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► **To cite this version:**

Frédérique Bec, Mélika Ben Salem, Fabrice Collard. Asymmetries in Monetary Policy Reaction Function: Evidence for U.S. French and German Central Banks. *Studies in Nonlinear Dynamics and Econometrics*, 2002, 6 (2), 10.2202/1558-3708.1006 . hal-04176268

HAL Id: hal-04176268

<https://hal.science/hal-04176268v1>

Submitted on 2 Aug 2023

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Studies in Nonlinear Dynamics & Econometrics

Volume 6, Issue 2

2002

Article 3

Asymmetries in Monetary Policy Reaction Function: Evidence for U.S. French and German Central Banks

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Abstract

This paper proposes an empirical exploration of the possible asymmetric nature of the preferences of central bankers, with respect to inflation and output targets. The idea underlying this work lies in the widespread belief that central bankers interventions - through changes in a short-term interest rate - are influenced by the state of the current and/or expected state of the business cycle. The GMM estimates of a threshold model support the asymmetric representation of the monetary policy reaction function for recent U.S, French and German data.

1 Introduction

This paper proposes an empirical exploration of the possible asymmetric pattern of the reaction function of central bankers over the business cycle. The idea behind this work is the widespread belief that, although central bankers claim their independency, their interventions — through changes in a short-term interest rate — may actually be influenced by the current and/or expected state of the business cycle. For example, it is probably easier — or at least acceptable — to maintain price stability when employment lies at (or above) its natural level.

Nowadays most central banks are viewed as independent, at least in the choice of the monetary policy instrument, since their main policy objective is inscribed in their statutes. For instance, the Federal Reserve Act specifies that, in conducting monetary policy, the US Federal Reserve System and the Federal Open Market Committee should seek “*to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates*”. Likewise, the statutes of the European Central Bank, mainly inspired by the Bundesbank’s, specifies that “*the primary objective of the ESCB shall be to maintain price stability*” (Chapter II, article 2). But in the next sentence, this article states that “*without prejudice to the objective of price stability, it shall support the general economic policies in the Community [...]*.” These examples, and especially the second, highlight two important features of the statutes of central banks: *(i)* the adoption of a nominal objective as a primary goal does not preclude real objectives and *(ii)* central bank interventions may be the result of other pressures than economic ones — those of the European Community for example. This may give rise to an asymmetric behavior of the central banker. Indeed, as noted by Alan Blinder, who was former Vice Chairman of the Fed

“In most situations the central bank will take far more political heat when it tightens preemptively to avoid higher inflation than when it eases preemptively to avoid higher unemployment” (Blinder (1998), pp. 19–20).

As a matter of fact, as long as the central bank is (at least to some extent) accountable to elected officials, this asymmetry is likely to permeate the objectives of the central bank.

Since the seminal contribution of Taylor (1993), the empirical literature devoted to the interest rate policy reaction function has developed in a linear setup, neglecting the possible asymmetric behavior of central bankers. But recent studies report empirical evidence supporting the existence of asymmetry in the reaction function of the monetary authorities. Dolado, Maria-Dolores and Naveira (2000) find empirical support for an asymmetric interest rate policy rule in France, Germany, Spain and the US in the post–1980 era, where the form of the rule depends on the sign of the inflation gap. Schächter and Stokman (1995) reach the same conclusion for the German economy. Gerlach (2000) provides empirical evidence of

another kind of asymmetry. He finds that the Federal Reserve may have been more concerned by negative rather than by positive output gaps in the pre-1980 period. Finally, Bouabdallah and Olmedo (2000) estimate a two-states Markov switching representation for the US interest rate reaction function. They find more aggressive behavior toward inflation during expansions than recessions and a greater concern of output stabilization during recessions for the post-1959 period.

Beyond the standard mis-specification problems associated with a linear — and therefore symmetric — representation of asymmetric behavior, the presence of this particular form of nonlinearity in the monetary policy reaction function has important theoretical implications, especially related to the inflation bias issue as defined in Kydland and Prescott (1977) or Barro and Gordon (1983). Indeed, the inflation bias in these papers arises from two features of the monetary policymakers behavior: *(i)* their objective is twofold — price stability and employment — and *(ii)* the employment level they target is above the natural level. Two decades later, the relevance of these two features has largely weakened. In particular, as argued by Blinder (1998), the policymakers at the Fed try to maintain employment at the natural level rather than above. For all that, does the spectre of inflation belong to the past? From a theoretical point of view, some recent studies show that this is anything but certain in presence of asymmetry.

Cukierman (1999) shows in a very simple framework that even if policymakers target the natural level of employment, there will be inflation bias if the central bank *(i)* is uncertain about the future state of the economy and *(ii)* is more sensitive to policy failures that drive employment below the normal level than to policy failures that raise employment above it. His model extends the framework developed by Kydland and Prescott (1977) and Barro and Gordon (1983) by explicitly considering an asymmetric loss function for the central bank. He then shows that the latter assumption suffices to create inflation bias. Indeed, there is some probability that a supply shock will be large enough to reduce employment below its natural rate. Therefore, the private sector attaches a positive probability to the central bank engaging in expansionary monetary policy so as to bring employment back to the targeted level. This consequently put upward pressure on prices. Conversely, the central bank is assumed to take no action when a positive supply shock pushes employment above the natural level. Hence, this model generates inflation bias. Similar conclusions are reached by Jordan (1998) and Gerlach (2000), whose models also make the assumption that policy makers attach greater losses to recessions than to expansions. Nobay and Peel (1998) slightly departs from the former models and rather consider that the central bank loss function exhibits asymmetries with regards to both inflation and real economic activity. While the asymmetric loss in inflation results in an inflation premium which can take either sign, the asymmetric preferences over output deviations imply that reducing the target level of output to the natural rate does not eliminate the inflationary bias.

This paper takes the asymmetric behavior seriously and tests the presence of

asymmetries in the monetary policy reaction of inflation and output gap from their targeted level. This paper takes the asymmetric behavior seriously and tests the presence of asymmetries in the monetary policy reaction function with respect to inflation and output targets. It departs however from the studies of Dolado et al. (2000) or Schächter and Stokman (1995) by exploring the possibility that the central bank reaction function depends on the state of the business cycle (measured by the output gap) rather than deviations of inflation from its targeted value. We first develop a simple theoretical model which extends the framework proposed by Svensson (1997) by taking this asymmetrical central bank behavior into account. We show that the monetary authority reaction function is piecewise linear. In other words, the interest rate policy rule is characterized by threshold dynamics. The estimation results of this kind of reaction function for post82 U.S., French and German monthly data support the hypothesis of asymmetry in the conduct of monetary policy, arising from the state of the business cycle.

The remainder of the paper is organized as follows. Section 2 briefly comments on the standard linear form of the monetary reaction functions à la Taylor (1993) and shows how a threshold autoregressive specification of the kind we propose can be obtained from a simple theoretical framework. Section 3 presents our estimation method. Section 4 presents the data, and discusses the results obtained for the Fed, the Bank of France, and the Bundesbank. A last section offers some concluding remarks.

2 Toward an Asymmetric Monetary Policy Reaction Function

Taylor (1993) proposed to capture the essential ingredients of the FED policy using a simple reaction function. Starting from the simple observation that the FED's main operating instrument of monetary policy is a short-term interest rate, Taylor proposes to link the nominal interest rate to inflation and output gaps according to the following rule:

$$i_t = 2 + \pi_t + 0.5(\pi_t - 2) + 0.5x_t \quad (2.1)$$

where i_t denotes the nominal interest rate, π_t is the inflation rate and x_t is a measure of the output gap. Then, according to (2.1) any positive deviation of the inflation rate from its targeted value (2%) leads the FED to increase the level of the interest rates. This component therefore aims at stabilizing the nominal side. Likewise, any increase in the output gap results in an increase in the nominal interest rate. This latter component actually acts as an automatic stabilizer on economic activity. Although very simple, this rule is intended to capture the essential elements of more realistic monetary policies for which the FED cares for "everything". Thus, this simple and fairly general rule is taken to be a good device for representing the way monetary policy is conducted by the FED. Implicit in that formulation is the fact

that domestic monetary policy is not subject to any significant external constraint, such as a fixed exchange rate, which turns out to be the case at least in the US. Svensson (1997) and Clarida, Gali and Gertler (1999) show how this rule can be derived from optimizing behavior if the central bank chooses the nominal interest rate so as to minimize expected deviations of the inflation rate from a target and the output gap. In this study, we depart from this specification and extend it to a non-linear framework. More precisely, following Cukierman (1999), Jordan (1998) or Gerlach (2000), we recognize the fact that the behavior of the central bank may differ over the business cycle. Monetary authorities may indeed adopt a more (less) aggressive monetary policy visavis the deviations of inflation rate and/or the output gap from their targeted levels depending on the state of the business cycle. Such a view makes the case that expansions may put some additional pressure on the central bank to be more aggressive in its stabilization policy — in particular in the inflation rate pegging policy, whereas recessions may be a time for accommodation. We therefore depart from the standard quadratic loss function of the central bank commonly assumed in the literature (see e.g. Clarida et al. (1999)), and rather assume that the form of the loss function may be contingent on the business cycle. The model we have in mind somehow generalizes the setup proposed by Svensson (1997). Indeed, assuming that the central banker (*i*) cares for both inflation and output gaps, and (*ii*) may display different behavior according to the state of the business cycle, we consider the following central banker intertemporal loss function which is given by the expected discounted sum of future losses

$$E_t \sum_{\tau=t}^{\infty} \delta^{\tau-t} \mathcal{L}(\pi_{\tau}, x_{\tau}) \quad (2.2)$$

where $\delta \in (0, 1)$ is the central banker's discount factor. We further assume that the instantaneous loss function $\mathcal{L}(\pi_{\tau}, x_{\tau})$ takes the form

$$\mathcal{L}(\pi_{\tau}, x_{\tau}) = \frac{1}{2} ((\pi_{\tau} - \pi^*)^2 + \omega_e x_{\tau}^2) \mathbf{1}_{[x_{\tau-d} > 0]} + \frac{1}{2} ((\pi_{\tau} - \pi^*)^2 + \omega_r x_{\tau}^2) \mathbf{1}_{[x_{\tau-d} \leq 0]} \quad (2.3)$$

where π_t denotes the inflation rate in period t and x_t is the output gap measured as the deviation of current output from potential output. ω_e and ω_r are positive relative weights to output stabilization in expansion (e) and recession (r) respectively. $\mathbf{1}[\cdot]$ is the Heaviside function which is equal to unity when the condition in the associated brackets holds, and zero otherwise. Note that this model encompasses the linear version analyzed by Svensson (1997), as it corresponds to the special case where $\omega_e = \omega_r$ in (2.3). This loss function can capture some asymmetries in the conduct of monetary policy, in that it leads to different monetary policies depending on the state of the business cycle. Therefore, the instantaneous loss function makes it clear that, depending on the state of the economy, monetary authorities may adopt a more (less) aggressive reaction to deviations of inflation and output gap from their targeted level.

Different variables may have been candidates to enter the transition function, among which the inflation rate (or the nominal exchange rate in Europe). We however restrict ourselves to the output gap, as it is expected to be an accurate indicator of the business cycle. Implicit in this assumption is the fact that lagged output gap is a sufficient statistic to describe the state of the business cycle — at least for central bankers.

Following Svensson (1997), we assume that the dynamics of this economy is characterized by the following AS/AD model:

$$\pi_{t+1} = \pi_t + \alpha_1 y_t + \varepsilon_{t+1}, \quad \alpha_1 > 0 \quad (2.4)$$

$$y_{t+1} = \beta_1 y_t - \beta_2 (i_t - \pi_t) + \eta_{t+1}, \quad 0 \leq \beta_1 < 1 \text{ and } \beta_2 > 0 \quad (2.5)$$

where ε_{t+1} and η_{t+1} are i.i.d. shocks occurring in $t + 1$, and not known at time t . Note that both aggregate supply (2.4) and aggregate demand (2.5) functions involve sluggish adjustment. Hence, given the lag structure of this economy, any date- t change in the nominal interest rate will affect demand — and therefore equilibrium output — with one lag, and inflation with 2 lags.

The program of the central banker then consists of choosing the nominal interest rate minimizing (2.2) subject to (2.3), (2.4) and (2.5). Proceeding along the lines developed in Svensson (1997), it can be shown that the central bank's optimal reaction function is state contingent and takes the form

$$i_t^* = \pi^* + \{\tilde{b}_{1,e}(\pi_t - \pi^*) + \tilde{b}_{2,e}x_t\}\mathbf{1}_{[x_{t-d}>0]} + \{\tilde{b}_{1,r}(\pi_t - \pi^*) + \tilde{b}_{2,r}x_t\}\mathbf{1}_{[x_{t-d}\leq 0]} \quad (2.6)$$

with

$$\begin{aligned} \tilde{b}_{1,j} &= \frac{1}{\beta_2 \alpha_1} \left(\frac{\delta \alpha_1^2 k_j}{\omega_j + \delta \alpha_1^2 k_j} \right) \\ \tilde{b}_{2,j} &= \alpha_1 \tilde{b}_{1,j} + \frac{\beta_1}{\beta_2}, \end{aligned}$$

for $j = e, r$, where k_j is a complicated function of ω_j , δ and α_1 such that $k_j \geq 1$ (see equation (B.6) in Svensson (1997)). The central bank reaction function given by (2.6) is much in the lines of that proposed by Taylor (1993). It however departs from Taylor's original specification in that it fundamentally depends on the state of the business cycle. From a technical point of view, this specification allows for regime switching and therefore suggests a threshold representation of monetary policy.

3 Estimation Procedure

Our estimation procedure closely follows the work of Clarida, Gali and Gertler (2000). In particular this led us to adapt the simple nonlinear policy rule we derived

in the previous section. Indeed, although they admit reacting according to basic Taylor rule principles, central bankers also claim to adopt a more subtle and more sophisticated behavior, taking into account their forecasts on inflation and/or output gaps. According to Fed Chairman Greenspan's words:

“Because monetary policy works with a lag, it is not the conditions prevailing today that are critical but rather those likely to prevail six to twelve months, or even longer, from now.” (January 21, 1997 testimony before the Senate Committee on the Budget)

Thus, in order to take all these features into account, it is now an usual practice in the literature (see Clarida et al. (2000) among others) to extend the previous reaction function to the following specification

$$i_t = \rho(L)i_{t-1} + (1 - \rho(1))i_t^* + \varepsilon_t \quad (3.7)$$

where $\rho(L)$ is a lag polynomial, with all roots lying outside the unit circle. i_t^* is the target rate that actually represents the “true” interest rate reaction function:

$$i_t^* = \alpha + \gamma(E_t\pi_{t+k} - \pi^*) + \beta E_t x_{t+j} \text{ with } k > 0, \quad (3.8)$$

This specification departs from Taylor's in at least two ways. First of all, it explicitly takes into account expectations of central bankers in conducting monetary policy. Therefore, any expected increase in the inflation rate or the output gap leads monetary authorities to increase the nominal interest rate. Second, this specification (equation (3.7)) includes lags, in order to account for partial adjustment in interest rate movements. Two different interest rates appear in (3.7) : the actual rate (i_t), which corresponds to the monetary policy instrument, and the target rate (i_t^*), which reflects the desired orientation of the monetary policy. These two rates are explicitly handled by the U.S. central bank. Indeed, in formulating monetary policy, the Federal Reserve sets a target level for the federal funds rate, and the Fed's announcements of changes in monetary policy specify the changes in the Fed's target for that rate. By facilitating the transfer of the most liquid funds between depository institutions, the federal funds market plays a major role in the implementation of monetary policy. The interest rate on federal funds is highly sensitive to Federal Reserve open market operations that influence the supply of reserves in the banking system and to the discretionary component of monetary policy.

Following the previous approach, we adopt specification (3.7) for the actual interest rate and specify the target rate as

$$i_t^* = \alpha + \begin{cases} \gamma_e (E_t\pi_{t+k} - \pi_{t+k}^*) + \beta_e E_t x_{t+j}, & \text{if } x_{t-d} > 0 \\ \gamma_r (E_t\pi_{t+k} - \pi_{t+k}^*) + \beta_r E_t x_{t+j}, & \text{if } x_{t-d} \leq 0 \end{cases} \quad (3.9)$$

where $d, k, j > 0$ and $\rho(L)$ is a lag polynomial, with all roots lying outside the unit circle. i_t^* is the target rule that actually represents that component of nominal

interest rate which effectively reflects the central bank orientation, the remaining being mostly attributable to money market phenomena. In the French case, specification (3.9) is extended in order to take the constraint imposed by EMS into account. More specifically, we will allow the French reaction function to depend on the German nominal interest rate:

$$i_t^* = \begin{cases} \alpha + \gamma_e (E_t \pi_{t+k} - \pi_{t+k}^*) + \beta_e E_t x_{t+j} + \lambda_e i_t^G & \text{if } x_{t-d} > 0 \\ \alpha + \gamma_r (E_t \pi_{t+k} - \pi_{t+k}^*) + \beta_r E_t x_{t+j} + \lambda_r i_t^G & \text{if } x_{t-d} \leq 0 \end{cases} \quad (3.10)$$

where $d, k, j > 0$ and i_t^G is the German nominal interest rate. Following Clarida et al. (2000), we set both k and j to 12, such that the central bank's behavior is based on annual expectations. d , the lag of the output gap in the transition function, is set to 1. This choice builds on the prior that a monthly lag of output gap is a good indicator of the contemporaneous state of the business cycle. Moreover, recessions (expansions) are defined by negative (positive) lagged output gaps.

The model is estimated using a Generalized Moment Method. The estimates of the variance–covariance matrix are robust to heteroskedasticity and MA(12) autocorrelation. A Parzen kernel was used. The set of instruments retained for the US includes, beside a constant term, two lags of the federal funds rate and twelve lags of $\pi - \pi^*$, x and the market interest rate spread — defined by the difference between 10-year bonds rate and 3-month bond rate. With respect to the French case, the set of instruments includes two lags of the intervention rate, and six lags of $\pi - \pi^*$, the output gap, the interest rate spread, the French Franc/Deutschmark exchange rate relative to central parity, and the German Lombard rate. Finally, the instrument set retained for Germany is the same as for US, augmented with twelve lags of the US Federal Funds rate.

4 Empirical Results

4.1 The data

The estimation is conducted on monthly data for the US, the French and the German economy (see figures 1 to 3 in Appendix A). The sample for the estimation of the U.S. model runs from 82:10 to 98:8. Indeed, October 1982 corresponds to the time at which the Fed adopted the Funds rate as its preferred instrument, instead of a monetary aggregate. Then, due to the annual expectations included in the reaction function, the last twelve observations of the available sample cannot be used. The beginning of the French and German samples is constrained by the interest rate data. So, the estimation sample runs from 83:07 to 97:12 for France and from 82:01 to 97:11 for Germany.

The first important issue concerning the estimation of an interest rate policy rule is the definition of the instrument — the nominal interest rate i_t . For each country, we actually consider the preferred instrument as announced by each central

bank. Hence, the federal funds rate was used for the US. Furthermore, data for the interest rate i_t^* are available for the US. Therefore, we also report estimation results for equation (3.9) using the federal funds target rate for that country. The discount rate is used in Germany. Note however, that the Bundesbank pursued two main monetary policies over our sample: a discount rate policy and a Lombard policy. As mentioned in Schächter and Stokman (1995), these policies are rated as means of “global-tuning”: they are conducted in such a way that the targets of the Bundesbank can be achieved in the long run. For comparison purposes, we only report the results concerning the discount rate (measured in the middle of the month).¹ Finally, the monthly average of the intervention rate was used for France.

The second important issue concerns the objectives.² As indicated in the previous section, our rule basically considers two main objectives: output and inflation stabilization. Data availability at the monthly frequency precludes the use of GDP for the construction of an output gap. We therefore relied on the industrial production index in each country. The output gap, x_t , is then measured by the Hodrick–Prescott cyclical component of the industrial production index. The inflation rate is the annualized CPI-based inflation rate. It is difficult to believe that the targeted inflation rate has remained constant over the whole sample. Indeed, the early eighties witnessed high inflation rates compared to the remainder of the sample. So, following Dolado et al. (2000), the inflation target is measured by the index published in the reports of the Council of Economic Advisors for the U.S., and in the Bundesbank annual reports for Germany. Such data are not available for France. We therefore follow these authors by retaining the German target inflation rate as a proxy of the French one.

4.2 Estimation results

Estimates of (3.7)-(3.9) for the US and Germany and (3.7)-(3.10) for France are reported in table 1.³ First, these asymmetric specifications of the nominal interest rate are not rejected by the data at the conventional significance level, as indicated by the over-identification tests (J-statistics). The second striking result is that the conduct of monetary policy is significantly affected by the state of the business

¹The conclusions arising from the use of the Lombard are quite similar, and available from the authors upon request.

²Note that throughout the paper, we will not use real-time data. Some recent studies (see e.g. Orphanides and van Norden (1999) or Orphanides (1998) among others) have pointed out that central bankers expectations are based on real-time data rather than revised data — as available in most databases. A direct implication of this observation is that empirical analysis of monetary policy based on fully revised data may be misleading. To our knowledge, some real-time data are available only for the US output gap at the quarterly frequency, which precludes estimating accurately the kind of nonlinear model we aim at studying. An alternative approach to the problem would be to make some assumption on the form of the revision and estimate the model using non-linear Kalman filtering, which is far beyond the scope of the paper.

³Actual and fitted interest rates are plotted in Appendix B.

cycle. The bottom-line of table 1 reports the Wald test for linearity. The equality of coefficients across regimes is rejected at the five percent level in every case. We now discuss each case in greater detail.

4.2.1 The United States

First and foremost, the over-identification test clearly indicates that the asymmetric representation of the monetary reaction function (3.7) is supported by the data, since the linearity hypothesis is rejected at the 3% level. A quick glance at the second column of table 1 reveals that the asymmetry essentially originates in the coefficients affecting inflation expectations, γ_i 's. Indeed, the Wald test of symmetry in the response to inflation gaps (row $\gamma_e = \gamma_r$) clearly indicates that the null hypothesis of a symmetric response to an inflation gap across the two states of the business cycle is rejected at the 5% significance level. Conversely, the symmetry in the response to the output gap cannot be rejected (row $\beta_e = \beta_r$). A more careful examination of the results then reveals the pattern of this asymmetry. γ_e is significantly positive (2.46 with a t-statistic of 6.95), γ_r is not found to be significantly different from zero. In other words, the weight attached to the inflation objective is greater during upswings — *i.e.* when the spectre of unemployment is distant — than downswings. The Fed has proven to be more aggressive regarding any inflation gap during expansions than during recessions, trying to fight inflationary pressure more aggressively. This conclusion also holds for the target rate equation (3.9), the estimates of which are reported in the first column of the table.⁴

As mentioned previously, another interesting feature that jumps out of the U.S. estimates is that the response of the central banker to the expected output gap is symmetrical. Furthermore, both β_e and β_r are significantly positive. It should be noted however that symmetry is not fully established as the estimation of the target rate equation (3.9) suggests that the output objective matters in recessions only. This last result is in accordance with the empirical findings by Dolado et al. (2001) and Gerlach (2000) which both find, with slightly different asymmetric reaction functions, that the Federal Reserve responds more aggressively to negative output gaps than to positive ones.

Hence, the Fed seems to be essentially concerned with inflationary pressures during economic booms — trying to avoid any economic overheating — whereas contractions are essentially devoted to economic activity stabilization.

4.2.2 Germany

The results obtained from German data are quite similar to those obtained for the US economy. Once more, there is a clear-cut asymmetry in the monetary policy

⁴Dolado, Maria-Dolores and Naveira (2001) also report an asymmetric reaction of the Fed funds rate to inflation gaps — namely a stronger reaction to positive inflation deviations than to negative ones. They reach this conclusion in a different setup, where they allow the inflation coefficient to differ according to the *sign* of the inflation gap.

Table 1: Asymmetric reaction functions

Parameter	US		GERMANY	FRANCE
	i_t^*	i_t	i_t	i_t
ρ_1	–	1.238 (81.61)	0.945 (242.48)	1.289 (44.91)
ρ_2	–	-.274 (-16.53)	–	-.346 (-15.92)
α	6.333 (48.07)	5.262 (9.34)	3.811 (32.50)	1.270 (2.19)
γ_e	1.143 (10.35)	2.460 (6.95)	2.463 (14.32)	1.566 (8.26)
β_e	0.039 (0.41)	1.703 (3.52)	.697 (9.87)	0.156 (1.36)
λ_e	–	–	–	0.839 (11.02)
γ_r	0.129 (0.50)	-2.425 (-0.94)	0.295 (1.72)	2.212 (12.59)
β_r	0.719 (6.81)	1.237 (2.79)	0.373 (5.49)	-0.107 (-0.69)
λ_r	–	–	–	0.604 (6.18)
J-stat	15.76 [0.99;34]	18.51 [0.97;32]	18.92 [0.99;44]	14.12 [0.94;24]
$\gamma_e = \gamma_r$	17.22 [0.00]	3.60 [0.05]	56.81 [0.00]	5.86 [0.01]
$\beta_e = \beta_r$	29.45 [0.00]	0.48 [0.43]	10.71 [0.00]	1.73 [0.19]
$\lambda_e = \lambda_r$	–	–	–	11.94 [0.00]
Linearity	31.61 [0.00]	7.13 [0.03]	68.03 [0.00]	12.01 [0.00]

Note: t-statistics in parentheses, p-values(;degrees of freedom) in brackets.

function, as indicated by the global specification test. However, there is a difference between policies followed in the two countries. Our results, and especially the symmetry tests, indicate that the response to both expected inflation and output gaps are responsible for the asymmetric behavior of the Bundesbank. Indeed, the Bundesbank seems to have attached a greater weight to both objectives in expansions than in recessions, as can be seen from the third column of table 1. While the inflation gap coefficient is the same as the one obtained for the Fed during expansions ($\gamma_e = 2.46$), much less weight is attached to the output gap, albeit it remains significantly different from zero in both regimes. It is worth noting that the weight given to the output gap is almost twice as big in expansions than in recessions ($\beta_e = 0.697$ and $\beta_r = 0.373$). This result, together with the greater concern for inflation in booms than in troughs⁵, suggests that the Bundesbank conducted stronger monetary contractions to contain inflationary pressures in times of upswings than monetary accommodation to sustain real activity during downswings. This confirms the Bundesbank widespread reputation for inflation–adverse behavior.

4.2.3 France

The French case calls for some preliminary comments. Indeed, compared to the two other economies under study, France is usually perceived as a small open economy, which actually follows the monetary policy of its German neighbor. Furthermore, France faced, like its neighbor, but to a greater extent the constraints imposed by the construction of EMS during most of the sample period. Therefore, we explicitly take these constraints into account by introducing a dependency of the French monetary policy rule on the German interest rate.

Like the two previous cases, the asymmetric behavior of the Bank of France is not rejected by the data. The coefficients are clearly different across regimes except the one related to the output gap. It is not significantly different from zero, neither in recession nor in expansion. Both the inflation target and German monetary policy seem to have played an important role in the conduct of the French monetary policy. The results reported in the last column of table 1 suggest that the alignment of the French monetary policy on that conducted by the Bundesbank is slightly stronger in expansions than in recessions. Indeed, $\lambda_e = 0.839$ while $\lambda_r = 0.604$ and the linearity hypothesis is rejected at the 1% significance level for this coefficient. In other words, the EMS constraint played a greater role during economic booms.⁶ Another interesting result is that the weight attached to the expected inflation gap is significantly greater in recessions than in expansions. This result may reflect the so-called “competitive disinflation” policy conducted from 1983 to the mid–nineties by the successive French governments. Indeed, this policy, first characterized by

⁵Dolado et al. (2001) reach the same conclusion while identifying booms (resp. troughs) with positive (resp. negative) inflation gaps.

⁶Another way of interpreting this result is to say that the constraint imposed by European construction was more effective when it was more politically admissible.

a price–freeze measure from 1983 to the end of 1985. Afterwards, a restrictive monetary policy was adopted regardless of its negative impact on unemployment. The policy aimed firstly at restoring the competitiveness of French exports and secondly at satisfying the Maastricht criteria imposed to the European Monetary Union candidates. The policy, which was undertaken during most of the sample period, probably explains the lack of explanatory role of the output gap in the reaction function, as well as the strong influence of the inflation target all over the sample.

5 Concluding Remarks

In this paper, we propose an empirical investigation of the presence of asymmetry in the behavior of the US, French and German central banks in the conduct of the monetary policy. For this purpose, we estimate central banks reaction functions using a threshold specification, which allows for an asymmetric response of the short–run interest rate both to *(i)* the expected departures of inflation from its targeted value and *(ii)* the expected output gap. Our empirical results support the view that the state of the business cycle matters for the *conduct* of the monetary policy in these countries. The shape of the reaction function is thus endogenously determined.

We find that for the post–82 period, the Fed and the Bundesbank cared about inflation during expansions only, whereas they always cared for activity stabilization. Contrary to the Fed, the Bundesbank gave significantly more weight to the output gap objective during booms. As for the Bank of France behavior, our findings suggest that it has been driven by the “competitive disinflation” policy, resulting in a stronger reaction to the inflation objective during recession. These results may question some well–established theoretical conclusions relative to the inflation bias issue.

6 Acknowledgments

We would like to thank the participants at the Econometric Society World Meeting, Seattle, and the seminar participants at the University of Strathclyde, Glasgow (Scotland), and at the European University Institute, Florence (Italy), G. Verdier and two anonymous referees for their valuable comments. The traditional disclaimer applies.

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A Data

Figure 1: US data

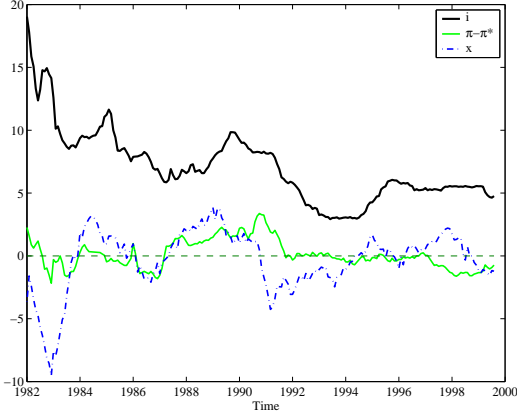


Figure 2: German data

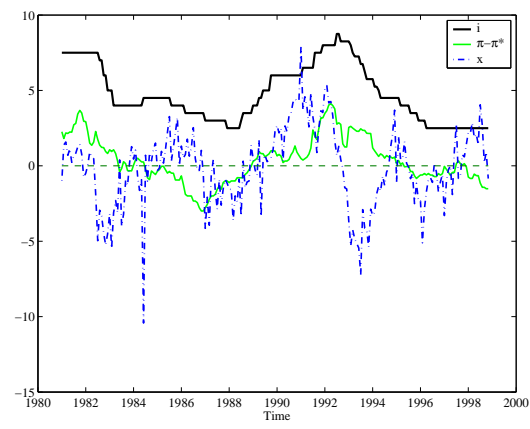
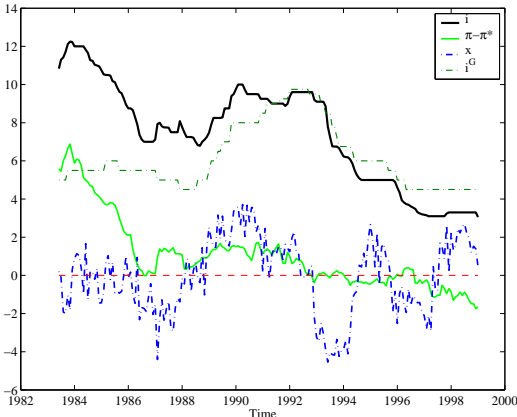


Figure 3: French data



B Actual and Fitted Interest Rates

Figure 4: US interest rate

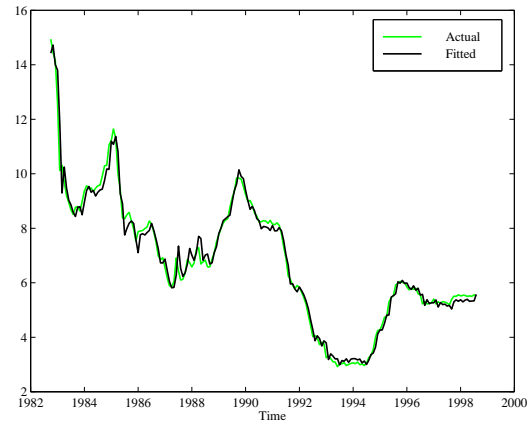


Figure 5: German interest rate

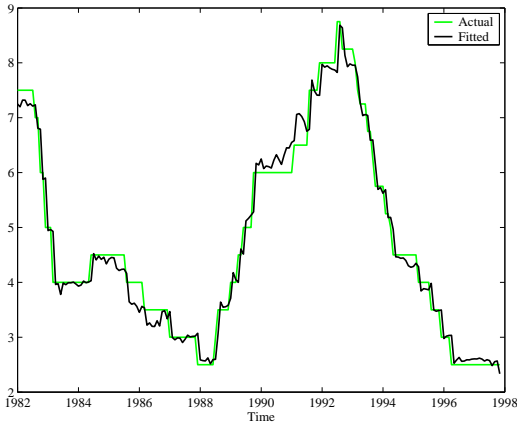


Figure 6: French interest rate

