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The Forecasts-based Instrument Rule and Repo Rates Decisions in Sweden. How closely interlinked?

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Keywords: *inflation targeting regime, decision making process, repo rates*

Abstract

Research background: The Central Bank of Sweden declares the use of the Svensson's concept of inflation forecast targeting (IFT). It means that the repo rate decision making process depends on the central banks' forecasts. The concept evolved from the strict IFT with the decision making algorithm called the 'rule of thumb' to the flexible IFT which later includes the optimal monetary policy plan.

Purpose of the article: The aim of the article is to: (1) analyse the influence of the inflation rate and GDP growth rate on the repo rate decisions, (2) analyse the influence of the inflation rate and GDP growth rate forecasts (in two year horizon) on the repo rate decisions in Sweden in years 1999-2006. The main research question is as follows: did the Monetary Policy Commitee in Sweden in years 1999-2006 made the decisions on the repo rates on the basis of forecast-based instrument rules and the rule of the thumb algorithm.

Methodology/methods: The analysis encompasses the repo rates decisions, CPI inflation rate, GDP growth rate, central paths of CPI inflation forecasts and central paths of GDP growth rate forecasts in the two years horizon published by The Central Bank of Sweden in years 1999-2006. The studies are based on the Taylor-type instrument rule and forecast-based Taylor-type instrument rule. The methodology used is multiple linear regression models.

Findings & Value added: The Central Bank of Sweden in years 1999-2006 implemented direct inflation forecast targeting (DIFT) rule. The decision making algorithm was based on the CPI inflation forecasts and rule of the thumb algorithm. The exact rule of the thumb was as follow: if the inflation forecast, in the two year forecast's horizon exceeded the inflation target by 1 p.p., then the central bank raised the repo rate by 0.4 p.p; if is below , then the central bank reduced the repo rate by 0.4 p.p. If the inflation forecast was equal to the inflation target, then the repo rate remained unchanged. The historical repo rates differ from the theoretical estimated rule of the thumb's repo rates by +/-0.28 p.p.

Introduction

In this paper we analyse the repo rate decisions in The Central Bank of Sweden (Sveriges Riksbank, SR) in years 1999-2006.The main aim of the study is to analyse empirically the application of rule of the thumb decision making algorithm and inflation forecast targeting (IFT) rule in SR. The main research question is as follows: did the Monetary Policy Commitee in Sweden in years 1999-2006 made the repo rates decisions on the forecasts-based instrument rule and the rule of the thumb algorithm.This will be achieved in the framework of the hypothesis: If the central bank implement the strict IFT with the algorithm 'the rule of the thumb', the Executive Boards' repo rate decisions depend on inflation forecasts; if flexible IFT with the algorithm ' the rule of the thumb', depend on inflation rate and GDP growth rate forecasts. According to this, the four sub-questions have been posted.

(1) Did SR apply in years 1999-2006 the rule of the thumb?
(2) What were the weights conferred on the inflation rate and GDP growth rate in the Monetary Policy Commitee repo rates decisions? How flexible were they?
(3) What were the weights conferred on the inflation rate forecasts and GDP growth rate forecasts in the Monetary Policy Commitee repo rates decisions? How flexible were they?
(4) Did the repo rates decisions easy to predict by economic agents?

The paper is organised as follows. It consists of five parts. The authors begin in section 1 by providing some theoretical background about instrument Taylor rule, Svensson's concept of IFT rule and Taylor-type forecasts-based instrument rules. The next three sections include the description of the methodology, the data and the results of the research. The conclusions and implications for monetary policy are contained in fifth section.

Theoretical Background

The study relates to the two similar and based on rules concepts on conducting the monetary policy. The first one is the Taylor instrument rule and the second one, the Svensson's rule of the thumb. Both concepts refer to setting the central bank's instrument rate on the basis of the deviations from the target variables. The rule of the thumb comprised, in addition to the Taylor rule, the forward looking approach on monetary policy, which requires the forecasts publication.

The original Taylor rule showed the relation between the federal funds rate, inflation and real GDP (Taylor, 1993, p. 202). The ground of the

L.E.O. Svensson's concept is the forward looking attitude on conducting monetary policy. The rule of the thumb implies that conditional inflation forecast should hit the inflation target in two year horizon. If the inflation forecast, in the chosen horizon, is above the inflation target, then the central bank should raise the repo rate. If the inflation forecast in the chosen horizon is lower than the inflation target, then the central bank should reduce the repo rate. If the inflation forecast is equal to the inflation target, then the repo rate should remain unchanged (Svensson, 1997, pp. 1111-1146). The rule of the thumb implementation indicates the publication of inflation forecasts made for two years horizon and on the assumption of constant instrument rate during the entire forecast horizon (called CIR). The inflation forecasts may shape the economic agents' inflation expectations and anchor them on the inflation target.

Inflation forecast targeting (IFT) may be divided into two types. The first one, called direct inflation forecast targeting (DIT), assumes setting the central bank's interest rate only on the basis of inflation forecasts. It is impossible to implement such an approach exactly in central banking practice. The flexible inflation forecast targeting (or forecasts targeting (Svensson, 2005a, pp.1-54) preconceived that instrument rate decisions depend on two target variables, inflation forecast and output gap forecast, and are made on the basis of its' deviations from the inflation target and potential output gap (respectively). In such a case the inflation target may be achieved in the longer horizon. The weight which is put on the output gap forecast may determine how quickly the inflation forecast is adjusted towards the inflation target (Svensson, 2009, pp. 1-9).

There are plenty of studies concerned the estimation of simple Taylor rule for specific economies. In our paper we refer to the concept, which posed the consensus between the simple original Taylor rule and L.E.O. Svensson forecasts targeting rule. In this point we refer to the Taylor-type forecasts-based instrument rules, which are the simple central bank implicit reaction functions, where the forecasts of inflation rate and output gap play a role of intermediate target variables (see: Levin *et al*, 2003, p. 625):. These forecasts are model consistent.

In our studies we are referring to the rules with the two year forecast horizon. Our choice was caused by three reasons. Firstly the original L.E.O. Svensson's rule of the thumb assumed the two year inflation forecast horizon (see: Svensson, 1997, pp. 1111-1146). Secondly, Batini & Nelson were analysing the optimal policy horizon for set of forecast-based target variables as a part of flexible inflation targeting framework. They found that 'it is optimal to remove the effects of the various shock considered over a period of 8 to 19 quarters'(2001, p. 910). Finally, SR officially declared the use of the rule of the thumb within two year time lags (see:

Rosenberg, 2006, pp. 1-8). According to this, the similar rules were analysed by Rudebush & Svensson (1999, pp.203-262).

Data

The Central Bank of Sweden (Sveriges Riskbank, SR) has been implemented IT strategy since 1993 and has determined the inflation target as 2 % measured by CPI index. During the years 1993-2016 it declared two types of IT rules: the rule of the thumb and optimal monetary policy algorithm. In this connection, the central bank published the inflation forecasts conditioned by the constant instrument rate during the entire forecast horizon (called CIR) and the set of macroeconomic forecasts conditioned by the interest rate path forecast. The forecast horizon depends on the chosen rule type. The data are analysed quarterly. The potential GDP growth rate was estimated and declared to be as a desirable value in a range 2-2.5% in Sweden (Heikensten, 2000 & 2003). At the end of 1999 SR has started to publish the forecasts' data. The author of the concept of inflation forecast targeting, L.E.O. Svensson, was active as advisor to SR during the years 1990-2007. The central banks' inflation forecasts in Sweden had a large impact on consumers' inflation expectations in Sweden (Szyszko, 2016, p.9). The analysis of the rule of the thumb includes the years 1999-2006.

Table 1. The main information on the forecast based monetary policy in Sweden

Year	The forecast based rule	The instrument rate assumption in the forecast	Published forecasts	Forecasts published per year	Forecasts horizon	Forward Guidance	Monetary Policy Committees Meetings	Monetary Policy Trade of Description
1999	Rule of the thumb	CIR	Inflation forecasts, GDP forecasts*	4	8 Q	No	Each month	No
2000								
2001								
2002								
2003								
2004								
2005		CIR and ME			12 Q			
2006								

CIR-Constant instrument rate during the forecast horizon
ME- Market expectations instrument rate during the forecast horizon
E- Endogenous instrument rate dovetailed with instrument rate forecast path
*In these years GDP growth forecasts were not published in the form of charts but were described in the inflation reports with all necessary central paths data
Source: Own elaboration

In this paper, the central bank forecasts' central paths are analysed at the two year prognostic moment of the forecasts' horizon. The forecasts' central paths have been downloaded from the swedish central bank website (inflation reports boxes) and Inflation/Monetary Policy Reports. The repo

rates data were collected from the SR website. The CPI inflation rate and GDP growth rate data were collected from the Eurostat database.

During the years 1999-2006 forecasts were made on the basis of the DSGE model RAMSES. The model application assumed setting the instrument rate on the rule of the thumb. The enforced in the model instrument rule has the following form (Adolfson *et al.*, 2007b, p. 21):

$$i_t = f(\pi_t - \pi^*; \Delta\pi_t; y_t; \Delta y_t; i_{t-1}; x_t) + \varepsilon_{i,t}, \quad (2)$$

We shall denote: i_t – policy rate; π_t – underlying inflation rate; $\Delta\pi_t$ – change in the rate of underlying inflation; π^* – inflation target; y_t – GDP gap; Δy_t – change in the GDP gap; x_t – exchange rate gap; $\varepsilon_{i,t}$ – is called as a as a measure of the element of monetary policy surprises; t – years, $t \in \{1,2,...\}$. According to the model of Adolfson *et al.* (2007a, pp.481-511) the real exchange rate gap is measured as the percentage deviation of the actual real exchange rate from an assumed equilibrium level that is constant. The model implemented also the interest rate smoothing.

Research Methodology

The research includes the estimations of different type-Taylor instrument rules for the Sweden economy based on historical data and a preposition. The estimations differ in the chosen targets variables and assumptions. The main method used is multiple linear regression models. The studies conducted have been divided into two parts. The whole research plan is presented in Table 2.

Table 2. Research plan

Part	Stage	Research question?	Rule	Equation
Part I	Stage I	How flexible is SR in his interest rate decisions?	Simple Taylor-type instrument rule	(Svensson, 2003, p.426, Taylor, 1999, p. 5) : $i_t = \alpha_0 + \alpha_\pi(\pi_t - \pi^*) + \alpha_y(y_t - y^*) + \alpha_i i_{t-1} + \varepsilon.$
	Stage II		Taylor-type instrument rule form from RAMSES	(Adolfson *et al.*, 2007, pp.5-40): $i_t = \alpha_0 + \alpha_\pi(\pi_t - \pi^*) + \alpha_{\Delta\pi}\Delta\pi_t + \alpha_y(y_t - y^*) + + \alpha_{\Delta y}\Delta y_t + \alpha_i i_{t-1} + \varepsilon.$
Resultts comapsrison with the exact historical repo artes and exact repo rates derived from the original instrument equation from the model RAMSES*				
Part I	Stage I	How flexible is SR in his forecast-based interest rate decisions?	Forecast-based Taylor-type instrument rule	(Svensson, 1997, pp. 1111-1146): $i_t = \alpha_0 + \alpha_{\pi\|t+2}(\pi_{t+2\|i_{t-1}} - \pi^*) + + \alpha_{y\|t+2}(y_{t+2\|i_{t-1}} - y^*) + \alpha_i i_{t-1} + \varepsilon.$
	Stage II		Forecast-based Taylor-type instrument rule form from RAMSES	$i_t = \alpha_0 + \alpha_\pi(\pi_{t+2\|i_{t-1}} - \pi^*) + \alpha_{\Delta\pi}\Delta\pi_t + + \alpha_y(y_{t+2\|i_{t-1}} - y^*) + \alpha_{\Delta y}\Delta y_t + \alpha_i i_{t-1} + \varepsilon.$
Resultts comapsrison with the exact historical repo artes and exact repo rates derived from the original instrument equation from the model RAMSES*				

i_t – policy rate; π_t – CPI inflation rate; π^* – CPI inflation target settled at 2%; y_t – GDP growth rate, y_t^* – potential GDP growth rate; t – years, $t \in \{1,2,...\}$. GDP growth rate gap is calculated as the difference between real GDP growth rate and the potential GDP growth rate (which was settled by the authors at 2.25% (as the midpoint of the range 2-2.5%)); $\Delta\pi_t$ change in the CPI inflation rate; Δy_t change in the GDP growth rate; $\pi_{t+2|i_{t-1}}$ - CPI inflation forecast in eight quarter horizon made on the assumption of CIR, $y_{t+2|i_{t-1}}$ – GDP growth rate forecast in eight quarter horizon made on the assumption of CIR.

*.The RAMSES model assumed the following weights: 1.7 for the inflation deviations from the inflation target, 0.3 for inflation changes, 0.04 for GDP growth rate gap and 0.1 for GDP growth rate changes (Adolfson *et al.*, 2007b, p.21).

Source: own.

Results

Firstly we estimated the simple linear Taylor-type instrument rule with target variables: deviations from the CPI inflation rate and inflation target, ad GDP growth rate gap. After that we estimated the Taylor-type instrument rule form downloaded from the model RAMSES. The derived in both cases target variables coefficients have significant, positive and similar influence on instrument rate (α_π =.14 and, α_y =0.1; α_π =0.14 and α_y =0.11) and indicate the flexible type of implemented IT regime

Secondly we estimated the simple linear Taylor-type forecast-absed instrument rule with target variables: deviations from the inflation forecast and inflation target, and deviations from GDP growth rate forecast and potential GDP growth rate. After that we estimated the Taylor-type instrument rule form from the model RAMSES. . The results are similar in both cases. Only the deviations of inflation forecast from the inflation target have significant, positive influence on instrument rate (0.4). It indicates the implementation of strict inflation forecast targeting and the original rule of the thumb. The repo rates from the model estimated differ from the historical by +/- 0.29.

In Table 3 there are the differences (absolute and average) between the exact historical repo rates and the theoretical repo rates derived from the calculation of weights from the RAMSES instrument equation put on the target variables.

Table 3. Differences between the exact historical repo rates and the theoretical repo rates derived from the exact RAMSES equation

Rule	Target variables	Diference (absolute average)
Simple Taylor-type instrument rule	CPI inflation, GDP growth rate	+/-1.65
Forecast-based Taylor-type instrument rule	CPI inflation, GDP growth rate forecasts	+/-0.4

Source: Own elaboration.

Table 4. Instrument rules' estimation results

		α_0	α_i	α_π	α_y	$\alpha_{\Delta\pi}$	$\alpha_{\Delta y}$	$\alpha_{\pi t+2\|i_{t-1}}$	$\alpha_{y_{t+2\|i_{t-1}}}$
Simple Taylor-Type Instrument Rule	Coefficient	0.25 [0.15]	0.91*** [0.04]	0.14*** [0.04]	0.1*** [0.04]	-	-	-	-
	R square	0.91							
	ε	0.27							
Taylor-Type Instrument Rule form from RAMSES	Coefficient	0.22 [0.16]	0.92*** [0.04]	0.14** [0.05]	0.11*** [0.03]	-0.1 [0.09]	-0.1* [0.05]	-	-
	R square	0.92							
	ε	0.27							
Weights declared in RAMSES (Adolfson *et al.*, 2007b, p.21)	Coefficient	-	-	1.7	0.004	0.3	0.1	-	-
Forecast-Based Simple Instrument Taylor Rule	Coefficient	0.07 [0.12]	0.96*** [0.03]	-	-	-	-	0.4* [0.17]	-0.01 [0.09]
	R square	0.91							
	ε	0.29							
Direct Inflation Forecast-Based Instrument Taylor Rule	Coefficient	0.07 [0.11]	0.91*** [0.03]	-	-	-	-	0.4* [0.16]	-
	R square	0.9							
	ε	0.29							
Forecast-Based Instrument Taylor-type Rule form from RAMSES	Coefficient	0.08 [0.12]	0.96*** [0.04]	-	-	0.004 [0.09]	-0.04 [0.05]	0.4* [0.17]	-0.01 [0.09]
	R square	0.9							
	ε	0.29							
Weights declared in RAMSES- forecasts based target variables (Adolfson *et al.*, 2007b, p.21)	-	-	-	-	-	0.3	0.1	1.7	0.004

***Significant at 0.001**Significant at 0.01*Significant at 0.05. Robust standard errors in parentheses

Source: Own elaboration.

Conclusions and implications for monetary policy in Sweden

In the years 1999-2006 The Swedish Central Bank declared the implementation of inflation targeting strategy. According to the estimated simple Taylor-type rule, we may state that the central bank applied inflation targeting flexible type, with the weights put on the CPI inflation rate and GDP growth rate. The estimations results for the simple Taylor-type rule and the form of this rule from the model RAMSES did not differ significantly.

The Central Bank of Sweden in years 1999-2006 also declared the use of the concept of inflation forecast targeting and the rule of the thumb decision making algorithm. In this case the deviations of CPI inflation forecasts from the inflation target and the deviations of GDP growth rate forecasts from the potential GDP growth rate were our target variables in Taylor-type forecast based instrument rules. The estimation results describe the implemented strategy as a direct inflation forecast targeting (DIFT), with the weight put on the CPI inflation forecast. The GDP growth rate forecasts transpired to be not significant in setting the repo rates. The weight put on the inflation forecasts is positive, consistent with the rule of the thumb. The exact rule of the thumb for Sweden in years 1999-2006 was as follow: if the inflation forecast, in the two year horizon exceeded the inflation target by 1 p.p., then the central bank raised the repo rate by 0.4 p.p. If the inflation forecast in the two year forecast horizon was lower by 1 p.p. than the inflation target, then the central bank reduced the repo rate by 0.4 p.p. If the inflation forecast was equal to the inflation target, then the repo rate remained unchanged. The historical repo rates differ from the theoretical rule of the thumb repo rates by +/-0.28 p.p.

There were large differences between the exact historical repo rates and theoretical the repo rates calculated from the exact instrument equation from forecasting model RAMSES. It means that the economic agents might not predict the repo rates changes on the basis of declared weights put on target variables from the model.

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