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*Monetary Policy Under Discretion Or  
Commitment? -An Empirical Study*

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MONETARY POLICY UNDER DISCRETION OR COMMITMENT?  
-AN EMPIRICAL STUDY

PIA FROMLET

# Monetary Policy Under Discretion Or Commitment?

## -An Empirical Study\*

Pia Fromlet<sup>†</sup>

April 26, 2013

### Abstract

In this paper, I investigate the monetary policy of five industrialized countries which have had explicit inflation targets for more than 15 years. Considering the case of discretionary policy as well as commitment, I estimate two first order conditions. The results support the theory of flexible inflation targeting under discretion for the United Kingdom. For New Zealand, the results under discretion suggests that monetary policymakers have been *leaning with the wind* rather than against the wind. The central banks of Canada, Sweden, and Australia have behaved in line with the theory of flexible inflation targeting under commitment.

Keywords: Inflation targeting, optimal policy under discretion, optimal policy under commitment

JEL Classification: E31, E52, E58, E61

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# 1 Introduction

Today, inflation targeting is a widely used monetary policy framework. New Zealand was the first country adopting inflation targeting in 1990. Since then, the number of inflation targeting countries has grown, both among advanced and developing economies. The spread of inflation targeting as a monetary policy framework is due to its success in first lowering and then maintaining low and stable inflation, without negative consequences for the real economy. Also, according to Svensson and Woodford (2004), inflation targeting can be expected to work well when it comes to short run responses of inflation and output to exogenous shocks.

Nowadays, the inflation targeting approach used by most countries can be characterized as "flexible inflation forecast targeting". Flexible inflation targeting involves the announcement of an explicit inflation target together with a sensible stabilization policy (Bullard, 2012). Forecast targeting means that the short-term nominal interest rate is set by the central bank in such a way that the forecast of the target variables is good relative to the monetary policy objective (Svensson, 2007). Optimal monetary policy is then characterized by a condition called "leaning against the wind". This means that high expected inflation is countered by a policy leading to an expected negative output gap. The aim with this paper is to test empirically whether this condition is fulfilled in terms of expectations. I consider the case of discretion as well as commitment for five inflation targeting countries. To put it simply, I test whether ex ante deviations from the inflation target can be explained by ex ante output gaps.

When testing whether the inflation targeting countries conduct monetary policy in line with flexible inflation forecast targeting I study five inflation targeting countries which adopted inflation targeting more than a decade ago. Data for these countries comprise more observations than later inflation targeters. The countries included in the analysis are New Zealand, Canada, the United Kingdom, Sweden, and Australia.

The empirical approach is based on the theoretical work by Clarida, Galí, and Gertler

(1999), Svensson and Woodford (2004), and Woodford (2003). For instance, Svensson and Woodford (2004) incorporate different forms of inflation targeting rules in their models and derive their implications. More specifically, they explore the possibility of implementing optimal equilibrium in three possible ways, in terms of a general targeting rule, a specific targeting rule, and an explicit instrument rule specifying the central bank's instrument as a function of predetermined variables. According to Svensson (2003), a *general* targeting rule is a specification of a monetary policy rule listing the target variables, the target levels, and the loss function which should be minimized. A *specific* targeting rule, on the other hand, specifies conditions for the target variables, or the forecasts of the target variables.

I start by testing whether the central bank pursues discretionary policy using a specific inflation targeting rule. Optimal policy under discretion implies that the central bank does not commit to future actions. Instead, the central bank chooses paths for inflation, output gap, and the interest rate sequentially, taking the public's expectations as given.

As an extension I also test whether the central banks commit to a state-contingent monetary policy. Optimal policy under commitment implies that the central bank commits itself to state contingent paths for future inflation, output gap, and interest rate. An advantage with committing to a targeting rule is that the predictability of policy by the private sector can be greatly improved and that the probability that the central bank itself will act in a correct manner increases (Woodford, 2003).

Testing the flexible inflation targeting framework under discretion and commitment is done by estimating two first order conditions, also referred to as leaning against the wind conditions.

So far, the number of papers studying the theory of flexible inflation targeting is limited. Thus, there is a lack of empirical evidence concerning the policies that the inflation targeting central bank actually pursue. One paper similar to this one is by Otto and Voss (2009). The authors examine whether observed behavior of the central banks of Australia, Canada, and the United States are in line with standard theoretical models of inflation

forecast targeting.<sup>1</sup> The authors estimate two first order conditions of strict and flexible inflation targeting. The two conditions under flexible inflation targeting are similar to the ones used in this paper. The estimation results indicate that Australia to some extent conducts monetary policy in line with discretionary forecast inflation targeting. The same is not true for Canada and the United States. For these two countries, it seems that discretionary monetary policy is not a good description of the conducted monetary policy. In fact, the estimation results for Canada suggests that monetary policymakers are *leaning with the wind* rather than against the wind. Estimating the condition under commitment gives somewhat mixed results, depending on which horizon is being used. Results become better, however, when looking at the system estimates. Now, the relevant parameters are statistically significant and have the right sign. Overall, the results in the paper by Otto and Voss (2009) indicate that all three countries can be described as flexible inflation targeters under commitment.

My paper differs from the paper by Otto and Voss (2009) when it comes to the number of countries included in the analysis, the estimation method, the included instruments, the number of instruments, the quality of the instruments, the horizons on which to focus on, and the measures used to estimate the output gap. Some of these differences will be discussed more below.

In this paper, the included countries are the first explicit inflation targeting adopters and, thus, data for evaluating the inflation targeting framework should be long enough. Also, the inflation targeting regimes are stable for these countries. Thus, in contrast to Otto and Voss (2009) all countries included in this analysis are explicit inflation targeters which have had inflation targeting for almost two decades.

Second, the quality of the instrument is better than in the paper by Otto and Voss

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<sup>1</sup>According to Bullard (2012), the Federal Open Market Committee's (FOMC's) decided in January 2012 to name an explicit, numerical inflation target of 2 percent. The inflation target should be measured by the annual change in the personal consumption expenditures (PCE) price index. However, for the period that Otto and Voss (2009) consider, the United States can be considered as an implicit inflation targeter.

(2009). In this paper, for the discretion case, the F-values are higher than 5 for all countries for all of the included horizons. For the commitment case, for Canada and Sweden, the F-values are higher than 5 for the majority of the included horizons. This is not the case in the paper by Otto and Voss (2009) who obtain F-values higher than 5 only for the minority of the included horizons.

Finally, the method to estimate potential output is different compared to the approach in Otto and Voss (2009). In this paper, potential output is estimated by a sliding window approach which means that I estimate a linear trend, iteratively, and that I use the last observation of this linear trend estimation procedure as a measure of potential output for that quarter. Otto and Voss calculate potential output by using the Hodrick-Prescott (HP) filter, which is a common procedure. However, HP-filter makes us of data not available to policymakers. This lack of data to policymakers together with the well-known endpoint problems using HP-filter, implies that I choose a different method to calculate potential output.

Considering the model with discretion, the results indicate that for the United Kingdom monetary policy has been in line with the theory of flexible inflation targeting for all of the included horizons. For New Zealand, estimation results suggests that monetary policy has been *leaning with the wind*. For Canada, Australia, and Sweden I find no evidence of flexible inflation targeting under discretion.

When we consider the model with commitment, for Canada and Sweden, the results support the theory of flexible monetary policy for all of the included horizons. The same is true for Australia for  $\tau = 4$  and 6. For the remaining two countries, i.e. New Zealand, and the United Kingdom, results are not in line with theory.

In Section 2 I present the theoretical model. In Section 3, I present the data and estimation method. In Section 4 and 5 I discuss the estimation results under discretion and commitment, respectively. Finally, in Section 6 I conclude.



## 2 The Model

The model is a general forward-looking model similar to the models used by Clarida, Gali and Gertler, (1999), Svensson and Woodford (2004), and Walsh (2003). As in Svensson and Woodford (2004), I use a standard New Keynesian model with the modification that agents plan their consumption  $\tau$  periods ahead.<sup>2</sup> Thus, inflation and output are both predetermined for  $\tau$  periods ahead. The model economy can be described by two structural equations, a New Keynesian Philips curve and an IS curve, i.e.,

$$\pi_{t+\tau} = \beta\pi_{t+\tau+1|t} + \kappa x_{t+\tau|t} + u_{t+\tau} \quad (1)$$

$$x_{t+\tau} = x_{t+\tau+1|t} - \sigma \left( i_{t+\tau|t} - \pi_{t+\tau+1|t} - r_{t+\tau}^n \right), \quad (2)$$

where  $\pi_{t+\tau}$  is inflation between periods  $t + \tau$  and  $t + \tau - 1$ ,  $0 < \beta < 1$  is a discount factor,  $\kappa$  is a positive coefficient, and  $u_{t+\tau}$  is an exogenous disturbance term, the value of which is realized first in period  $t + \tau$ . Svensson and Woodford (2004) consider the special case when the cost-push shock is a first order autoregression process, i.e. an AR(1) process, i.e.

$$u_{t+\tau} = \rho u_{t+\tau-1} + \varepsilon_{t+\tau}, \quad (3)$$

where  $0 \leq \rho < 1$  and  $\varepsilon_{t+\tau}$  is an exogenously independently and identically distributed (i.i.d) shock. For any variable,  $z$  and any horizon  $\tau \geq 0$ , the notation  $z_{t+\tau|t} \equiv E_t z_{t+\tau}$  is used to denote private-sector expectations of  $z_{t+\tau}$  conditional on information available in period  $t$ . Thus, the variable  $\pi_{t+\tau+1|t}$  denotes private sector inflation expectations in period  $t$  of inflation between periods  $t + \tau$  and  $t + \tau + 1$  and  $x_{t+\tau|t}$  is the expectation in period  $t$  for the output gap in period  $t + \tau$ . The output gap (in logs) is defined as  $x_t \equiv y_t - y_t^*$  and measures how much output ( $y_t$ ) in period  $t$  exceeds/ falls below its potential ( $y_t^*$ ) in

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<sup>2</sup>Actually, in Svensson and Woodford (2004), the focus is on the first horizons, i.e.  $\tau = 1$ . However, the first order condition which is the main focus in this paper should hold for all horizons beyond 1, a point emphasized by Woodford (2007).

period  $t$ . Looking at the IS- curve,  $i_{t+\tau|t}$  denotes private sector expectations in period  $t$  of the short nominal interest rate for the period  $t + \tau$ ,  $\sigma$  is a positive coefficient, and  $r_{t+\tau}^n$  is an exogenous disturbance. I assume that the natural rate of interest follows the AR(1) process,

$$r_{t+\tau}^n = \bar{r} + \omega (r_{t+\tau-1}^n - \bar{r}) + \eta_{t+\tau}, \quad (4)$$

where  $0 \leq \omega \leq 1$ ,  $\bar{r}$  is the average real rate, and  $\eta_{t+\tau}$  is an exogenous i.i.d. shock in period  $t + \tau$ . Since the structural equations are predetermined for  $\tau$  periods, this implies that inflation and the output gap can be written as

$$\pi_{t+\tau} = \pi_{t+\tau|t} + u_{t+\tau} - u_{t+\tau|t}, \quad (5)$$

$$x_{t+\tau} = x_{t+\tau|t} - \sigma \left( r_{t+\tau}^n - r_{t+\tau|t}^n \right), \quad (6)$$

thus implying that both inflation and the output gap are determined  $\tau$  periods in advance, up to exogenous deviations of the shock terms.

The intuition from equations (5) and (6) is that monetary policy should aim at influencing the private sector's inflation and output gap expectations in period  $t$ . By taking the expectations in period  $t$  of equations (1) and (2), they can be interpreted as describing how private sector, in period  $t$ , plan for inflation and the output gap in period  $t + \tau$ . These plans are determined by expectations of inflation and output gap in period  $t + \tau + 1$ ,  $\pi_{t+\tau+1|t}$  and  $x_{t+\tau+1|t}$ , the interest rate in period  $t + \tau$ ,  $i_{t+\tau|t}$ , and the cost-push shock and natural interest rate in period  $t + \tau$ ,  $u_{t+\tau|t}$  and  $r_{t+\tau|t}^n$ . One important implication of this model is that monetary policy affects the economy through expectations regarding future interest rates, not current short interest rates. Actual inflation and output are then determined by equations (5) and (6).

In this model, it will be optimal for the central bank to make the interest rate perfectly

forecastable  $\tau$  periods in advance since this is what affects private sector's expectations.

I assume that the central bank can commit in period  $t_0$  to a state-contingent path for the interest rate from  $t_0 + \tau$  periods onwards. Since the central bank can control private sector's expectations regarding inflation and output by setting the interest rate  $\tau$  periods in advance, the problem is to choose paths for the forecastable components of inflation and the output gap, the private sector  $\tau$ -period-ahead plans for inflation and the output gap,  $\{\pi_{t+\tau|t}\}_{t=t_0}^{\infty}$  and  $\{x_{t+\tau|t}\}_{t=t_0}^{\infty}$  in order to minimize

$$E_{t_0} \sum_{t=t_0}^{\infty} \beta^{t+\tau-t_0} \frac{1}{2} \left[ (\pi_{t+\tau|t} - \pi_t^*)^2 + \lambda (x_{t+\tau|t} - x^*)^2 \right] \quad (7)$$

subject to the constraint

$$\pi_{t+\tau|t} = \beta \pi_{t+\tau+1|t} + \kappa x_{t+\tau|t} + u_{t+\tau|t}, \quad (8)$$

obtained by taking the conditional expectations of equation (1)  $\tau$  periods in advance. The variable  $x^*$  denotes the socially optimal output, which in line with Svensson and Woodford (2004) for simplicity is assumed to be constant.<sup>3</sup> The Lagrangian looks as follows

$$\begin{aligned} \mathcal{L}_{t_0} \equiv & E_{t_0} \sum_{t=t_0}^{\infty} \beta^{t+\tau-t_0} \\ & \left\{ \frac{1}{2} \left[ (\pi_{t+\tau|t} - \pi_t^*)^2 + \lambda (x_{t+\tau|t} - x^*)^2 \right] + \varphi_{t+\tau} [\beta \pi_{t+\tau+1|t} + \kappa x_{t+\tau|t} + u_{t+\tau|t} - \pi_{t+\tau|t}] \right\} \end{aligned} \quad (9)$$

where  $\varphi_{t+\tau}$  is the Lagrange multiplier associated with the period  $t + \tau$  aggregate supply relation (8). Differentiating with respect to  $\pi_{t+\tau|t}$  and  $x_{t+\tau|t}$  gives the first order conditions

$$(\pi_{t+\tau|t} - \pi_t^*) - \varphi_{t+\tau} + \varphi_{t+\tau-1} = 0, \quad (10)$$

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<sup>3</sup>The constant property of the socially optimal output, i.e.  $x^*$  is questioned in Blanchard and Galí (2007). The authors argue that  $x^*$  is assumed to be constant only in the absence of nontrivial real imperfections in the standard New Keynesian model, such as real wage rigidities. However, for simplicity reasons and in line with Svensson and Woodford (2004), I assume  $x^*$  to be constant.

$$\lambda(x_{t+\tau|t} - x^*) + \kappa\varphi_{t+\tau} = 0 \quad (11)$$

for all  $t \geq t_0 + \tau$ ). For  $t = t_0 + \tau - 1$  one substitutes the initial condition in (10), that is

$$\varphi_{t_0+\tau-1} = 0. \quad (12)$$

The zero value of the constraint in (12) comes from the fact that the policy is being chosen in period  $t_0$  and private decisions for  $t_0 + \tau - 1$  have already been made (Woodford, 2010). After elimination of the Lagrange multipliers the consolidated first order condition is obtained, i.e.,

$$(\pi_{t+\tau|t} - \pi_t^*) + \frac{\lambda}{\kappa}(x_{t+\tau|t} - x^*) = 0 \quad (13)$$

for  $t = t_0 + \tau$  and

$$(\pi_{t+\tau|t} - \pi_t^*) + \frac{\lambda}{\kappa}(x_{t+\tau|t} - x_{t+\tau-1|t-1}) = 0 \quad (14)$$

for  $t \geq t_0 + \tau$ . Condition (13) arises under the assumption that monetary policy is discretionary and that the central bank re-optimized monetary policy in period  $t - \tau$ . This condition is also referred to as *leaning against the wind*. It says that when expected inflation is above target, the central bank will lower expected output below its capacity in order to minimize the loss. Thus, the central bank will focus on the contemporaneous trade-off between the output gap and inflation in period  $t + \tau$ . Condition (13) is also referred to as a *specific inflation forecasting targeting rule*. Condition (14) arises under the assumption that the central bank committed to state-contingent paths for the interest rate, the output gap, and the inflation rate before period  $t$ . Under commitment, the central banks has to take into account that the aggregate supply relation is dynamic in that current inflation depends on future inflation through the forward-looking aggregate supply curve. This implies that the trade-off between inflation and output also is dynamic, as seen in condition (14).

The fraction  $\lambda/\kappa$  in conditions (13) and (14) reflects the relative weight that the output

gap receives in the flexible inflation targeting framework. The more the central bank cares about inflation, the lower is the (absolute) value of the fraction  $\lambda/\kappa$ . Thus, the central bank reacts weaker (stronger) to the output gap and the deviation of the output gap from its lagged value the lower (higher) the fraction of  $\lambda/\kappa$ . The parameter  $\kappa$  is a positive coefficient and  $\lambda$  is nonnegative so we would expect the fraction  $\frac{\lambda}{\kappa}$  to be positive. The absolute size of the fraction  $\frac{\lambda}{\kappa}$  is more difficult to predict. However, previous studies by for instance Dennis (2004) and Favero and Rovelli (2003) suggest that the  $\lambda$  parameter should be rather small. For the US, they estimate it to be close to zero suggesting a small value of  $\frac{\lambda}{\kappa}$ . Otto and Voss (2009) estimate  $\frac{\lambda}{\kappa}$  to be larger than zero but less than one in absolute values.

Further, optimal policy under discretion implies that policy is time-consistent. This is because policy is re-optimized each period, consistently yielding equation (11). However, this is not true in the commitment case. This can be seen from the fact that the two first order conditions (13) and (14) differ. I.e. the solutions are not the same for  $t = t_0 + \tau$  and  $t \geq t_0 + \tau$ . Condition (14) holds only if it is possible to commit to a state-contingent inflation path and have this be expected by the public. But the public should be able to observe the central bank's reasoning, rather than its announced future promise and conclude that the central bank in the present should wish to create inflation for just this time. Instead, the central bank could gain by choosing a non-inflationary policy rather than doing one thing today but promising to behave in another way in the future. More specifically, for the commitment case, I assume that the central bank at the start of the inflation targeting framework committed itself to a state-contingent policy according to equation (14) and that it has followed this policy since then. Also, given the fact that I assume commitment at the start of the inflation targeting period, there is a possibility that the central bank exploited the fact that variables in the beginning of the inflation targeting period were predetermined. Taking this into account, I exclude the initial adjustment period and exclude the first year of inflation targeting.

## 3 Data And Estimation

### 3.1 Data

The data included in the estimated equations are: Consumer Price Index (CPI), other price indices for which the inflation target is defined<sup>4</sup>, and Gross Domestic Product (GDP). In addition to these variables, I also include data on share prices, consumer confidence index, and business confidence as instruments for the output gap.<sup>5</sup>The data, which is seasonally adjusted, is collected from central banks, statistical institutions, and from the OECD. Inflation rates, growth rates etc. for all of the included horizons are measured in annual percentage terms. In order to get a more detailed description of the included data and the data sources, see the data appendix.

### 3.2 Estimation

First, I will assume that the central bank pursues discretionary monetary policy and that monetary policy is re-optimized every period. Thus, condition (13) is relevant here. Second, I will estimate the condition (14) assuming that monetary policy is characterized

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<sup>4</sup>For New Zealand, the United Kingdom, and Australia, there have been periods for which the inflation target was defined in terms of annual rises in other price indices than the CPI. For New Zealand, for the period 1998-1999, the inflation target was defined in terms of annual rises in CPIX (All Groups Consumer Price Index excluding Credit Services). For the remaining years, the inflation targets were defined in terms of annual rises in CPI. For the United Kingdom, the target was initially defined in terms of the annual change in the retail price index (RPIX) excluding mortgage interest payment. However, in April 2003, there was a switch in terms of specifying inflation targets in terms of the CPI. Finally, for Australia the inflation target was initially specified in terms of core inflation (excluding the impact of interest on CPI). In September 1998, the inflation target was specified in terms of annual rises in CPI. For information on the data sources to the CPI and other price indices I refer to the Data Appendix.

<sup>5</sup>For Sweden and the United Kingdom, data on business confidence can be found only for the different sectors separately. Thus, there is no index measuring business confidence for all sectors jointly. For Sweden and the United Kingdom, I therefore use the confidence indicator for the manufacturing sector. Being aware of the shortage using only business confidence for the manufacturing sector, I refer to previous studies by for instance Barnes and Ellis (2005). They conclude that surveys in the manufacturing sector about business optimism may contain information about firms' current situation and expectations of the future. This, will in turn, affect the decisions about future investment in manufacturing. Changes in manufacturing investment are then reflected in business investment as a whole and business investment accounts for almost 10% of GDP in the United Kingdom.

by commitment.<sup>6</sup> Assuming that the efficient output gap level is equal to zero, i.e.  $x^* = 0$  I estimate the equations<sup>7</sup>

$$\pi_{t+\tau} - \pi_t^* = \alpha + \beta x_{t+\tau} + \varepsilon_{t_1+\tau}. \quad (15)$$

$$\pi_{t+\tau} - \pi_t^* = \alpha + \beta (x_{t+\tau} - x_{t+\tau-1}) + \varepsilon_{t_2+\tau}. \quad (16)$$

where  $\pi_{t+\tau}$  is the annual inflation rate in period  $t+\tau$ ,  $\pi_t^*$  is the the inflation target in period  $t$  and  $x_t$  is the output gap in period  $t$ . The two equations (15) and (16) correspond to the optimality conditions (13) and (14) mentioned in the previous section. More precisely, Equation (15) is estimated under the assumption that monetary policy is re-optimized every period and Equation (16) is estimated under the assumption that the central bank commits itself to a specific targeting rule. The parameter of interest,  $\beta = -\frac{\lambda}{\kappa}$  measures the extent to which central banks are leaning against the wind. I.e. it captures to what extent the inflation targeting central bank will lower output below its capacity in order to minimize the loss when inflation rates are above targets.

The applied estimation method will be 2SLS and the first stage regressions are given

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<sup>6</sup>For New Zealand quarterly GDP data is not available until the second quarter of 1987. However, I approximate quarterly GDP numbers for the first eight years (since I want GDP data from the last quarter of 1979 onwards) by using an industrial production index, using the fact that the correlation between GDP and industrial production is known to be high. For those years when quarterly GDP data is available I estimate the following equation:

$$\frac{GDP_t - \overline{GDP}_t}{\overline{GDP}_t} = \alpha + \beta \left( \frac{IND_t - \overline{IND}_t}{\overline{IND}_t} \right) + \varepsilon_t$$

where  $GDP_t$  and  $IND_t$  are GDP and industrial production index in quarter  $t$ . Further,  $\overline{GDP}_t$  and  $\overline{IND}_t$  is average GDP and industrial production index for the calendar year in quarter  $t$ . The estimation results from the equation above is then used to calculate quarterly GDP for the first missing eight years. I simply use the estimates for  $\alpha$  and  $\beta$  in the equation above together with average GDP and industrial production index for the calendar year in quarter  $t$  ( $\overline{GDP}_t$  and  $\overline{IND}_t$ ), and the industrial production index in quarter  $t$  ( $IND_t$ ) in order to obtain quarterly GDP ( $GDP_t$ ) numbers for the first eight years.

<sup>7</sup>The socially optimal output gap, i.e.  $x^*$ , is positive if potential output, on average, falls short of the socially optimal output level. This can happen if there are some distortion (Svensson and Woodford, 2004).

by

$$x_{t+\tau} = \alpha + \beta_1 x_{t-2} + \beta_2 (\pi_{t-1} - \pi_{t-1}^*) + \beta_3 dsp_t + \beta_4 cci_t + \beta_5 ibc_{t-1} + \varepsilon_{t_3+\tau} \quad (17)$$

$$x_{t+\tau} - x_{t+\tau-1} = \alpha + \beta_1 x_{t-2} + \beta_2 (\pi_{t-1} - \pi_{t-1}^*) + \beta_3 dsp_t + \beta_4 cci_t + \beta_5 ibc_{t-1} + \varepsilon_{t_4+\tau}, \quad (18)$$

where Equation (17) is the first stage regression under discretion and Equation (18) is the first stage regression under commitment.<sup>8</sup> Also,  $x_{t-2}$  is the two quarter lagged output gap,  $\pi_{t-1} - \pi_{t-1}^*$  is the lagged deviation of the inflation rate from target in period  $t - 1$ ,  $dsp_t$  is the percentage change in share prices in period  $t$  compared to period  $t - 4$ ,  $cci_t$  is the consumer confidence index in period  $t$ , and  $ibc_{t-1}$  is the lagged index of business confidence in period  $t - 1$ . The instruments are variables assumed to be known by the central bank in period  $t$ . Since data for inflation, output, and business confidence is reported with a lag, I use lagged values of these three variables. Since there is a two to three months delay in the production of the output series, I lag the output gap two quarters to be sure that output data is available at time  $t$ . For Australia and New Zealand, data on consumer price inflation is not available until after the end of the quarter. For the remaining three countries, data on monthly inflation is available, thus making it possible to approximate within quarter inflation. However, for consistency I use lagged inflation rates from targets for all five countries as an instrument.

According to theory, the deviation of the inflation rate from target in period  $t - 1$

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<sup>8</sup>Otto and Voss (2009) estimate the first order conditions by GMM. In addition to single equation estimates, they also estimate a restricted system. In the restricted system they test whether the relevant parameter is equal at a horizon of two and four quarters. They fail to reject the hypothesis that the parameter is equal at these short-run horizons. I estimate the first order conditions by 2SLS. Theory suggests that for overidentified models, it is best to use optimal GMM. However, one should use optimal GMM with caution when the sample is finite, due to the poor small sample approximation to the distribution of the optimal GMM estimator. My model is overidentified, thus theory suggest using optimal GMM would be more efficient than 2SLS, especially in case of heteroscedasticity and autocorrelation of error terms. However, the efficiency gain need not be great, and together with the problem of small sample properties of optimal GMM, 2SLS is preferable for this paper. Since I use quarterly data from the early 90s to 2011, my samples are rather small. Therefore, to avoid the bad small sample properties of optimal GMM, I choose to estimate my equations with 2SLS.



should be negatively correlated with the future output gap. Whenever the deviation of the inflation rate from target in period  $t - 1$  increases, the monetary policy is expected to become more contractionary, and, consequently output gap in posterior periods is expected to decrease. Thus, I expect  $\beta_2$  to be negative.

The effect of the change in share prices, consumer confidence index and business confidence index is not easy to predict. Without any reaction of the instrument rate to changes in share prices, the future output gap should increase as a response to an increase in share prices. However, changes in share prices are indicators of changes in demand. Central bankers may react to an increase by raising the interest rates and, consequently, demand may fall. Thus, the sign of the  $\beta_3$  parameter is ambiguous. The same is true for the consumer and business confidence index. An increase in the consumer and business confidence index in period  $t$  and  $t - 1$ , respectively, could lead to an increase in future output gap since the indices are signals of peoples' future consumption and investment plans. Thus, an increase in the indices could be a signal that people plan to consume and invest more. On the other hand, since these two variables are indicator variables for monetary policymakers, they could react to an increase in the indices by increasing the policy interest rate. This would result in a (short-run) negative effect on output. Thus, the sign of the  $\beta_4$  and  $\beta_5$  parameters can be either positive or negative.

Further, estimating potential output is a non-trivial matter and different methods can imply different results.<sup>9</sup> In this paper, I estimate potential output using a sliding window approach. This sliding window approach implies dropping the first  $z$  observations and estimating a linear trend to the quarter 18 months before the first observation. The next step is to drop the first  $z + 1$  observations and estimate a linear trend to the quarter 15 months before the first observation. The number of observations in the estimation procedure is always the same (here 41), irrespective of the quarter estimated. The linear trend estimation is then repeated for all quarters included in the sample. When estimating

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<sup>9</sup>For instance, see the discussion by Orphanides and van Norden (2002).

potential output by using a sliding window approach, it is important to use a sufficient number of observations. This in order to exclude temporary deviations from the trend while still being able to pick up actual changes in the trend itself. Using 41 observations (approximately 10 years) seems like a plausible number in order to fulfill the previously mentioned criterion.

Another aspect that needs to be taken into account is the appropriate choice of horizon that should be focused on. I need to consider horizons for which monetary policy has an ability to affect output and inflation. Thus, the horizon should not be too short. However, near term horizons for which monetary policy affects output can be motivated if there are no departures from standard assumptions in dynamic stochastic models, such as no habit formation. See for instance Christiano, Eichenbaum and Evans (2005). However, due to departures from standard assumption in dynamic stochastic models, for instance habit formation, longer implementation lags in monetary policy can be motivated. In this paper, I take short as well as longer horizons into account and choose to focus on horizons for which monetary policy has some ability to affect inflation and output up to those horizons for which monetary policy reaches its maximum effect. Thus, I include four, six, and eight quarters, i.e.  $\tau = 4, 6, \text{ and } 8$ .<sup>10</sup>

Finally, for countries with targets defined in terms of a narrow band, say 2 – 3%, I use the midpoint of the band (2.5%) when calculating the deviation of the inflation rate from the target.

In the following two sections I present the estimation results under discretion as well as commitment. I start with the results under discretion. Second I talk about the results under commitment. First stage estimation results are also presented to allow readers to evaluate the relevance of the instruments. Results of Hansen’s  $J$  test of the validity of the instruments and of F-tests of overall fit in the first stage regression of instrument strength

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<sup>10</sup>Due to instrument quality, Otto and Voss (2009) choose to focus on the two and four quarter horizons. I also include a four quarter horizon. However, I find the longer run horizons, i.e. 6 and 8 quarters more interesting since this is more in line with the horizon that inflation-targeting central banks focus on.

are also listed.

## 4 Results Under Discretion

In Table 1 and 2 I present the results from the first stage regression under discretion, i.e. Equation (17).

For Canada and Sweden, the estimation results show that the lagged output gap (i.e.  $x_{t-2}$ ) is a significant predictor for future output gap, i.e. the  $x_{t+\tau}$  variable, for all of the included horizons. For Australia, this is the case in the short/ medium run, i.e. for  $\tau = 4$  and 6. For New Zealand the  $x_{t-2}$  variable has a significant effect on  $x_{t+\tau}$  only in the short run, i.e. for  $\tau = 4$ . Also, the  $\beta_1$  parameter is positive in all cases except for the United Kingdom, for  $\tau = 8$ . This results in line with expectation.

For Canada and Sweden, the  $(\pi_{t-1} - \pi_{t-1}^*)$  variable has statistically significant coefficient for all of the included horizons. Also, the  $\beta_2$  parameter has the right expected negative sign. For New Zealand, the United Kingdom, and Australia, the  $(\pi_{t-1} - \pi_{t-1}^*)$  variable is not a significant predictor for  $x_{t+\tau}$  for any of the included horizons.

Moving on to the percentage change in share prices, i.e. the  $dsp_t$  variable, we see that it helps to predict future output gap for the United Kingdom, Sweden, and Australia. For the United Kingdom and Sweden, the  $dsp_t$  variable has statistically significant coefficient for all of the included horizons. For Australia, the same is true for  $\tau = 6$  and 8. Also, the parameter takes a positive value for all of the included horizons, suggesting that an increase in share prices today compared to the corresponding quarter in the previous year, has a positive effect on expected future output gap. For New Zealand and Canada, the  $dsp_t$  variable has no significant effect.

The consumer confidence index,  $cci_t$ , has a significant effect for all countries. However, when it comes to the included horizons, the significant effects differ between the countries. For Canada, Sweden, and Australia, the  $cci_t$  variable is a significant predictor for all of the included horizons. For New Zealand and the United Kingdom, the  $cci_t$  variable is a

significant predictor for  $\tau = 4$ . Also the sign of the parameter differ between the countries. For Canada, Sweden, and Australia, it is negative for all of the included horizons. For New Zealand and the United Kingdom, the parameter in front of the  $cci_t$  variable is positive for the first two horizons (i.e. for  $\tau = 4$  and 6) and negative respectively positive for the third horizon (i.e. for  $\tau = 8$ ). The negative sign for Canada, Sweden, and Australia can probably be explained by the fact that the consumer confidence index is used by the central bank as an indicator of future economic climate and inflationary pressure. When the consumer confidence index rises, monetary policy becomes more contractionary and this has a negative effect on output gap. The positive sign for New Zealand and the United Kingdom for the first two horizons can probably be explained by the fact that an increase in the consumer confidence index is a signal of consumer optimism regarding future economic climate and, hence, future output gap strengthens or increases.

At last, looking at the lagged index of business confidence, i.e. the  $ibc_{t-1}$  variable we see that for New Zealand and Australia the  $\beta_5$  parameter is positive and statistically significant for all of the included horizons. When the index of business confidence rises, future output gap also rises. For Canada, the United Kingdom, and Sweden the lagged index of business confidence does not seem to explain the variation in future output gap.

To sum up, many variables enter the first stage regression with significant coefficients and expected signs. However, the sign of the coefficients differ between countries. For instance, for Canada, Sweden, and Australia the  $cci_t$  variable has a negative coefficient for all of the included horizons, whereas for New Zealand the coefficient takes positive as well as a negative values depending on horizon. For the United Kingdom, the variable has a positive coefficient for all of the included horizons. This is not surprising, since the expected sign of the coefficient in front of the  $cci_t$  variable was unambiguous, see the discussion in Section (3).

Further, I look at the instrument quality. I test whether the instruments pass the test of overidentifying restrictions by Hansen's  $J$ - test and the strength of the instruments by

the F-statistic of overall fit in the first stage regression. For the overidentification test, the null hypothesis is that the instruments are valid instruments, i.e., uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation. A priori, there is no reason to believe that the chosen instruments are correlated with the error term in period  $t + \tau$ , since all five instruments are dated in period  $t$  (i.e.  $dsp_t$  and  $cci_t$ ),  $t - 1$  (i.e.  $\pi_{t-1} - \pi_{t-1}^*$  and  $ibc_{t-1}$ ) or period  $t - 2$  (i.e.  $x_{t-2}$ ). Results from this test are presented in table A1 in Appendix 1. From this table, we see that the instruments pass the test of overidentifying restrictions for all countries, except for Canada for  $\tau = 4$  and 6. However, most important are the result for the two year horizon since a two year horizon is more in line with the announced objectives of inflation targeting central banks. The instruments pass the test of overidentifying restrictions for all five countries for  $\tau = 8$ .

Next, I look at instrument strength. According to Cameron and Trivedi (2005), instruments are weak if the F-statistic for test of overall fit in the first stage regression is small. In line with Staiger and Stock (1997) I use the rule of thumb that  $F > 5$ . Since I cannot reject the null hypothesis of no autocorrelation in the error term of the first stage regression for the majority of the included countries, I use robust standard errors when calculating the F-statistic. I apply the approach from Kleibergen and Paap (2006) when testing the strength of the instruments using robust standard errors.<sup>11</sup> Having only one endogenous variable, the Kleibergen-Paap (K-P) statistic reduces to the F-statistic with robust standard errors. In Table 1 and 2, the corresponding F- and p-values of overall fit in the regression of  $x_{t+\tau}$  on the instruments  $x_{t-2}$ ,  $(\pi_{t-1} - \pi_{t-1}^*)$ ,  $dsp_t$ ,  $cci_t$ , and  $ibc_{t-1}$  are listed. Looking at Table 1 and 2, the instruments are strong for all countries for all of the included horizons. More specifically, the F-values are larger than five for all countries and

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<sup>11</sup>More specifically, I use the K-P rk Wald F-statistic when testing the strength of the instruments. The K-P rk LM statistic is also used when testing the strength of the instruments. However, the K-P rk LM statistic has a  $\chi^2$  distribution implying that the probability of committing a type II error is larger given that the sample is small. For the five countries included in this paper, the sample is rather small. Therefore I choose to present only the K-P rk Wald F-statistic since this statistic has more favorable small sample properties.

for all of the included horizons.

To sum up: the instruments used in the first stage regression under discretion both pass the test of overidentifying restrictions and weak instruments. The results of Hansen's J test implies that the instrument pass the test of overidentifying restrictions for all countries except for Canada for  $\tau = 4$  and 6. Further, for all five countries the results of the F-test of overall fit in the first stage regression support the strength of the instruments for all of the included horizons.

Finally, in Table 3 and 4 I present the results from the 2SLS estimation together with the results of the F-tests of overall fit in the first stage regression. The purpose with this repetition of the F-values from the first stage regression is to provide the reader with an overall picture of instrument quality.

As mentioned in Section (3), comparing equation (15) to (13), we have that  $\beta = -\frac{\lambda}{\kappa}$ . Thus, the higher the absolute value of  $\beta$ , the higher is the relative weight on the output gap in the central bank's loss function.

We start with the countries for which the parameter in front of the  $\hat{x}_{t+\tau}$  variable is statistically significant. The  $\hat{x}_{t+\tau}$ -variable is the estimated value of future output gap from the first stage regression. The  $\beta$  parameter is statistically significant for New Zealand, Canada, and the United Kingdom. For the United Kingdom,  $\beta$  is statistically significant for all of the included horizons. For New Zealand and Canada,  $\beta$  is statistically significant for  $\tau = 4$  and 6 and  $\tau = 4$ , respectively. In line with theory, for the United Kingdom the  $\beta$  parameter is negative for all of the included horizons. Thus, monetary policymakers in the United Kingdom have been leaning against the wind in line with the theory of optimal monetary policy under discretion. For New Zealand, the sign of the  $\beta$  parameter is positive and statistically significant for  $\tau = 4$  and 6, suggesting that monetary policymakers in New Zealand in the short and medium run have been leaning with the wind rather than against the wind. The same is true for Canada for  $\tau = 4$ . For the remaining two countries, i.e., Australia and Sweden, the  $\hat{x}_{t+\tau}$  variable has no effect. However, for both these countries,

the  $\beta$  parameter has the expected negative sign for all of the included horizons.

Finally, for New Zealand, Canada, Sweden, and Australia,  $\alpha$  is statistically significant for all of the included horizons. It is positive for New Zealand and Australia and negative for Canada and Sweden. For the United Kingdom,  $\alpha$  is negative and statistically significant for  $\tau = 4$  and 6. Since  $\alpha$  is statistically significant for all or for the majority of the included horizons, one could check whether it is approximately equal to the average value of the deviation of the inflation rate from target, i.e. the average of the  $\pi_{t+\tau} - \pi_t^*$  variable. This should be the case given that  $\hat{x}_{t+\tau}$  sometimes should equal zero. From Table A3 in Appendix 2, we see that that the sign of  $\alpha$  and the average deviation of the inflation rate from target, i.e. the  $\pi_{t+\tau} - \pi_t^*$  variable is the same for all countries and for all of the included horizons. The values do not differ much either. Thus, one can conclude that the constant captures a large part of the average deviation of the inflation rate from target. For New Zealand, Canada, and Australia, the average deviation of the inflation rate from target has been positive. For the United Kingdom and Sweden, the average deviation of the inflation rate from target has been negative.

In summary, the estimation results from the second stage regression suggests that the United Kingdom has been leaning against the wind in accordance with the theory of optimal monetary policy under discretion. The absolute value of the  $\beta$  parameter is consistent with previous estimates by Favero and Rovelli (2003) and Otto and Voss (2009), which taken together suggest that  $\beta$  should be larger than zero but less than one. New Zealand, on the other hand, has been leaning with the wind, since the relation between expected output gap and the deviation of the inflation rate from target is positive. For the remaining three countries, results are not in line with the theory of flexible inflation targeting under discretion.

After estimating Equation (15), for those countries where significant estimation results for the  $\beta$  parameter for at least two of three horizons are obtained, I plot the deviation of the inflation rate from target against the output gap and the expected deviation of the

inflation rate from target against the expected output gap. In order to save space, plots for those countries where results are insignificant for the  $\beta$  parameter for the majority of the included horizons are presented in Appendix 3. The first three columns in the first row plot actual values and the first three columns in the second row plot estimated values. Also, a regression line in all figures are depicted in order to more clearly show the relation between the deviation of the inflation rate from target and the output gap and their estimated counterparts. If the two plots with actual and estimated relations differ, that could probably be attributed to forecast errors or that the inflation targeting central banks have not behaved according to the models under discretion and commitment.

Expected deviation of the inflation rate from target is calculated by estimating a regression with the same variables as those used as instruments in the first stage regression, i.e. Equation (17). Thus, I use  $x_{t-2}$ ,  $\pi_{t-1} - \pi_{t-1}^*$ ,  $dsp_t$ ,  $cci_t$ , and  $ibc_{t-1}$  as variables when deriving fitted values of the deviation of the inflation rate from target.

For New Zealand and the United Kingdom, significant estimation results for the  $\beta$  parameter were obtained for the majority of the included horizons. For these two countries, Figure 1-2 plot the deviation of the inflation rate from target against the output gap and the expected deviation of the inflation rate from target against the expected output gap.

Starting with New Zealand, we see from Figure 1 that both the actual and estimated relations are positive. The regression lines show a more positive relation between the expected deviation of the inflation rate from target and the output gap than the actual relation between these two variables. Monetary policy has systematically been leaning with the wind, and the reason for the difference between the actual and estimated relation is probably unpredictable forecast errors.

Finally, for the United Kingdom, we see from Figure 2 that there is a clear pattern between the actual and estimated relation. The slope of the regression line is negative for both actual and estimated values and the difference between the actual and estimated relation is, again, probably due to forecast errors. Thus, for the United Kingdom, monetary



policymakers have behaved systematically according to the model under discretion.

Table 1: Estimation Results For the First Stage Regression Under Discretion When the Dependent Variable is  $x_{t+\tau}$

Variable	New Zealand			Canada			The United Kingdom		
	$\tau = 4$	$\tau = 6$	$\tau = 8$	$\tau = 4$	$\tau = 6$	$\tau = 8$	$\tau = 4$	$\tau = 6$	$\tau = 8$
$\alpha$	-8.091*** (2.979)	-4.839 (3.434)	2.662 (4.537)	2.799 (3.100)	3.676 (3.350)	4.628 (3.425)	0.854 (0.656)	0.248 (1.036)	-0.399 (1.273)
$x_{t-2}$	0.321*** (0.111)	0.088 (0.116)	0.019 (0.133)	0.637*** (0.142)	0.437*** (0.147)	0.280** (0.130)	0.209 (0.156)	0.111 (0.190)	-0.551 (0.360)
$\pi_{t-1} - \pi_{t-1}^*$	0.136 (0.227)	0.044 (0.252)	0.013 (0.324)	-0.869*** (0.180)	-0.794*** (0.200)	-0.707*** (0.176)	0.823 (0.513)	0.550 (0.778)	0.019 (1.002)
$dspt$	0.008 (0.018)	0.013 (0.021)	0.034 (0.028)	0.032 (0.022)	0.024 (0.019)	0.024 (0.017)	0.048*** (0.016)	0.063*** (0.019)	0.062*** (0.019)
$ccit$	0.074*** (0.027)	0.048 (0.032)	-0.018 (0.043)	-0.046*** (0.016)	-0.084*** (0.017)	-0.105*** (0.021)	0.173*** (0.065)	0.122 (0.074)	0.038 (0.074)
$ibc_{t-1}$	0.045*** (0.010)	0.055*** (0.012)	0.060*** (0.012)	0.009 (0.034)	0.034 (0.034)	0.043 (0.033)	0.006 (0.043)	-0.023 (0.060)	-0.007 (0.073)
F-value	41.128	25.961	17.112	19.289	11.881	12.205	22.578	16.928	11.956
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

A variable marked by \*, \*\*, or \*\*\* indicates significance at the 10, 5, and 1% levels, respectively.

Newey-West standard errors reported in parenthesis.

Table 2: Estimation Results For the First Stage Regression Under Discretion

When the Dependent Variable is  $x_{t+\tau}$

Variable	Sweden			Australia		
	$\tau = 4$	$\tau = 6$	$\tau = 8$	$\tau = 4$	$\tau = 6$	$\tau = 8$
$\alpha$	-0.146 (0.937)	0.084 (0.837)	0.579 (0.618)	5.573** (2.653)	8.079*** (2.963)	8.135*** (2.142)
$x_{t-2}$	0.403*** (0.113)	0.284** (0.137)	0.260* (0.149)	0.543*** (0.156)	0.373** (0.175)	0.296 (0.189)
$\pi_{t-1} - \pi_{t-1}^*$	-1.023** (0.315)	-1.298*** (0.353)	-1.180*** (0.347)	-0.144 (0.143)	-0.086 (0.156)	-0.052 (0.174)
$dsp_t$	0.056*** (0.017)	0.059*** (0.016)	0.054*** (0.012)	0.010 (0.011)	0.024*** (0.009)	0.029*** (0.011)
$cci_t$	-0.095** (0.038)	-0.168*** (0.044)	-0.231*** (0.050)	-0.053** (0.024)	-0.077*** (0.028)	-0.081*** (0.021)
$ibc_{t-1}$	0.004 (0.060)	-0.033 (0.051)	-0.033 (0.040)	0.065*** (0.015)	0.075*** (0.018)	0.104*** (0.018)
F-value	7.787	5.602	5.802	6.767	8.793	19.739
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

A variable marked by \*, \*\*, or \*\*\* indicates significance at the 10, 5, and 1% levels, respectively.

Newey-West standard errors reported in parenthesis.

Table 3: Estimation Results For the Discretion Case When the Dependent Variable Is  $\pi_{t+\tau} - \pi_t^*$

Variable	New Zealand			Canada			The United Kingdom		
	$\tau = 4$	$\tau = 6$	$\tau = 8$	$\tau = 4$	$\tau = 6$	$\tau = 8$	$\tau = 4$	$\tau = 6$	$\tau = 8$
$\alpha$	0.588*** (0.176)	0.510*** (0.190)	0.633*** (0.203)	-0.316* (0.185)	-0.333* (0.199)	-0.423* (0.225)	0.220*** (0.078)	0.242*** (0.079)	0.258 (0.160)
$\hat{x}_{t+\tau}$	0.175*** (0.057)	0.160** (0.067)	0.101 (0.084)	0.109* (0.065)	0.012 (0.070)	0.071 (0.080)	-0.092** (0.036)	-0.149*** (0.046)	-0.256*** (0.057)
F-value	41.128	25.961	17.112	19.289	11.881	12.205	22.578	16.928	11.956
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Variable	Sweden			Australia		
	$\tau = 4$	$\tau = 6$	$\tau = 8$	$\tau = 4$	$\tau = 6$	$\tau = 8$
$\alpha$	-0.615** (0.299)	-0.621* (0.324)	-0.676** (0.322)	0.346** (0.156)	0.468*** (0.165)	0.416** (0.186)
$\hat{x}_{t+\tau}$	-0.089 (0.103)	-0.105 (0.118)	-0.087 (0.118)	-0.005 (0.236)	-0.118 (0.178)	-0.123 (0.088)
F-value	7.787	5.602	5.802	6.767	8.793	19.739
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

A variable marked by \*, \*\*, or \*\*\* indicates significance at the 10, 5, and 1% levels, respectively. Newey-West standard errors reported in parenthesis.

# New Zealand

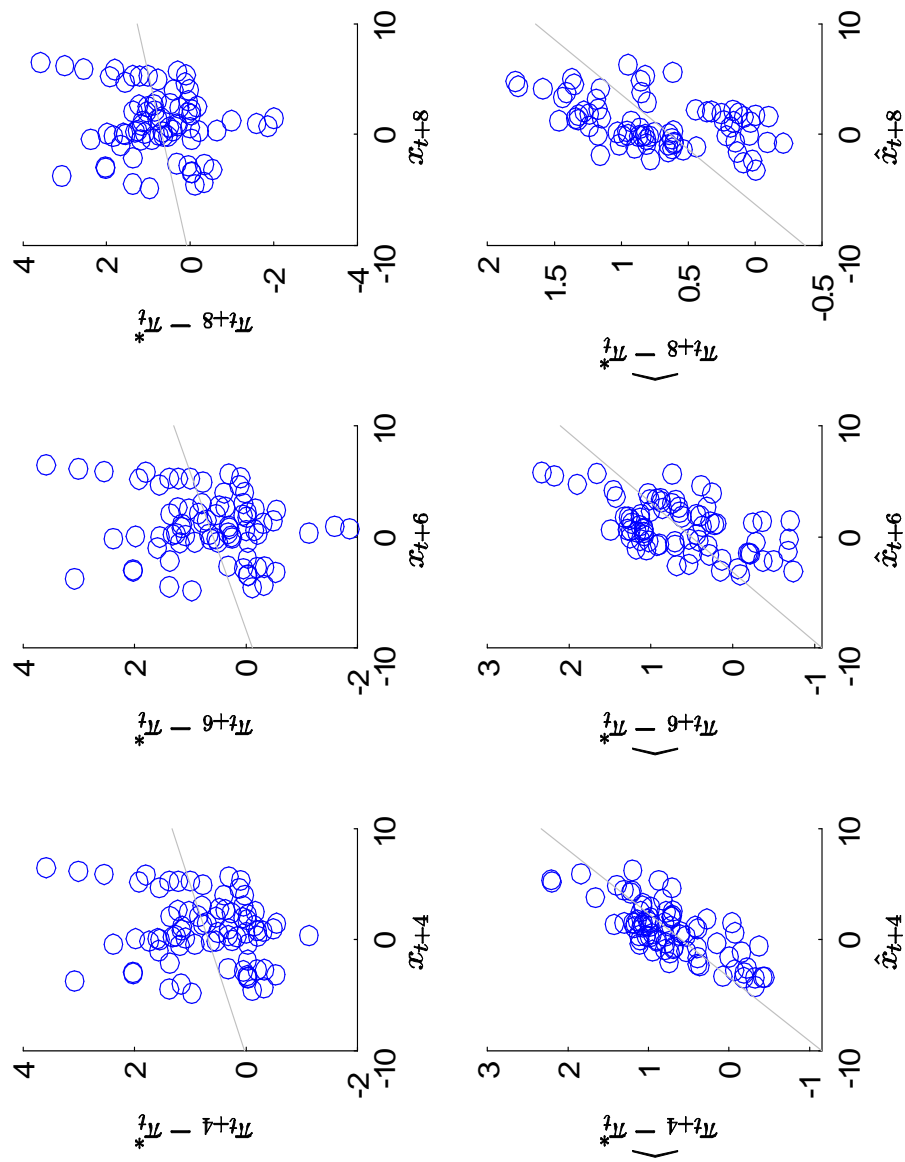


Figure 1: Scatter diagram showing the deviation of the inflation rate from target on the Y axis and the output gap on the X axis. Actual values in the first row and estimated values in the second row. Variables are in %.

## The United Kingdom

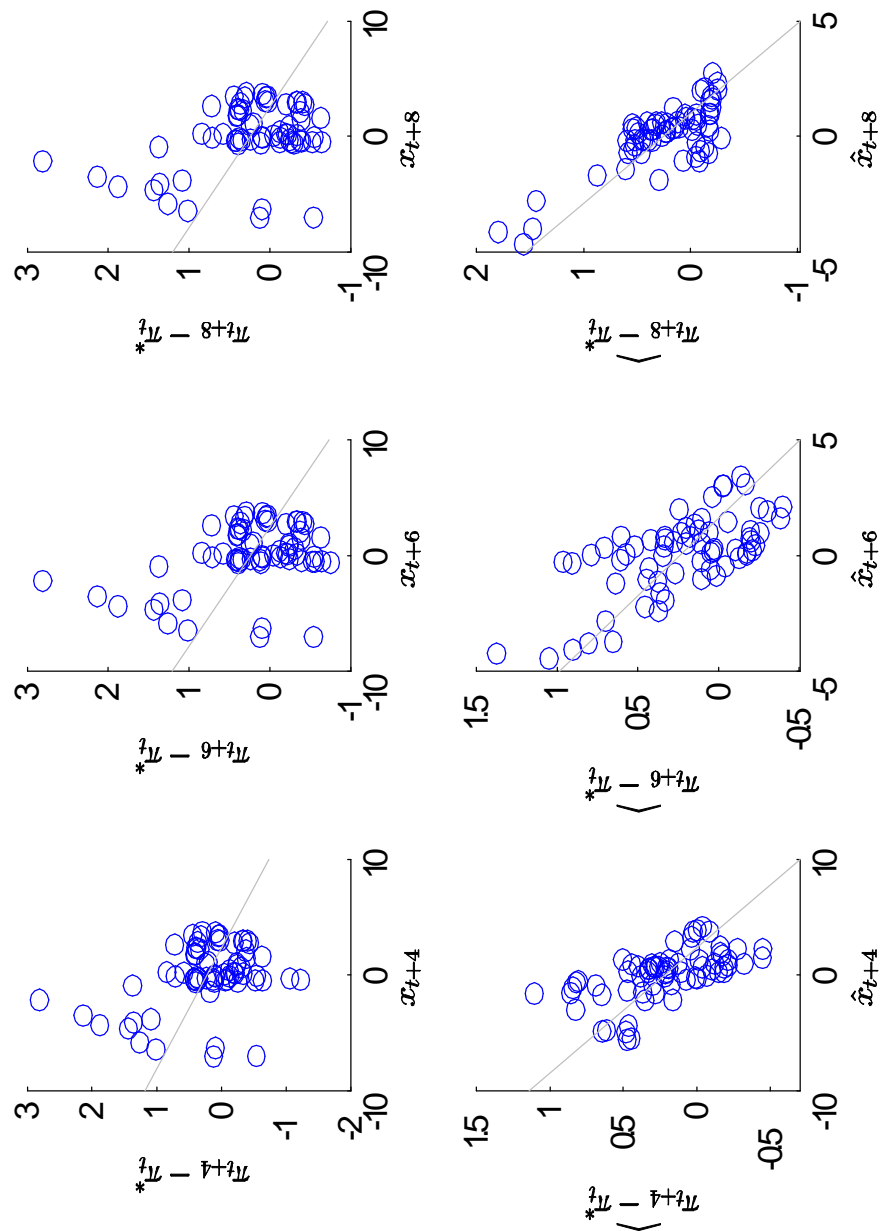


Figure 2: Scatter diagram showing the deviation of the inflation rate from target on the Y axis and the output gap on the X axis. Actual values in the first row and estimated values in the second row. Variables are in %.

## 5 Results Under Commitment

The results for the commitment case are presented in Table 5-7. Starting with the first stage regression (i.e. Equation (18)), from Table 5, three conclusions can be drawn.

First, the number of significant coefficients is fewer, compared to the case with discretion. This is not surprising, since it should be harder to predict a change in the output gap than the level.

Second, the lagged output gap, i.e. the  $x_{t-2}$  variable, and the consumer confidence index, i.e. the  $cci_t$  variable, have negative and statistically significant coefficients in many cases. In turn, this is not surprising since an increase in any of these two variables should be followed by a contractionary monetary policy and a decrease in demand and, hence, a falling output gap.

Third, there are a few remaining variables which help to predict the change in future output gap. However, the signs of these coefficients differ. For instance, for Sweden and the United Kingdom, the  $(\pi_{t-1} - \pi_{t-1}^*)$  variable has a negative significant effect for  $\tau = 4$  respectively 8. The opposite is true in the long run for Sweden (i.e. for  $\tau = 8$ ). Also, for Sweden, the lagged index of business confidence,  $ibc_{t-1}$ , has significant negative effect for  $\tau = 4$ . The opposite is true for Australia for  $\tau = 4$  and 6 and for New Zealand for  $\tau = 4$ .

Next, looking at the instrument quality, I again conduct Hansen's  $J$ -test of overidentifying restrictions and perform an F-test for the strength of the instruments.

From Table A2 in Appendix 1 we see that the instrument for the commitment case pass the overidentification test for all countries except for Sweden for  $\tau = 4$ . Again, since the main focus is on the longer term horizons and the remaining countries pass the test of overidentifying restrictions for all of the included horizons, I conclude that the instruments, overall, are uncorrelated with the error term.

Moving on to the F-test we immediately see that the instruments are strong for the majority of the included horizons for Canada and Sweden. For Canada, the F-value is larger than 5 for the first two horizons, i.e. for  $\tau = 4$  and 6. For Sweden, the same is for

$\tau = 4$  and 8. For New Zealand, the United Kingdom, and Australia, the instruments are weak for the majority of the included horizons.

In summary, the instrument under the commitment case pass the test of overidentifying restrictions. However, there is a problem with the strength of the instrument in some cases. The instruments are strong only for Canada and Sweden for a majority of the included horizons. Thus, if the estimation results from the second stage regression suggest that monetary policies do not lean against the wind, that could in some cases be explained by the fact that the monetary policy makers have not been able to predict the actual outcome. Perhaps this is not so strange, since the predicted variable is the percentage change in the output gap. Obviously, an increase in a variable is harder to predict than the level of the same variable.

Obviously, the conclusion that the instruments in the commitment case are weak for the majority of the included countries is problematic. However, the instruments are strong for Canada and Sweden, countries for which estimation results are significant. Thus, we can conclude that these two countries have been flexible inflation targeters under commitment. This in contrast to the results in Otto and Voss (2009), who conclude that "the relative weakness of instruments is obviously an important qualification to our results".

To circumvent the presence of weak instruments, Otto and Voss choose to focus on the two and four quarter horizons, where the instruments are strongest. However, I choose not to focus on short-term horizons because six to eight quarter horizons are more in line with the stated monetary policy objectives of the inflation targeting countries and the evidence that monetary policy affects inflation with a lag of 6 – 8 quarter.

The estimation results from the second stage regression (i.e. Equation (16)) are listed in Table 7. We see that there is evidence of flexible inflation targeting under commitment for Canada, Sweden, and Australia.<sup>12</sup> For Canada and Sweden, the  $\beta$  parameter is sta-

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<sup>12</sup>The significant estimation results for Australia could be biased since the instruments are weak. However, since the instruments are economically justifiable we conclude that the Reserve Bank of Australia has been leaning against the wind according to the theory of optimal policy under commitment, keeping in mind the



tistically significant and has the right negative sign for all of the included horizons. For Australia, the  $\beta$  parameter is statistically significant and negative for  $\tau = 4$  and 6. For New Zealand, the  $\Delta \hat{x}_{t+\tau}$  variable plays a significant role only for  $\tau = 4$ . For the United Kingdom, the estimation results do not support the theory of flexible inflation targeting under commitment since the  $\beta$  parameter is not negative and statistically significant for any of the included horizons.

Also, for New Zealand, the United Kingdom and Sweden, we see that  $\alpha$  is statistically significant and positive respectively negative for all of the included horizons. Inflation has, on average, been systematically above respectively below target. That there is a bias for these three countries can also be confirmed by looking at Table A4 in Appendix 2. From Table A4, we see that for New Zealand, the United Kingdom, and Sweden, the sign and the value of the constant are in line with the average deviation of the inflation rate from target. For New Zealand and the United Kingdom, the average deviation of the inflation rate from target is positive, whereas it is negative for Sweden.

Concluding, the results support flexible inflation targeting under commitment for Canada and Sweden for all of the included horizons and for Australia for horizons  $\tau = 6$  and 8. For New Zealand results are in line with flexible inflation targeting only for  $\tau = 4$  and for the United Kingdom, results are not in line with theory.

For those countries where significant estimation results for the  $\beta$  parameter are obtained for the majority of the included horizons, I plot the deviation of the inflation rate from target against the change in the output gap and the expected deviation of the inflation rate from target against the expected change in the output gap. For Canada, Sweden, and Australia, the  $\beta$  parameter is significant for the majority of the included horizons. Plots for these three countries are presented in Figure 3-5. Plots for countries with insignificant  $\beta$  parameter are depicted in Appendix 3, in Figure A4-A5.

From Figure 3- 5, we see from the plots that both the ex post and ex ante relation is

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problem with weak instruments.

negative. Also, we see that for all three countries, the ex ante relation is somewhat more negative than the ex post one. This can probably be explained by forecast errors. Since the pattern between actual and estimated relations are the same for Canada, Sweden, and Australia, one can conclude that monetary policy in these three countries has been conducted systematically in line with flexible inflation targeting under commitment.

Table 5: Estimation Results For the First Stage Regression Under Commitment When the Dependent Variable Is  $\Delta x_{t+\tau}$

Variable	New Zealand			Canada			The United Kingdom		
	4	6	8	4	6	8	4	6	8
$\alpha$	8.887 (5.634)	15.920*** (4.752)	12.823** (6.165)	5.468* (3.270)	1.929 (3.554)	-0.156 (4.550)	-0.440 (0.683)	-1.263 (1.204)	-1.184 (1.284)
$x_{t-2}$	-0.289** (0.141)	-0.244 (0.149)	-0.171 (0.144)	-0.323** (0.129)	-0.340** (0.128)	-0.331* (0.175)	-0.245** (0.122)	0.108 (0.270)	-0.536 (1.079)
$\pi_{t-1} - \pi_{t-1}^*$	0.138 (0.364)	0.089 (0.413)	-0.019 (0.439)	0.323 (0.256)	0.123 (0.226)	0.231 (0.357)	0.858 (0.687)	-0.873 (1.086)	-1.317*** (0.486)
$dspt$	0.010 (0.030)	0.042 (0.037)	(0.033) (0.035)	-0.017 (0.017)	-0.014 (0.021)	-0.002 (0.021)	-0.005 (0.013)	-0.000 (0.019)	-0.004 (0.017)
$ccit$	-0.078 (0.050)	-0.140*** (0.043)	-0.113** (0.054)	-0.078*** (0.014)	-0.071*** (0.020)	-0.031 (0.028)	0.040 (0.058)	-0.131* (0.071)	-0.163* (0.091)
$ibc_{t-1}$	0.027** (0.013)	0.017 (0.011)	0.009 (0.013)	0.016 (0.034)	0.043 (0.028)	0.029 (0.043)	-0.052 (0.045)	-0.027 (0.051)	0.016 (0.021)
F-value	2.084	5.590	2.424	11.639	6.346	1.309	5.445	3.026	2.149
(p-value)	(0.078)	(0.000)	(0.045)	(0.000)	(0.000)	(0.272)	(0.000)	(0.017)	(0.073)

A variable marked by \*, \*\*, or \*\*\* indicates significance at the 10, 5, and 1% levels, respectively.

Newey-West standard errors reported in parenthesis.

Table 6: Estimation Results For the First Stage Regression Under Commitment

When the Dependent Variable Is  $\Delta x_{t+\tau}$

Variable	Sweden			Australia		
	$\tau = 4$	$\tau = 6$	$\tau = 8$	$\tau = 4$	$\tau = 6$	$\tau = 8$
$\alpha$	0.092 (0.634)	0.414 (0.682)	0.803 (0.711)	7.026 (5.625)	15.214** (6.515)	-6.741 (5.194)
$x_{t-2}$	-0.294*** (0.089)	-0.023 (0.134)	0.201 (0.180)	-0.254 (0.219)	-0.364 (0.263)	0.095 (0.216)
$\pi_{t-1} - \pi_{t-1}^*$	-0.678* (0.388)	0.036 (0.360)	1.035** (0.485)	0.202 (0.256)	-0.116 (0.331)	0.422 (0.275)
$dsp_t$	0.014 (0.021)	0.014 (0.014)	0.008 (0.015)	-0.014 (0.025)	0.037 (0.026)	-0.005 (0.024)
$cci_t$	-0.124** (0.047)	-0.159*** (0.051)	-0.126*** (0.046)	-0.069 (0.052)	-0.147** (0.062)	0.054 (0.049)
$ibc_{t-1}$	-0.093* (0.051)	-0.086 (0.062)	0.014 (0.052)	0.061** (0.027)	0.058** (0.028)	0.069 (0.045)
F-value	12.187	3.918	5.991	2.180	1.580	1.050
(p-value)	(0.000)	(0.004)	(0.000)	(0.069)	(0.181)	(0.398)

A variable marked by \*, \*\*, or \*\*\* indicates significance at the 10, 5, and 1% levels, respectively.

Newey-West standard errors reported in parenthesis.

Table 7: Estimation Results For the Commitment Case When the Dependent Variable Is  $\pi_{t+\tau} - \pi_t^*$

Variable	New Zealand			Canada			The United Kingdom		
	$\tau = 4$	$\tau = 6$	$\tau = 8$	$\tau = 4$	$\tau = 6$	$\tau = 8$	$\tau = 4$	$\tau = 6$	$\tau = 8$
$\alpha$	0.747*** (0.170)	0.693*** (0.187)	0.774*** (0.222)	-0.184 (0.146)	-0.259 (0.158)	-0.345 (0.220)	0.282* (0.164)	0.300** (0.150)	0.304** (0.148)
$\hat{\Delta} x_{t+\tau}$	-0.131* (0.072)	-0.070 (0.061)	0.064 (0.125)	-0.377*** (0.067)	-0.401*** (0.101)	-0.673*** (0.174)	0.216 (0.142)	0.197 (0.189)	0.194 (0.134)
F-value	2.084	5.590	2.424	11.639	6.346	1.309	5.445	3.026	2.149
(p-value)	(0.078)	(0.000)	(0.045)	(0.000)	(0.000)	(0.272)	(0.000)	(0.017)	(0.073)

Variable	Sweden			Australia		
	$\tau = 4$	$\tau = 6$	$\tau = 8$	$\tau = 4$	$\tau = 6$	$\tau = 8$
$\alpha$	-0.739*** (0.152)	-0.806*** (0.227)	-0.855*** (0.232)	0.280 (0.192)	0.234 (0.208)	0.221 (0.151)
$\hat{\Delta} x_{t+\tau}$	-0.164** (0.069)	-0.206* (0.113)	-0.217* (0.127)	-0.402* (0.219)	-0.480* (0.260)	-0.205 (0.181)
F-value	12.187	3.918	5.991	2.180	1.580	1.050
(p-value)	(0.000)	(0.004)	(0.000)	(0.069)	(0.181)	(0.398)

A variable marked by \*, \*\*, or \*\*\* indicates significance at the 10, 5, and 1% levels, respectively. Newey-West standard errors reported in parenthesis.

# Canada

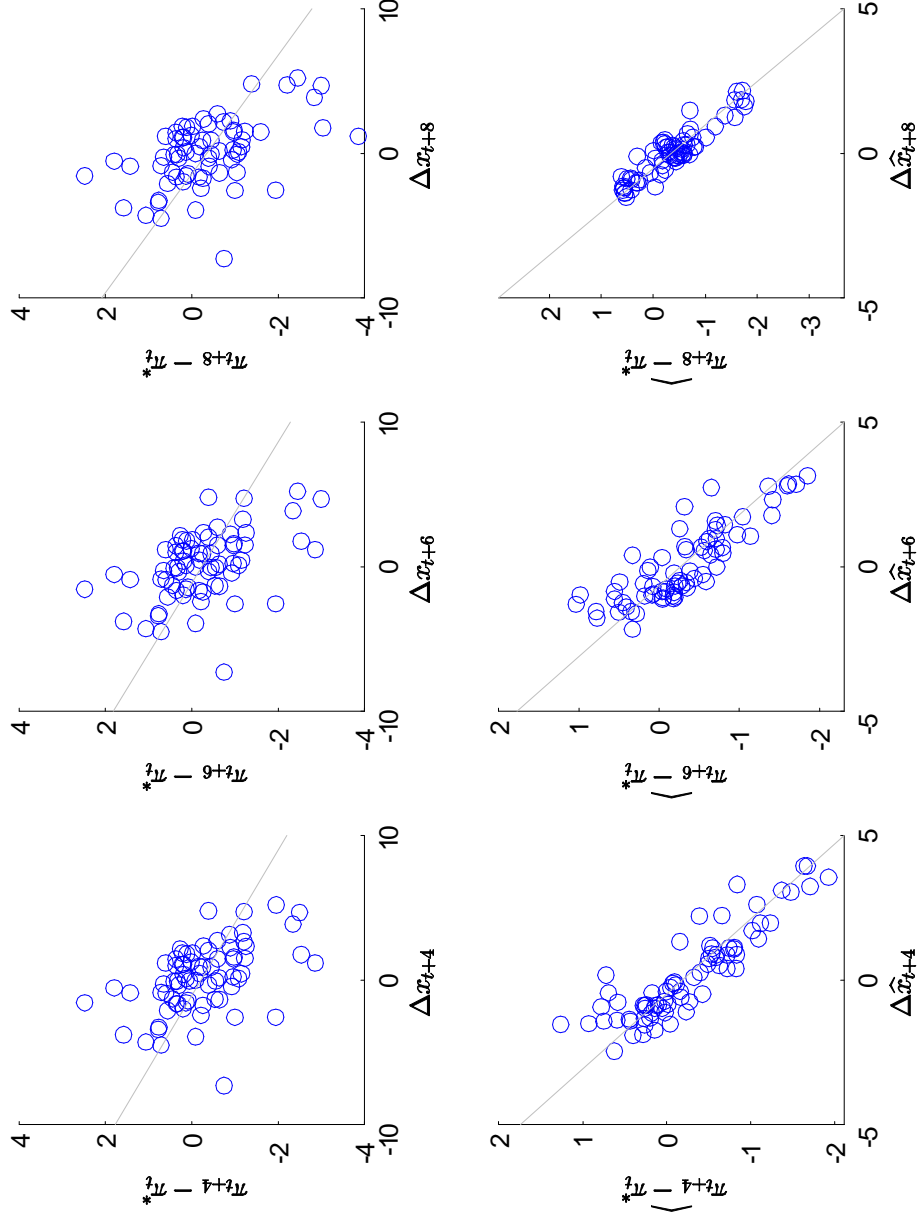


Figure 3: Scatter diagram showing the deviation of the inflation rate from target on the Y axis and the change in the output gap on the X axis. Actual values in the first row and estimated values in the second row. Variables are in %.

# Sweden

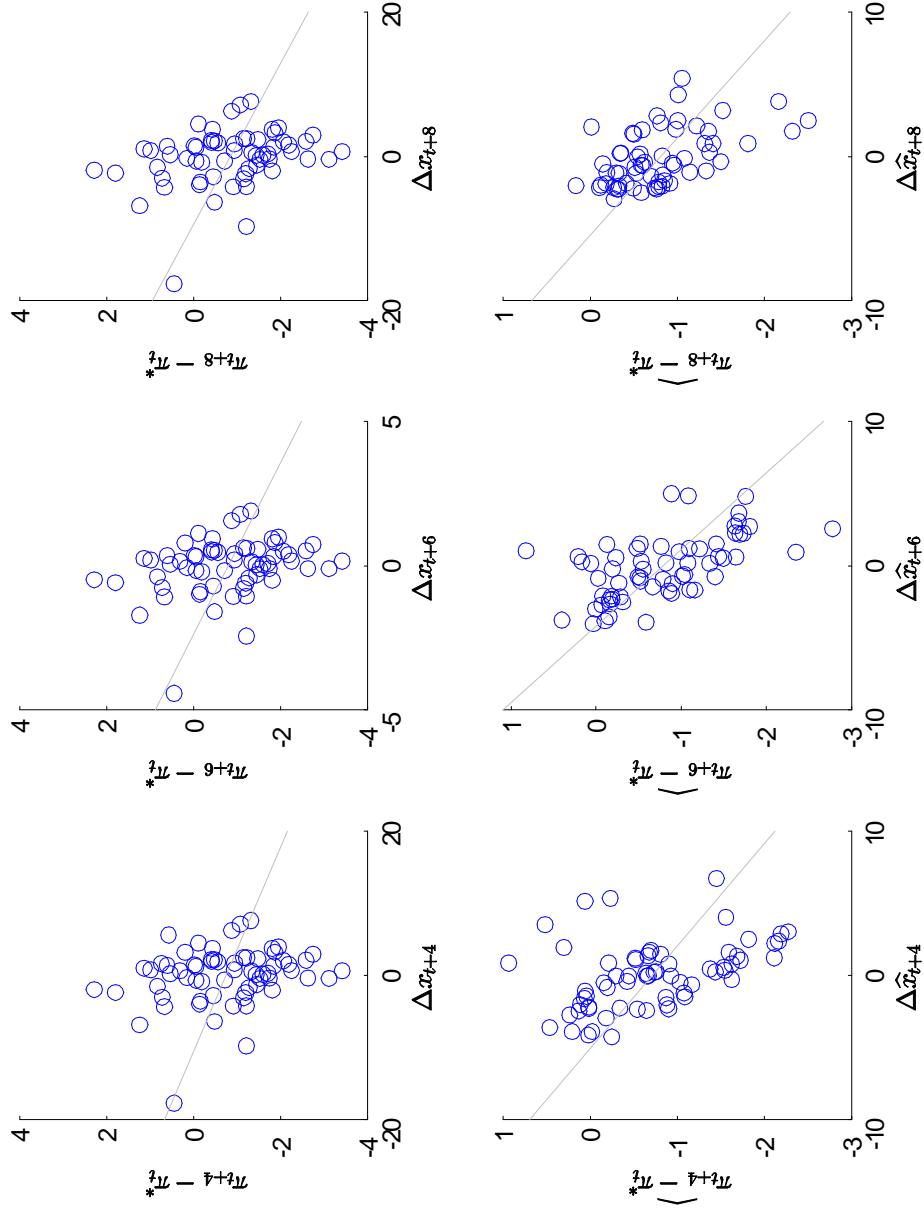


Figure 4: Scatter diagram showing the deviation of the inflation rate from target on the Y axis and the change in the output gap on the X axis. Actual values in the first row and estimated values in the second row. Variables are in %.

Australia

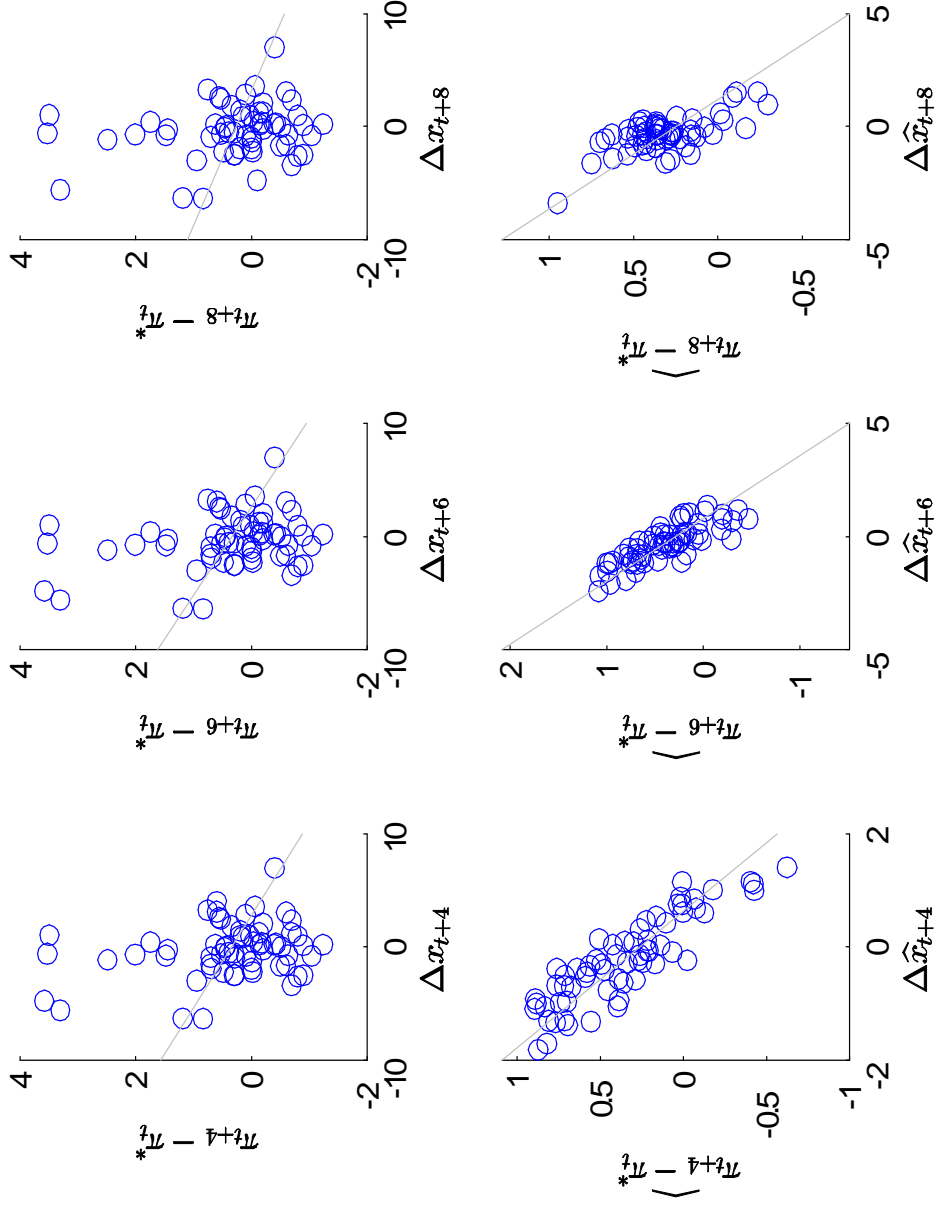


Figure 5: Scatter diagram showing the deviation of the inflation rate from target on the Y axis and the change in the output gap on the X axis. Actual values in the first row and estimated values in the second row. Variables are in %.



## 6 Conclusions

The purpose with this paper is to shed light on the behavior of some central banks which have had explicit inflation targets for more than 15 years. Can they be described as flexible inflation targeters, and if so, under discretion or commitment? More specifically, this paper provides some empirical evidence to what extent inflation targeting central banks balance inflation and output.

I include five early inflation targeting countries, namely New Zealand, Canada, the United Kingdom, Sweden, and Australia. The flexible inflation targeting framework under discretion as well as commitment is tested by estimating two first order conditions, derived from the minimization problem of the central bank and the model economy.

Overall, the results suggest that the United Kingdom has conducted monetary policy in line with the theory of flexible inflation targeting under discretion. Thus, monetary policy in the United Kingdom can be characterized by the leaning against the wind approach, where a high expected inflation rate is countered by an expected negative output gap. For New Zealand, results suggest that monetary policy has been characterized by the *leaning with the wind* approach, instead of the leaning against the wind approach as suggested by theory. Thus, a high expected inflation rate is associated with an expected positive output gap. For the remaining three countries, i.e., Australia, Sweden, and Canada, results are not in line with the theory of flexible inflation targeting under discretion.

For the commitment case, the results support the theory under commitment for Canada, Sweden and Australia. For New Zealand, the results support flexible inflation targeting under commitment only at the short run horizon, i.e. for  $\tau = 4$ . For the United Kingdom, results are not in line with the theory under commitment for any of the included horizons.

However, compared to the discretion case, the instrument quality for the commitment case is rather weak. This result is not surprising since it should be easier to predict the future output gap, as in the discretion case, than the change in the gap, as in the commitment case. For the commitment case, one positive aspect is that the instruments

are relevant and strong for Canada and Sweden, countries for which significant estimation results are obtained and, thus, the probability of a bias in these significant results is low. For Australia, the results of the instrument test indicate that the significant coefficient can be biased. However, the instruments used here are all known at time  $t$ , so they should be uncorrelated with the residual in the second stage regression. The results of Hansen's  $J$  test seem to support the view that the instruments are uncorrelated with the residual. Finally, I think it is important to use the same instruments for all five countries, and to use instruments that are easily motivated theoretically, which is the case here.

Concluding, the results of my paper indicate that the United Kingdom has conducted flexible inflation targeting under discretion. Canada, Sweden, and Australia has conducted flexible inflation targeting under commitment. For those countries where insignificant estimation results were obtained a reasonable explanation could be that monetary policy-makers have to take into account other factors than inflation and output when conducting monetary policy or that the economy has been hit by unpredictable demand shocks. Both explanations appear logical and have been highlighted in previous studies. For instance, according to Bernanke, Laubach, Mishkin, and Posen (1999), "inflation targeting requires the central bank to use structural and judgmental models of the economy, in conjunction with whatever information it deems relevant, to pursue its price-stability objective".

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## Appendix 1

Table A1: Results Of Hansen's Overidentification Test For the Discretion Case

	New Zealand	Canada	The United Kingdom	Sweden	Australia
$\tau$	$J$	$J$	$J$	$J$	$J$
	(p-value)	(p-value)	(p-value)	(p-value)	(p-value)
4	4.925 (0.295)	11.139 (0.025)	5.112 (0.276)	6.789 (0.148)	4.260 (0.372)
6	7.004 (0.136)	7.813 (0.099)	7.109 (0.130)	6.829 (0.145)	7.549 (0.110)
8	5.534 (0.237)	6.974 (0.137)	5.634 (0.228)	5.436 (0.245)	2.467 (0.651)

Hansen's  $J$  statistic is  $\chi^2(4)$  distributed.

Table A2 Results Of Hansen's Overidentification Test For the Commitment Case

	New Zealand	Canada	The United Kingdom	Sweden	Australia
$\tau$	$J$	$J$	$J$	$J$	$J$
	(p-value)	(p-value)	(p-value)	(p-value)	(p-value)
4	6.579 (0.160)	3.949 (0.413)	4.474 (0.346)	7.874 (0.096)	1.587 (0.811)
6	6.796 (0.147)	4.350 (0.361)	3.761 (0.439)	6.325 (0.176)	2.905 (0.574)
8	3.613 (0.461)	2.657 (0.617)	4.494 (0.343)	2.914 (0.572)	2.714 (0.607)

Hansen's  $J$  statistic is  $\chi^2(4)$  distributed.

## Appendix 2

Table A3: Constant And Mean Of the Deviation Of the Inflation Rate From Target For the Discretion Case

Variable	New Zealand			Canada			The United Kingdom		
	$\tau = 4$	$\tau = 6$	$\tau = 8$	$\tau = 4$	$\tau = 6$	$\tau = 8$	$\tau = 4$	$\tau = 6$	$\tau = 8$
$\alpha$	0.588*** (0.732)	0.510*** (0.661)	0.633*** (0.737)	-0.316* -0.300	-0.333* -0.289	-0.423* -0.393	0.220*** (0.214)	0.242*** (0.229)	0.258 (0.240)
$\frac{\pi_{t+\tau} - \pi_t^*}{\pi_t^*}$									
Variable	Sweden			Australia					
	$\tau = 4$	$\tau = 6$	$\tau = 8$	$\tau = 4$	$\tau = 6$	$\tau = 8$			
$\alpha$	-0.615** -0.697	-0.621* -0.727	-0.676** -0.765	0.346** 0.300	0.472*** 0.361	0.416** 0.300			
$\frac{\pi_{t+\tau} - \pi_t^*}{\pi_t^*}$									

Table A4: Constant And Mean Of the Deviation Of the Inflation Rate From Target For the Commitment Case

Variable	New Zealand			Canada			The United Kingdom		
	$\tau = 4$	$\tau = 6$	$\tau = 8$	$\tau = 4$	$\tau = 6$	$\tau = 8$	$\tau = 4$	$\tau = 6$	$\tau = 8$
$\alpha$	0.747***	0.693***	0.774***	-0.184	-0.259	-0.345	0.282*	0.300**	0.304**
$\overline{\pi_{t+\tau} - \pi_t^*}$	0.749	0.691	0.764	-0.249	-0.255	-0.358	0.227	0.244	0.238

Variable	Sweden			Australia		
	$\tau = 4$	$\tau = 6$	$\tau = 8$	$\tau = 4$	$\tau = 6$	$\tau = 8$
$\alpha$	-0.739***	-0.806***	-0.855***	0.280	0.234	0.221
$\overline{\pi_{t+\tau} - \pi_t^*}$	-0.744	-0.789	-0.823	0.400	0.369	0.300



## Appendix 3

Figure A1-A3 are plots for countries with insignificant  $\beta$  parameters for all or for the majority of the included horizons under discretion.

Figure A4-A5 are plots for countries with insignificant  $\beta$  parameters for all or for the majority of the included horizons under commitment.

# Canada

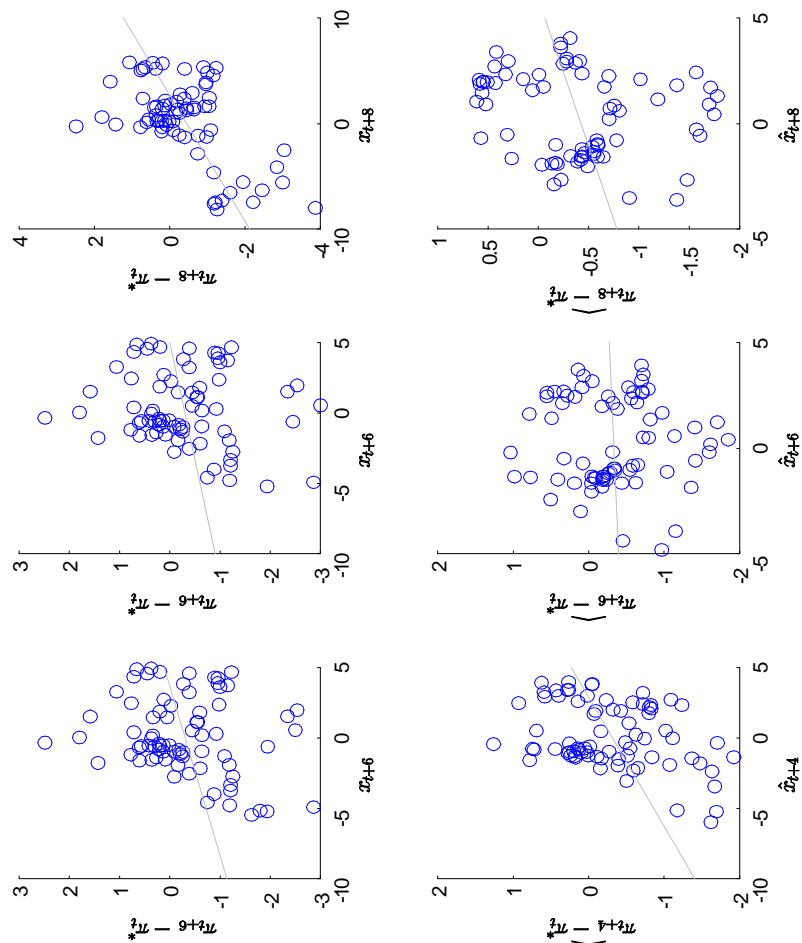


Figure A1: Scatter diagram showing the deviation of the inflation rate from target on the Y axis and the output gap on the X axis. Actual values in the first row and estimated values in the second row. Variables are in %.

# Sweden

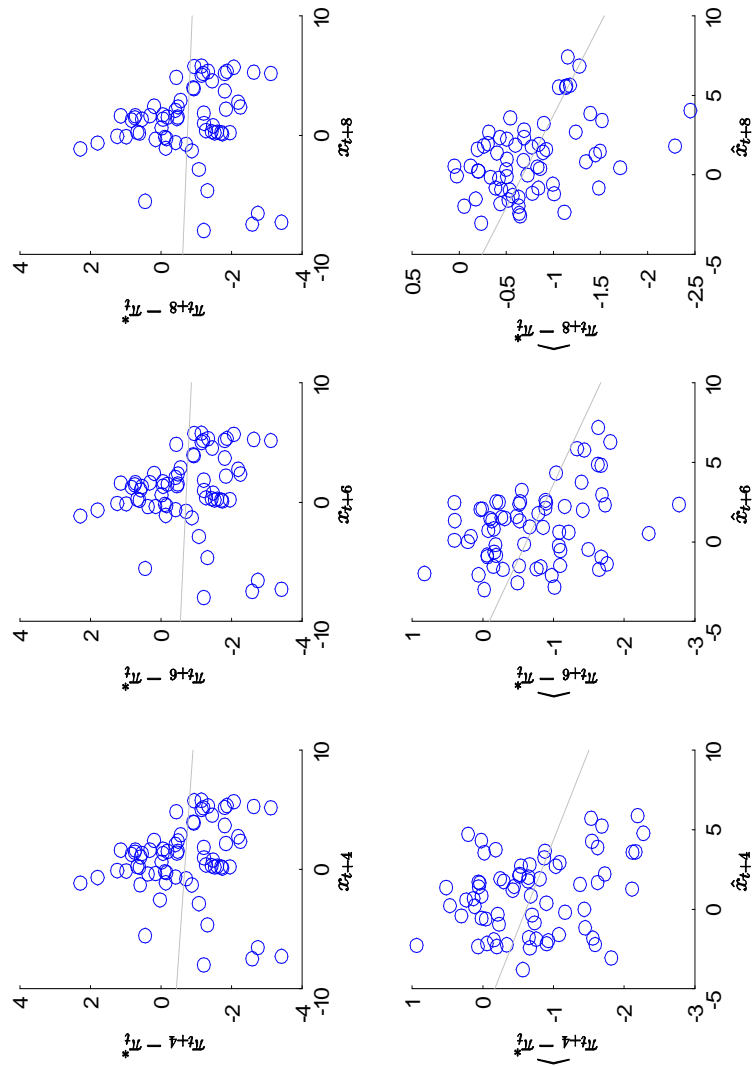


Figure A2: Scatter diagram showing the deviation of the inflation rate from target on the Y axis and the output gap on the X axis. Actual values in the first row and estimated values in the second row. Variables are in %.

# Australia

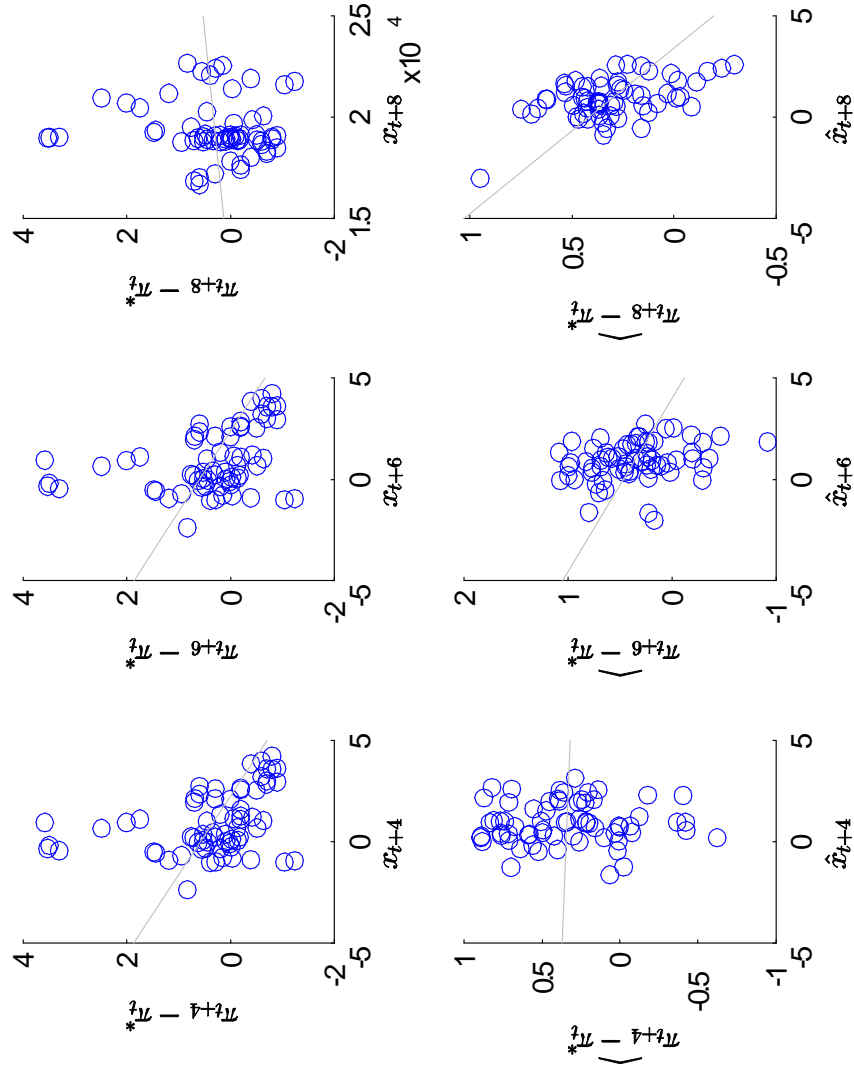


Figure A3: Scatter diagram showing the deviation of the inflation rate from target on the Y axis and the output gap on the X axis. Actual values in the first row and estimated values in the second row. Variables are in %.

# New Zealand

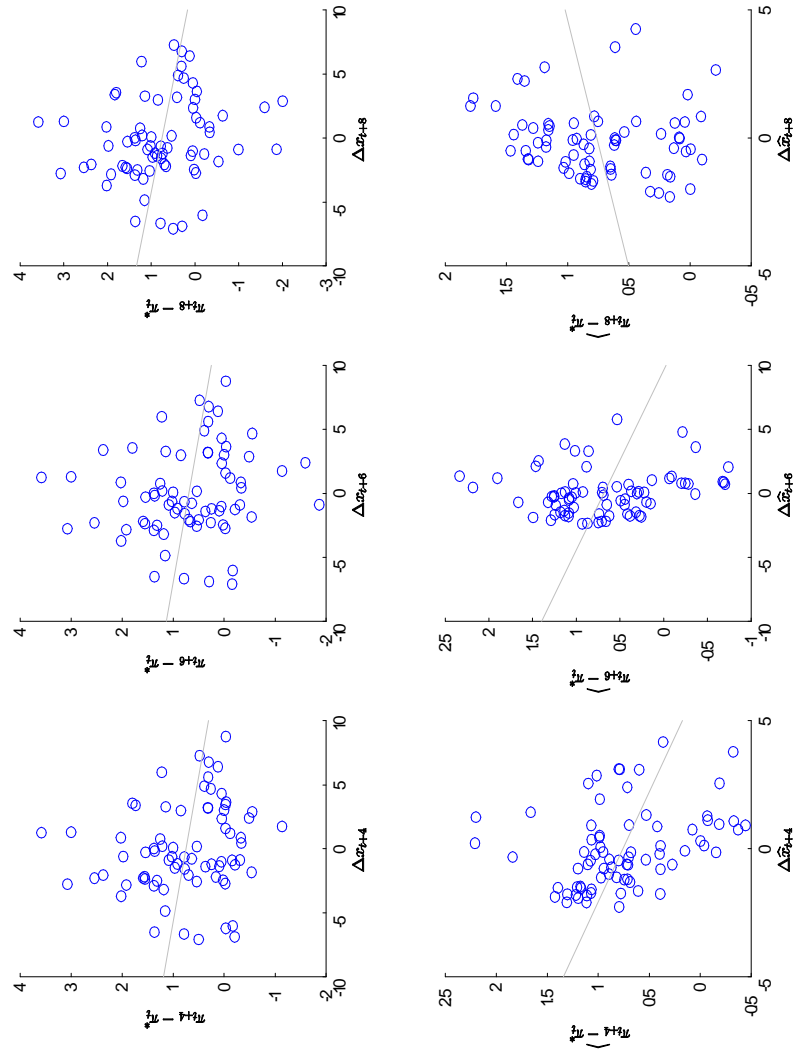


Figure A4: Scatter diagram showing the deviation of the inflation rate from target on the Y axis and the change in the output gap on the X axis. Actual values in the first row and estimated values in the second row. Variables are in %.

## The United Kingdom

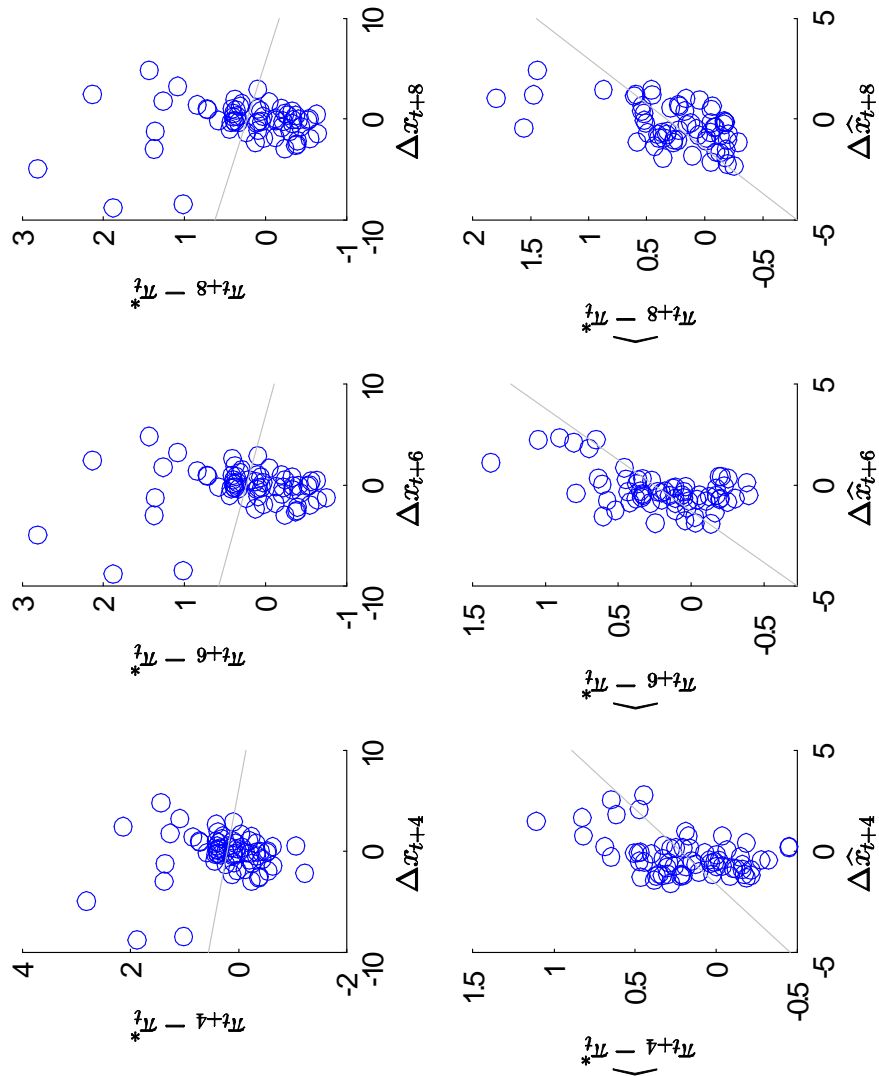


Figure A5: Scatter diagram showing the deviation of the inflation rate from target on the Y axis and the change in the output gap on the X axis. Actual values in the first row and estimated values in the second row. Variables are in %.

## Data Appendix

### Data Gross Domestic Product and Consumer Price Index

Quarterly data on Gross Domestic Product (GDP) are in constant prices and is seasonally adjusted. Data on Consumer Price Index (CPI) are also on quarterly levels. Data for all five countries are from OECD and Statistics Sweden. For New Zealand, data on All Groups Consumer Price Index excluding Credit Services (CPIX) is downloaded using the Infoshare tool available at the webpage of Statistics New Zealand. For the United Kingdom, the Retail Price Index (RPIX) is obtained by the Office for National Statistics. Further, the core CPI index for Australia is obtained from the webpage of the Reserve Bank of Australia.

The inflation rate is calculated according to  $\pi_t = 100 \cdot (P_t - P_{t-4}) / P_{t-4}$ . Output gap,  $x_t$ , is equal to GDP (in logs) in period  $t$  minus its potential level (in logs) in period  $t$ , i.e.  $x_t = \left( \ln Y_t - \ln \bar{Y}_t \right) \cdot 100$ . Quarterly first-difference output gap equals the output gap in period  $t$  minus the output gap in period  $t-1$ , multiplied by 4 in order to follow the trend on a yearly basis. I.e.  $\Delta x_t = (x_t - x_{t-1}) \cdot 4$ .

For Sweden, GDP data from Statistics Sweden is only available from 1993 onward. In order to obtain GDP numbers from 1980 to 1993, I link the series from Statistics Sweden with an old series from OECD for which I have data from 1980 to 2009 by dividing the series from Statistics Sweden with the series from OECD for those quarters where data for both series are available. I calculate the mean of this fraction and then I calculate GDP for the missing quarters for the series from Statistics Sweden by multiplying the old series from OECD with the average number of the previously mentioned fraction. These numbers are then inserted into the series from Statistics Sweden for those quarters where data are missing.

### Data Share Prices

Many of the definitions below are cited from OECD.stat which is a direct source of

the data.

According to OECD Glossary Of Statistical Terms, a share price index is defined as "Prices of common shares of companies traded on national or foreign stock exchanges". An important distinction is between a price index which measures how the value of the stocks in the index is changing and a return index which is an index showing the "return" , i.e. how much money an investor would make as a result of investing in that basket of shares.

*Share prices New Zealand.* Quarterly data from OECD which uses the Reserve Bank of New Zealand as its direct source. Quarterly data is an average of monthly figures. The index relates to the equity securities of all 150 listed companies. Generally, equity securities consists of securities giving a right to vote or to participate in the assets of the company, or those which may be converted into securities having such voting or participation rights. Fixed interest securities and overseas listed issuers are excluded. Data refer to the "Capital" (price) component of New Zealand Exchange Limited's NZSX All index. It measures movements in the capital value of all securities traded on the exchange. Thus, it excludes payments to shareholders.

*Share prices Canada.* Quarterly data from OECD which uses Statistics Canada as its direct source. Quarterly data is an average of monthly figures. The S&P/TSX composite index of the Toronto Stock Exchange measures the performance of the broad Canadian equity market and is a market capitalisation-weighted index. The index covers the top 300 shares in terms of float market capitalization of those eligible for inclusion in the index. The index includes all classes of common shares, both issued and outstanding.

*Share prices Australia.* Quarterly data from OECD which uses the Australian



Stock Exchange as its direct source. Quarterly data is an average of monthly figures. Share price indices summarize movements in share prices which are the result of trade on the Australian Stock Exchange. From April 2000, all figures refer to the S&P/ASX 200. Prior to April 2000, the All Ordinaries index is used.

*Share prices Sweden.* Quarterly data from OECD which uses OMX Stockholm AFGX general as a direct source. The AFGX (Affärsvärldens Generalindex) is a broad stock market index designed to measure the market performance of the Stockholm Stock Exchange. The index is used to evaluate share performance, not portfolio performance, as dividends are not reinvested in the index. The index consists of all shares of all companies registered on the Stockholm Stock Exchange "A-list". When the index is calculated, the closing offer prices of all shares are used. Finally, the index is capital weighted and adjusted for new subscriptions.

*Share prices the United Kingdom.* Quarterly data from OECD which uses the Bank of England as a direct source. The index comprises the 100 most highly capitalized blue chip companies, representing approximately 80% of the UK market.

#### **Data Consumer Confidence**

*Consumer confidence index New Zealand.* Data from EcoWin. The index is originally calculated by WestpacTrust McDermott Miller and is percentage response to five internationally standardized questions. These questions cover consumers' personal financial circumstances, national economic expectations and attitudes to major purchases. It is 100 plus the average of the difference between positive answers and negative responses. A score above 100 implies more optimism than pessimism while a score below 100 implies more pessimism.

*Consumer confidence index the United Kingdom.*

Source: Gesellschaft für Konsumforschung (GfK). Research carried out by GfK NOP on behalf of the European Commission. The index is based on survey questions concerning personal financial situation over last 12 months, personal financial situation over next 12 months, general economic situation over last 12 months, general economic situation over next 12 months, and climate for major purchases.

*Consumer Sentiment Index Australia.* Source: Westpac-Melbourne Institute. Data from the Reserve Bank of Australia. The Consumer Sentiment Index is an average of five component indexes. These five indices reflect consumers' evaluations of their household financial situation over the past year and the coming year, anticipated economic conditions over the coming year and the next five years, and buying conditions for major household items.

*Konjunkturbarometer hushåll, Households' confidence indicator (CCI), Sweden.* Source: Konjunkturinstitutet. Data from Statistics Sweden. The CCI is calculated as an average of the net numbers of the four questions concerning the own and the Swedish economy, today respectively 12 months ahead, and whether it is profitable to buy capital goods today.

*Index of consumer confidence Canada.* Source: Conference Board Canada. The Index of Consumer Confidence is constructed by the Conference Board Canada and is derived from a survey of Canadian households. The index measures consumers' levels of optimism regarding current economic conditions. It is constructed by using the responses to four attitudinal questions posed to a random sample of Canadian households. The people in the sample are asked to give their views about their households' current and expected financial positions and the short-term employment outlook. They are also asked to decide whether now is a good time or a bad time to

make a major purchase such as a house, car or other big-ticket items. The index is derived by dividing the percentage of positive responses by the percentage of positive responses plus the percentage of negative response.

### **Data Business Confidence**

*General business confidence, New Zealand, all sectors.* Source: The National Bank of New Zealand. Data from EcoWin. The Business Outlook aimed to provide a description of business opinions regarding the expected future state of business and the New Zealand economy overall. It is a monthly sample survey with around 700 respondents. The statistic is a good predictor of the future business situation. The index is a net index, thus measuring the percentage of respondents expecting an increase (improve/rise) minus the percentage of respondents expecting a decrease (worsen/decline). Those surveyed give their opinions on things like production or employment level, new orders, inventories, etc.

*CBI industrial confidence indicator for the manufacturing sector, the United Kingdom.* Source: DG ECFIN - Directorate General for Economic and Financial Affairs. Data from EcoWin. The industrial confidence indicator is derived by calculating the arithmetic average of the balances (in percentage points) of the answers to the questions on production expectations, order books and stocks of finished products (the last with inverted sign).

*NAB business confidence index Australia. Net balance.* Data from the Reserve Bank of Australia. The index is from the National Australia Bank *Quarterly Business Survey*. The index measures respondents' expectations of business conditions in their industry for the upcoming quarter.

*Konfidensindikator tillverkningsindustrin (Confidence indicator manufacturing),*

*Sweden.* Source: Konjunkturinstitutet. The confidence indicator balances the answers from questions concerning, for instance, order books, expectations of production capacity and volume etc. The purpose with the questions is to provide a summary about the conditions in that business.

*Index of business confidence Canada.* Source: Conference Board Canada. The index is constructed by using the responses to 10 attitudinal questions aimed to measure CEOs' perceptions of the current economic environment, their investment intentions and their determinants.

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