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Stability of Central Bank Preferences, Macroeconomic Shocks, and Efficiency of the Monetary Policy. Empirical Evidence for Canada[1]

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Abstract

Following the approach suggested by Favero and Rovelli (2002), I estimate a three-equations system for different sub-samples for Canada. The results indicate that the preferences of the monetary authority have changed between the different regimes. In particular, the parameter associated to the implicit target of inflation has been reduced significantly. The macroeconomic conditions from the side of the aggregate demand have been more favorable than those related to the aggregate supply. The standard deviation of the monetary rule suggests that it has been conducted successfully in the last regime.

Keywords: Interest Rate Rule, Structural Breaks, Inflation Targeting, Output Gap, Preferences, Macroeconomic Shocks.

JEL: C2, E5

Résumé

Nous utilisons l'approche de Favero et Rovelli (2002) pour estimer un système à trois équations pour différent échantillons pour le Canada. Les résultats montrent que les préférences de la Banque Centrale ont changé entre les différents périodes. En particulier, le paramètre associé à l'inflation cible a été réduit de façon significative. Les conditions macroéconomiques du coté de la demande globale ont été plus favorables que celles reliées à l'offre globale. L'écart type de la règle monétaire suggère que la politique monétaire a été conduite de façon efficace dans la dernière période.

Mots-clés: Régle de taux d'intérêt, Changement structural, Inflation cible, Préférences, Chocs macroéconomiques.

Code JEL: C2, E5.

1 Introduction

The literature dedicated to the estimation and analysis of interest-rate rules is very extensive. One of the issues more discussed in this literature is related to the analysis of the behaviour of the parameter associated to the gap between expected and target inflation. When the estimate of this parameter is larger than unity, it is concluded that the monetary policy has been adequate. Representative researches on this aspect are Clarida et al. (1998, 2000), Judd and Rudebusch (1998), and Nelson (2003); see Hamalainen (2004) for a detailed survey. In order to analyze the behavior of the above mentioned parameter, the estimations have been performed by sub-samples, which have been selected based on prior exogenous criteria.

An interest-rate rule may be observed, following Svensson (1997), as the result of an optimization of an intertemporal loss function subject to two equations describing the structure of the economy (aggregate demand and supply). In general, the arguments of the loss function are the gap between expected and target inflation, and the output gap. The important issue in this context is that the parameters of the interest-rate rule are convolutions of the original parameters associated to the preferences of the Central Bank and the structure of the economy. Even assuming very simple specifications for the structure of the economy and the loss function, the convolution is complex.

In the above context, as Favero and Rovelli (2002) argue, estimation of an interest-rate rule in a single-equation specification is not a good advise, except if the researcher is only interested in the behaviour of the coefficient associated to the gap between expected and target inflation. The recommendation is the estimation of a three-equations system, allowing for the possibility to retrieve the structural parameters associated to the preferences of the monetary authority and the structure of the economy.

In this paper, I adopt the approach recommended by Favero and Rovelli (2002) using data for Canada for the period 1961:1-2003:3. To the best of my knowledge, no similar approach has been used for this Country. The results show important sensitivities of the smoothing coefficient and the weight assigned to the output gap according to which measure of output gap is used. All estimations indicate that the economic conditions related to the aggregate demand have been favorable in comparison to those related to the aggregate supply. Furthermore, all estimations indicate that the monetary policy has been successful in the last regime.

The rest of the paper is organized as follows. Section 2 presents the model. The empirical results are presented and discussed in Section 3. Sec-

tion 4 concludes.

2 The Model

I consider the simplest version of the inflation targeting problem as described by Svensson (1997). Using a similar notation as in Favero (2001), and Favero and Rovelli (2002), I assume that monetary authority preferences may be described by the following intertemporal loss function:

$$E_t \sum_{i=0}^{\infty} \delta^i L_{t+i}, \tag{1}$$

$$L = 0.5[(\pi_t - \pi^*)^2 + \lambda x_t^2 + \mu(i_t - i_{t-1})^2], \tag{2}$$

where π_t is the inflation rate, x_t is the output gap, i_t is the policy instrument, E_t defines the expectations taken with respect to the information available at time t, π^* is the target level of inflation, δ is the intertemporal factor of discount, λ is the weight associated to the output stabilization, and μ is the weight attached to interest rate smoothing. Equation (2) may be observed as a general characterization of the policy goals, where special cases such as strict targeting ($\lambda = 0, \mu = 0$), or flexible inflation targeting ($\lambda \neq 0, \mu = 0$) may be considered.

When the goal is the specification of an instrument rule, (1) and (2) have to be complemented by specifications of the structure of the economy. Following standard assumptions in the literature, see among others Favero (2001), and Favero and Rovelli (2002), I assume the following specifications for the demand and aggregate supply:[3]

$$x_{t+1} = \beta_x x_t - \beta_r(i_t - E_t\pi_{t+1} - \overline{r}) + u_{t+1}^d, \tag{3}$$

$$\pi_{t+1} = \alpha_\pi \pi_t + \alpha_x x_t + u_{t+1}^s, \tag{4}$$

where u_{t+1}^d and u_{t+1}^s represent shocks to the aggregate demand and supply, respectively. In the empirical section, I use the exchange rate as an additional variable.

[3] The equations (3) and (4) may be considered as the solutions of intertemporal optimization problems by agents of the private sector.

In summary, the intertemporal optimization problem is then to minimize (1) and (2) subject to the restrictions (3) and (4). The coefficients of the obtained monetary rule are convolutions of the parameters associated to the preferences of the central bank (δ, λ, π^*) and the structure of the economy $(\alpha_\pi, \alpha_x, \beta_r, \beta_x, \overline{r})$. It represents a serious issue in terms of estimating an interest rate rule as a single equation since it implies that the structure of the economy cannot be identified.

I adopt the approach suggested by Favero and Rovelli (2002), which is based in a three-equations model. This system is obtained by minimizing the loss function (2) under the assumption of finite horizon, and subject to a general distributed lag specification of the aggregate demand and supply from the stylized specifications (3) and (4).

Then, the estimated system , written for $j = 1$, is the following:

$$\begin{aligned} x_{t+1} &= c_1 + c_2 x_t + c_3 x_{t-1} + c_4(i_{t-1} - \overline{\pi}_{t-1}) + c_5(i_{t-2} - \overline{\pi}_{t-2}) \\ &\quad + u^d_{t+1} \end{aligned} \tag{5}$$

$$\pi_{t+1} = c_6 \pi_t + c_7 \pi_{t-1} + c_8 x_t + c_9 \Delta w_t + u^s_{t+1} \tag{6}$$

$$\begin{aligned} 0 &= \mu E_t(i_{t+1} - i_t) - \mu\delta E_t(i_{t+2} - i_{t+1}) + \delta^3 E_t\{c_8 c_4(\pi_{t+4} \\ &\quad - \pi^*) + \delta[c_6 c_8 c_4 + c_8(c_5 + c_2 c_4)](\pi_{t+5} - \pi^*)\} + \\ &\quad \lambda\delta^2 E_t\{c_4 x_{t+3} + \delta(c_5 + c_2 c_4) x_{t+4} + \delta^2[c_2(c_5 + \\ &\quad c_2 c_4) + c_3 c_4] x_{t+5}\}. \end{aligned} \tag{7}$$

where w_t is an additional explanatory variable which is explained in the empirical section. As in Favero and Rovelli (2002), I use $\delta = 0.975$ because estimation of this parameter is very instable. However, unlike them, I do not impose the restriction that $c_6 + c_7 = 1$.

3 Empirical Results

It is worth to note the following issues concerning the estimation of the system (5)-(7): i) the variable w_t is the growth rate of the exchange rate; ii) overall, the set of instruments includes four lags of the inflation rate, the output gap, the interest rate, and the growth rate of the exchange rate. However, given that the sample size changes, the set of instruments changes consequently.

Quarterly data is used from 1961:1 to 2002:3. As a measure of the output gap, we have three measures. One measure is obtained after application of the filter of Hodrick and Prescott (1997). The other two measures are obtained after using a linear and a quadratic trend, respectively. The three measures are denoted by HP, LT and QT, respectively. Annual inflation is measured as $100 \times (p_t - p_{t-4})$, where p_t denotes logarithms of Consumer Price Index (CPI)[4]. The source of the information for Canada is the Bank of Canada.

The literature on monetary rules has suggested an estimation by subsamples, where the break point is considered exogenous. In a recent paper, Rodríguez (2004) has estimated interest rate rules for Canada and the US using endogenous break points selected by the approach suggested by Bai and Perron (1998, 2003). In general, his results show that the selected break dates are consistent with what previous research has used for the US. I decided to use the same break dates selected by Rodríguez (2004) for Canada.

Two breaks are selected for any measure used in calculating the output gap. When the HP filter is used to calculate the output gap, the breaks are identified at 1980:3 and 1994:2. Using the approaches LT and QT allow to identify 1980:3 and 1995:4 as the break dates.

Table 1 shows the estimates. Panel A presents the estimates obtained when the HP filter has been used to calculate the output gap. The estimates of the coefficient π^* reflect clearly the evolution of this parameter through the different samples. The value of π^* in the third regime is close to the middle point of the target inflation followed by the Bank of Canada. On the other hand, the values for the coefficients μ and λ are difficult to interpret given the opposite sign found in more than one regime. The economic conditions related to the aggregate demand have been favorable in comparison with those related to the aggregate supply[5]. The standard deviation of the monetary rule indicates that the monetary policy has been successful in the third regime in comparison with the other two regimes. In particular, observing this parameter, it seems that the second regime (1980:4-1994:1) has been characterized by a bad conduction of the monetary policy.

Panel B shows the estimates obtained when the LT filter has been used to calculate the output gap. As in the panel A, similar observations are obtained from these estimates. The values of the coefficients μ and λ seem

[4] I also consider estimations using a more narrow measure of Consumer Price Index, frequently denoted as the Core CPI. Results are available upon request.

[5] It is also found by Favero and Rovelli (2002) for the case of the US.

to suggest that reduced smoothing of the interest rates is assigned by the Central Bank and slight weight to the output gap is also attributed.

Panel C, based on estimations using the QT filter to calculate the output gap, show very similar conclusions.

A general conclusion from the estimates is the extreme sensitivity of the estimates to the different approaches in calculating the output gap. It is particularly the cases for the parameters λ and μ. Another conclusion is the fact that preferences of the monetary authorities have changed drastically in last regimes. It is clearly reflected in the estimates of the π^*. Better macroeconomic conditions are also observed from the side of the aggregate demand in comparison with those from the aggregate supply. The empirical evidence suggests, without any doubt, the fact that the monetary policy has been conducted efficiently in the last regime.

4 Conclusions

Estimations of an interest rate rule using single-equation methods has been criticized by Favero and Rovelli (2002) based on the fact that structural parameters, associated to the preferences of the monetary authority and the structure of the economy, cannot be retrieved. This issue of convolution of parameters may be fixed in estimating a three-equations system by GMM as suggested by Favero and Rovelli (2002). In this paper, I applied this approach for the case of Canada. Estimation by sub-samples was performed using different measures to calculate the output gap.

The results showed important sensitivities of the smoothing coefficient and the weight assigned to the output gap according to which measure of output gap is used. All estimations indicated that the economic conditions related to the aggregate demand have been favorable in comparison to those related to the aggregate supply. Furthermore, all estimations indicated that the monetary policy has been successful in the last regime. It is observed in the value of the π^*, which is approximately 2.0%, that is, the middle point of the official target level established by the Bank of Canada.

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Table 1. Estimates of the system (5)-(7) for Canada; Total CPI

	A) Estimates using HP			
	No Breaks	Two Breaks		
	1961:1-2003:3	1961:1-1980:2	1980:4-1994:1	1994:3-2003:3
	Coefficient	Coefficient	Coefficient	Coefficient
c_1	0.071^a	0.063^a	0.736^a	-0.129^a
c_2	1.080^a	0.730^a	1.254^a	1.483^a
c_3	-0.262^a	-0.088^a	-0.322^a	-0.662^a
c_4	0.008^a	0.072^a	-0.124^a	-0.054^a
c_5	-0.033^a	-0.092^a	-0.016^b	0.090^a
c_6	1.297^a	1.367^a	1.373^a	1.019^a
c_7	-0.312^a	-0.372^a	-0.399^a	-0.089^b
c_8	0.131^a	0.098^a	0.084^a	0.200^a
c_9	-0.016^a	-0.004	-0.004^c	-0.033^a
δ	0.975^e	0.975^e	0.975^e	0.975^e
π^*	4.742^a	6.052^a	4.218^a	1.912^a
μ	0.000^a	-0.011^a	0.032^a	-0.004^a
λ	-0.002	-0.177^a	0.035^a	-0.216^a
$\sigma(u^d)$	0.723	0.796	0.693	0.374
$\sigma(u^s)$	0.634	0.664	0.551	0.610
$\sigma(u^m)$	0.002	0.039	0.099	0.014
J	18.501	9.329	7.688	5.427
(p-value)	0.139	0.097	0.174	0.020

^{a,b,c,d} denote statistic significance at the 1.0, 2.5, 5.0 and 10.0% levels, respectively. An ^{e} indicates that the coefficient has been imposed in the estimation.

Table 1 (continued). Estimates of the system (5)-(7) for Canada; Total CPI

	B) Estimates using LT			
	No Breaks	Two Breaks		
	1961:1-2003:3	1961:1-1980:2	1980:4-1995:3	1996:1-2003:3
	Coefficient	Coefficient	Coefficient	Coefficient
c_1	0.305^a	0.516^a	0.844^a	-0.383^a
c_2	1.231^a	0.881^a	1.379^a	1.520^a
c_3	-0.255^a	0.066^a	-0.380^a	-0.582^a
c_4	-0.057^a	0.032^a	-0.186^a	-0.063^a
c_5	-0.029^a	-0.108^a	0.000	0.111^a
c_6	1.376^a	1.424^a	1.368^a	1.108^a
c_7	-0.402^a	-0.433^a	-0.422^a	-0.197^a
c_8	0.024^a	0.010^a	0.049^a	-0.020^a
c_9	-0.012^a	-0.005^c	-0.022^a	-0.023^a
δ	0.975^e	0.975^e	0.975^e	0.975^e
π^*	4.135^a	6.158^a	3.831^a	1.954^a
μ	0.001^a	0.000^a	0.002^d	0.000^c
λ	-0.010^a	-0.000^a	-0.018^a	0.017^a
$\sigma(u^d)$	0.781	0.862	0.701	0.401
$\sigma(u^s)$	0.648	0.672	0.577	0.622
$\sigma(u^m)$	0.009	0.000	0.065	0.001
J	18.516	9.261	8.340	5.051
(p-value)	0.138	0.099	0.138	0.025

^{a,b,c,d} denote statistic significance at the 1.0, 2.5, 5.0 and 10.0% levels, respectively. An ^{e} indicates that the coefficient has been imposed in the estimation.

Table 1 (continued). Estimates of the system (5)-(7) for Canada; Total CPI

	C) Estimates using QT			
	No Breaks	Two Breaks		
	1961:1-2003:3	1961:1-1980:2	1980:4-1995:3	1996:1-2003:3
	Coefficient	Coefficient	Coefficient	Coefficient
c_1	0.366^a	0.500^a	0.762^a	0.103^a
c_2	1.201^a	0.825^a	1.384^a	1.533^a
c_3	-0.260^a	0.015	-0.406^a	-0.554^a
c_4	-0.065^a	0.034^a	-0.172^a	-0.077^a
c_5	-0.035^a	-0.135^a	0.006	0.102^a
c_6	1.351^a	1.359^a	1.387^a	1.075^a
c_7	-0.370^a	-0.395^a	-0.408^a	-0.156^a
c_8	0.037^a	0.095^a	0.039^a	0.025^a
c_9	-0.017^a	-0.004	-0.018^a	-0.030^a
δ	0.975^e	0.975^e	0.975^e	0.975^e
π^*	4.609^a	2.918^a	5.307^a	1.785^a
μ	0.005^a	0.002^a	0.005^a	-0.003^a
λ	-0.011^a	-0.025^a	-0.018^a	-0.008^a
$\sigma(u^d)$	0.768	0.837	0.698	0.406
$\sigma(u^s)$	0.644	0.657	0.589	0.616
$\sigma(u^m)$	0.026	0.005	0.054	0.002
J	18.646	9.289	8.350	4.434
(p-value)	0.134	0.098	0.138	0.035

^{a,b,c,d} denote statistic significance at the 1.0, 2.5, 5.0 and 10.0% levels, respectively. An ^{e} indicates that the coefficient has been imposed in the estimation.