AN ESSAY ON THE MONGOLIAN OPTIMAL MONETARY POLICY RULE*

by

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Abstract

In this essay, we proved that the optimal monetary policy rule for Mongolia is the Taylor-rule that including only domestic inflation and changes in nominal interest rate. However, if the Bank of Mongolia only consider the CPI inflation, then the optimal policy rule form will turn to the total inflation and changes in nominal interest rate. These results are obtained under main results of the previous chapter[1], the current effective policy rule does not include inflation target rate and posterior estimations.

The robustness of these results is proved based on the household utility measurements with non-restricted and various substitution elasticity assumptions.

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Абстракт

Энэ эссенд бид Монгол Улсын хувьд оновчтой мөнгөний бодлогын дүрэм нь зөвхөн дотоодын инфляци болон нэрлэсэн хүүгийн түвшний өөрчлөлтийг агуулсан Тайлор-дүрэм байна гэдгийг батлан харуулсан. Гэхдээ, хэрэв Монгол Банк зөвхөн ХҮИ-ийг тооцон үздэг гэвэл оновчтой бодлогын хэлбэр нь нийт инфляци болон нэрлэсэн хүүгийн өөрчлөлтийг агуулсан хэлбэрт шилжинэ. Энэ бүх үр дүнг өмнөх бүлгийн[2] гол үр дүн болох өнөөгийн мөнгөний бодлогод инфляцийн зорилтод түвшин тооцогддоггүй болон "posterior" үнэлгээний үр дүнд үндэслэн олж авсан.

Үр дүнгийн найдвартай байдлыг өрх гэрийн хязгаарлалтгүй ханамжийн хэмжилт болон орлуулалтын мэдрэмжийн утгын ялгаатай таамаглалууд дээр үндэслэн батласан.

[2]Энэ сэтгүүлийн 2018 оны 31(493)-р дугаараас харж болно.

1 Introduction

In general, the main goal of any central bank is to determine the optimal monetary policy and to implement it. In regarding with the central bank of Mongolia, the BoM, we proved that the current effective monetary policy rule is a CITR without inflation targeting rates in the previous chapter. It means that in the current Mongolian macroeconomic environment, which is expressed by the used DSGE model, this rule is an effective or more fitted on the observations. Then, we need to judge this rule in terms of the optimality in order to determine whether the BoM achieves its main goal or not. We can formalize the research questions as follows: Does the current effective policy rule in Mongolia, CITR, an optimal or not? If not what alternative policy rule would be the optimal for Mongolia?, and consequently, the main purpose of this chapter is to perform a welfare evaluation analysis of alternative policy rules for Mongolia.

We follow welfare analysis in Gali and Monacelli (2005) which shows one of the influential ways to derive the welfare criteria that solve for optimal monetary policy in open economy. It follows Woodford (2003) and find welfare loss function that is a sum of variations of the domestic inflation and the output gap with weights as a function of deep parameters. However, we show a different derivation way of this welfare loss function than in Woodford (2003).

Moreover, Gali and Monacelli (2005) shows that under specific restriction that involve a unit elasticity of substitution between bundles of goods produced in different countries, the optimal policy requires that the output gap and the domestic price level is fully stabilized. However, as proved in Chapter 4 of Gali (2016), this result is associated with an indeterminate equilibrium, and hence, does not guarantee that the outcome of fully price stability is attained. As shown there, the indeterminacy problem can be avoided, and the uniqueness of the price stability outcome restored by having the central bank follow a rule that makes the interest rate respond with sufficient strength to deviations of domestic inflation and/or the output gap from target.

The current effective rule in Mongolia, CITR, satisfies this condition in somewhat dimension, but we do not know about its optimality. We then determine the alternative policy rules that can be compared to the rule by the relative welfare losses. In addition to the CITR, the domestic inflation-based Taylor-rule (DITR, for short) is a possible rule to implement, and we can expand alternative policy rules by imposing restrictions on the policy parameters.

We determine the optimal monetary policy rule by ranking corresponding welfare losses derived from the calculations based on the welfare loss function. We use a simulation analysis based on the same DSGE model, prior assumption, and posterior estimates that are used and obtained in the previous chapter. Why we are using same things are i) we compare the CITR from the previous chapter to other rules and ii) we are only possible to compare the welfare results from alternative policy rules in a same economic environment.

The remainder of the chapter is organized as follows. In section 2 we summarize the important research papers that supporting our following model and approach. In section 3, we perform welfare evaluation analysis of the alternative monetary policy rules. Section 4 contains our concludes.

2 Literature review

Clarida (2014) documents that there are two ways to specify the central bank's objective function that to solve for optimal monetary policy in open economy. The first way is an assumption - as in the much of the "pre-Woodford" international monetary literature - that the objective function is quadratic in inflation and the output gap with arbitrary weight, for example α, on stabilizing output at its natural level. The second way is derived in Gali and Monacelli (2005), to follow Woodford (2003) and solve for α - and thus the optimal policy rule - as a function of deep parameters.

Gali and Monacelli (2005) is one of illustration for a SOE of the recent frameworks that have adopted the staggered price setting structure of Calvo. Their analysis is based on producer currency pricing, complete asset markets, log utility of consumption, and a unit elasticity of substitution between domestic and foreign goods and replicating the flexible price equilibrium allocation through full stabilization of domestic prices is optimal. An extension of that framework, incorporating cost-push shocks and featuring tradeoffs can be found in Clarida et al. (2001). Erceg et al. (2009) analyze the role of openness in the transmission of shocks using a version of the Gali - Monacelli model that incorporates staggered wage setting.

Many papers examined the consequences on optimal monetary policy based on the benchmark assumptions of the Gali - Monacelli model. They show that, in order to improve welfare, how the size of the elasticity of substitution between domestic and foreign goods affects the extent to which the central bank wants to stabilize the exchange rate. The main result suggest that the central bank should design the optimal monetary policy departing from strict domestic inflation targeting. Campolmi (2014) introduces staggered wage setting in a small open economy. She shows that the presence of sticky wages generally makes CPI inflation targeting more desirable than domestic inflation targeting.

In contrast with the Gali - Monecelli framework, which study monetary policy in a small open economy, a number of papers have framed their analysis of monetary policy design in the context of two-country models with staggered price setting of Calvo. The papers by Pappa (2004) and Benigno and Benigno (2006) provide examples of that literature, with a special focus on the gains from cooperation, and under the assumption of producer currency pricing. Engel (2011) studies the implications for optimal monetary policy of assuming local currency pricing instead in an otherwise similar framework, showing how that modification warrants a focus on CPI rather than domestic price-stabilization. Benigno (2009) studies the implications of incomplete asset markets and financial imbalances in a similar environment, showing that those factors may justify a deviation from a strict domestic inflation targeting policy.

3 Welfare evaluation analysis

In the present section we do welfare analysis of alternative monetary policy rules based on the welfare losses function derived in the online Appendix[3].

$$\mathbb{L} = -\frac{1-\alpha}{2}\left[\frac{\varepsilon}{\lambda}var\left(\pi_{h,t}\right) + (1+\varphi)var\left(x_t\right)\right]$$

In order to find the corresponding variations of output gap and domestic inflation, first we estimate the same model in the previous chapter by using Bayesian estimation technique under the additional assumptions. By

[3] Please see at the web page of the journal.

obtaining parameter estimates, we simulate the model for each form of purposed monetary policy rules. Then, the optimal rule for Mongolia will be determined based on the ranking of their corresponding welfare losses. At the end, we check robustness of the result based on the household utility computations.

3.1 Alternative monetary policy rules

In regarding with monetary policy rules, the following two form of Taylor-type rule are available due to the indeterminacy of the model mentioned in the online Appendix for optimality condition. As mentioned there, the indeterminacy problem can be avoided, and the uniqueness of the price stability outcome restored by having the central bank follow a rule that makes the interest rate respond with sufficient strength to deviations of total inflation, domestic inflation, and the output from target.

1. CPI inflation-based Taylor rule (CITR), which is proved that the current effective rule in Mongolia in the previous chapter.

$$r_t = \rho_R r_{t-1} + (1 - \rho_R)\left[\psi_1 \pi_{t-1} + \psi_2 \Delta y_t + \psi_3 \Delta e_t\right] + \epsilon_{R,t}$$

2. Domestic inflation-based Taylor rule (DITR),

$$r_t = \rho_R r_{t-1} + (1 - \rho_R)\left[\psi_1 \pi_{h,t-1} + \psi_2 \Delta y_t + \psi_3 \Delta e_t\right] + \epsilon_{R,t}$$

We can derive possible alternative policy rules from these Taylor-type rules by imposing restrictions on the policy parameters, ψ_1, ψ_2, and ψ_3. The following Table 3.1 summarizes these possibilities and implications. The parameter indicating a response of inflation term, ψ_1, should be higher than 1 which is the fundamental determinacy condition of the model as shown in Chapter 4 of Gali (2016). Thus, we cannot assume that $\psi_1 = 0$.

3.2 Simulation analysis of welfare losses

We use $\mathcal{M}_0^1$ as the benchmark model (the model without inflation targeting rates) and baseline priors described in the previous chapter for the estimations since the observations are more fitted in this model. However, the

Table 3.1: Alternative monetary policy rules for Mongolia

Rules	**Implications**
Benchmark (CITR): $\psi_1 > 1, \psi_2 > 0, \psi_3 > 0$	BoM reacts CPI inflation, output growth and exchange rate changes
DITR $\psi_1 > 1, \psi_2 > 0, \psi_3 > 0$	BoM reacts domestic inflation, output growth and exchange rate changes
$\psi_2 = 0$	BoM reacts to CPI inflation (domestic inflation when DITR) and exchange rate changes
$\psi_3 = 0$	BoM reacts CPI inflation (domestic inflation when DITR) to output growth
$\psi_2 = 0$ and $\psi_3 = 0$	BoM only reacts to CPI inflation (domestic inflation when DITR)

following assumptions and relations include in addition to the model due to the assumptions used in the derivation of the welfare losses function.

1. An assumption of unit elasticity on $\sigma = 1$. The DIS equation given by equation (58) in the previous chapter includes σ as a form of $\tau \equiv \frac{1}{\sigma}$ the inter-temporal substitution elasticity; thus, we need to restrict $\tau = 1$ in the estimation.

2. In order to find a variation of domestic inflation we add the relationship between CPI inflation and domestic inflation, $\pi_t = \pi_{h,t} + \alpha \Delta s_t$ given by equation (16) in the previous chapter.

3. Due to the unit elasticity assumptions, the natural level of output given by equation (52) in the previous chapter becomes

$$y_t^n = \Omega + \Gamma a_t + \alpha \Psi y_t^* \qquad \Rightarrow y_t^n = a_t$$

   where, with parameter restrictions, $\Omega \equiv \frac{\nu+\mu}{\sigma_\alpha+\varphi} = 0$, $\Gamma \equiv \frac{1+\varphi}{\sigma_\alpha+\varphi} = \frac{1+\varphi}{1+\varphi} = 1$, and $\Psi \equiv -\frac{\Theta\sigma_\alpha}{\sigma_\alpha+\varphi} = 0$ since $\Theta = (\sigma\gamma - 1) + (1-\alpha)(\sigma\eta - 1) = 0$.

Next, we proceed to estimate the model under the additional assumptions and then, simulate the models that differs on only their monetary policy rules by using the Bayesian posterior estimates[4].

Table 3.2 summarizes the standard deviations of several key variables and the corresponding welfare losses.

[4]The estimated posterior means are in Table A.2 of the online Appendix.

Table 3.2: Properties of alternative policy rules

	CITR				DITR			
	Benchmark	$\psi_2 = 0$	$\psi_3 = 0$	$\psi_2 = 0$, $\psi_3 = 0$	$\psi_1 > 1$, $\psi_2 > 0$, $\psi_3 > 0$	$\psi_2 = 0$	$\psi_3 = 0$	$\psi_2 = 0$, $\psi_3 = 0$
$\sigma(y_t)$	0.8899	0.9014	1.3545	1.3601	0.6984	0.7045	0.7470	0.7470
$\sigma(x_t)$	1.3841	1.3848	1.7009	***1.7015***	1.2859	**1.2827**	1.3245	1.3206
$\sigma(\pi_{h,t})$	0.5451	0.5447	***0.9419***	0.9300	0.4523	**0.4485**	0.4983	0.4937
$\sigma(\pi_t)$	0.4833	0.4833	0.8414	0.8310	0.4758	0.4721	0.5240	0.5215
$\sigma(\Delta e_t)$	0.6576	0.6568	1.0603	1.0485	0.5676	0.5643	0.6661	0.6615
$\mathbb{L}_1$	5.7021	5.6987	14.3951	14.1029	4.2378	4.1843	4.9072	4.8375
	VI	V	VIII	VII	II	I	IV	III

Note: Bold and bold italics indicate the lowest and highest values within alternative policy rules, respectively.

By following a comparison analysis of Gali and Monacelli (2005) we can conclude that the critical element that distinguishes each rule relative to the optimal policy is an excess smoothness of the output and nominal exchange rate changes in Mongolia. In general, this in turn often reflected in too high a volatility of the output gap and domestic inflation. In particular, the CITR rule with restrictions of $\psi_3 = 0$ and $\psi_2 = \psi_3 = 0$ are the cases that increases both output gap and domestic inflation volatility to the largest extent.In calculation of the corresponding welfare losses of alternative policy rules, we need to determine ε, φ and λ which are not known from the estimation and the restriction. In regarding with φ and ε, we follow Gali and Monacelli (2005) and choose same values for these parameters, $\varphi = 3$ (labor supply elasticity is $\frac{1}{3} \approx 0.33$) and $\varepsilon = 6$ (the elasticity of substitution between differentiated goods of the same origin). For λ, we use a parameter definition in (53) of the previous chapter under elasticity restrictions:

$$\kappa = \lambda (1 + \varphi) \qquad \Rightarrow \qquad \lambda = \frac{\kappa}{(1 + \varphi)}$$

In the last row of Table 3.2 we report the welfare losses associated with the alternative policy rules expressed as a percentage of steady state consumption.

The results suggest that the DITR with policy parameter restriction of $\psi_2 = 0$, which implies a case when the BoM only reacts to the domestic inflation and NER changes, would deliver the smallest welfare losses. However, if the BoM observes only total/CPI inflation in a reality, then the optimal policy form would be determined as the CITR with restriction of $\psi_2 = 0$, which implies that the BoM reacts to CPI inflation and NER changes. In this case, the BoM do not need to concern the output growth rates.

3.3 Simulation analysis of household utility

In this section, we also use $\mathcal{M}_0^1$ model in the previous chapter but we do not impose the additional unit substitution elasticity assumption on σ (or τ). The main reasons for performing utility based analysis are i) to try weakening the strong restriction and ii) to check robustness of the previous welfare losses ranking results based on $\sigma = 1$.

We can use posterior estimates of $\mathcal{M}_0^1$ model presented by Table 4.2 in the previous chapter because we do not modified priors. By using these estimates, we simulate the models that differ on only their monetary policy rules which are described in the above. Then, we compute the corresponding representative household utility given in equation (1) in the previous chapter by using values of simulated variables.

$$\sum_{t=0}^{280} \beta^t \left(\frac{C_t^{1-\sigma}}{1-\sigma} - \frac{N_t^{1+\varphi}}{1+\varphi} \right)$$

In here, we choose simulation period as $t = 280$ because we assume that the average life expectancy of the representative household is 70 years. Moreover, $\sigma = \frac{1}{\tau} = \frac{1}{0.8432} = 1.1859$ and $\varphi = 3$ (the last is same as in the welfare loss analysis). The following Table 3.3 summarizes the final results of utility computations.

If we compare two ranking results we can conclude that, in general, the monetary policy based on DITRs would provide a higher well-being to households and whole society than in based on CITRs. In other words, the conclusion that DITRs are better than CITRs do not depend on the unit substitution elasticity assumption on σ. In either case, the DITR with policy parameter restriction of $\psi_2 = 0$, which implies a case when the BoM reacts to the domestic inflation and NER changes, is proved as the best monetary policy rule.

Next, we check the sensitivity of the utility results with the different values of τ. We perform the same simulation analysis on the household utility based on the much smaller prior mean of $\tau = 0.50$ which is used in the robustness analysis in the previous chapter. In order to get posterior estimates under this assumption, we re-estimate the $\mathcal{M}_0^1$ model[5]. In this case, since the posterior mean of τ is estimated as 0.4804, we have $\sigma = \frac{1}{\tau} = \frac{1}{0.4804} = 2.0814$. Then, we simulate the models under alternative policy rules and compute the corresponding household utility same as the previous computations. The following Table 3.4 summarizes the results.

[5]The estimated posterior means are in Table A.3 of the online Appendix.

Table 3.3: Household utility under alternative policy rules

	CITR				DITR			
	Benchmark	$\psi_2 = 0$	$\psi_3 = 0$	$\psi_2 = 0$, $\psi_3 = 0$	$\psi_1 > 0$, $\psi_2 > 0$, $\psi_3 > 0$	$\psi_2 = 0$	$\psi_3 = 0$	$\psi_2 = 0$, $\psi_3 = 0$
U_t	-44.14	-44.15	-62.33	-62.63	-37.41	-37.38	-41.03	-41.10
	V	VI	VII	VIII	II	I	III	IV

Table 3.4: Household utility under $\tau = 0.50$

	CITR				DITR			
	Benchmark	$\psi_2 = 0$	$\psi_3 = 0$	$\psi_2 = 0$, $\psi_3 = 0$	$\psi_1 > 0$, $\psi_2 > 0$, $\psi_3 > 0$	$\psi_2 = 0$	$\psi_3 = 0$	$\psi_2 = 0$, $\psi_3 = 0$
U_t	-71.81	-71.04	-181.91	-183.32	-60.74	-59.88	-110.08	-110.34
	IV	III	VII	VIII	II	I	V	VI

As we see from the table, now all DITRs are not better than CITRs. The rank of benchmark and the CITR with $\psi_2 = 0$ are improving by the two positions. However, we can conclude that the DITR with $\psi_2 = 0$ and the non-restricted DITR are the best policy rules within these alternative policy rules in terms of the both welfare measurements. This conclusion does not change by depending on the different values of τ.

If the BoM only concern the total inflation, the CITR with $\psi_2 = 0$, which implies a case when the BoM reacts to the total inflation and NER changes, and the non-restricted CITR have an almost same welfare/utility results and either of them would be a better policy rule.

4 Conclusion

In this chapter we showed how to derive a second order approximation to the utility of the small open economy's consumer and the welfare level implied by alternative monetary policy rules can be evaluated.

The welfare loss function penalizes fluctuations in domestic inflation and the output gap. Under the special restriction, the strict domestic inflation targeting becomes the conditions for optimal policy rule.

By following research framework of Gali and Monacelli (2005) we found that if the BoM do not concern output growth rates and reacts to domestic inflation and NER changes would deliver the highest welfare than in all other alternative policy rules. However, if the BoM only consider the CPI inflation (includes foreign goods prices), then the optimal policy rule form will turn to the case when reacting to the total inflation and NER changes. The robustness of these conclusions is proved based on the household utility measurements with non-restricted, various substitution elasticity assumptions.

As consistent with Gali and Monacelli (2005), we point that, in order to solve its disadvantages and limitations, the used research framework can be extended through the ways mentioned in the literature review section that are i) to weaken the specific restriction and to use more general preferences, ii) to use two-country version of the framework that would allow us to analyze a number of issues that cannot be addressed with the present model, including the importance of spillover effects in the design of optimal monetary policy, the potential benefits from monetary policy coordination, and the implications of exchange rate stabilization agreements, iii) to introduce a sticky nominal wages along with sticky prices, iv) to complete exchange rate pass-through of nominal exchange rate changes to prices of imported (or exported) goods.

References

Benigno, G. and Benigno, P. (2006). Designing targeting rules for international monetary policy cooperation. *Journal of Monetary Economics*, 53:473–506.

Benigno, P. (2009). Price stability with imperfect financial integration. *Journal of Money, Credit and Banking*, 41(s1):121–149.

Campolmi, A. (2014). Which inflation to target? a small open economy with sticky wages. *Macroeconomic Dynamics*, 18:145–174.

Clarida, R. H. (2014). Monetary policy in open economies: Practical perspectives for pragmatic central bankers. Working Paper w20545, National Bureau of Economic Research (NBER).

Clarida, R. H., Gali, J., and Gertler, M. (2001). Optimal monetary policy in closed versus open economies: An integrated approach. Working Paper w8604, National Bureau of Economic Research (NBER).

Engel, C. (2011). Currency misalignments and optimal monetary policy: A re-examination. *American Economic Review*, 101(6):2796–2822.

Erceg, C. J., Gust, C., and Lopez-Salido, D. (2009). *International Dimensions of monetary Policy*, chapter The transmission of domestic shocks in open economies, pages 89–148. University Chicago Press.

Gali, J. (2016). *Monetary Policy, Inflation, and Business Cycle: An Introduction to the New Keynesian Framework*. Princeton University Press, 2nd edition.

Gali, J. and Monacelli, T. (2005). Monetary policy and exchange rate volatility in a small open economy. *The Review of Economic Studies*, 72(3):707–734.

Pappa, E. (2004). Do the ecb and the fed really need to cooperate? optimal monetary policy in a two-country world. *Journal of Monetary Economics*, 51:753–779.

Woodford, M. (2003). *Interest and Prices: Foundation of a Theory of Monetary Policy*. Princeton University Press.