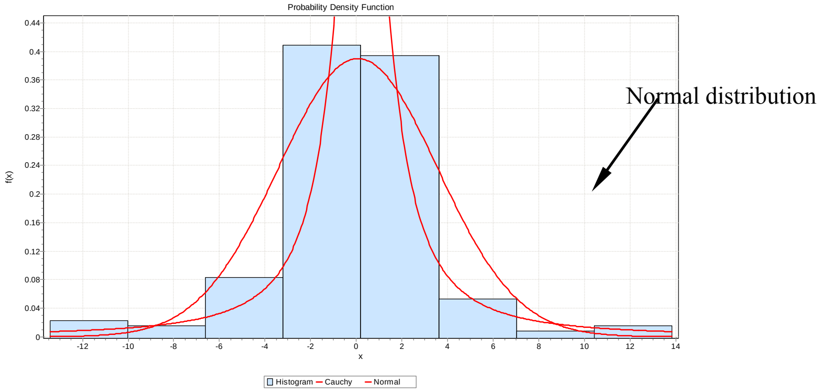
Conclusion drawn from the threshold level of EMP index calculated by three-sigma rule:

1. Critical value for depreciation period is 7.04;
2. Critical value for appreciation period is -10.4;
3. Currency crisis occurred during 2008/12-2009/02;
4. By additional criterion of depreciation of nominal exchange rate over 25%, crisis occurred only in Feb 2009;
5. Pressure for nominal exchange rate of togrog to sharply appreciate occurred in Aug of 2009 and 2010.

If series are assumed to be normally distributed and three-sigma rule is applied, above conclusion can be drawn.

However, in practice, financial indicators are mainly distributed abnormally. Therefore, we determined distribution of EMP index using EasyFit program and found distribution of Cauchy–Lorentzwith mean 0.24 and variation 1.21. Figure 13 shows comparison of Cauchy-Lorentz and normal distribtutions of EMP index.

Figure 13. Distribution of EMP index



Accordingly, next sub section calculates the criterion of EMP index that can lead to the crisis using extreme value theory.

4.2 Application of extreme value theory

4.2.1 Explanation of extreme value theory

Extreme value theory is statistical methodology widely used in economy and is applied in measuring extreme event. Regarding EMP index, this theory has been applied widely since Koedjik (1990, 1992) and Hols &de Vries (1991) used it in the study of exchange market pressure.

Let's take series $X_1,\ X_2,\dots,X_n$ of random measurement with ordinary distribution function. When we determined probability of maximum value M_n of first random number n to be below certain level x, distribution function turns out to be as follows as shown in (6):

$$\boldsymbol{M_n = \max(X_1, X_2, \dots, X_n)},\ n \geq 1 \qquad (7)$$

$$\boldsymbol{P(M_n \leq x) = F^n_{(x)}} \qquad (8)$$

$$\boldsymbol{P(X_1 \leq x, \dots, X_n \leq x) = F^n_{(x)}},\quad \boldsymbol{x \in \mathbb{R}, n \in \mathbb{N}} \qquad (9)$$

In this case, extreme or maximum value of the series is located in upper part or right tail of the distribution. So, Generalized Extreme Value Distribution is defined as follows.

$$\boldsymbol{f^n_x = 1 - F^n_{(x)} = 1 - P(X_1 \leq x, \dots, X_n \leq x)} \qquad (10)$$

$$\boldsymbol{f^n_x} = \begin{cases} \boldsymbol{1 - \exp\left[-(1 + kx)^{\frac{1}{k}}\right]} \text{ if } \boldsymbol{k \neq 0} \\ \boldsymbol{1 - \exp[\exp(x)]} \text{ if } \boldsymbol{k = 0} \end{cases} \qquad (11)$$

where, k is a parameter which has function to direct property of extreme distribution tail, and $\alpha = -1/k$ is called tail index.

Extreme distribution estimation can be done by two methods: parameter and non-parameter. Following section briefly explains estimation method of Hill (1975) used in this paper.

4.2.2 Hill and HKKP estimations

Let's take sample of n positive series with undefined distribution. Let's assume $x_{(i)}$ as "i"th number of the sample where $x_{(i)} \geq x_{(i-1)}$, $i = 2, \dots, n$. Assuming k sample from right tail is taken into estimation, Hill (1975) offered following evaluation for γ:

$$\gamma_{(k)} = \frac{1}{k}\sum_{j=1}^{k} \ln(x_{n-j+1}) - \ln(x_{n-k}) \qquad (12)$$

This is estimation method with maximum truth proportion and Pareto distribution that assumes number (k+1) as criterion. The difficulty with this estimation is the selection of value of k. In other words, undistorted evaluation of tail index largely depends on the selection of k. For small sample, 1/k value substantially differs from zero, and evaluation value is distorted. Therefore, most researchers apply following estimation method of Huisman, Koedijk, Kool & Palm (2001) /hereinafter "HKKP"/ for small sample.

$$\frac{1}{\alpha} = \gamma_{(k)} = \gamma + \beta * k + \varepsilon_k \qquad (13)$$

where, k=1, 2,…,K ε_k is error

HKKP (11) demonstrated that the estimation is most optimal when value of K is approximately $\frac{n}{2}$. In practice, $\gamma_{(k)}$ is calculated for value of 1 to K.

WOLS method is used to evaluate equation (11) by HKKP methodology. This has advantage to correct Heteroskedasticity error as deviation of $\gamma_{(k)}$ is not constant at different k.

4.2.3 HKKP estimation and its result

Using program Xtremes 4.1, we estimated the extreme value of EMP index by HKKP method based on method taught at Workshop on Extreme Exchange Market Pressure of the SEACEN Expert Group (SEG) by SEACEN.

First step: As to extreme value theory, ascending series of EMP index with positive numbers is created. EMP index is sorted in ascending order according to HKKP methodology and positive values are selected randomly.

Second step: Using program Xtremes 4.1, multivariate data is transferred to univariate data, and Hill (GP1) estimation method is applied to estimate value of Alfa index (α).

Figure 14. Hill estimation of Xtremes 4.1 program

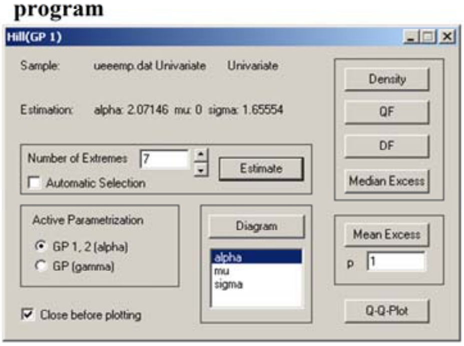
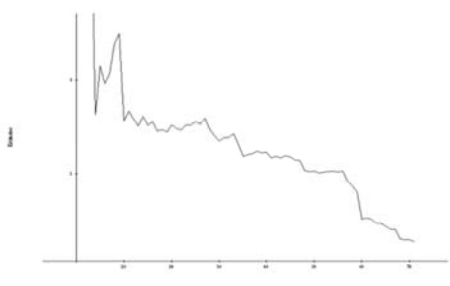


Figure 15. Estimation of Alfa index



Third step: Value of Alfa index is sorted by order of sample where 70th value is at the beginning and 69th is next. Then, equation 11 is estimated using Weighted Least Squares method. Result of estimation is:

$$y_t = 2.178659 - 0.025228 * x_t + \varepsilon_t \tag{14}$$

Figure 16. Weighted Least Squares method

Dependent Variable: Y
Method: Least Squares
Date: 02/23/11 Time: 10:10
Sample: 1 69
Included observations: 69
Weighting series: SQR(X)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.178659	0.058823	37.03773	0
X	-0.025228	0.001163	-21.69575	0

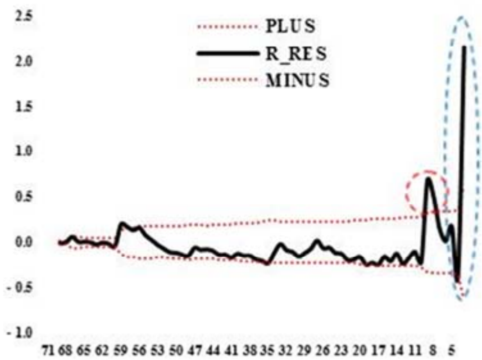
Weighted Statistics

R-squared	0.875397	Mean dependent var	1.088351
Adjusted R-squared	0.873537	S.D. dependent var	0.292567
S.E. of regression	0.169931	Akaike info criterion	-0.678292
Sum squared resid	1.934727	Schwarz criterion	-0.613536
Log likelihood	25.40109	Hannan-Quinn criter.	-0.652601
F-statistic	470.7057	Durbin-Watson stat	0.622708
Prob(F-statistic)	0		

Unweighted Statistics

R-squared	0.733817	Mean dependent var	1.252592
Adjusted R-squared	0.729844	S.D. dependent var	0.606674
S.E. of regression	0.315328	Sum squared resid	6.66192
Durbin-Watson stat	1.22452		

Figure 17. Omission of estimation



Fourth step: We estimated stability of estimation within error ±2 limit using Stability test-Recursive estimates (OLS only) of EViews 7 program. It turns out that 9, 8, and 3th values of the sample are over the band thus extreme values.

Fifth step: Values of EMP index for above sample are firstly within value of Nov 2008 and next two are within 6 months. Therefore, extreme value theory shows financial crisis that started in late 2008 and stabilized in early 2009.

Table 9. Estimation of crisis criterion

Date	EMP value	Note
2008-11	5.042	Month crisis begun
2009-02	9.768	Crisis continued
2009-03	4.871	Crisis continued

Source: Estimation by researchers

Result: When we estimated the criterion of EMP index using extreme value theory, it shows that the currency crisis started in Nov 2008 and lasted for 5 months. Also, the criterion of EMP index that can lead to currency crisis is 5.04.

4.3 Comparison of the results of two methods

Looking at the results of above two methods, the result of extreme value theory explains better terms of start and end of currency crisis in 2008. Exchange market pressure during this period was absorbed by 40% depreciation of nominal exchange rate of togrog against USD, 39% decrease of foreign official reserves, and 2.3 unit increase of togrog interest rate (Table 9).

Table 10. Crisis signal

№	Date	EMP index	Annual change in nominal exchange rate, %	Annual change in reserves, %	Change in interest rate, monthly	Inflation, yearly	Crisis or not
1	Nov-08	5.0	2.3	-17.6	-0.68	24.5	Yes
2	Dec-08	13.8	8.3	-30.0	-0.26	23.2	Yes
3	Jan-09	11.1	17.9	-33.9	-2.71	21.0	Yes
4	Feb-09	9.8	25.5	-40.4	-0.93	17.2	Yes
5	Mar-09	4.9	30.5	-38.6	2.45	17.2	Yes

As above results show, it is significant to use EMP index as a signal to prevent crisis but it is very difficult to make its assumption. In other words, big error can occur in assuming above three indicators then EMP index. Therefore, we tried to determine macro economic factors that determine EMP index in the next chapter.

V. MACROECONOMIC DETERMINATION OF THE EMP INDEX

We applied widely used model of exchange market pressure of Girton& Roper (1997) in determining macro economic variables that define EMP index.

5.1 Girton &Roper model

This model was applied firstly in explaining exchange rate formation in free floating exchange rate regime in Canada during 1952-1962. Traditional approach considers that intervention by central banks in foreign currency market aims to protect exchange rate, whereas this model considers that intervention is designed for not only for stable exchange rate but also meeting the balance of domestic money market through exchange market pressure.

This monetarist model aims to show (i) how exchange market pressure is determined, and (ii) how money supply exceeded demand in free floating exchange rate regime affects exchange rate and official reserves. Main idea is based on idea that exchange market pressure of over money supply is absorbed in the depreciation of nominal exchange rate or decrease of official foreign reserves, or in both of them.

To explain the model simply as stated in Connolly&Silveira (1979):

Traditional function of money demand: $$\boldsymbol{M_t^d = kP_tY_t} \quad (15)$$

where:k-surplus income or a constant, P-domestic price, Y-real income

Function of money supply: $$\boldsymbol{M_t^s = m_tB_t} \quad (16)$$

where:m_t-money mulitplier, B_t-base money($B_t = R_t + DC_t$), whereR_t-net foreign assets of central bank, DC_t- net domestic assets

If it is assumed that money market and purchasing power are both balanced:

$$\boldsymbol{M_t^d = M_t^s} \quad (17)$$

$$\mathbf{P_t = E_tP_t^*} \quad (18)$$

where, P_t-domestic price, E_t- nominal exchange rate of national currency against foreign currency, P_t^*- foreign price

Substituting equation (18) in (15), equation (17) is:

$$\boldsymbol{kE_tP_t^*Y_t = m_tB_t} \quad (19)$$

$$\boldsymbol{kE_tP_t^*Y_t = m_t(R_t + DC_t)} \quad (20)$$

Following equation will come out when natural logarithm is taken from both sides of equation(6):

$$\boldsymbol{\ln k + \ln E_t + \ln P_t^* + \ln Y_t = \ln m_t + \ln(R_t + DC_t)} \quad (21)$$

To differentiate both sides of above equation

$$\boldsymbol{0 + \frac{\frac{dE_t}{dt}}{E_t} + \frac{\frac{dP_t^*}{dt}}{P_t^*} + \frac{\frac{dY_t}{dt}}{Y_t} = \frac{\frac{dm_t}{dt}}{m_t} + \frac{\frac{dR_t+DC_t}{dt}}{R_t+DC_t}} \quad (22)$$

$$\boldsymbol{\frac{\frac{dR_t}{dt}}{R_t+DC_t} - \frac{\frac{dE_t}{dt}}{E_t} = -\frac{\frac{DC_t}{dt}}{R_t+DC_t} + \frac{\frac{dY_t}{dt}}{Y_t} + \frac{\frac{dP_t^*}{dt}}{P_t^*} - \frac{\frac{dm_t}{dt}}{m_t}} \quad (23)$$

$$\boldsymbol{r_t - e_t = -d_t + y_t + p_t^* - m_t} \quad (24)$$

where, r_t-change in official foreign reserves, e_t-change in nominal exchange rate, d_t-change in share of domestic credit in money supply, y_t- change in domestic income, p_t^*-change in foreign price level, m_t-change in money multiplier

Equation (24) has proportional correlation which is, given foreign inflation and growth of domestic income, increase in domestic credit or money multiplier decreases reserves in fixed exchange rate regime, depreciates nominal exchange rate in floating regime, and causes decreased reserves and depreciation of exchange rate in managed floating regime.

Furthermore, increase of domestic income or foreign price has correlation to appreciation of national currency or increased inflow of foreign currency.

Girton & Roper (1977), Connolly& Silveira (1979), and Bahmani-Oskooee&Shiva (1998) inserted $\boldsymbol{q_t = \frac{e_t}{r_t}}$ into equation (24) and tried to show whether monetary policy absorbed exchange market pressure by change in nominal exchange rate or decrease of foreign reserves.

$$\boldsymbol{r_t - e_t = -d_t + y_t + p_t^* - m_t + q_t} \quad (25)$$

coefficient before variable q_t:

- Reliability and positiveness in terms of statistics demonstrate exchange market pressure is absorbed mainly by depreciation of exchange rate ,
- Reliability and negativeness in terms of statistics demonstrate absorption mainly by decrease of reserves,
- Inreliability in terms of statistics demonstrates no response of EMP index to monetary policy.

Also, coefficient of variable q_t shows whether monetary approach of the balance of payments, on which exchange rate is formed, is implemented.

5.2 Empirical study

Exchange market pressure index [emp_t]

EMP index is represented by EMP2 index as described in chapter 3.

Inflation [cpi_t](+)

Domestic inflation rate reduces export income and raises exchange market pressure through the appreciation of real exchange rate. In Mongolia, increased inflation decreases real interest rate of togrog and creates trend for market participants to sell their assets in togrog and convert into USD, thus raising pressure for togrog to depreciate.

Bank credit[bd_t] (+)

High growth of domestic credit raises money supply and causes depreciation of national currency or increased exchange market pressure.

Difference of interest rate [id_t] (-)

Increased difference between domestic and foreign interest rates raises capital inflow and decreases EMP index. Especially, in situation when current exchange rate trend tends to continue and action of central bank is predictable, financial capital largely comes in to profit from interest rate difference.

Terms of trade [fb_t](-)

Improved terms of foreign trade upgrades trade balance, raises currency supply and decreases EMP index.

Budget expenditure [feg_t] (+)

State budget expenditure increases demand for imports through domestic demand and tends to raise EMP index. Particularly, the growth of demand in trade sector promotes imports if domestic industry is underdeveloped. Therefore, this indicator is represented by annual growth of state consolidated budget expenditure.

Dummy 1[$dm1_t$]

Dummy variable is included in indicator of Aug 2007 in order to remove impact of EMP index due to interrupted cash replenishment of foreign currency.

Table 11. Augmented Dickey-Fuller (ADF) Unit Roots Test

Variable	Without difference			Difference of first order			Integration rate
	None	Intercept	Trend & intercept	None	Intercept	Trend & intercept	
EMP	0.0000	0.0000	0.0000				I (0)
DDR	0.8152	0.6831	0.9993	0.0000	0.0000	0.0000	I (1)
IRD	0.2939	0.1887	0.4192	0.0000	0.0000	0.0000	I (1)
TOT	0.7900	0.7539	0.2268	0.0000	0.0000	0.0000	I (1)
FEG	0.0473	0.0563	0.0812				I (0)

Variables except emp_tandfeg_twere unstable when we checked stability of variables; so, we stabilized by taking difference of first order.

5.2.1 Estimation of Single equation model

Following results are turned out when correlation of factors explaining EMP index is estimated by OLS[**].

$$emp_t = 0.42 * \mathrm{EMP}(-1)_t - 8.20 * \mathrm{TOT2}(-2)_t + -0.46 * \mathrm{IRD}(-1)_t + 0.53 * \mathrm{DOL2}_t + 0.19 * \mathrm{DDR2}(-2)_t - 3.77 * \mathrm{DUM}_t + 0.0 * \mathrm{FEG}(-3)_t + \varepsilon_t \quad (26)$$

Table 12.Estimation results

Variable	Coefficient	Probability	Other indicators			
EMP(-1)	0.418138	0.0000	R^2	0.327775	SCI	5.214226
TOT2(-2)	-8.202151	0.0312	R^2 adj.	0.294715	HQ cri.	5.122096
IRD2(-1)	-0.464263	0.0061	S.E.R.	2.957116	LM	3.144903
DOL2	0.535705	0.0022	S.S.R.	1066.833		
DDR2(-2)	0.196756	0.0477	DW	1.858043		
DUM2	-3.773796	0.0003	AIC	5.059042		
FEG(-3)	0.017369	0.0352				

We checked above equation by coefficient test (Wald test, Ommitted variables test, Redundant variable test), estimation error test (LM test, Heteroskedasticity) and stabilization test (Chow, Ramsey, CUSUM test).

Figure 18. Residual

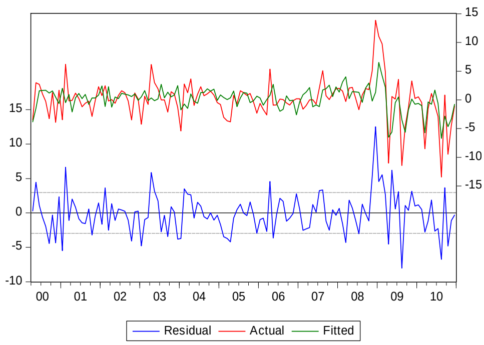
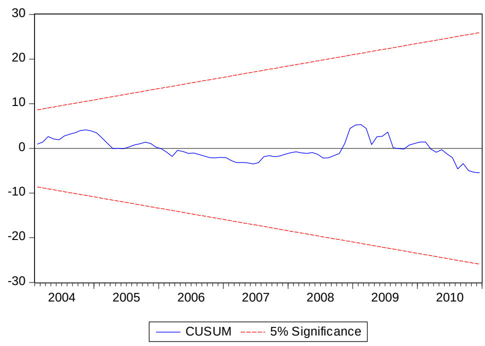


Figure 19. Chow test



At the result of estimation, EMP index is explained by credit balance of banks, the difference of interest rate, dollarization, government expenditure and terms of foreign trade[††].

In other words, dollarization raises pressure for togrog to depreciate by 0.5 unit, increases of credit balance of banks and state budget expenditure raise the pressure after two months by 0.2 and 0.02 units. Improved terms of foreign trade and increased difference of interest rate raise the pressure of togrog appreciation in two months by 8.2 and 0.46 units.

5.2.2 SVAR method

In this section, we empirically check correlation between EMP index based on the balance of money market determined by Girton-Roper(1977) and factors that affect it by VAR method, which was firstly used by Tanner (1999, 2001, 2002).

[**]Please see details in Appendix 1.

[††]Model excludes inflation as statistical estimation was unreliable.

Tanner (1999) showed that above mentioned EMP model of Girton-Roper (1977) based on the balance of money market can be studied using VAR method for currency crisis in Brazil, Chile, Mexico, Indonesia, Korea and Thailand. Main objective of the paper is to answer the question "What kind of means (domestic credit or NDA, or policy rate) of short term monetary policy can soften and remove EMP index?".

In 2002, he tested again correlation between monetary policy and EMP index for 32 countries of east Europe and Asia. The empirical result of his study was consistent with expected or model value of Girton-Roper (1977) theory. Particularly, he showed that increase of domestic credit raises EMP index and pressures national currency to depreciate. Also, he emphasized that the effect of domestic credit growth on EMP index is stronger than the effect of the growth of interest rate difference. He considered application of VAR method in study of EMP index has following advantages over traditional estimation of OLSmethod:

- Can avoid distortion of Simultaneity problem through limitation.
- Can avoid endogeneity problem.
- Can estimate feedback between variables and allows determination of shock affect created by its deviation.

Based on data of three main indicators of monetary policy which are growth of domestic credit (NDA of banking system), difference between domestic and foreign interest rates (dif), and EMP index during Jan 2003-Dec 2010, we checked correlation between the variables using SVAR model.

A. Structure of model

Model takes endogenous variables as follows.

$$x_t = \{EMP_t ; NDA\_G_t ; D\_DIF_t\}. \quad (27)$$

However, exogenous variables are represented by dummy variable of months of crisis or sudden shock. Where:

EMP_t	-EMP index (estimated by non-parameter method of Siregar & Pontines (2007));
NDA_G_t	-net domestic assets;
D_dif_t	-difference of foreign and domestic interest rates

Seasonal impact is removed by taking logarithm in above variables in modeling.

For most countries, EMP and SVAR model construction uses structural limitation or same time correlation between variables depending on characteristic of a country and frequency of data.

Considering Z statistics of model estimation, SVAR model uses limitation based on following assumption. We assume in this paper that EMP index and interest rate difference do not affect NDA within one month but NDA affects EMP index and interest rate difference. Appendix 1 shows estimation of SVAR model and matrix of limitation. Results of LR test show that limitation of same time correlation to transfer VAR model to semi structural model is fully consistent for data of Mongolia.

Б. Expected correlation between variables:

- ***Domestic credit (NDA) and EMP index.*** In the model of Girton-Roper (1977) based on the balance of domestic money market, the growth of domestic credit is expected to increase EMP index. The reason is imbalance of payments demonstrates imbalance of money market; loss of the balance of payments is compensated by money supply exceeded its demand, whereas surplus is compensated by money demand exceeded its supply. Adjustment to above imbalance in fixed exchange rate regime is currency reserves; it is regulated by exchange rate in pure floating regime. In managed floating regime, exchange rate and reserves are used both. Then, it means that above mentioned growth of domestic credit is compensated by the depreciation of exchange rate or the decrease of foreign reserves. This depreciation of exchange rate and decrease of foreign reserves will raise EMP index.
- ***Relationship between difference of interest rate and EMP index.*** Theoretical relationship between EMP and interest rate is determined by money demand balance of interest rate (UIP condition). Monetarist and Keins approaches differently explain the relationship between interest rate and exchange rate. Monetarists think that the increase in domestic interest rate cuts money demand, thus causes depreciation of national currency. On the other hand, Keynesians explain that the increase of domestic interest rate promotes capital inflow and causes appreciation of national currency. However, in real economy, above two cases are observed both and either can dominate depending on economic condition of certain period .

$$
\begin{aligned}
\text{Interest rate } \uparrow &\Rightarrow \text{Real money demand } \downarrow \text{ (Supply exceeded demand of money)} \\
&\Rightarrow \text{Foreign reserves} \downarrow \text{Depreciation of national currency} \\
&\Rightarrow \text{Change in } \textbf{EMP} \text{ index}
\end{aligned}
$$

B. Results of SVAR model estimation

Estimation of SVAR model. Table 1 shows estimation of the model. Detailed estimation results are shown in Appendix 3.

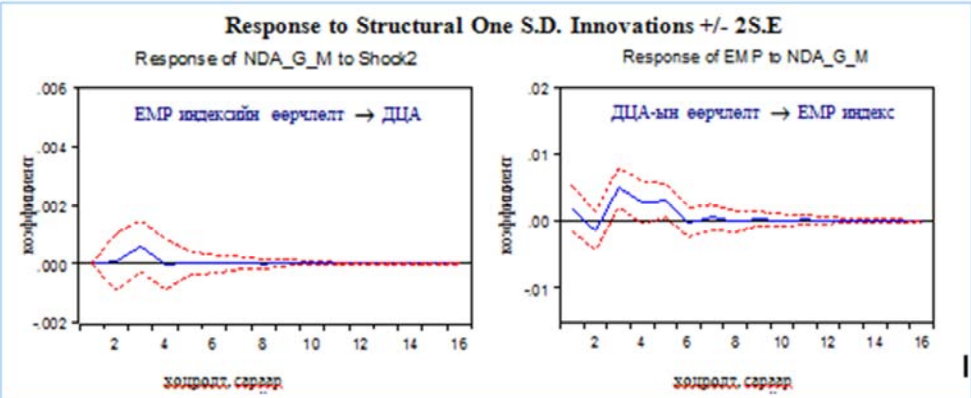
Table 13. Estimation of SVAR model

	NDA	EMP	fference of interest rate
B_0=	1	0	0
	0.39 (0.355921)	1	0
	-0.25 (0.244715)	0.53 (0.085788)	1

Table 13 shows statistically that there is same time correlation between DNA, EMP index and the difference of interest rate. Also, it can be accepted statistically that EMP index has same time correlation with the difference of interest rate. Sign of these correlations is consistent with expected economic value. Standard error of estimated coefficients of matrix B_0 is relatively small. Breakdown of response function and variation of SVAR model is shown below.

Impact of a certain factor in the model on inflation and other endogenius indicators is determined using response function. Figure 22 shows functions of the response between EMP index and NDA, whereas Figure 23 shows mutual response function of the difference of interest rate and EMP index. Appendix 2 shows the results of these and other response functions of the model.

Figure 20. Response function: Response of NDA to shock of EMP index (1 standard deviation)



Test results of granger cause show that EMP index is not granger cause of NDA and it is approved statistically NDA is granger cause of EMP index. When we estimated response function of SVAR model, it turns out that the change in NDA of that month raises EMP index in that same month and the biggest impact is observed after 3 months from shock occurrence. Above result is consistent with expected theoretical value and the growth of domestic credit causes depreciation of togrog exchange rate. On the other hand, the growth of EMP index of that month raises NDA in that same month and the biggest impact is observed in 3 months. This is consistent with the results of other studies (Tanner (2001, 2002) and Bautista & Bautista (2005)).

In theory, policy makers should withdraw togrog from the market or decrease NDA in order to reduce EMP for togrog depreciation. However, empirical studies (Tanner (2002) and Bautista & Bautista (2005)) emphasize that the growth of EMP index increases NDA, and explain it in relation to the fact that financing issued by central bank to banks goes up to support liquidity of banking system rather than restricting the growth of domestic credit when capital escapes from domestic economy and national currency depreciates sharply.

In Mongolia, also, during the crisis of 2008-2009, financing issued by central bank to commercial banks sharply rose to support liquidity of banks (Figure 21). Figure 21. EMP index, foreign and domestic net assets

Figure 21. EMP index, foreign and domestic net assets

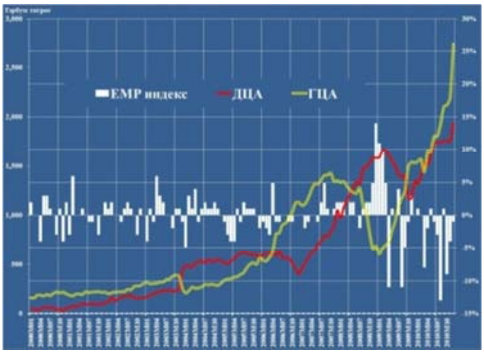
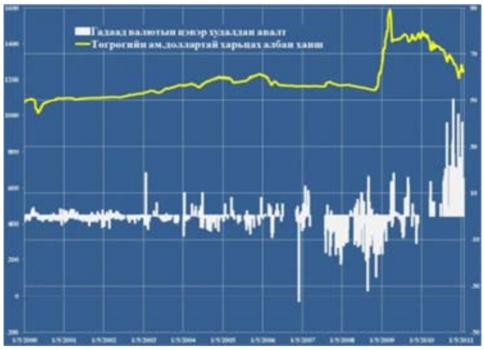
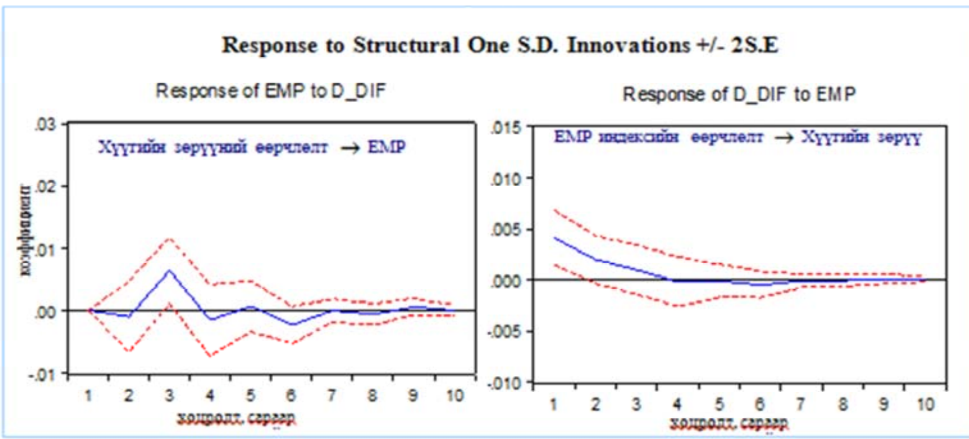


Figure 22. Intervention of Bank of Mongolia



Difference of interest rate and EMP index: As seen from the results of Granger cause test, EMP index is not granger cause of the difference of interest rate and it can be accepted at 80% probability that the difference of interest rate is granger cause of EMP index. However, the results of the response function of SVAR model, estimated total sample or data during 2003.01-2010.12, show that the change in the difference of interest rate of that month raises EMP index with 1 month lag and the biggest impact is observed after 4 months from the shock, while the growth of EMP index of that month increases the difference of interest rate in the same time. This is consistent with the results of other studies (Tanner (2001, 2002) and Bautista & Bautista (2005)).

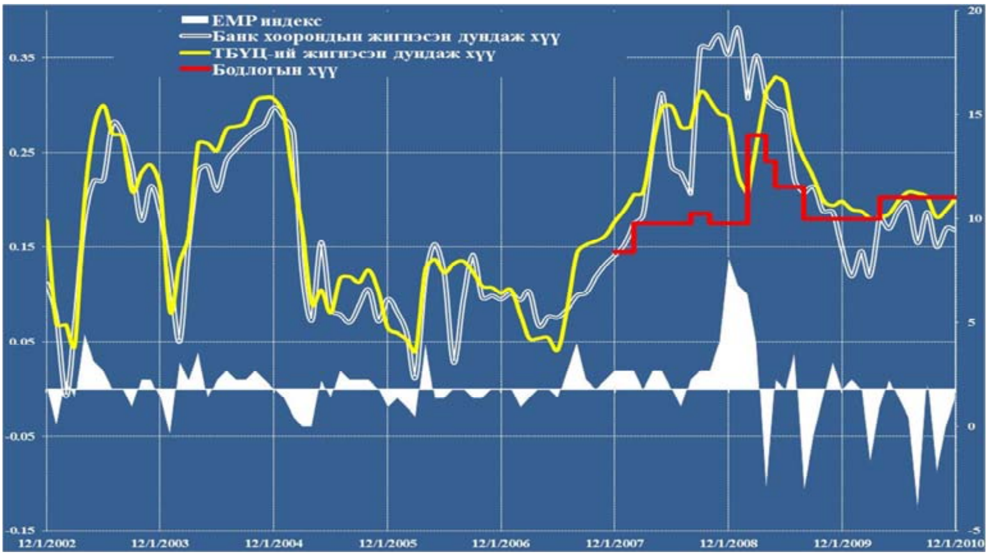
Figure 23. Response function: Mutual response of EMP index and difference of interest rate



Above result is consistent with the value of Keynsian theory; increased domestic interest rate causes appreciation of togrog. It is related to sharp depreciation of togrog due to substantial decrease of official foreign reserves and foreign assets in banking system, and large foreign trade loss because of foreign economy crisis (Figure 21).

At that time, rise of interest rate by central bank against depreciation of togrog affected positive correlation between difference of interest rate and EMP index. As seen from response function of the model based on data during pre-crisis period (2003.1-2008.6), change in the difference of interest rate of that month decreases EMP index with lag of 2 months, and the biggest effect is observed after 4 months from shock. This result is consistent with the value of Keyns theory. Increased domestic interest rate promotes capital inflow thus leads to appreciation of togrog.

Figure 24. EMP index and weighted average interest rate of Central bank bill



VI. CONCLUSION

In this paper, we calculated EMP index based on FX intervention for 2000-2010 and estimated its threshold level that leads to currency crisis using three sigma rule and extreme value theory.

Additionally, we examined macro factors which determine EMP index using single variable and multiple variable methods. We conclude as follows:

1. **Estimation of EMP:** Estimation of EMP index, that considers official international reserves only change by intervention amount taking beginning balance of foreign reserves as USD1.7 billion, precisely explains exchange market pressure. Therefore, further studies need to apply this indicator.
2. **Threshold level of EMP index that can lead to currency crisis:** Threshold level of EMP index which can lead to currency crisis was estimated using (i) three sigma rule, and (ii) extreme value theory. EMP index threshold is 5.8 during depreciation trend and -10.4 during current appreciation trend.
3. **Macroeconomic fundamentals that explain EMP index:** Factors that determine EMP index are estimated based on model of Girton &Roppen (1997) using OLS and VAR methods. The results are:
   - In Mongolia, it can be explained by the model of Girton&Ropper (1997).
   - EMP is directly related to the growth of bank credit, the difference of foreign and domestic interest rates, state budget expenditure and dollarization of banking system.
4. **Projection of EMP index:** We projected trend of EMP index for the first quarter of 2011 using above model as follows: In future, EMP index tends to decline or pressure for nominal exchange rate of togrog tends to rise as (i) market pressure is lower than the critical value, and (ii) interest rate difference is high.

Furthermore, based on above results, we recommend following policy proposals:

1. To estimate EMP index monthly and apply it in policy proposals,
2. To improve the frequency of EMP index and make its projection.

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VII. APPENDIX 1

OLS estimation

Dependent Variable: EMP
Method: Least Squares
Date: 03/15/11 Time: 16:29
Sample (adjusted): 2000M04 2010M12
Included observations: 129 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EMP(-1)	0.418138	0.092159	4.537144	0.0000
TOT2(-2)	-8.202151	3.762024	-2.180249	0.0312
IRD2(-1)	-0.464263	0.166210	-2.793236	0.0061
DOL2	0.535705	0.171131	3.130373	0.0022
DDR2(-2)	0.196756	0.098358	2.000413	0.0477
DUM2	-3.773796	1.017694	-3.708184	0.0003
FEG(-3)	0.017369	0.008153	2.130308	0.0352

R-squared	0.327775	Mean dependent var	0.060032
Adjusted R-squared	0.294715	S.D. dependent var	3.521162
S.E. of regression	2.957116	Akaike info criterion	5.059042
Sum squared resid	1066.833	Schwarz criterion	5.214226
Log likelihood	-319.3082	Hannan-Quinn criter.	5.122096
Durbin-Watson stat	1.858043		

VIII. APPENDIX 2

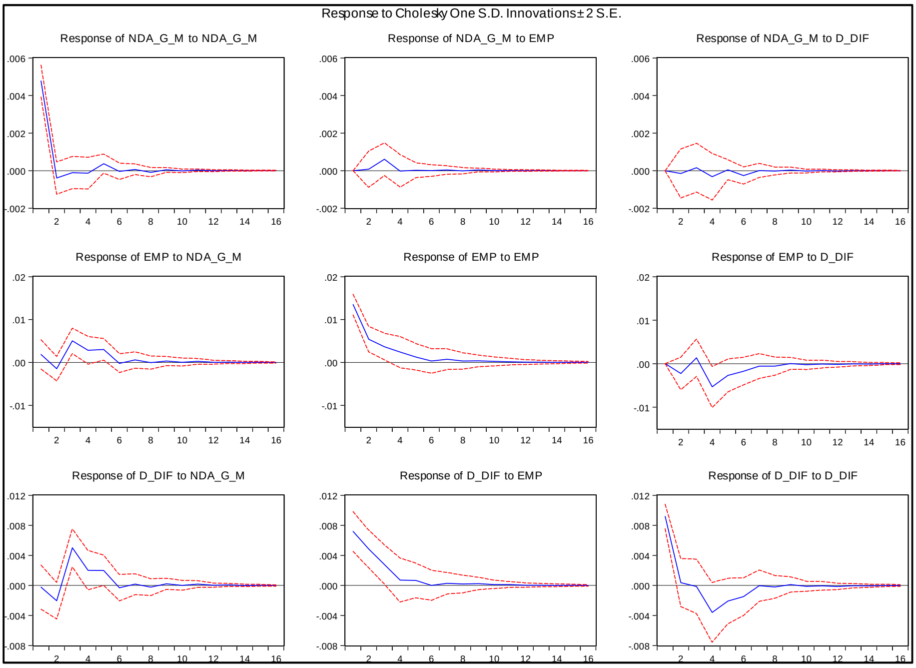
Granger cause test

Date: 03/01/11 Time: 17:17
Sample: 2000M01 2010M12
Lags: 2

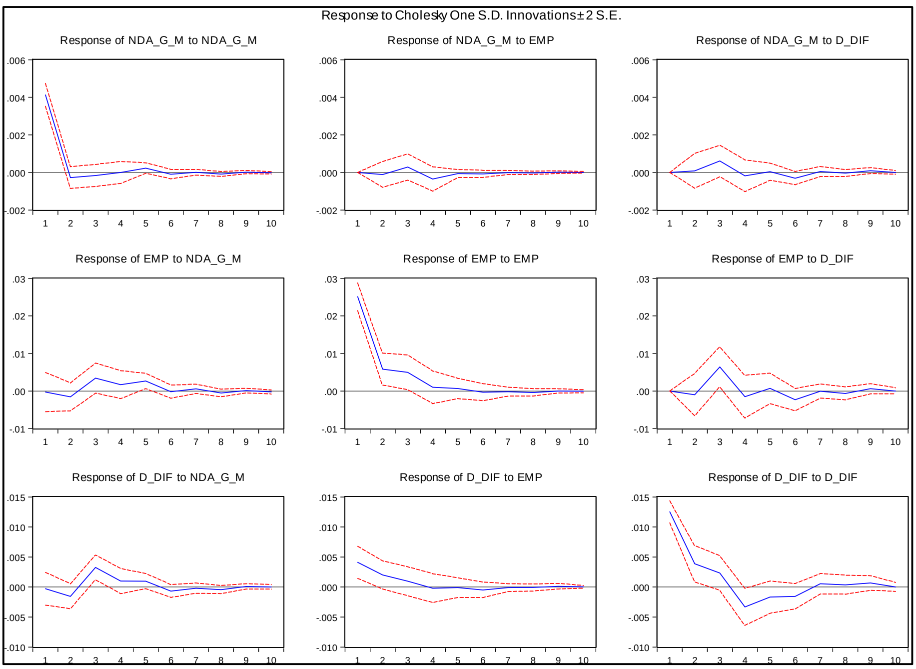
Null Hypothesis:	Obs	F-Statistic	Prob.
EMP does not Granger Cause NDA_G_M	128	0.83488	0.4364
NDA_G_M does not Granger Cause EMP		**2.93959**	**0.0566**
D_DIF does not Granger Cause NDA_G_M	94	0.48237	0.6189
NDA_G_M does not Granger Cause D_DIF		**9.06090**	**0.0003**
D_DIF does not Granger Cause EMP	**94**	**1.57033**	**0.2137**
EMP does not Granger Cause D_DIF		0.32363	0.7244

IX. APPENDIX 3

Response function /2003.01-2008.06/



RESPONSE FUNCTION (2003.1-2010.12)



X. APPENDIX 4

Estimation of VAR model
Date: 03/02/11 Time: 14:27
Sample (adjusted): 2003M04 2010M12
Included observations: 93 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	NDA_G_M	EMP	D_DIF
NDA_G_M(-1)	-0.066759	-0.373104	-0.354236
	(0.07014)	(0.42644)	(0.22372)
	[-0.95174]	[-0.87494]	[-1.58339]
NDA_G_M(-2)	-0.040107	0.909940	0.898270
	(0.07081)	(0.43048)	(0.22584)
	[-0.56641]	[2.11379]	[3.97745]
NDA_G_M(-3)	0.010126	0.518545	0.025795
	(0.07503)	(0.45614)	(0.23930)
	[0.13496]	[1.13681]	[0.10779]
EMP(-1)	-0.005540	0.245026	0.029204
	(0.01450)	(0.08815)	(0.04625)
	[-0.38205]	[2.77952]	[0.63147]
EMP(-2)	0.004238	0.054384	-0.010525
	(0.01483)	(0.09013)	(0.04728)
	[0.28586]	[0.60341]	[-0.22259]
EMP(-3)	-0.013489	0.008228	0.035716
	(0.01457)	(0.08857)	(0.04647)
	[-0.92593]	[0.09290]	[0.76867]
D_DIF(-1)	0.006285	-0.078668	0.307644
	(0.03713)	(0.22571)	(0.11842)
	[0.16929]	[-0.34853]	[2.59801]
D_DIF(-2)	0.046834	0.558001	0.095031
	(0.03513)	(0.21359)	(0.11206)
	[1.33304]	[2.61246]	[0.84806]
D_DIF(-3)	-0.023483	-0.388279	-0.354070
	(0.03429)	(0.20847)	(0.10937)
	[-0.68483]	[-1.86252]	[-3.23739]
C	-0.001412	0.006952	-0.000848
	(0.00096)	(0.00582)	(0.00305)
	[-1.47466]	[1.19397]	[-0.27756]
CRIS	0.068250	1.084431	-9.89E-05
	(0.04668)	(0.28377)	(0.14887)

	[1.46219]	[3.82156]	[-0.00066]
D0312	0.042723	-0.025006	-0.016570
	(0.00424)	(0.02576)	(0.01351)
	[10.0833]	[-0.97077]	[-1.22620]
D0904	-0.000622	-0.140760	-0.004198
	(0.00501)	(0.03043)	(0.01596)
	[-0.12435]	[-4.62565]	[-0.26296]
D1008	-0.000482	-0.136624	-0.011763
	(0.00426)	(0.02589)	(0.01358)
	[-0.11324]	[-5.27724]	[-0.86608]
D0612	-0.014435	0.003711	0.001989
	(0.00429)	(0.02606)	(0.01367)
	[-3.36782]	[0.14241]	[0.14549]
D0910	-0.010055	0.002792	-0.001984
	(0.00481)	(0.02925)	(0.01535)
	[-2.08990]	[0.09544]	[-0.12929]
D0908	-0.000752	-0.127253	-0.003275
	(0.00460)	(0.02795)	(0.01466)
	[-0.16354]	[-4.55349]	[-0.22341]
INF_US(-1)	0.054346	-0.234794	0.060321
	(0.03134)	(0.19053)	(0.09995)
	[1.73412]	[-1.23235]	[0.60348]
R-squared	0.652293	0.660722	0.347120
Adj. R-squared	0.573479	0.583818	0.199134
Sum sq. resids	0.001281	0.047353	0.013033
S.E. equation	0.004133	0.025127	0.013182
F-statistic	8.276397	8.591609	2.345627
Log likelihood	388.4924	220.6354	280.6267
Akaike AIC	-7.967579	-4.357749	-5.647885
Schwarz SC	-7.477398	-3.867569	-5.157705
Mean dependent	0.000279	0.001183	0.000659
S.D. dependent	0.006329	0.038950	0.014730

Determinant resid covariance (dof adj.)	1.69E-12
Determinant resid covariance	8.88E-13
Log likelihood	894.4987
Akaike information criterion	-18.07524
Schwarz criterion	-16.60470