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Monetary Policy Reaction  
Functions in the OECD

**Douglas Sutherland**

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ABSTRACT / RESUMÉ

**Monetary policy reaction functions in the OECD**

Monetary policy reaction functions can provide insights into the factors influencing monetary policy decisions. Empirical estimates suggest that differences exist across countries as to whether monetary policy reacts solely to expected inflation or also takes into account expected output developments. A range of other factors, such as monetary policy in large economies, can also influence monetary policy reactions in smaller ones. On the other hand, monetary policy has reacted less to contemporaneous measures of the output gap, while asset price developments do not generally appear to have influenced monetary policy decisions.

*JEL Codes:* E42

*Keywords:* Monetary policy; output gap; asset prices

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**Les fonctions de réaction de la politique monétaire dans la zone de l'OCDE**

Les fonctions de réaction de la politique monétaire peuvent utilement éclairer les facteurs qui influent sur les décisions de politique monétaire. Les estimations empiriques montrent qu'il y a des différences d'un pays à l'autre sur le point de savoir si la politique monétaire réagit uniquement à l'inflation anticipée, ou prend également en compte l'évolution prévisible de la production. Plusieurs autres facteurs, notamment la politique monétaire des grandes économies, peut également influencer sur les réactions de politique monétaire dans les petites économies. En revanche, la politique monétaire a moins réagi aux mesures instantanées de l'écart de production et l'évolution des prix des actifs ne paraît pas en général avoir influencé les décisions de politique monétaire.

*Codes JEL :* E42

*Mots-clés :* politique monétaire ; écart de production ; prix des actifs

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## MONETARY POLICY REACTION FUNCTIONS IN THE OECD

By Douglas Sutherland<sup>1</sup>

### Introduction and findings

1. Since the early 1980s, monetary policy has been successful in bringing inflation down and to keep it low and stable. This accompanied the sizeable reduction in output volatility with the success of monetary policy identified as one of the factors contributing to the great moderation. Monetary policy's contribution to improved macroeconomic outcomes arose in a number of different ways. Monetary policy changed from a stance that accommodated inflation to a stance that responded strongly to inflation pressures and thereby stabilised expectations (Clarida, Gali and Gertler, 2000; Taylor, 1998). Indeed, anchoring inflation expectations at low and stable rates counts as a major success of monetary policy. The spread of central bank mandates that constrained policy to focus at low levels of inflation arguably was a major factor contributing to the stabilisation of inflation expectations. The spread of mandates has also implied that monetary policy attempts to stabilise economic activity are implemented only to the extent that they do not jeopardise inflation control (Orphanides, 2004).

2. Monetary policy reaction functions can provide insights into the factors influencing monetary policy, such as whether inflation targets dominate or other factors such as output and asset price stabilisation also influence policy. Forward-looking reaction functions are well suited to this purpose. Monetary policy bases policy rates on expected developments in inflation and, in some cases, output.<sup>2</sup> Even monetary authorities with only an explicit inflation target may attempt to respond to output volatility or at least aim to meet their medium-term inflation target without creating excessive volatility in output. To examine the forward-looking element of monetary policy more formally, monetary policy reaction functions were estimated. The estimations, which also control for other possible monetary policy objectives, suggest:

- In a number of countries since 1980, monetary policy appears to move only in relation to developments in future inflation, the expected output gap being insignificant (Australia, Czech Republic, Hungary, Poland, Sweden and the United Kingdom). This may reflect difficulties in forecasting the output gap in these countries.

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1. OECD Economics Department. This is one of the background papers for the OECD's project on counter-cyclical economic policy. The main paper was issued as the *OECD Economics Department Working Paper* No. 760. Without implication, the author would like to thank Sebastian Barnes, Balázs Égert, Jorgen Elmeskov, Peter Hoeller, Diego Moccero, Oliver Röhn, and Jean-Luc Schneider for valuable comments and suggestions and Susan Gascard for excellent editorial assistance.

2. Note, however, if monetary policy is only based on forecasts, particularly on inflation, this may lead to inflation indeterminacy (Woodford, 2003).

- In a second group of countries, monetary policy appears to move in relation with future changes in inflation as well as the output gap (Canada, Iceland, New Zealand, Switzerland and the United States). The reaction to the contemporaneous output gap is less marked. This should not be surprising, if monetary policy is forward looking. The contemporaneous output gap influences future inflation, which is already taken into account in the inflation forecast and central banks pursuing output stabilisation are more likely to respond to projected output developments given the lags with which policy affects the economy.
- In most cases the Taylor principle is satisfied with the short-term interest rates moving more than proportionally to changes in inflation.<sup>3</sup>
- Asset prices generally do not appear to influence monetary policy in most countries.

### Literature review

3. Monetary policy reaction functions have been widely studied, often using variants of Taylor-type rules (Taylor, 1993). The empirical set-up usually adopts a form such as:

$$i_t = (1 - \rho)\alpha + (1 - \rho)\beta\pi_t + (1 - \rho)\gamma y_t + \rho i_{t-1} + \varepsilon_t$$

where  $i_t$  is the short-run interest rate,  $\pi_t$  is the inflation rate at time  $t$ , and  $y_t$  is the output gap. The coefficients  $\beta$  and  $\gamma$  give the weights assigned to the stabilisation objectives for inflation and output. Typically a lagged interest rate is included to account for auto-correlation. This approach is fairly adaptable and can accommodate different monetary policy objectives, such as stabilising the exchange rate. Judd and Rudebusch (1998) amongst others have estimated this type of equation.

4. As monetary policy is effective only with a lag, policymakers make their decisions based on evaluations of future rather than contemporaneous conditions. For example, policymakers typically “look through” surges in commodity prices when they expect these relative price movements to be temporary. This not only suggests that the Taylor rule is forward-looking, but that in some cases the measure of inflation may be stripped of large relative price changes. The Taylor-rule formulation above can also be expressed in a forward looking way. In this case the reaction function is given by:

$$i_t = (1 - \rho)\alpha + (1 - \rho)\beta E[\pi_{t+n}] + (1 - \rho)\gamma E[y_{t+m}] + \rho i_{t-1} + \varepsilon_t$$

where variables are as before, but inflation and output are now expressed as expected values. This forward-looking monetary policy reaction function is a more realistic characterisation of policymaking.

5. Previous results using forward-looking monetary policy reaction functions have highlighted differences in monetary policymaking across countries and over time (Table 1). For example, Clarida *et al.* (1998) found that monetary policy reaction functions in the United States, Germany and Japan could be characterised as inflation targeting with short-term interest rates moving more than proportionally than inflation such that the Taylor principle is satisfied. On the other hand, monetary policy in the United Kingdom, Italy and France was found to react more strongly to monetary policy decisions in Germany rather than domestic inflation developments. In examining monetary policy over different periods of time, Clarida *et al.* (2000) found evidence that the reaction to expected inflation in the United States became stronger when Volcker became chairman of the Federal Reserve.

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3. If the coefficient for the inflation variable divided by the coefficient of the lagged interest rate is lower than -1 the Taylor principle is satisfied.

Table 1. Findings from the reaction function literature

6. The basic setup has been augmented by a number of different considerations for monetary policy. These include:

- *Asset prices*: Smets (1997) estimates forward looking policy reaction functions for Australia and Canada. The results suggest that Canada, but not Australia, also responds to changes in exchange rates and asset prices.
- *The state of the financial sector*. Cecchetti and Li (2005) augmented the basic monetary policy reaction function with leverage ratios to examine whether monetary policymakers react to changes in bank balance sheets. Their findings suggest that policy in the United States did react to higher-than-trend leverage ratios during economic upturns, other things being equal. In Germany and Japan, the estimates suggest that policymakers raised rates when leverage rates rose, but only when the output gap was negative.
- *Non-linearities*: Dolado *et al.* (2005) argue that monetary policy reactions may be non-linear with stronger reactions to expected inflation when the output gap is also positive. They find some evidence for this type of reaction in European countries, but not the United States.

## Estimation issues

### *Time-series properties*

7. The choice of estimator is potentially important for estimating monetary policy reaction functions. Many empirical exercises rely on GMM estimators. There are two major drawbacks to this approach. First, weak identification is a serious problem (Shibamoto, 2008), particularly with ex-post data (Orphanides, 2001).<sup>4</sup> Second, estimations in levels are potentially spurious when variables are non-stationary. Of the core variables in these reaction functions, output gaps are typically stationary, but, depending on the sample used, interest and inflation rates are often non-stationary (or trend stationary). Few authors have explicitly recognised this potential problem (Carare and Tchaidze, 2005). In this context, de Mello and Moccero (2009) use multivariate GARCH methodology for a number of South American countries to examine spillovers between the monetary stance and inflation expectations. Siklos and Wohar (2004) use an error-correction formulation as well as estimating reaction functions using first differences.

8. An alternative way to estimate reaction functions is the so-called bounds testing approach with autoregressive distributed lag (ARDL) models (Pesaran *et al.*, 2001). This approach allows the estimation of a relationship in levels as well as complex short-run dynamics and the mixing of series that are stationary and non-stationary. The bounds test sets a threshold above which the null hypothesis of no long-run relationship can be rejected irrespective whether the data are stationary or non-stationary. In the following analysis the ARDL specification is used, but also some results from GMM estimators will be reported. The basic set up is as follows:

$$\Delta i_t = c + \alpha_i i_{t-1} + \beta \pi_{t+3} + \gamma y_{t+3} + \sum_{i=1}^{p-1} \varphi' \Delta z_{t-i} + \delta' \Delta x_t + u_t$$

where,  $i_t$  is the short-run interest rate,  $\pi_t$  is the inflation rate at time  $t$ , and  $y_t$  is the output gap,  $z_t$  is composed of  $i_t$ ,  $\pi_t$ , and  $y_t$  while  $x_t$  contains the terms  $\pi_t$ , and  $y_t$ .

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4. Consolo and Favera (2009) suggest that weak identification in GMM models can also lead to findings of monetary policy inertia.



## Data

9. There are two main data-related issues in estimating implied monetary policy reaction functions. These are the vintage and choice of the variables. Following one strand of the literature, the estimations use actual outturns for the projected values, thus assuming perfect foresight.<sup>5</sup> In this context, the exercise does not address whether monetary policy could have been better, but seeks to identify how the implied reaction to inflation and the output gap differs over time and across countries. As such, the estimates do not use the information set available to the policymaker in real time. Assuming projections are unbiased at the horizon used in forward-looking policy, using outturns should not bias the estimates. The estimates will be biased if there is a systematic bias in the forecast estimates of inflation and output gaps. Orphanides (2001) points out that using ex post data can lead to bias as at times there are systematic errors in forecasts. Using ex ante data can lead to different results. For example, Belke and Klose (2009) argue that real time data for the euro area can lead to higher estimates of inflation coefficients and lower estimates of output gap coefficients in a monetary policy reaction function. The second issue concerns which variables are used. For example, Taylor's (1993) paper used the GDP deflator, whereas central bank objectives, explicit or implicit, typically relate to a measure of CPI or core inflation. The choice is not necessarily innocuous. Different estimates of the output gap can change the estimated coefficients in some settings (Vera, 2009). To address this, measures of CPI and core inflation as well as output gaps derived from production functions and HP filters are used systematically to examine the importance of the different measures

10. Almost all the data are from the OECD ADB quarterly database with output gap estimates taken from the EO86 database. HP filter based estimates of output gaps use the smoothing parameter of 1600. Asset prices are taken from Datastream or the Economics Department's series for housing prices. In some cases, such as the euro area, the length of the data sample is very short.

11. The time series properties of the data suggest for the main variables that the null hypothesis that they contain a unit root cannot be rejected for the majority of the series (Table 2). This is also true when including a deterministic trend. The hypothesis that the first difference of these series are non-stationary can be rejected for most, implying that most of the series (with or without a deterministic trend) are I(1). These results would generally invalidate the use of GMM estimators, although researchers often argue that the power of the unit root test is low. The mixed nature of the results suggests that the ARDL approach is appropriate.

Table 2. Time series properties of the main variables

## Results

12. A baseline forward-looking ARDL specification considers inflation and the output gap as the only variables of interest to the monetary authorities.<sup>6</sup> The long-run coefficients from this specification for equations for which the F-test suggests that there is a long-run relationship are reported in Table 3. Several countries appear to react only to the inflation objective (Czech Republic, Hungary, Island and Mexico), while some also appear to consider output stabilisation (in some specifications Canada, New Zealand, Switzerland and the United States). Generally, the inflation objective has greater weight in the reaction

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5. A theoretical possibility in this case is that a central bank that perfectly controls inflation would appear not to react to inflation.

6. The lagged interest rate is an error-correction term and measures the speed of reaction to a shock to the long-run equilibrium. The autoregressive term is dropped as the ARDL framework addresses serial correlation by design.

function than output stabilisation.<sup>7</sup> The results are not always stable to the different specifications which may partly reflect mis-specification (see below) of the central bank's implied reaction function and limited data availability. Nonetheless, the specifications generally support using a measure of core inflation in estimating the implied reaction functions. The choice of the output gap measure appears less important.

Table 3. **Baseline specification, full sample**

13. When the sample is limited to the period after 1980, several countries appear to change monetary policy in reaction to expected inflation but not output (Australia, Czech Republic, Hungary, Poland, Switzerland and the United Kingdom) (Table 4). Output stabilisation also appears to be important in a number of countries (Canada, Iceland, New Zealand and the United States). These results are generally robust to the inclusion of a trend (Table 5). In addition, when a trend is included Sweden appears to react to developments in core inflation. Estimations for the period before 1980, reveal that Japan's monetary policy appeared to move in reaction to inflation but not stabilisation, while New Zealand appeared to put greater weight on output stabilisation (Table 6).

Table 4. **Baseline specification, post 1980**

Table 5. **Baseline specification with trend**

Table 6. **Baseline specification, pre 1980**

14. The empirical literature often uses a contemporaneous output gap. The consequences of following this convention are presented in Table 7. In general, fewer estimations indicate a long-run relationship between the variables (as the F-test rejects most of the estimations). These estimates suggest that monetary policymakers are generally not reacting to the contemporaneous output gap. Of the monetary authorities that responded to the forward-looking output gap, the reaction to the contemporaneous output gap becomes insignificant for the United States in comparison with the baseline results.

Table 7. **Specification with contemporaneous output gap**

15. Some of the results above may be affected by the misspecification of the monetary policy reaction function. For instance interest rate developments in another major economy may influence the decisions of a central bank. To examine this, the reaction functions were augmented with the short-term interest rates in the United States and Germany (Table 8). It is clear that US interest rates are important for Canada and Korea and perhaps Iceland. German and, later on euro area interest rates, are important for Denmark.

Table 8. **Other objectives: US and German interest rates**

16. Monetary policymakers may respond to other objectives. Asset prices have been found to be explicative in some cases (Smets, 1997). First, deviations of stock market returns from trend (measured by the HP filter) may induce monetary policy reactions. There is only limited evidence for this with some estimations suggesting a monetary policy reaction to deviations from trend in Australia and Korea. Second, the results suggest that monetary policy reacted to house price deviations from trend in Australia and possibly New Zealand (Table 9).

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7. The level relationship – given by the coefficient value of the variable of interest divided by the coefficient value of lagged interest rates multiplied by -1 – is in the range of 1.5 to 2 for the United States, which is in line with previous estimates (Taylor, 1993).

**Table 9. Other objectives: stock market returns and house prices**

17. Finally, to allow comparisons with the GMM estimators that are mainly used in the literature a set of estimates, using forward-looking core inflation and forward looking output gaps are presented in Table 10. While the Hansen J-statistic generally suggests that the null for overidentifying restrictions cannot be rejected, the tests for under identification and weak instruments raise some doubts about most of the estimates. Only the equations for Canada, Norway and the United States satisfy all three tests.

**Table 10. Monetary policy reaction functions using GMM**

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Table 1. Findings from the reaction function literature

Study	Country coverage	Time sample	Approach	data	Other	Findings
Belke and Klose (2009)	Euro area	1999-2007	GMM	ex post real time		ECB reacts more to inflation, especially with real time data
Cecchetti and Li (2005)	USA, DEU, JPN	1989-2000	GMM	ex post	leverage ratio	USA reacts more to inflation and also leverage ratio during upturns
Clarida <i>et al.</i> (1998)	DEU, JPN, USA, GBR, FRA, ITA	1979-1993	GMM	ex post	DEU monetary policy	DEU, JPN and USA targetted inflation while GBR, FRA and ITA paid more attention to output
Clarida <i>et al.</i> (2000)	USA	1960-1996	GMM	ex post		Taylor principle not satisfied for pre-Volcker period
Dolado <i>et al.</i> (2005)	USA, DEU, FRA, ESP, euro area	1980-2001	GMM	ex post	non-linearities	Monetary policy non-linear in Europe
Mihov (2001)	USA, DEU, FRA, ITA	1990-1998	GMM	ex post		USA inflation objective; DEU and FRA inflation and output objectives; ITA weak inflation objective
Orphanides (2004)	USA	1966-1995	Non-linear least squares	real time		Monetary policy more activist in pre-Volcker period
Shibamoto (2008)	JPN	1988-2001	GMM			JPN inflation target only
Smets (1997)	AUS, CAN	1989-1996	GMM	ex post	asset prices	Strong reactions to inflation. CAN also reacts to output gap, exchange rate and stock market
Vera (2009)	USA	1987-2005	GMM	ex post		Inflation objective larger weight, but output weight differs with measure of output gap

Table 2. Time series properties of the main variables

	ADF constant, no trend			ADF constant, trend			ADF constant, first differenced					
	stat	p-val	obs	stat	p-val	obs	stat	p-val	obs			
Short-term interest rates												
AUS	-1.92	0.32	153	-2.58	0.29	153	-11.43	0.00	***	153		
AUT	-2.23	0.20	159	-2.96	0.14	159	-9.88	0.00	***	159		
BEL	-2.11	0.24	153	-3.08	0.11	153	-8.30	0.00	***	153		
CAN	-2.10	0.24	169	-2.77	0.21	169	-9.94	0.00	***	169		
CZE	-1.04	0.74	60	-1.98	0.61	60	-8.86	0.00	***	60		
DNK	-1.54	0.52	113	-1.86	0.68	113	-5.72	0.00	***	113		
FIN	-1.26	0.65	130	-2.39	0.39	130	-11.14	0.00	***	130		
FRA	-1.83	0.36	150	-3.42	0.05	*	150	-8.36	0.00	***	150	
DEU	-2.30	0.17	65	-2.93	0.15	65	-2.27	0.18		65		
GRC	-0.31	0.92	133	-2.00	0.60	133	-8.02	0.00	***	133		
HUN	-1.22	0.66	65	-2.87	0.17	65	-5.77	0.00	***	65		
ISL	-0.96	0.77	76	-3.46	0.04	*	78	-3.74	0.00	***	76	
IRE	-2.48	0.12	100	-3.48	0.04	*	97	-10.42	0.00	***	98	
ITA	-1.75	0.41	151	-3.21	0.08	**	151	-7.95	0.00	***	150	
JPN	-1.83	0.37	153	-3.53	0.04	*	153	-10.03	0.00	***	153	
KOR	-1.63	0.47	69	-2.99	0.13	70	-6.21	0.00	***	69		
LUX	-1.67	0.45	129	-3.00	0.13	129	-8.67	0.00	***	129		
MEX	-2.05	0.26	65	-2.95	0.15	65	-4.50	0.00	***	65		
NLD	-3.14	0.02	*	153	-3.88	0.01	*	153	-9.85	0.00	***	153
NZL	-1.69	0.44	113	-3.11	0.11	113	-7.78	0.00	***	113		
NOR	-1.06	0.73	116	-3.75	0.02	*	119	-5.44	0.00	***	115	
POL	-1.59	0.49	53	-4.10	0.01	***	53	-3.77	0.00	***	53	
PRT	-0.88	0.79	113	-3.23	0.08	**	113	-4.45	0.00	***	113	
SVK	-1.05	0.74	53	-2.79	0.20	53	-5.26	0.00	***	53		
ESP	-0.87	0.80	120	-3.13	0.10	**	120	-11.79	0.00	***	120	
SWE	-0.99	0.76	108	-3.15	0.09	**	107	-5.54	0.00	***	104	
CHE	-2.43	0.13	133	-2.81	0.19	133	-7.83	0.00	***	133		
TUR	-1.52	0.53	23	-2.08	0.55	23	-1.54	0.51		22		
GBR	-1.61	0.48	150	-3.73	0.02	*	150	-10.26	0.00	***	150	
USA	-1.74	0.41	172	-2.58	0.29	172	-10.74	0.00	***	172		
euro area	-2.37	0.15	75	-2.93	0.15	75	-5.00	0.00	***	75		
CPI												
AUS	-1.92	0.32	153	-3.31	0.06	**	153	-10.09	0.00	***	153	
AUT	-1.86	0.35	159	-3.78	0.02	*	159	-9.81	0.00	***	159	
BEL	-2.34	0.16	153	-3.87	0.01	*	153	-7.17	0.00	***	153	
CAN	-1.87	0.35	169	-2.72	0.23	169	-9.80	0.00	***	169		
CZE	-1.76	0.40	60	-2.53	0.31	60	-7.83	0.00	***	60		
DNK	-1.56	0.50	145	-3.65	0.03	*	145	-10.16	0.00	***	145	
FIN	-2.51	0.11	130	-3.42	0.05	*	130	-6.67	0.00	***	130	
FRA	-1.41	0.58	150	-3.07	0.11	150	-7.01	0.00	***	150		
DEU	-2.22	0.20	65	-2.21	0.48	65	-9.32	0.00	***	65		
GRC	-1.00	0.75	133	-2.43	0.36	133	-9.15	0.00	***	133		
HUN	-1.66	0.45	65	-2.56	0.30	65	-5.50	0.00	***	65		
ISL	-1.83	0.37	113	-1.13	0.92	113	-8.87	0.00	***	113		
IRE	-1.36	0.60	119	-1.71	0.75	119	-11.06	0.00	***	119		
ITA	-2.09	0.25	159	-3.52	0.04	*	159	-7.10	0.00	***	159	
JPN	-1.54	0.52	153	-2.61	0.28	153	-6.01	0.00	***	153		
KOR	-2.08	0.25	130	-2.57	0.29	130	-9.46	0.00	***	130		
LUX	-2.42	0.14	129	-2.84	0.18	129	-7.65	0.00	***	129		
MEX	-2.72	0.07	**	65	-3.62	0.03	*	65	-4.07	0.00	***	65
NLD	-1.97	0.30	153	-2.89	0.16	153	-6.02	0.00	***	153		
NZL	-2.85	0.05	**	113	-3.48	0.04	*	113	-6.84	0.00	***	113
NOR	-1.97	0.30	122	-3.82	0.02	*	122	-8.81	0.00	***	122	
POL	-2.35	0.16	53	-1.72	0.74	53	-4.81	0.00	***	53		
PRT	-1.19	0.68	113	-3.13	0.10	**	113	-7.84	0.00	***	113	
SVK	-2.26	0.18	57	-3.84	0.01	*	57	-6.36	0.00	***	57	
ESP	-1.94	0.31	120	-2.17	0.51	120	-10.20	0.00	***	120		
SWE	-1.67	0.45	157	-3.47	0.04	*	157	-11.13	0.00	***	157	
CHE	-2.71	0.07	**	133	-3.38	0.05	**	133	-8.11	0.00	***	133
TUR	-1.98	0.29	117	-2.19	0.50	117	-8.63	0.00	***	117		
GBR	-2.43	0.13	150	-3.82	0.02	*	150	-7.27	0.00	***	150	
USA	-2.33	0.16	172	-3.12	0.10	172	-8.33	0.00	***	172		
Euro area	-4.79	0.00	***	75	-5.33	0.00	***	75	-10.36	0.00	***	75

Table 2 (continued)

	ADF constant, no trend			ADF constant, trend			ADF constant, first differenced					
	stat	p-val	obs	stat	p-val	obs	stat	p-val	obs			
Output gap (EO86)												
AUS	-2.89	0.05	*	157	-2.98	0.14		157	-12.85	0.00	***	157
AUT	-2.96	0.04	*	163	-3.22	0.08	**	163	-13.96	0.00	***	163
BEL	-4.29	0.00	**	157	-4.37	0.00	***	157	-7.20	0.00	***	157
			*									
CAN	-3.06	0.03	*	173	-3.05	0.12		173	-9.07	0.00	***	173
CZE	-3.08	0.03	*	64	-3.09	0.11		64	-5.68	0.00	***	64
DNK	-2.18	0.21		149	-2.17	0.51		149	-11.78	0.00	***	149
FIN	-1.33	0.62		134	-1.26	0.90		134	-3.74	0.00	***	134
FRA	-3.36	0.01	*	154	-3.45	0.05	*	154	-5.72	0.00	***	154
DEU	-2.98	0.04	*	69	-2.86	0.18		69	-5.56	0.00	***	69
GRC	-6.02	0.00	**	137	-6.17	0.00	***	137	-5.18	0.00	***	133
			*									
HUN	-1.59	0.49		69	-1.21	0.91		69	-2.52	0.11		69
ISL	-1.67	0.45		117	-1.61	0.79		117	-14.84	0.00	***	117
IRE	-1.42	0.57		123	-1.40	0.86		123	-6.02	0.00	***	123
ITA	-3.73	0.00	**	163	-4.03	0.01	***	163	-8.98	0.00	***	163
			*									
JPN	-2.63	0.09	**	157	-2.71	0.23		157	-10.74	0.00	***	157
KOR	-3.32	0.01	*	134	-3.31	0.07	**	134	-8.89	0.00	***	134
LUX	-1.79	0.39		133	-1.65	0.77		133	-11.88	0.00	***	133
MEX	-2.97	0.04	*	69	-2.97	0.14		69	-5.43	0.00	***	69
NLD	-3.42	0.01	*	157	-3.41	0.05	**	157	-15.44	0.00	***	157
NZL	-1.73	0.42		117	-1.90	0.65		117	-9.59	0.00	***	117
NOR	-1.43	0.57		126	-0.84	0.96		126	-16.18	0.00	***	126
POL	-1.49	0.54		57	-1.06	0.94		57	-7.55	0.00	***	57
PRT	-2.95	0.04	*	117	-2.92	0.16		117	-3.59	0.01	***	117
SVK	-2.42	0.14		61	-2.78	0.20		61	-10.05	0.00	***	61
ESP	-0.63	0.87		124	-0.22	0.99		124	-3.81	0.00	***	124
SWE	-1.56	0.50		161	-1.62	0.78		161	-7.09	0.00	***	161
CHE	-4.56	0.00	**	137	-4.35	0.00	***	137	-5.90	0.00	***	137
			*									
TUR	-2.43	0.13		121	-2.41	0.37		121	-10.78	0.00	***	121
GBR	-1.75	0.41		154	-1.85	0.68		154	-11.43	0.00	***	154
USA	-4.23	0.00	**	176	-4.27	0.00	***	176	-9.92	0.00	***	176
			*									
Euro area	-2.60	0.09	**	75	-2.63	0.27		75	-3.97	0.00	***	75

\*, \*\*, \*\*\* denote that the null hypothesis of a unit root in the series can be rejected at the 90%, 95% and 99%.



Table 3. Baseline specification, full sample

		Full sample																
		Aus	Can	Cze	DNK	Hun	Isl	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	Usa	euro
Interest rates (lag)		-0.09	-0.59						-0.14				-0.11		-0.15			-0.30
		0.03	0.13						0.07				0.03		0.04			0.07
		**	***										***		***			***
Gap (3 leads)		0.09	-0.23						0.20				0.02		0.03			0.26
		0.05	0.12						0.15				0.06		0.03			0.05
																		***
CPI inflation (3 leads)		0.11	1.10						0.35				0.09		0.16			0.07
		0.04	0.26						0.39				0.04		0.05			0.14
		**	***									*		***				
Constant		0.17	-0.71						-0.59				0.57		0.19			0.72
		0.18	0.27						0.90				0.29		0.09			0.46
			*											*				
Adjusted R-squared		0.21	0.61						0.59				0.47		0.30			0.59
	Observations	171	55						62				57		115			38
		Aus	Can	Cze	DNK	Hun	Isl	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	Usa	euro
Interest rates (lag)		-0.10	-0.26			-0.37	-0.19		-0.04				-0.18		-0.25		-0.09	-0.36
		0.04	0.09			0.10	0.09		0.06				0.05		0.06		0.04	0.11
		*	**			***							***		***		**	**
Gap (3 leads)		0.06	-0.04			0.23	0.07		0.17				-0.09		-0.01		0.21	0.37
		0.06	0.06			0.15	0.08		0.10				0.07		0.04		0.06	0.12
																	***	**
Core inflation (3 leads)		0.17	0.50			0.45	0.21		-0.03				0.18		0.32		0.19	0.05
		0.14	0.21			0.13	0.10		0.28				0.06		0.08		0.06	0.21
			*			***	*					**		***		**	**	
Constant		0.13	-0.57			0.62	0.91		0.14				1.12		0.25		-0.08	0.94
		0.16	0.31			0.50	0.64		0.56				0.38		0.10		0.19	0.62
												**		*				
Adjusted R-squared		0.20	0.42			0.45	0.69		0.60				0.45		0.36		0.35	0.79
	Observations	96	54			56	75		65				54		115		175	38
		Aus	Can	Cze	DNK	Hun	Isl	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	Usa	euro
Interest rates (lag)		-0.10	-0.26						-0.18		-0.16				-0.14		-0.07	-0.24
		0.03	0.08				0.10		0.05		0.03				0.05		0.03	0.07
		***	**				**		**		***				**	*	**	**
HP Gap (3 leads)		0.35							0.22		0.35				0.30		0.26	0.15
		0.08							0.24		0.11				0.09		0.08	0.04
		***								**				**	**		***	
CPI inflation (3 leads)		0.11							0.64		0.21				0.23		0.04	0.04
		0.04							0.28		0.03				0.07		0.03	0.10
		**						*		***				**				
Constant		0.22							-1.21		0.61				-0.05		0.31	0.66
		0.16							0.72		0.20				0.08		0.17	0.35
										**								
Adjusted R-squared		0.29							0.58		0.65				0.50		0.18	0.52
	Observations	189							62		127				129		154	38
		Aus	Can	Cze	DNK	Hun	Isl	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	Usa	euro
Interest rates (lag)		-0.09	-0.26				-0.31				-2.23				-0.14		-0.11	-0.27
		0.03	0.08				0.10				0.70				0.04		0.03	0.06
		***	**			**			**		**			***		**	**	***
HP Gap (3 leads)		0.30	-0.09				0.28				0.54				0.08		0.27	0.17
		0.08	0.10				0.10				0.89				0.08		0.07	0.03
		***				**					**			***		***	***	
Core inflation (3 leads)		0.12	0.52				0.28				2.39				0.13		0.16	0.12
		0.09	0.22				0.09				0.68				0.06		0.06	0.11
			*			**			**	**			*	***		**	**	
Constant		0.11	-0.61				1.77				11.77				0.77		0.15	0.60
		0.17	0.37				0.62				4.55				0.24		0.15	0.22
						**	**		*	*			**	*	*		*	*
Adjusted R-squared		0.26	0.43				0.75				0.74				0.43		0.36	0.62
	Observations	95	54				75				93				54		191	38

Note: The long-run coefficients from the ARDL estimates are presented. The interest rate is the 3 month interbank rate from the EO database. The coefficient estimate is presented in the first row with the robust standard error below and the \* denoting the statistical significance. The lag length of the short-run coefficients (not reported) was selected on the basis of the Akaike information criteria.

Table 4. Baseline specification, post 1980

Post 1980																	
	Aus	Can	Cze	Dnk	Hun	Isl	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	Usa	euro
Interest rates (lag)	-0.13 0.04 ***		-0.59 0.13 ***					-0.14 0.07				-0.11 0.03 ***		-0.15 0.04 ***	-0.14 0.04 ***		-0.30 0.07 ***
Gap (3 leads)	0.09 0.08		-0.23 0.12					0.20 0.15				0.02 0.06		0.03 0.03	0.11 0.05		0.26 0.05 ***
CPI inflation (3 leads)	0.23 0.05 ***		1.10 0.26 ***					0.35 0.39				0.09 0.04 *		0.16 0.05 ***	0.21 0.07 **		0.07 0.14
Constant	0.16 0.18		-0.71 0.27 *					-0.59 0.90				0.57 0.29		0.19 0.09 *	0.41 0.14 **		0.72 0.46
Adjusted R-squared	0.36		0.61					0.59				0.47		0.30	0.18		0.59
Observations	114		55					62				57		115	114		38
Interest rates (lag)		-0.10 0.04 *	-0.26 0.09 **		-0.37 0.10 ***	-0.19 0.09		-0.04 0.06		-0.15 0.05 **		-0.18 0.05 ***		-0.25 0.06 ***		-0.17 0.05 ***	-0.36 0.11 **
Gap (3 leads)		0.06 0.06	-0.04 0.06		0.23 0.15	0.07 0.08		0.17 0.10		0.04 0.06		-0.09 0.07		-0.01 0.04		0.18 0.07 **	0.37 0.12 **
Core inflation (3 leads)		0.17 0.14	0.50 0.21 *		0.45 0.13 ***	0.21 0.10 *		-0.03 0.28		0.12 0.05 *		0.18 0.06 **		0.32 0.08 ***		0.35 0.12 **	0.05 0.21
Constant		0.13 0.16	-0.57 0.31		0.62 0.50	0.91 0.64		0.14 0.56		0.87 0.32 **		1.12 0.38 **		0.25 0.10 *		-0.03 0.15	0.94 0.62
Adjusted R-squared		0.20	0.42		0.45	0.69		0.60		0.22		0.45		0.36		0.56	0.79
Observations		96	54		56	75		65		115		54		115		115	38
Interest rates (lag)	-0.14 0.03 ***	-0.11 0.04 **						-0.18 0.05 **		-0.20 0.05 ***				-0.15 0.04 ***	-0.14 0.04 ***		-0.24 0.07 **
HP Gap (3 leads)	0.19 0.09 *	0.37 0.12 **						0.22 0.24		0.25 0.07 ***				0.08 0.05 ***	0.14 0.08 ***		0.15 0.04 ***
CPI inflation (3 leads)	0.24 0.05 ***	0.17 0.08 *						0.64 0.28 *		0.20 0.05 ***				0.17 0.06 **	0.19 0.07 **		0.04 0.10
Constant	0.19 0.17	0.13 0.16						-1.21 0.72		0.96 0.33 **				0.18 0.09 *	0.44 0.13 ***		0.66 0.35
Adjusted R-squared	0.39	0.32						0.58		0.35				0.31	0.16		0.52
Observations	114	114						62		115				115	114		38
Interest rates (lag)		-0.09 0.03 ***	-0.26 0.08 **			-0.31 0.10 **			-2.23 0.70 **	-0.19 0.05 ***		-0.14 0.04 ***		-0.23 0.05 ***			-0.27 0.06 ***
HP Gap (3 leads)		0.30 0.08 ***	-0.09 0.10			0.28 0.10 **			0.54 0.89 **	0.41 0.08 ***		0.08 0.08		0.08 0.04			0.17 0.03 ***
Core inflation (3 leads)		0.12 0.09	0.52 0.22 *			0.28 0.09 **		2.39 0.68 **	0.20 0.05 ***		0.13 0.06 *		0.29 0.07 ***				0.12 0.11
Constant		0.11 0.17	-0.61 0.37			1.77 0.62 **		11.77 4.55 *	0.90 0.28 **		0.77 0.24 **		0.23 0.09 **				0.60 0.22 *
Adjusted R-squared		0.26	0.43			0.75		0.74	0.57		0.43		0.38				0.62
Observations		95	54			75		93	115		54		115				38

Note: The long-run coefficients from the ARDL estimates are presented. The interest rate is the 3 month interbank rate from the EO database. The coefficient estimate is presented in the first row with the robust standard error below and the \* denoting the statistical significance. The lag length of the short-run coefficients (not reported) was selected on the basis of the Akaike information criteria.

Table 5. Baseline specification with trend

	Aus	Can	Cze	Dnk	Hun	Isl	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	Usa	euro	
Interest rates (lag)	-0.15 0.05 **	-0.35 0.08 ***	-0.61 0.13 ***		-0.32 0.07 ***							-0.43 0.11 ***	-0.17 0.05 ***	-0.21 0.05 ***				-0.45 0.10 ***
Output gap (3 leads)	0.09 0.08	0.05 0.06	-0.04 0.14		0.29 0.17							0.33 0.11 **	0.02 0.03	0.10 0.05				0.29 0.05 ***
CPI inflation (3 leads)	0.21 0.05 ***	0.16 0.08	0.87 0.27 **		0.29 0.09 **							-0.01 0.06 ***	0.16 0.05 ***	0.18 0.06 **				0.22 0.14
Trend	0.00 0.00	-0.03 0.01 ***	-0.04 0.02		-0.05 0.02 *							-0.19 0.05 ***	0.00 0.00	-0.01 0.01 *				-0.01 0.01 *
Constant	1.04 1.02	6.06 1.51 ***	7.81 4.42		8.67 4.30							37.24 9.72 ***	0.51 0.48	2.57 1.04 *				3.16 1.25 *
Adjusted R <sup>2</sup>	0.36	0.35	0.63		0.40							0.67	0.29	0.21				0.68
Observations	114	114	55		55							53	115	114				38
	Aus	Can	Cze	Dnk	Hun	Isl	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	Usa	euro	
Interest rates (lag)		-0.29 0.07 ***			-0.38 0.09 ***			-0.31 0.07 ***		-0.16 0.06 **			-0.38 0.11 ***	-0.25 0.07 ***	-0.46 0.18 *	-0.20 0.05 ***		-0.76 0.18 ***
Output gap (3 leads)		0.17 0.06 **			0.23 0.15			-0.03 0.07		0.04 0.06			-0.10 0.07	-0.01 0.04	0.91 0.26 **	0.17 0.07 *		0.57 0.10 ***
Core inflation (3 leads)		-0.25 0.14			0.43 0.14 **			0.27 0.20		0.11 0.06			0.76 0.14 ***	0.33 0.08 ***	0.49 0.18 *	0.31 0.13 *		0.54 0.25 *
Trend		-0.03 0.01 ***			-0.01 0.02 **			-0.05 0.02 **		-0.01 0.01			-0.01 0.01	0.00 0.00	-0.04 0.02 *	-0.01 0.00 *		-0.03 0.01 *
Constant		7.16 1.82 ***			2.38 4.15			9.97 3.19 **		1.88 1.44			2.49 1.74	0.08 0.47	8.73 3.43 *	0.97 0.75		5.82 1.76 **
Adjusted R <sup>2</sup>		0.34			0.44			0.35		0.22			0.81	0.36	0.50	0.56		0.83
Observations		95			56			69		115			72	115	45	115		38
	Aus	Can	Cze	Dnk	Hun	Isl	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	Usa	euro	
Interest rates (lag)	-0.15 0.04 ***	-0.31 0.06 ***	-0.62 0.12 ***		-0.35 0.07 ***	-0.85 0.23 **					-0.21 0.05 ***			-0.16 0.04 ***	-0.21 0.05 ***			
HP output gap (3 leads)	0.19 0.09 *	0.38 0.11 **	-0.06 0.14		-0.23 0.27 **	0.83 0.25 **					0.47 0.10 ***			0.10 0.05	0.15 0.08			
CPI inflation (3 leads)	0.23 0.05 ***	0.17 0.08 *	0.97 0.26 ***		0.31 0.09 **	0.86 0.32 *					0.14 0.04 **			0.14 0.05 **	0.18 0.06 **			
Trend	0.00 0.00	-0.02 0.01 ***	-0.04 0.02 *		-0.01 0.03 **	0.00 0.02					-0.01 0.01 *			0.00 0.00	-0.01 0.00 *			
Constant	0.86 0.97	4.77 1.26 ***	6.17 3.16		4.10 5.87	5.35 3.18					3.21 1.08 **			0.80 0.46	2.43 0.98 *			
Adjusted R <sup>2</sup>	0.39	0.40	0.65		0.61	0.77				0.60			0.31	0.19				
Observations	114	114	55		66	69				115			115	114				
	Aus	Can	Cze	Dnk	Hun	Isl	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	Usa	euro	
Interest rates (lag)		-0.23 0.05 ***			-0.16 0.70 ***			-0.30 0.06 ***		-0.18 0.05 **			-0.39 0.07 ***	-0.30 0.06 ***	-0.23 0.08 ***	-0.30 0.08 ***		-1.02 0.18 ***
HP output gap (3 leads)		0.39 0.08 ***			-6.62 1.49 **			0.01 0.08		0.14 0.07			0.43 0.14 **	0.06 0.08	0.08 0.05	0.30 0.07 ***	0.11 0.08	0.62 0.10 ***
Core inflation (3 leads)		-0.05 0.11			0.97 0.58			0.29 0.20		0.12 0.05			0.01 0.08	0.68 0.13	0.29 0.06	0.14 0.16	0.20 0.12	0.84 0.29 **
Trend		-0.02 0.01 **			0.38 0.14 *			-0.05 0.01 **		-0.01 0.01			-0.15 0.04 ***	-0.01 0.01	0.00 0.01 ***	-0.02 0.01 **	-0.01 0.00 **	-0.04 0.01 **
Constant		4.40 1.34 **			-72.04 28.64 *			9.04 2.89 **		1.93 1.39			29.56 7.50 ***	1.00 1.51	0.25 0.49	5.13 1.36 ***	1.90 0.80 **	8.95 2.01 ***
Adjusted R <sup>2</sup>		0.36			0.72			0.34		0.24			0.60	0.83	0.37	0.38	0.53	0.82
Observations		95			56			69		115			52	72	115	48	115	38

Note: The long-run coefficients from the ARDL estimates are presented. The interest rate is the 3 month interbank rate from the EO database. The coefficient estimate is presented in the first row with the robust standard error below and the \* denoting the statistical significance. The lag length of the short-run coefficients (not reported) was selected on the basis of the Akaike information criteria.

Table 6. Baseline specification, pre 1980

	Aus	Can	Jpn	Nzl	Usa
Interest rates (lag)	-0.48	-0.19	-0.31		
	0.10 ***	0.11	0.09 **		
Output gap (3 leads)	-0.13	0.07	0.06		
	0.22	0.14	0.09		
CPI inflation (3 leads)	0.18	0.10	0.14		
	0.14	0.07	0.05 **		
Constant	2.56	0.86	1.16		
	1.18 *	0.47	0.53 *		
Adjusted R <sup>2</sup>	0.22	0.34	0.63		
Observations	42	57	41		
	Aus	Can	Jpn	Nzl	Usa
Interest rates (lag)			-0.28	-0.84	-0.40
			0.11 *	0.15 ***	0.11 ***
Output gap (3 leads)			0.08	-0.69 **	0.09
			0.15	0.17	0.12
Core inflation (3 leads)			0.16	0.22	0.25
			0.06 *	0.18	0.07 **
Constant			0.73	5.89	1.73
			0.70	3.17	0.85 *
Adjusted R <sup>2</sup>			0.56	0.67	0.45
Observations			38	20	58
	Aus	Can	Jpn	Nzl	Usa
Interest rates (lag)	-0.46	-0.23	-0.30		
	0.10 ***	0.10 *	0.08 ***		
HP output gap (3 leads)	-0.13	0.31	0.10		
	0.23	0.16	0.11		
CPI inflation (3 leads)	0.20	0.12	0.16		
	0.12	0.07	0.04 **		
Constant	2.06	0.97	0.93		
	0.93 *	0.33 **	0.53		
Adjusted R <sup>2</sup>	0.22	0.39	0.64		
Observations	45	74	41		
	Aus	Can	Jpn	Nzl	Usa
Interest rates (lag)			-0.26	-0.86	-0.26
			0.09 **	0.18 ***	0.07 ***
HP output gap (3 leads)			0.20	-0.64	0.46
			0.15	0.18 **	0.13 ***
Core inflation (3 leads)			0.17	0.11	0.15
			0.06 **	0.17	0.07 *
Constant			0.42	7.56	1.30
			0.64	3.10 *	0.29 ***
Adjusted R <sup>2</sup>			0.60	0.61	0.49
Observations			38	20	73

Note: The long-run coefficients from the ARDL estimates are presented. The interest rate is the 3 month interbank rate from the EO database. The coefficient estimate is presented in the first row with the robust standard error below and the \* denoting the statistical significance. The lag length of the short-run coefficients (not reported) was selected on the basis of the Akaike information criteria.

Table 7. Specification with contemporaneous output gap

	Aus	Can	Cze	DNK	Hun	Isl	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	Usa	euro	
Interest rates (lag)			-0.65 0.16 ***		-0.28 0.05 ***									-0.44 0.42 ***	-0.15 0.04 ***	-0.14 0.04 ***		-0.41 0.08 ***
Output gap			-0.29 0.12 *		-0.08 0.20 *									-0.14 0.32 *	0.08 0.03 *	0.10 0.05 *		0.40 0.07 ***
CPI inflation (3 leads)			1.20 0.31 ***		0.21 0.07 **									1.61 0.65 ***	0.17 0.05 ***	0.22 0.07 **		-0.03 0.06 ***
Constant			-0.72 0.31 *		1.20 0.48 *									1.43 2.75 ***	0.16 0.09 *	0.34 0.14 *		1.30 0.28 ***
Adjusted R <sup>2</sup>			0.60		0.44									0.96	0.35	0.23		0.61
Observations			55		51									42	111	114		38
Interest rates (lag)			-0.25 0.09 **		-0.37 0.10 ***					-0.08 0.08 ***				-0.34 0.09 **	-0.21 0.05 ***			-0.42 0.06 ***
Output gap			-0.02 0.07 ***		-0.24 0.13 ***					0.37 0.10 ***				-0.04 0.11 ***	0.03 0.04 ***			0.42 0.06 ***
Core inflation (3 leads)			0.49 0.20 *		0.28 0.12 *					0.09 0.10 ***				0.50 0.12 ***	0.27 0.07 ***			-0.09 0.10 ***
Constant			-0.60 0.27 *		2.02 0.47 ***					0.30 0.40 ***				2.15 0.71 **	0.20 0.08 *			1.42 0.26 ***
Adjusted R <sup>2</sup>			0.42		0.45					0.56				0.63	0.37			0.71
Observations			54		52					105				49	111			38
Interest rates (lag)			-0.16 0.05 **		-0.30 0.06 ***	-0.43 0.12 ***				-0.14 0.05 **				-0.23 0.04 ***	-0.15 0.03 ***			-0.41 0.09 ***
HP output gap			0.27 0.08 **		-0.41 0.15 **	0.31 0.13 *				0.04 0.16 ***				0.36 0.10 ***	0.14 0.09 ***			0.33 0.06 ***
CPI inflation (3 leads)			0.17 0.13 **		0.31 0.07 ***	0.33 0.12 **				0.55 0.26 *				0.24 0.05 ***	0.14 0.04 ***			0.01 0.05 **
Constant			-0.01 0.24 ***		0.95 0.41 *	2.71 0.73 ***				-1.05 0.64 ***				1.11 0.25 ***	0.69 0.26 **			1.27 0.25 ***
Adjusted R <sup>2</sup>			0.31		0.67	0.74				0.60				0.48	0.36			0.58
Observations			60		66	76				65				115	66			38
Interest rates (lag)			-0.08 0.02 ***		-0.25 0.08 **					-2.43 0.81 **				-0.26 0.04 **	-0.23 0.05 ***			-0.46 0.06 ***
HP output gap			0.15 0.07 *		0.00 0.09 *					-0.66 0.96 ***				0.39 0.10 ***	0.32 0.13 *			0.35 0.05 ***
Core inflation (3 leads)			0.14 0.08 *		0.47 0.21 *					2.58 0.79 **				0.25 0.04 ***	0.40 0.09 ***			0.01 0.09 ***
Constant			0.03 0.17 ***		-0.55 0.33 ***					13.13 5.13 *				1.33 0.25 ***	1.51 0.46 **			1.39 0.25 ***
Adjusted R <sup>2</sup>			0.36		0.42					0.74				0.49	0.62			0.70
Observations			96		54					93				115	49			38

Note: The long-run coefficients from the ARDL estimates are presented. The interest rate is the 3 month interbank rate from the EO database. The coefficient estimate is presented in the first row with the robust standard error below and the \* denoting the statistical significance. The lag length of the short-run coefficients (not reported) was selected on the basis of the Akaike information criteria.

Table 8. Other objectives: US and German interest rates

## Panel A. US interest rates

	Aus	Can	Cze	DNK	Hun	Isl	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	euro
Interest rates (lag)	-0.14 0.04 **	-0.27 0.04 ***				-0.28 0.12 *		-0.51 0.08 ***				-0.22 0.07 **		-0.16 0.04 ***	-0.17 0.04 ***	-0.28 0.06 ***
Output gap (3 leads)	0.09 0.08	0.05 0.04				0.05 0.07		0.14 0.12				-0.25 0.16		0.02 0.05	0.11 0.06	-0.07 0.10
CPI inflation (3 leads)	0.21 0.05 ***	-0.05 0.08 ***				0.35 0.14 *		1.53 0.33 ***				0.14 0.05 **		0.16 0.04 ***	0.15 0.06 *	0.76 0.17 ***
Usa interest rates	0.03 0.04 ***	0.34 0.06 ***				0.16 0.05 **		0.54 0.11 ***				0.38 0.17 *		0.01 0.04 ***	0.07 0.04 ***	0.25 0.05 ***
Constant	0.13 0.16	-0.09 0.16				0.62 0.62		-4.17 0.88 ***				0.30 0.21		0.15 0.18	0.34 0.14 *	-1.66 0.56 **
Adjusted R <sup>2</sup>	0.36	0.47				0.74		0.71				0.52		0.29	0.20	0.85
Observations	114	114				74		62				57		115	114	38
	Aus	Can	Cze	DNK	Hun	Isl	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	euro
Interest rates (lag)		-0.24 0.06 ***			-0.38 0.09 ***			-0.54 0.13 ***		-0.15 0.05 **		-0.44 0.07 ***		-0.25 0.06 ***		-0.44 0.08 ***
Output gap (3 leads)		0.01 0.07			0.26 0.15			-0.11 0.11		0.04 0.06		-0.66 0.13 ***		-0.01 0.05		-0.16 0.09
Core inflation (3 leads)		0.22 0.13			0.49 0.13 ***			1.67 0.44 ***		0.11 0.07		0.44 0.08 ***		0.32 0.08 ***		0.53 0.15 **
Usa interest rates		0.23 0.05 ***			-0.13 0.10 ***			0.66 0.19 **		0.01 0.07		0.57 0.14 ***		0.00 0.04 ***		0.28 0.07 ***
Constant		-0.33 0.18			0.92 0.67			-4.07 1.11 ***		0.83 0.27 **		1.19 0.47 *		0.25 0.18		-0.51 0.33
Adjusted R <sup>2</sup>		0.31			0.47			0.70		0.22		0.76		0.36		0.72
Observations		95			56			63		115		50		115		38
	Aus	Can	Cze	DNK	Hun	Isl	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	euro
Interest rates (lag)	-0.14 0.04 ***	-0.25 0.04 ***			-0.37 0.07 ***			-0.55 0.08 ***		-0.20 0.05 **				-0.15 0.03 ***		-0.35 0.07 ***
HP output gap (3 leads)	0.19 0.09 *	0.24 0.10 *			-0.51 0.26 *			0.20 0.20 ***		0.24 0.07 ***				0.08 0.05		0.09 0.05
CPI inflation (3 leads)	0.23 0.05 ***	-0.01 0.07 ***			0.34 0.07 ***			1.76 0.28 ***		0.21 0.07 **				0.14 0.04 ***		0.68 0.17 **
Usa interest rates	0.02 0.05 ***	0.28 0.05 ***			0.16 0.16 ***			0.57 0.12 ***		-0.02 0.07				0.02 0.03 ***		0.22 0.03 ***
Constant	0.17 0.15	-0.07 0.16			1.20 0.50 *			-4.76 0.81 ***		1.01 0.27 ***				0.11 0.15		-1.12 0.53 *
Adjusted R <sup>2</sup>	0.39	0.49			0.62			0.71		0.34				0.31		0.85
Observations	114	114			66			62		115				115		38
	Aus	Can	Cze	DNK	Hun	Isl	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	euro
Interest rates (lag)		-0.22 0.05 ***						-0.49 0.10 ***	-3.08 0.92 **	-0.18 0.05 ***		-0.19 0.05 ***		-0.23 0.05 ***		-0.61 0.12 ***
HP output gap (3 leads)		-0.01 0.18						-0.09 0.15	-0.05 0.87	0.41 0.08		-0.12 0.16		0.08 0.05		0.21 0.13
Core inflation (3 leads)		0.27 0.11 *						1.52 0.32 ***	3.13 0.87 ***	0.18 0.05 ***		0.16 0.07 *		0.30 0.07 ***		0.67 0.23 *
Usa interest rates		0.21 0.06 ***						0.66 0.17 ***	2.75 1.18 *	0.02 0.04		0.24 0.14		0.00 0.03 ***		0.26 0.06 ***
Constant		-0.54 0.20 **						-3.94 0.92 ***	6.29 3.00 **	0.82 0.24 ***		0.27 0.33		0.25 0.16		-0.14 0.67
Adjusted R <sup>2</sup>		0.49						0.71	0.78	0.56		0.44		0.37		0.86
Observations		90						63	93	115		54		115		38

Note: The long-run coefficients from the ARDL estimates are presented. The interest rate is the 3 month interbank rate from the EO database. The coefficient estimate is presented in the first row with the robust standard error below and the \* denoting the statistical significance. The lag length of the short-run coefficients (not reported) was selected on the basis of the Akaike information criteria.

Table 8. Other objectives: US and German interest rates (cont)

## Panel B. German interest rates

	Aus	Can	Cze	DNK	Hun	Isl	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	Usa
Interest rates (lag)	-0.13 0.04 **		-0.59 0.14 ***	-0.31 0.07 ***			-0.95 0.19 ***	-0.10 0.07					-0.11 0.03 **		-0.27 0.06 ***	-0.19 0.05 ***
Output gap (3 leads)	0.10 0.09		-0.22 0.13	0.19 0.10			0.28 0.11	0.20 0.10					0.03 0.06		0.03 0.03	0.17 0.07
CPI inflation (3 leads)	0.23 0.05 ***		1.11 0.27 ***	0.18 0.14			0.60 0.17 **	0.27 0.31					0.09 0.04 *		0.09 0.04 *	0.20 0.07 **
Deu interest rates	0.02 0.05		-0.06 0.25	0.45 0.10 ***			0.56 0.11 ***	-0.13 0.10					-0.09 0.15		0.18 0.08 *	0.12 0.08
Constant	0.12 0.19		-0.53 0.70	-0.85 0.34 *			4.32 0.94 ***	-0.07 0.73					0.81 0.48		-0.15 0.18	0.23 0.18
Adjusted R <sup>2</sup>	0.36		0.60	0.44			0.81	0.57					0.46		0.35	0.19
Observations	114		55	109			69	64					57		115	114
Interest rates (lag)		-0.18 0.06 **		-0.41 0.09 ***	-0.42 0.12 ***										-0.38 0.07 ***	-0.17 0.05 ***
Output gap (3 leads)		0.13 0.05 *		0.08 0.06	0.15 0.17										-0.04 0.04	0.17 0.07 *
Core inflation (3 leads)		0.19 0.14		0.37 0.14	0.51 0.15 **										0.27 0.07 ***	0.38 0.13 **
Deu interest rates		0.15 0.07 *		0.44 0.10 ***	-0.28 0.23										0.19 0.07 **	-0.03 0.04
Constant		-0.15 0.21		-0.50 0.32	1.70 1.24										-0.13 0.17	0.02 0.17
Adjusted R <sup>2</sup>		0.23		0.25	0.46										0.43	0.55
Observations		96		115	56										115	115
Interest rates (lag)	-0.14 0.04 ***	-0.17 0.06 **		-0.33 0.07 ***			-0.95 0.21 ***								-0.27 0.05 ***	
HP output gap (3 leads)	0.19 0.10	0.31 0.10 **		0.23 0.14			0.75 0.26 **								0.25 0.09 **	0.09 0.05
CPI inflation (3 leads)	0.24 0.05 ***	0.17 0.07 *		0.24 0.14			0.89 0.19 ***								0.20 0.05 ***	0.08 0.05
Deu interest rates	0.00 0.05	0.11 0.07		0.39 0.09 ***			0.15 0.14								0.19 0.08 *	
Constant	0.18 0.16	0.01 0.16		-0.62 0.35			4.70 0.98 ***								0.94 0.27 ***	-0.18 0.17
Adjusted R <sup>2</sup>	0.38	0.32		0.42			0.78								0.37	
Observations	114	114		109			69								115	
Interest rates (lag)		-0.14 0.07 *		-0.41 0.09 ***	-0.67 0.12 ***	-0.91 0.21 ***				-2.25 0.75 **	-0.19 0.05 ***				-0.34 0.07 ***	
HP output gap (3 leads)		0.30 0.08 ***		0.07 0.09	0.23 0.18	0.60 0.18 **				0.38 0.99	0.45 0.10 ***				0.07 0.04	
Core inflation (3 leads)		0.20 0.11		0.38 0.15 *	0.84 0.14 ***	0.71 0.15 ***				2.39 0.70 **	0.19 0.05 ***				0.21 0.06 ***	
Deu interest rates		0.07 0.08		0.40 0.09 ***	-0.85 0.15 ***	0.28 0.09 **				0.18 0.89	0.03 0.04				0.17 0.07 *	
Constant		-0.05 0.21		-0.39 0.30	4.48 0.83 ***	4.46 1.19 ***				11.41 4.23 **	0.77 0.27 **				-0.11 0.17	
Adjusted R <sup>2</sup>		0.26		0.24	0.70	0.76				0.73	0.56				0.44	
Observations		95		115	65	70				93	115				115	

Note: The long-run coefficients from the ARDL estimates are presented. The interest rates is the 3 month interbank rate from the EO database. The coefficient estimate is presented in the first row with the robust standard error below and the \* denoting the statistical significance. The lag length of the short-run coefficients (not reported) was selected on the basis of the Akaike information criteria.

Table 9. Other objectives: stock market returns and house prices

## Panel A. Stock market returns

	Aus	Can	Cze	Dnk	Hun	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	Usa
Interest rates (lag)	-0.13 0.04 ***						-0.18 0.06 **				-0.11 0.03 ***		-0.16 0.04 ***	-0.14 0.04 ***	
Output gap (3 leads)	0.11 0.07						0.06 0.11				0.07 0.07		0.02 0.04	0.11 0.06	
CPI inflation (3 leads)	0.24 0.05 ***						0.51 0.30				0.10 0.03 **		0.19 0.05 ***	0.21 0.07 **	
stock market returns	-2.10 1.02 *						3.74 1.27 **				-0.83 0.73		0.58 0.51	-0.14 0.61	
Constant	0.18 0.18						-0.74 0.66				0.54 0.28		0.18 0.09	0.40 0.14 **	
Adjusted R <sup>2</sup>	0.38						0.63				0.46		0.30	0.17	
Observations	114						64				57		115	114	
	Aus	Can	Cze	Dnk	Hun	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	Usa
Interest rates (lag)		-0.10 0.04 *			-0.36 0.09 ***				-0.15 0.05 **		-0.20 0.05 ***		-0.29 0.07 ***	-0.17 0.05 ***	
Output gap (3 leads)		0.05 0.06			0.29 0.15				0.04 0.06		-0.20 0.10		-0.06 0.05	0.19 0.07 **	
Core inflation (3 leads)		0.18 0.14			0.45 0.12 ***				0.12 0.05 *		0.21 0.07 **		0.41 0.10 ***	0.35 0.12 **	
stock market returns		0.40 0.72			-1.48 1.06				-0.07 1.51		1.35 0.84		1.27 0.54 *	-0.35 0.86	
Constant		0.12 0.17			0.51 0.46				0.87 0.33 **		1.33 0.42 **		0.25 0.10 *	-0.04 0.16	
Adjusted R <sup>2</sup>		0.19			0.46				0.22		0.46		0.38	0.55	
Observations		96			56				115		54		115	115	
	Aus	Can	Cze	Dnk	Hun	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	Usa
Interest rates (lag)	-0.14 0.03 ***	-0.11 0.04 **					-0.17 0.05 **		-0.20 0.05 ***				-0.15 0.04 ***		
HP output gap (3 leads)	0.29 0.10 **	0.45 0.14 **					0.08 0.17		0.27 0.08 ***				0.06 0.07		
CPI inflation (3 leads)	0.26 0.05 ***	0.17 0.08 *					0.55 0.24 *		0.21 0.05 ***				0.18 0.06 **		
stock market returns	-3.22 1.08 **	-1.81 1.09					4.50 1.50 **		-0.69 1.12				0.35 0.53		
Constant	0.20 0.16	0.12 0.16					-0.94 0.59		0.95 0.32 **				0.18 0.09 *		
Adjusted R <sup>2</sup>	0.43	0.33					0.63		0.35				0.30		
Observations	114	114					64		115				115		
	Aus	Can	Cze	Dnk	Hun	Jpn	Kor	Mex	Nzl	Nor	Pol	Swe	Che	Gbr	Usa
Interest rates (lag)		-0.08 0.03 **					-0.10 0.04 *	-2.09 0.66 **	-0.19 0.05 ***		-0.14 0.04 ***	-0.24 0.06 ***	-0.24 0.06 ***		
HP output gap (3 leads)		0.35 0.10 ***					0.05 0.14	2.10 1.24	0.45 0.09 ***		0.03 0.19	0.13 0.10	0.06 0.06		
Core inflation (3 leads)		0.09 0.09					0.30 0.22	2.24 0.64 ***	0.21 0.05 ***		0.14 0.07 *	0.67 0.14 ***	0.30 0.07 ***		
stock market returns		-0.85 0.93					4.03 1.35 **	-21.78 10.61 *	-0.90 0.78		0.45 1.39	-0.40 0.51	0.48 0.44		
Constant		0.13 0.18					-0.43 0.48	11.41 4.42 *	0.89 0.27 **		0.76 0.26 **	-0.55 0.15 ***	0.24 0.09 **		
Adjusted R <sup>2</sup>		0.26					0.64	0.75	0.57		0.41	0.83	0.38		
Observations		95					65	93	115		54	72	115		

Note: The long-run coefficients from the ARDL estimates are presented. The interest rates is the 3 month interbank rate from the EO database. The coefficient estimate is presented in the first row with the robust standard error below and the \* denoting the statistical significance. The lag length of the short-run coefficients (not reported) was selected on the basis of the Akaike information criteria.



Table 9. Other objectives: Stock market returns and house prices (cont)

Panel B. House prices											
	Aus	Can	Dnk	Jpn	kor	Nzl	Nor	Swe	Che	Gbr	Usa
Interest rates (lag)	-0.13 0.03 ***					-0.07 0.05			-0.14 0.04 **	-0.13 0.04 ***	
Output gap (3 leads)	0.10 0.08					0.16 0.07 *			0.04 0.04	0.10 0.05	
CPI inflation (3 leads)	0.24 0.05 ***					0.09 0.05			0.12 0.07	0.17 0.07 *	
Real house prices	0.07 0.02 **					0.05 0.01 ***			0.02 0.02	0.04 0.02	
Constant	0.12 0.17					0.30 0.29			0.21 0.09 *	0.40 0.13 **	
Adjusted R <sup>2</sup>	0.41					0.56			0.30	0.19	
Observations	114					113			115	114	
Interest rates (lag)	-0.08 0.02 **	-0.09 0.04 *									-0.17 0.05 ***
Output gap (3 leads)	0.10 0.05 *	0.04 0.06									0.18 0.08 *
Core inflation (3 leads)	0.20 0.06 **	0.17 0.14									0.35 0.12 **
Real house prices	0.03 0.01 **	0.03 0.02 *									0.00 0.03
Constant	-0.07 0.12	0.09 0.16									-0.03 0.16
Adjusted R <sup>2</sup>	0.64	0.22									0.55
Observations	84	96									115
Interest rates (lag)	-0.14 0.03 ***	-0.11 0.04 **				-0.21 0.05 ***			-0.14 0.04 ***		
HP output gap (3 leads)	0.15 0.09	0.38 0.14 **				0.19 0.08 *			0.08 0.05		
CPI inflation (3 leads)	0.25 0.05 ***	0.17 0.08 *				0.21 0.05 ***			0.15 0.07 *		
Real house prices	0.06 0.02 **	0.00 0.02				0.03 0.02			0.01 0.02		
Constant	0.15 0.16	0.13 0.16				0.99 0.34 **			0.19 0.08 *		
Adjusted R <sup>2</sup>	0.43	0.31				0.35			0.30		
Observations	114	114				115			115		
Interest rates (lag)	-0.09 0.02 ***	-0.09 0.03 ***				-0.19 0.05 ***			-0.23 0.06 ***		
HP output gap (3 leads)	0.19 0.08 *	0.31 0.11 **				0.37 0.09 ***			0.08 0.05		
Core inflation (3 leads)	0.18 0.05 **	0.12 0.09				0.21 0.05 ***			0.29 0.07 ***		
Real house prices	0.03 0.01 **	0.00 0.02				0.01 0.01			0.00 0.02		
Constant	0.03 0.11	0.11 0.17				0.91 0.28 **			0.23 0.08 **		
Adjusted R <sup>2</sup>	0.66	0.25				0.56			0.37		
Observations	84	95				115			115		

Note: The long-run coefficients from the ARDL estimates are presented. The interest rates is the 3 month interbank rate from the EO database. The coefficient estimate is presented in the first row with the robust standard error below and the \* denoting the statistical significance. The lag length of the short-run coefficients (not reported) was selected on the basis of the Akaike information criteria.

Table 10. Monetary policy reaction functions using GMM

	Aus	Can	Jpn	Nor	Swe	Che	Gbr	Usa
Core inflation	0.41	0.21	0.06	0.23	0.05	0.29	-0.17	0.20
	0.12 ***	0.10 *	0.02 **	0.05 ***	0.13	0.08 ***	0.09	0.06 ***
Output gap	0.16	0.13	0.05	0.01	0.10	0.10	0.39	0.18
	0.05 ***	0.03 ***	0.02	0.02	0.05	0.04 **	0.05 ***	0.04 ***
Interest rates	0.87	0.93	0.92	0.87	0.96	0.78	0.85	0.91
	0.03 ***	0.03 ***	0.02 ***	0.03 ***	0.06 ***	0.04 ***	0.04 ***	0.03 ***
Constant	-0.30	-0.16	0.08	0.23	-0.04	0.16	0.72	-0.16
	0.19	0.14	0.04	0.17	0.13	0.08 *	0.20 ***	0.17
Adjusted R <sup>2</sup>	0.98	0.94	0.95	0.97	0.95	0.94	0.91	0.92
obsevatons	79	90	146	111	75	130	42	169
jp	0.33	0.37	0.60	0.85	0.18	0.33	0.30	0.24
idp	0.12	0.01	0.00	0.02	0.63	0.00	0.25	0.00
widstat	2.08	6.05	8.31	15.69	0.83	2.95	7.30	28.40

Note: The long-run coefficients from two-step efficient GMM estimation are presented using heteroskedastic and autocorrelation consistent inference. The instruments are lagged variables. The coefficient estimate is presented in the first row with the robust standard error below and the \* denoting the statistical significance. jp is the Hansen J test statistic for overidentification, idp is the Kleibergen-Paap rk statistic for underidentification and widstat the Crag-Donald Wald statistic for weak instruments.

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