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by

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Abstract

It is commonly observed that central banks respond gradually to economic shocks, moving the interest rate in small discrete steps in the same direction over an extended period of time. This paper examines the empirical evidence regarding central banks' smoothing of interest rates, paying particular attention to the case of Canada. It then reviews the alternative explanations of the stylized facts that have recently emerged in the literature.

JEL classification: E5
Bank classification: Monetary policy implementation

Résumé

On voit généralement les banques centrales réagir de façon graduelle aux chocs économiques, en modifiant les taux d'intérêt à petites doses de façon à étaler le mouvement de hausse ou de baisse sur une longue période. L'auteur analyse le comportement des banques centrales à l'égard des taux d'intérêt à la lumière des résultats empiriques, en mettant l'accent sur le cas du Canada. Il passe ensuite en revue les différentes explications des faits stylisés qui ont récemment été avancées dans la littérature sur le sujet.

Classification JEL : E5
Classification de la Banque : Mise en œuvre de la politique monétaire

> *. . . even though we may know our destination and the general route by which we must get there, conducting monetary policy . . . is akin to driving without full vision—perhaps like driving in a rainstorm with defective windshield wipers. It can be done, but only very carefully.*
>
> *(Crow 1988)*

1. Introduction

It is commonly observed that efficient monetary policies that target inflation usually call for interest rate responses to shocks that are significantly sharper or quicker than those central bankers seem willing to induce. To account for this fact, some authors incorporate a desire to smooth interest rates directly into a policy-maker's preferences.[1] But while this is analytically expedient, it is unclear why policy-makers should prefer to smooth interest rates over and beyond the objective of achieving price (and output) stability. Yet, this question may be at the heart of the tension between the theory and practice of monetary policy.

The purpose of this paper is first to examine the empirical evidence regarding central banks' smoothing of interest rates, and then to review the alternative theoretical explanations that have emerged in the literature.

On the empirical side, summary statistics across industrialized countries indicate that, typically, movements in central bank-controlled interest rates occur in small discrete steps, in the same direction, over an extended period. A comparison of the historical behaviour with model-based optimal behaviour confirms the appearance of a bias for gradual movements.

On the theoretical side, there are three types of explanation. The first invokes a policy-maker's uncertainty about the state of the economy and the effects of monetary actions. Under such conditions, it is usually better for a central bank to respond cautiously to a shock; that is, move bank rates gradually and wait until there is less uncertainty.[2] To paraphrase the words of then-governor Crow, quoted at the top of this page, it is better to get more acquainted with the road

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1. That is, policy-makers are assumed to minimize a loss function of the form $\alpha var(y_t) + \beta var(\pi_t) + \gamma var(i_t)$ or of the form $\alpha var(y_t) + \beta var(\pi_t) + \gamma var(i_t - i_{t-1})$, where i is the instrument of policy, α, β, and γ are positive constants, and *var(x)* denotes the variance of *x*. Notice that $var(i_t - i_{t-1}) = 2(1-\rho)var(i_t)$, where ρ is *i*'s first lag autocorrelation.
2. There may be times—e.g., when there is concern that inflation becomes incorporated in public expectations, or during a quick deterioration of investors' confidence in the domestic currency—when, on the contrary, caution owing to uncertainty dictates immediate sharp movements in the interest rate, followed by a gradual return to normal, to curb the momentum in public anticipation (Srour 1999a).

conditions, and the manner in which the car responds during a rainstorm, before stepping on the accelerator or the brakes.

The second type of explanation refers to financial stability. A central bank avoids large swings in interest rates because they can cause large swings in cash flow among individual corporations, financial intermediaries, and governments with large debts, which can destabilize financial and exchange markets.

The third type of explanation is based on the idea of commitment and credibility. Because private agents are forward looking, small movements in the interest rate that are expected to persist may be more effective than movements that are large and transitory. For the same reason, policy-makers may be more effective if they commit to a certain course of action over an extended period of time. Such commitments are unavoidably rigid to some extent and imply that, lest they lose credibility, policy-makers cannot change their path of action too quickly in response to unforeseen developments in the economy.

The latter explanation underscores the importance of transparency and communication in the conduct of monetary policy. A central bank needs to ensure that its outlook for the future and its commitment to a particular course of action are clearly communicated to the public.[3] The explanation can also provide a rationale for signalling to the public in advance a possible future change in policy stance, as the Fed does when it announces its bias regarding future policy.[4]

This paper complements other studies on the same subject, particularly Lowe and Ellis (1998), Goodhart (1998), and Sack and Wieland (1999). It pays particular attention to the Canadian context, and reviews explanations previously not considered. The paper is organized as follows: section 2 examines the empirical evidence on interest rate smoothing, section 3 reviews the various explanations in the literature, and section 4 concludes.

2. The Empirical Evidence

Casual observation and empirical studies have led many economists to conclude that central banks move interest rates gradually, in small steps, and that reversals in the movement of interest rates are relatively infrequent. (While somewhat less evident, it also appears that downward movements in the interest rate are more gradual than upward movements.)

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3. Perhaps more importantly, a central bank needs to ensure that its message does not convey the wrong commitment.
4. However, this approach has so far met with mixed results, and needs further study.

2.1 Summary statistics

The stylized facts just described can be seen by means of simple statistics. Table 1 provides the number of consecutive changes and reversals in the operational targets of central banks in twelve industrialized countries over various periods ending 31 March 1998. For Canada, the operational target, since mid-April 1994, has been the 50-basis-point operating band within which the Bank of Canada aims to keep the overnight rate. The table also provides the average lapse of time between changes, as well as the average size of a change.

The statistics clearly show that the great majority of changes in the central banks' operational targets are in the same direction. For Canada, of 34 changes in the operating band from mid-April 1994 until the end of March 1998, 31 follow a previous change in the same direction, and only 3 reverse direction. The average lapse of time between consecutive changes in the same direction is about 22 days, whereas it is about 57 days and 103 days for consecutive changes in opposite directions.

It is also noteworthy that, except for Sweden, the average consecutive change is significantly larger when the interest rate is moving upwards than when it is moving downwards, suggesting that movements in the interest rate are more gradual downwards than upwards. This is consistent with the fact that, for all countries, there is a substantially smaller number of consecutive changes moving upwards than moving downwards. For Canada, the average consecutive change is 43 basis points upwards and 25 basis points downwards, and the number of consecutive changes is 10 upwards and 21 downwards.[5] Perhaps this reflects a greater concern over this period for increases in inflation than for decreases.

Given the small size of the sample for some of the countries considered, including Canada, the above statistics may be circumstantial. In fact, the findings regarding the number of consecutive changes and the average lapse of time between them are not as stark for countries that have longer data samples (e.g., Germany, France, Italy, the United Kingdom, and the Netherlands). To provide further evidence for Canada, we attempt below to extend the statistics back to 1984, by relying on the Bank Rate as a proxy for a publicly announced operational target.

Between 1984 and mid-1994, every week, the Bank of Canada adjusted its cash setting to achieve a target for the Bank Rate. Although a target was not publicly announced, the various operations that the Bank undertook to achieve its objectives were mostly public, and these provided strong

5. This is all the more surprising because there is some evidence that demand responds less to downward than to upward movements in the interest rate (Macklem, Paquet, and Phaneuf 1996).

signals about the Bank's intentions. Between mid-1994 and February 1996, the Bank Rate was set systematically at 25 basis points above the weekly three-month treasury bill tender average, after which period it was set at the upper end of the publicly announced operating band. Thus, except perhaps for the transitional period between 1994 and 1996, movements in the Bank Rate between 1984 and 1999 ought to reasonably describe the manner in which the Bank conducted policy during that time.

Table 2 provides statistics for Canada regarding changes in the weekly average Bank Rate that are above 15 basis points. Following Goodhart (1998),[6] we focus on such changes because they are likely to represent a new monetary stance, whereas changes that are less than 15 basis points are likely to be caused by market fluctuations and adjustments.[7] Figures 1 and 2 plot the weekly Bank Rate together with a number of other economic variables.

The statistics in Table 2 confirm the stylized facts described earlier, although they are less pronounced than in Table 1. The statistics for Canada regarding the number of consecutive changes between 1984 and 1999 are in accordance with the statistics obtained in Table 1 for countries that had longer samples (Austria, whose sample runs from May 1985 to March 1998, is an exception): of 181 consecutive changes, 140 followed a previous change in the same direction and 41 followed a previous change in the opposite direction. The statistics regarding the average size of consecutive changes are consistent with the previous results, while those regarding the average lapse of time between changes are not (though the latter may be driven by some outliers, such as in the late 1980s). At first glance, it would seem that monetary policy actions were reversed more frequently in Canada over the earlier period, and occurred more quickly, than in recent years.

Of course, one must exercise caution before drawing any conclusions from these statistics, because it is difficult over such a small sample to distinguish general biases in policy-makers' behaviour from the effects of special circumstances. Indeed, it is well documented that, between 1984 and 1999, autonomous movements in the exchange rate caused some of the more striking fluctuations in the Bank Rate.[8] During many of these events, the Bank acted quickly and forcefully to halt a quick deterioration in investors' sentiment, and reversed its stance as soon as the domestic currency had itself turned around, although the interest rate may have been returned

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6. Goodhart applies this method to changes in U.S. interest rates.
7. Alternative measures of policy adjustment, such as the weekly average of the three-month treasury bill rate, daily Bank Rate, or mid-week Bank Rate and/or a demarcation level equal to 10 basis points instead of 15, yield similar qualitative results. A demarcation level higher than 15 basis points risks eliminating changes that cumulatively can be significant (Figure 3).
8. Notably in 1984, 1985, 1986, 1987, 1992, 1994, 1994–95, and 1998.

only gradually to its former level. It is possible, therefore, that the summary statistics are driven by the Bank's responses to these particular shocks. However, to the extent that the interest rate responses to these autonomous exchange rate movements were relatively sharper and smaller in duration than average, behaviour during these events should bias the results *against* our findings of interest rate smoothing.[9]

It is even more hazardous to draw any conclusions regarding a possible change in bias since the adoption of operating bands in 1994. The differences in statistics observed before and after 1994 may be spurious, or they may reflect other changes in the conduct of monetary policy, such as the implementation of inflation targeting. They may also reflect the greater transparency in the conduct of monetary policy ensuing from the adoption of operating bands: Transparency enhances public credibility in the Bank and results in less variability in interest rates (Srour 1998, Yetman 2000). Still, as we shall see in section 3 (explanations 6 to 9), the enhanced ability to make credible commitments because of greater transparency can explain a stronger bias for interest rate smoothing.

2.2 Econometrics studies

To identify a possible bias in the conduct of monetary policy, several authors compared monetary policy in the past with the optimal policy that would have been called for by standard models of the transmission mechanism. They found that, in the past, interest rate responses to shocks were indeed significantly more gradual, and weaker, than the optimal responses.

For example, Rudebusch (1998) obtains the following rough estimate of the historical reaction function in the United States from 1987Q1 to 1996Q4:

$$i_t = 0.63 + 0.82 y_t + 1.78 \pi_t ,$$

where i_t is the average federal funds rate, y_t is the output gap, and π_t is the 4-quarter inflation rate. He also estimates a simple IS and Phillips curve and derives the policy rule of the form

$$i_t = k + A y_t + B \pi_t ,$$

which minimizes the loss function:

$$var(\pi_t - \pi^*) + \lambda var(y_t) + \mu var(\Delta i_t) .$$

9. See Zelmer (1996) for a comprehensive analysis of the conduct of monetary policy during exchange rate turbulence.

Rudebusch then shows that the latter type of rule can be reconciled with the historical reaction function only if the relative weight on interest rate stability in the loss function is quite high (e.g., $\lambda = 1$ and μ close to 5). Otherwise, the optimal response coefficients, *A* and *B*, on the output gap and inflation are significantly larger than the historical estimates. For instance, with $\lambda = 1$ and $\mu = 0.5$, the optimal response coefficient on output is 1.63 and that on inflation is 2.83.

Similarly, Sack (1998a) estimates a five-variable[10] vector autoregression (VAR) with U.S. monthly data from January 1984 to June 1998, and derives the policy rules that minimize an expected loss function of the form

$$E_t \sum_{i=1}^{\infty} \beta^t [(\pi_{t+i} - \pi^*)^2 + \lambda(u_{t+i} - u^*)^2] ,$$

where π and u denote the rates of inflation and unemployment, respectively. (Note that the loss function does not incorporate deviations in interest rates.) Sack finds that historical movements in the federal funds rate are significantly more gradual and persistent than the optimal movements that would have been called for by the estimated model, even when policy-makers' preferences (e.g., λ and π^*) are modelled to minimize the divergence between historical and optimal movements.

Conducting a similar exercise for Canada is complicated by the fact that Canada is a small open economy and its monetary transmission mechanism and, hence, its monetary policy, is a complex function of a number of factors other than domestic variables. Still, it is suggestive to conduct the exercise even if one assumes a rough representation of the economy; e.g., involving only output, inflation, and interest rates.

Ordinary least squares estimation of a very simple IS curve and Phillips curve over the period 1984Q1 to 1999Q1 in Canada yields[11]:

10. Unemployment, the growth of industrial production, inflation, a commodity price inflation rate, and the federal funds rate.

11. The sample period chosen excludes times of apparent changes in regime and high instability in Canada in the mid-1970s and early 1980s, but it does not exclude the shift in regime in 1991, when Canada implemented explicit inflation targets. This is likely to bias the estimate of the constant and the degree of persistence of inflation in the Phillips curve. However, the use of a dummy variable to control for the break and the estimation of the Phillips curve over various subperiods suggest that the optimal rule should not be affected significantly, and the estimate of the degree of persistence of inflation in the Phillips curve is in fact biased upwards, which would bias the results against finding evidence of interest rate smoothing.

$$y_t = 1.28y_{t-1} - 0.34y_{t-2} + 0.02rsp_{t-1} - 0.16rsp_{t-2} + \varepsilon_t \tag{1}$$
$$(10.9) \quad (-2.9) \quad (0.34) \quad (-2.56)$$

$$R^2 = 0.93, DW = 2.15;$$

$$\hat{\pi}_t = 0.008 + 0.34\hat{\pi}_{t-1} + 0.15\hat{\pi}_{t-2} + 0.22y_{t-1} + 0.08y_{t-2} - 0.08rsp_{t-1} + 0.08rsp_{t-2} + \eta_t \tag{2}$$
$$(2.5) \quad (1.4) \quad (0.75) \quad (0.95) \quad (0.28) \quad (-0.41) \quad (0.5)$$

$$R^2 = 0.6, DW = 1.95,$$

where y is the output gap, π is the quarterly rate of inflation (at annual rates), $\hat{\pi}$ is the inflation rate minus the current inflation target (i.e., $\hat{\pi} \equiv \pi - 0.02$), and *rsp* is the real yield spread, defined as the nominal yield spread, *nsp*, minus $\hat{\pi}$.[12] Numbers in parentheses represent *t*-statistics.

The historical reaction function over that period is estimated to be

$$rsp_t = 0.008 - 0.15y_t + 0.46y_{t-1} - 1.1\hat{\pi}_t + 0.66\hat{\pi}_{t-1} + 0.67rsp_{t-1} + \mu_t \tag{3}$$
$$(3.95) \quad (-0.9) \quad (2.34) \quad (-10.7) \quad (6) \quad (8.6)$$

$$R^2 = 0.8, DW = 1.7,$$

or equivalently,

$$nsp_t = 0.008 - 0.15y_t + 0.46y_{t-1} - 0.1\hat{\pi}_t - 0.01\hat{\pi}_{t-1} + 0.67nsp_{t-1} + \mu_t\ . \tag{4}$$

On the basis of the above-estimated IS and Phillips curves, the optimal rule that minimizes the loss function,[13]

12. The output-gap series is the Bank's conventional measure used in the Quarterly Projection Model and published in the *Monetary Policy Report*; the inflation rate is defined using the consumer price index excluding food, energy, and the effect of changes in indirect taxes; the nominal yield spread is expressed in deviations from its mean and is defined as the short-term minus the real long-term interest rate, where the short-term interest rate is the three-month treasury bill rate, and the long-term interest rate is the 10-year bond rate. The interest rate has been included as an explanatory variable in the Phillips curve as a substitute for the exchange rate. Its effect, however, is statistically insignificant.
13. Notice that the loss function is slightly different from Rudebusch's in that it involves, for computational simplicity, the variance of the yield spread *level* rather than its *change*. A positive weight, μ, is imposed on interest rates as a slight compromise to the Lucas critique: a zero weight gives rise to unacceptably large interest rate variability without significant increase in output or inflation variability.

$$0.5 var(\hat{\pi}_t) + 0.5 var(y_t) + 0.1 var(rsp_t) ,$$

can be shown to be[14]

$$rsp_t = 1.6 y_t - 0.6 y_{t-1} + 0.03 \hat{\pi}_t + 0.02 \hat{\pi}_{t-1} - 0.26 rsp_{t-1} , \quad (5)$$

or equivalently,

$$nsp_t = 1.6 y_t - 0.6 y_{t-1} + 1.03 \hat{\pi}_t + 1.28 \hat{\pi}_{t-1} - 0.26 nsp_{t-1} . \quad (6)$$

Not surprisingly, given the low degree of persistence of inflation in the estimated Phillips curve, the optimal response coefficient of the real yield spread to inflation shocks is quite small. The negative coefficient on the lagged yield spread suggests that this rule allows reversals in policy relatively quickly.

The first panel in Figure 4 plots the impulse responses to various shocks in the historical model as defined by equations (1) to (4).[15] Broadly speaking, the results conform with conventional wisdom: interest rates affect output with a lag, which in turn affects inflation with a lag. Less satisfactory is the finding that, while the nominal interest rate has responded positively to increases in the output gap in the past, it does not seem to have responded significantly, at least not in the first quarters following the shock, to changes in inflation. This could be the result of the very rough representation of the transmission mechanism, but it could also reflect past drives to bring (or preferences to keep) the rate of inflation down. The second panel in Figure 4 plots the impulse responses that would result if interest rates reacted according to the optimal rule (equation (5)) derived above, rather than according to the historical reaction function (equation (3)).

It is immediately apparent from the two panels that the historical responses of the nominal interest rate (as represented by the nominal yield spread) to shocks, especially the immediate responses, have been significantly more gradual and persistent than the optimal responses. The optimal rule calls for an immediate substantial response to a shock, followed by a gradual return to equilibrium, whereas historically the interest rate has responded in small steps.[16]

14. Constants in estimated regressions are ignored when deriving optimal rules.
15. The shocks are assumed to be orthogonal. Similar exercises conducted within a VAR context gave similar qualitative results and did not affect the conclusions.
16. Optimal rules associated with different weights in the loss function on inflation and output variability lead to similar conclusions.

Admittedly, these results are open to question, given the crude specification of the model. But they appear to be quite robust to alternative specifications. Two other studies of Canada are worth noting in this context. Black, Macklem, and Rose (1997) examine the implications of alternative policy rules within the context of the Bank's Canadian Policy Analysis Model (CPAM), a partially structural, small-open-economy model. The authors find that a more vigorous response to inflation forecasts than the one incorporated in CPAM can lead to lower variability in the output gap and inflation, but at the cost of higher variability in interest rates. (They also find that efficient Taylor rules of the form $rsp_t = Ay_t + B(\pi_t - \pi^*)$ require considerably larger response coefficients on both inflation and the output gap than the weight, 0.5, that Taylor (1998) evaluated for the Federal Reserve historical reaction function.) Armour, Fung, and Maclean (2001) obtain similar results within the context of the Bank's current model for economic projections and policy analysis (the Quarterly Projection Model).

3. Review of Explanations

Listed below are some of the arguments that have been proposed to explain the behaviour of the historical interest rates.

1. *Gradual movements in the interest rate reflect the dynamic structure of the transmission mechanism*.

The argument is that the effects of shocks on output and inflation are often highly persistent and gradual; accordingly, so ought to be interest rate responses.

However, as the impulse response functions in Figure 4 show, the dynamic structure of the transmission mechanism does not fully account for the observed behaviour. Moreover, it cannot explain the relative infrequency of reversals. Indeed, if one agrees that the nature of most shocks is usually unknown at first—witness, for example, the frequent revisions of the output gap—and that policy responses ought to be based on the expected nature of the shocks, then accordingly one ought to observe an equal number of policy reversals as policy continuations.

2. *Uncertainty about the data leads to more cautious responses*.

The argument is that central banks respond cautiously to shocks because they are mindful not to respond to noise in the data (Orphanides 1998).

Although intuitive, this argument is disputable. Under certainty-equivalence, the optimal policy calls on central banks to respond to a shock as if their forecasts of the state of the economy based on current data were certain; noise in the data may affect the forecasting error, but it ought not to affect the optimal response (Srour 1999b, section 4.0.3).

3. *Uncertainty about the coefficients in the transmission mechanism leads to more cautious responses to shocks*.

Uncertainty about the coefficients in the transmission mechanism can arise from a wide variety of sources. For instance, the difficulty of fully conveying to the public the motives for the central bank's actions leads to uncertainty about the manner in which the public will react to monetary policy action.

The rationale behind the argument is that, with uncertain coefficients, the greater the change of the policy instrument, the greater the uncertainty about its effects on output and inflation. This leads to smaller interest rate responses to shocks (than without uncertainty), and consequently requires a greater persistence in interest rate movements to achieve the objective.

While this claim is unambiguously true when the uncertainty is solely about the coefficient of the policy instrument (Brainard 1967), in general it depends on the relative uncertainties of the coefficients of all the variables in the transmission mechanism (Srour 1999a). Nonetheless, empirical results seem to confirm the claim. Sack (1998a) shows that taking into consideration the uncertainty about the coefficients' estimates in the VAR indeed brings optimal responses closer to historical behaviour in the United States, but it still does not fully account for the persistent and gradual movements in interest rates. Moreover, uncertainty about the coefficients cannot account for the relative infrequency of reversals (see explanation 1).

4. *The actions taken by policy-makers are those with outcomes that they are confident about. For that reason, they delay action until they acquire enough information about a shock, and they choose actions that closely resemble those taken earlier, the outcomes of which have already been observed.*

There is likely to be greater uncertainty about the effect of monetary policy actions immediately following a shock, and this uncertainty subsequently diminishes as more information about the shock becomes available. For example, there is likely to be greater uncertainty about the interest rate elasticity of the exchange rate immediately following a shock to investors' confidence. Under such circumstances, policy-makers would delay action and take gradually stronger actions as they became more confident of the outcome, thus giving rise to interest rate movements in the same direction (Sack 1998b, and Balvers and Cosimano 1994).[17]

17. If, as is intuitive, uncertainty about the nature of additive shocks is positively correlated with uncertainty about the coefficients, then the above argument can also explain the low frequency of reversals.

Notice, however, that, as in explanation 3, the claim depends on the relative uncertainties of the parameters involved. For example, a large shock, such as an exchange rate crisis, which raises the spectrum of an accelerating inflation, may on the contrary call for a sharper response at first when the uncertainty is high, followed by a gradual return to normal as the uncertainty diminishes.

5. *Large movements in the interest rate are avoided because they destabilize financial and exchange markets.*

Large surprises in short-term interest rates can cause volatility in exchange markets, and thus increase the aversion to holding domestic-currency-denominated assets. They can also cause private agents and financial institutions to become illiquid and provoke a credit crunch if long-term investments are financed by short-term debt.[18]

6. *Reversals in monetary policy actions are avoided because they are perceived by the public as mistakes or as evidence of inconsistency.*

If reversals are interpreted by the public as evidence of mistakes, they may lead to a loss of confidence in the policy-makers' abilities to steer the economy, and consequently to a loss of credibility in the central bank's objectives. For this reason, central banks take action only when they have acquired enough information about observed shocks to avoid reversing themselves later.

In support of this argument, Goodhart (1998) quotes the following instructive passage from an article on the Bank of England in the *Sunday Business*:

> Where the committee lost credibility last week is in its inconsistency. . . . What is the outside world meant to make of members who can change their view so readily? It suggests a fickle committee, influenced by the latest anecdotal or statistical evidence, swaying its opinions one way or the other and back again.

7. *Pre-emptive monetary policy actions are difficult to justify on the basis of forecasts*.

One reason for this argument is the inherent uncertainty of forecasts. Another possible reason is the public's unfamiliarity with the idea of lags in the transmission mechanism. Consequently, policy-makers are constrained to wait until shocks are reflected in contemporaneous inflation or output, hence the reaction to shocks will be slow and reversals will be infrequent (Freedman 1998).

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18. Everything else being equal, the prospect of large surprises in the short-term interest rate implies that greater resources will be devoted to central-bank-watching and speculative activity.

Implicit in Goodhart's and Freedman's arguments (6 and 7, respectively) is that certain types of behaviour by a central bank have a special weight in the public's eye; e.g., reversals in the case of Goodhart, and action (vs. inaction) in the case of Freedman. However, it is not clear why the public should have such conceptions, nor that a central bank should be concerned about them. For instance, monetary policy actions that are perceived to be too late or too weak also provoke criticism and can lead to equally harmful loss of confidence by the public. The following interpretations, one emphasized by Woodford and the other by the author, rely on the idea that agents are forward looking and that, as a consequence, monetary policy must involve a significant level of commitment. Deviations from these commitments will be seen as inconsistent behaviour and inevitably provoke the kind of criticism or difficulties that Goodhart and Freedman allude to.

8. *In a forward-looking environment with rational expectations, concern about the variance of the level of the interest rate induces interest rate smoothing*.

Central banks avoid large variations in the level of interest rates to keep the zero bound on nominal interest rates non-binding. To achieve policy targets while keeping the level of interest rates relatively low, a central bank has to keep interest rates at a certain level longer, which implies interest rate smoothing. Further smoothing occurs in an environment where the medium- or long-term interest rate affects demand, since equal effects on current demand can be achieved through changes in the interest rate over still longer periods. Moreover, since fluctuations of the interest rate are more costly when the interest rate is already away from equilibrium, the policy-maker is better off committing initially to a strategy of small future changes in the interest rate around the expected future level in response to unanticipated future shocks (Woodford 1999).

9. *The complexity of the economy leads a central bank to follow, implicitly or explicitly, some simple verifiable rules. This implies that contingencies that are not anticipated by the rule will not be responded to immediately, resulting in a certain degree of inertia in the conduct of monetary policy.*

Because of the inherent uncertainties in the economy and asymmetric information, it is not enough for private agents to know the objectives of monetary policy. They must also know how the objectives will be achieved so that they can assess the risks involved in medium- or long-term investments. Failure to do so raises the risks of investment considerably. Clearly, however, it is practically impossible to formulate a policy ahead of time that describes conduct under all contingencies. Rather, policy-makers are confined to commit to simple verifiable rules that, for the sake of credibility, they must sometimes abide by even if the current state of the economy requires otherwise. Hence, there is a certain degree of inertia in the conduct of monetary policy (Srour 1999b).

This can explain the intuition in Goodhart's and Freedman's claims (arguments 6 and 7, respectively). Namely, if it is not easy to communicate in advance the conditions under which an increase in the interest rate would be reversed, then a central bank must be ready to uphold the increase, once implemented, even if it is no longer warranted by the state of the economy. Also, if a central bank implicitly formulates its policy on the basis of a simple Taylor rule of the form

$$r_t = A\pi_t + By_t ,$$

then it will be difficult to justify a response to a shock in terms of the inflation forecast, unless the shock affects contemporaneous inflation or the output gap as well.

Of course, a once-and-for-all commitment to a simple mechanical rule, such as the Taylor rule, is not likely to be tenable, and a certain degree of discretion and flexibility is inevitable. In other words, monetary policy must combine elements of a rule with elements of discretionary behaviour. Perhaps a plausible formulation is a reaction function of the form

$$r_t = A\pi_t + By_t + \varepsilon_{t|t-1} + \mu_t ,$$

where μ_t is an adjustment to the rule that expresses the inevitable degree of discretion allowed without forewarning (intuitively, we would expect this adjustment to occur only in exceptional circumstances), ε_t has the unconditional mean 0, and $\varepsilon_{t|t-1}$ is an adjustment to the rule that expresses the degree of discretion allowed based on publicly available information at time $t-1$. The idea behind the term $\varepsilon_{t|t-1}$ is that it allows a central bank to adjust its policy as long as it provides advance notice that a shift in the outlook has taken place.

4. Conclusion

This paper has examined the empirical evidence on interest rate smoothing over the last 20 years. Using summary statistics, it was shown that reversals in interest rate movements have been relatively infrequent in the past. It was also shown that the historical reaction of central banks to economic shocks in Canada has been significantly more gradual and persistent than the optimal reaction that standard models of the transmission mechanism in principle would call for. The latter involves an immediate substantial response to a shock, whereas historically the interest rates moved in small steps in the same direction.

This paper has also reviewed some of the explanations that have emerged recently in the literature. These involve, alternatively, uncertainty in the economy, financial markets' stability, and commitment and credibility. The explanation pertaining to commitment and credibility underscores the need for a central bank to communicate its intentions to the public in a coherent manner.

While some important progress has been made on optimal policy, the question of interest rate smoothing needs further research: How sharply and quickly, or, equivalently, how gradually, should a central bank respond to a shock? For now, the conduct of monetary policy in this regard remains more of an art than a science.

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Table 1: Policy Rate Adjustment

	Sequence of adjustment											
	Number of changes				Average lapse[1]				Average change[2]			
	++	+ -	- +	- -	++	+ -	- +	- -	++	+ -	- +	- -
United States	6	1	2	22	41	108	321	39	0.46	0.25	0.25	0.28
Germany	65	31	31	107	22	24	34	14	0.25	0.19	0.12	0.15
France	8	5	6	86	47	72	77	31	0.51	0.40	0.83	0.21
Italy	9	6	6	24	122	182	121	83	1.31	0.88	0.96	0.73
United Kingdom	28	17	18	84	36	69	49	23	0.94	0.50	0.77	0.37
Canada	10	1	2	21	22	57	103	21	0.43	0.25	0.25	0.25
Spain	4	5	4	33	56	72	67	35	0.42	0.24	0.35	0.38
Australia	2	1	1	17	43	413	264	67	1.00	0.50	0.75	0.79
Netherlands	55	27	28	108	16	15	32	15	0.42	0.53	0.40	0.21
Belgium	9	7	8	82	17	10	82	10	0.45	0.24	0.34	0.14
Sweden	14	1	2	24	16	132	146	10	0.12	0.25	0.27	0.18
Austria	15	1	1	48	70	42	150	34	0.38	0.50	0.25	0.16

Notes: + + = two successive increases (tightenings); + - = increase followed by decrease;
- + = decrease followed by increase; -- = two successive decreases (easings).
Policy rates are starting dates of the sample periods: Australia, official target rate, 23 January 1990; Austria, GOMEX, 6 May 1985; Belgium, central rate, 29 January 1991; Canada, operating band, 15 April 1994; France, tender rate, 4 January 1982; Germany, repurchase rate, 19 June 1979; Italy, discount rate, 1 January 1978; Netherlands, special advances rate, 1 January 1978; Spain, repurchase rate, 14 May 1990; Sweden, repurchase rate, 1 June 1994; United Kingdom, Band 1 bank bills, 1 January 1978; United States, federal funds target rate, 10 August 1989. End of sample periods, 31 March 1998.

[1]In days.

[2]In percentage points.

Source: Bank for International Settlements. 1998. *68th Annual Report*, p. 68.

Table 2: Bank Rate Adjustments for Canada[1]

Number of changes[1]						Average duration				Average change			
+	++	-	- -	- +	+ -	++	- -	- +	+ -	+	+ +	-	- -
81	61	100	79	20	21	8.7 w	4.4 w	5.9 w	3.5 w	0.36	0.38	0.27	0.27

[1]Sample (weekly) 1 January 1984 to 31 March 1999 (i.e., 792 observations). Changes are larger than or equal to 15 basis points.

Figure 1

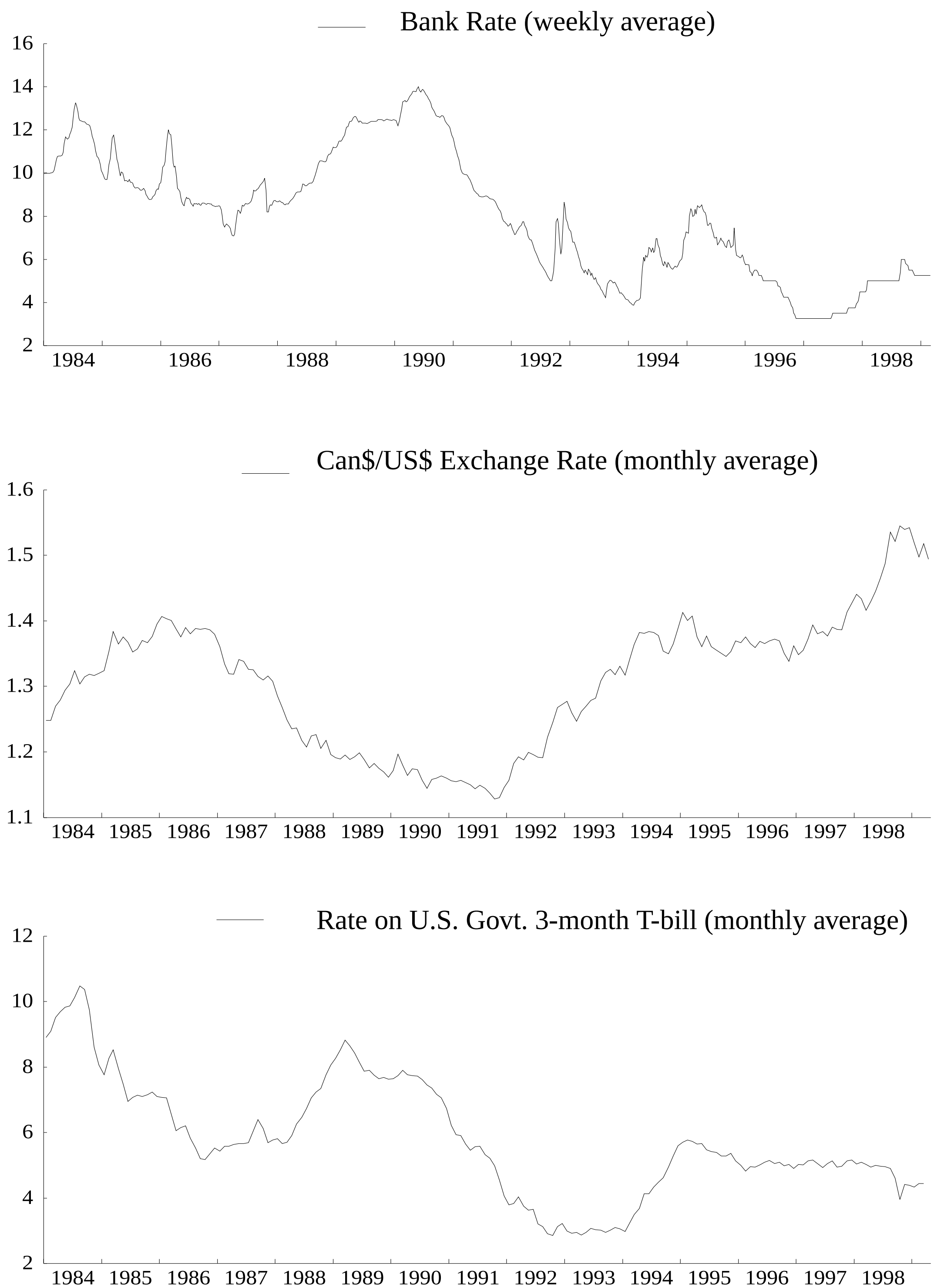

Bank Rate (weekly average)
16
14
12
10
8
6
4
2
1984
1986
1988
1990
1992
1994
1996
1998
Can$/US$ Exchange Rate (monthly average)
1.6
1.5
1.4
1.3
1.2
1.1
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998
Rate on U.S. Govt. 3-month T-bill (monthly average)
12
10
8
6
4
2
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998

Figure 2

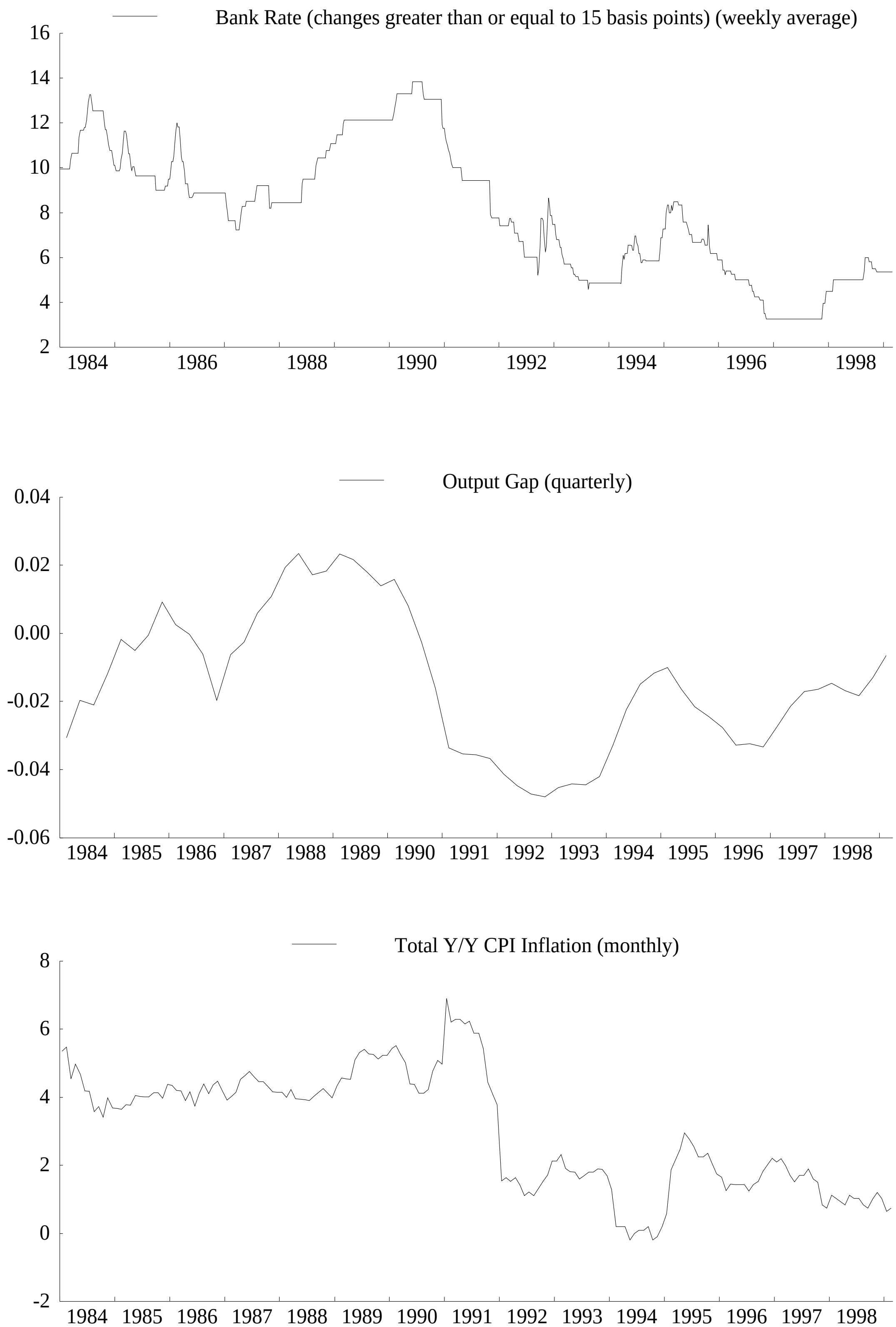
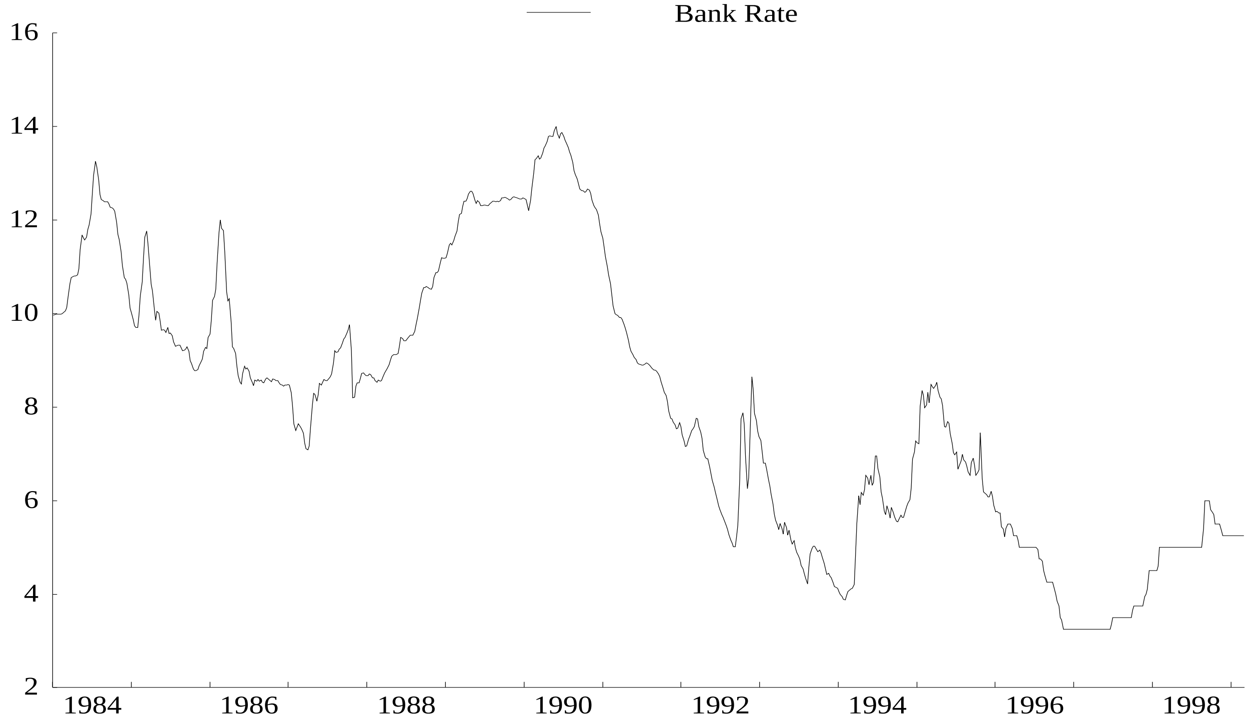

Bank Rate (changes greater than or equal to 15 basis points) (weekly average)
16
14
12
10
8
6
4
2
1984
1986
1988
1990
1992
1994
1996
1998
Output Gap (quarterly)
0.04
0.02
0.00
-0.02
-0.04
-0.06
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998
Total Y/Y CPI Inflation (monthly)
8
6
4
2
0
-2
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998

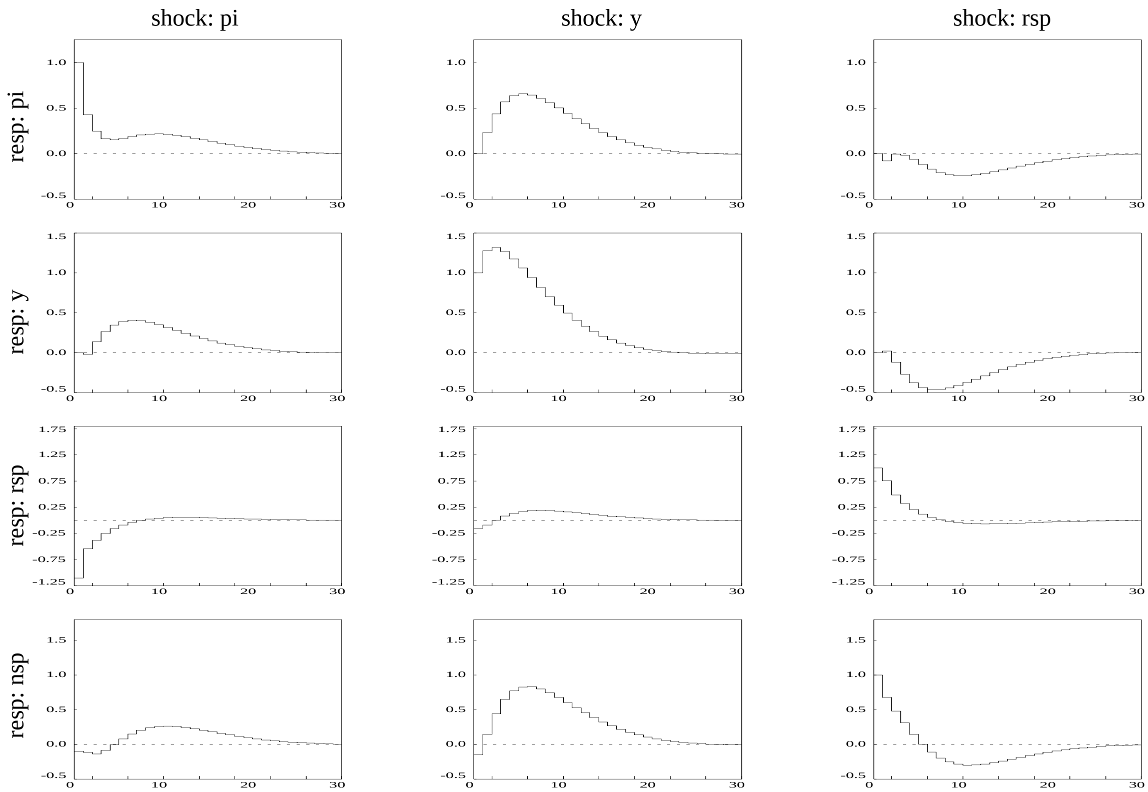
Figure 3


Bank Rate
16
14
12
10
8
6
4
2
1984
1986
1988
1990
1992
1994
1996
1998

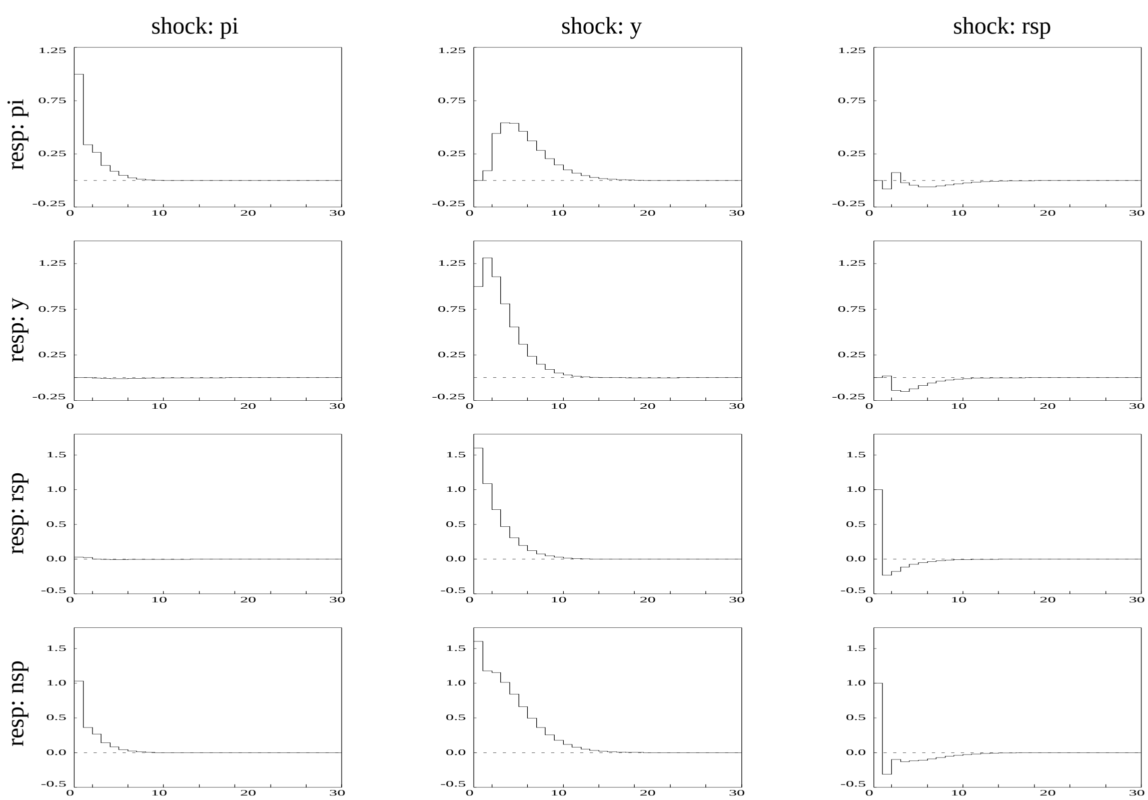

Bank Rate (changes greater than or equal to 25 basis points)
14
12
10
8
6
4
2
1984
1986
1988
1990
1992
1994
1996
1998

Figure 4

Impulse Response Function under the Historical Rule



Impulse Response Function under the Optimal Rule



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