Monetary policy under a quasi-fixed exchange rate regime. The case of France between 1987 and 1996 *

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1. Introduction

For the last fifteen years, the major objective of French monetary policy has been widely described as decreasing inflation by pegging the franc to the Deutsche Mark (DM) within the European Exchange Rate Mechanism (ERM). This *competitive disinflation* policy was implemented in a context of growing financial integration with total freedom of capital circulation installed in the late 1980s. In theory, the combination of the latter with fixed exchange rate precludes independent monetary policy, but the European Monetary System was not a purely fixed exchange rate system. Thanks to the ERM bands, the possibility of realignment or leaving the EMS, and imperfect substitutability between franc-denominated assets and foreign currency-denominated assets, the Banque de France (BdF) was left with some leeway to implement a monetary policy independent from German policy.

The purpose of this paper is to assess the existence of a purely French monetary policy in the period of the 'hard EMS'. My approach is empirical, applying institutional and historical insights to

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build a model of French monetary policy. With analysis of the BdF procedures regarding the French interbank liquidity market and knowledge of the periods of EMS crises, I can rationalise the reaction function of the BdF and single out what may be seen as purely French monetary policy. My analysis focuses on the period starting in 1987, which marks the last change in the EMS peg of franc to DM and full achievement of deregulation in the domestic financial markets, employing the method of structural VAR econometrics, which is particularly suited to the analysis of macroeconomic policy shocks, as shown by its increasing use by monetary policy analysts.

The model presented in this paper avoids two important shortcomings of the previous VAR literature on French monetary policy. In the first place, economists simply ignored the EMS context of French monetary policy. For instance De Bandt (1990) has no exchange rate in his model while Kim and Roubini (1997) use the dollar exchange rate but ignore the DM. Secondly, most economists impose a common structure on (roughly) the last twenty years (Bruneau and De Bandt 1998, Kim 1998, Smets 1997), which might not be consistent with the profound changes in the background and procedures of French monetary policy that took place during the mid-Eighties. Here, instead, I propose a model estimated subsequent to 1987, which insures a stable framework for the implementation of monetary policy. It also means a monetary policy regime of moderate inflation and quasi-fixed exchange rate, without realignment of the franc in the EMS. Thus I implement a procedural identification of monetary policy in the spirit of Bernanke and Mihov (1995 and 1996). The intervention rate is assumed to be the instrument of monetary policy while the market day-to-day rate accounts mainly for shocks to the risk premium on the franc, while the use of two domestic interest rates helps overcome the problem posed by simultaneity between exchange rate shocks and monetary policy shocks.

The paper is planned as follows. I briefly survey structural VAR identification of monetary policy shocks in small open economies in Section 2. Section 3 introduces the identification scheme for French monetary policy shocks. Section 4 presents the estimations of the structural VAR simulations, while Section 5 draws some conclusions.

2. Identification of French monetary policy

2.1. *VAR models and the quest for exogenous monetary policy shocks*

The measurement of monetary policy is not an easy task. Even the preliminary stage of ascertaining when monetary policy is activated requires designation of precisely what exogenous monetary policy shocks are, and what the endogenous response of central banks is to shocks originating elsewhere in the economy. This is far from obvious, as shown by the growing literature on the identification of monetary policy. Most contributors use structural VARs to pursue the quest for truly exogenous monetary policy shocks. Plain vanilla VAR models decompose the dynamics of a vector of macroeconomic variables into two parts. On the one hand, we have the autoregressive part of the model representing the endogenous response of the economy through time and, on the other hand, innovations of the variables defined as deviations from the average autoregressive dynamic representing the original shocks to the economy. The first VAR analyses of monetary policy simply assumed the bare innovation[1] of some tool of monetary policy instrument, like a monetary aggregate or a short-term interest rate, over an unrestricted autoregressive vector of macroeconomic variables, to be an exogenous monetary policy shock. Further research thereafter demonstrated that using economic theory to identify monetary policy shocks as combinations of innovations greatly improved the VAR modelling of monetary policy.[2]

The identification of monetary policy shocks in small open economies is particularly concerned with the simultaneity between exchange rate and short-term interest rate variations. As a matter of fact, the two variables can react instantaneously to one another, the short-term interest rate usually being assumed to be the instrument of monetary policy. The next step is to determine whether its innovation is an exogenous monetary policy shock or an endogenous response to some innovation in the exchange rate. Grilli and Roubini (1995 and 1996) find that the problem of simultaneity between ex-

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[1] Or the Choleski orthogonalisation of this bare innovation with respect to the innovations of the other variables when the monetary policy instrument is not ordered first in the VAR.

[2] For a recent survey, see Leeper, Sims and Zha (1995).

change rate and interest rate generates an exchange rate puzzle in simulations of responses to monetary policy shocks. In particular, an adverse monetary policy shock appears to increase interest rates and to depreciate the currency. This occurs when the interest rate is modelled as reacting only with a lag to exchange rate innovations, so that the reaction of the central bank to exchange rate shock innovations is not properly taken into account.

Solving the simultaneity problem requires an instrument that can be introduced in the interest rate equation or in the exchange rate equation but not in both. Clarida and Gertler (1996) in Germany, and Kim and Roubini (1997) in the G7 countries use the US Federal funds rate to this end. They assume that in the space of one month, the central banks attach little importance to US interest rate innovation except for its impact on their exchange rates. Cushman and Zha (1997) study Canadian monetary policy in a model containing both Canada and US variables, the four US macroeconomic variables included in addition to traditional domestic variables being exogenous with respect to the Canadian variables. In other words, the latter have no impact on the US macro-economy. Thus, both the flexible exchange rate regime and the fact that the Canadian economy depends on the US real economy and on the stance of US monetary policy are taken into account in the identification of monetary policy shocks. The short run money supply function of the Bank of Canada contains innovations in the exchange rate as also in the US federal funds rate, but it does not contain all the private sector variables, whether Canadian or US, that can be observed only after some delay, i.e. consumer prices, trade and output. These private sector variables are the instruments used to overcome the simultaneity problem between interest rate and exchange rate.

2.2. *Domestic monetary policy in the EMS*

The case of European monetary policies is more difficult because the unquestioned leadership of Germany in the EMS challenges their very existence. In theory, being in the EMS means foregoing monetary policy. Financial integration among the European countries is now such that a country intending to remain in the EMS must use its interest rate to stabilise its exchange rate with respect to the DM.

Empirical evidence on the determinants of European interest rates is mixed, while investigation of interest rate linkages in Europe has been undertaken in a literature of its own. An example of this literature is offered by Artus *et al.* (1991), who show that in the 1980s the French short-term interest rate responded more to German monetary policy than to domestic prices or production. Another instance is the recent paper by Garcia-Herrero and Thornton (1996), which demonstrates that the leadership of German interest rates cannot be proved while Henry and Weidmann (1994), who use high frequency euro-rates, conclude that there is a dominance of German over French rates, especially since reunification.

This paper departs from the above literature in its aims, confining the focus to the margins of an autonomous French monetary policy in the EMS. In fact, the margins around ERM central parity – the possibility of realignments and/or of leaving the EMS, and imperfect substitutability between domestic assets and foreign currency-denominated assets – might leave some leeway to implement a monetary policy independent of Germany's. In any case, the exercise should take due account of German leadership in monetary policy.

Recent VAR analyses of European monetary policies do in fact take this leadership into account more or less explicitly. The minimum representation of the EMS constraint is to introduce the exchange rate of domestic currencies with respect to the DM into the model (Barran, Coudert and Mojon 1996). The EMS constraint should then appear through a reaction function of monetary authorities where depreciation shocks foster a rise in domestic interest rates. This raises two issues. In the first place, there is a simultaneity problem in the identification of monetary policy shocks because the exchange rate reacts instantaneously to interest rates and *vice versa*. Secondly, it is to some extent a dubious exercise to estimate purely domestic monetary policy shocks, as commitment to the EMS means foregoing domestic monetary policy.

In recent papers attempts have been made to reveal purely domestic monetary policy shocks in EMS countries. Kim and Roubini (1997) study the case of G7 countries, including France, Italy and the UK, Smets (1997) focuses on Italy and France, Montalvo and Shioji (1997) study Spain, Italy, Belgium, France, the Netherlands and the UK, and Kim (1998) investigates the cases of Spain and France. De Arcangelis and Di Giorgio (1998) concentrate on Italy, Shioji (1997) on Spain, while Bruneau and De Bandt (1998) and Levy and Halikias (1997) focus on France. In these papers, the EMS constraint on monetary is more or less taken into account.

Kim and Roubini (1997) ignore *de facto* the EMS regime, as it is the exchange rate to the dollar which they bring into their model.[3] Embarking on an identification strategy inspired by the literature on the Monetary Condition Index (MCI), Smets (1997) defines exogenous monetary policy shocks as a weighted average of exchange rate and interest rate innovations, which can be seen as a short run MCI. The EMS constraint is taken into account twice: firstly, the exchange rate used in the model is domestic parity to the ecu; secondly, in the case of France and Italy, the German short-term interest rates and DM-dollar exchange rates are taken instrument to estimate exogenous monetary policy shocks. More precisely Smets uses the innovations of these two variables over their own lags and over lags in Italian or French variables constituting the Italian and French models.

This comes very close to the strategy of putting a foreign interest rate in the VAR to alleviate the simultaneity problem between the domestic exchange rate and the interest rate targeted by monetary policy (Clarida and Gertler 1996 and Kim and Roubini 1997). Along the same lines Shioji (1997) uses the DM-dollar exchange rate in his model for Spain. One limit of using foreign interest rates or exchange rate as instrument, which can be excluded from the domestic interest rate equation, is that the latter can react directly to the former, which is especially the case in the EMS. As most models use monthly variables, it is most likely that a change in the German rate will be transmitted to other countries' interest rates without the bilateral 'monthly average' or the 'end of the month' exchange rates being affected.

This issue is addressed by Bruneau and De Bandt (1998) and Levy and Halikias (1997). Both studies use the differential between the French and German interest rates to account for any independent French monetary policy, although Bruneau and De Bandt (1998) do not include the DM exchange rate or the German interest rate in their model, thus failing to account for the BdF's endogenous response to exchange rate pressure and German interest rate shocks. By contrast,

[3] This does not amount to complete ignorance of EMS, which has been and still is very much influenced by the dollar exchange rate to the DM.

Levy and Halikias (1997) distinguish between three structural shocks – shocks to the German interest rate, shocks to the franc-DM exchange rate and shocks to the differential between the French and German interest rates – finding that the German interest rate shocks have a strong impact on the French economy while the shocks to the differential do not. They conclude that the risk premium of the franc over the DM represented no harm to the French economy. In other words, the instrument they choose for French monetary policy is so greatly influenced by the risk premium of the franc over the EMS anchor currency that they do not see it in terms of exogenous monetary policy shocks.

Finally,[4] Kim (1998) offers structural VAR analyses of French and Spanish monetary policy with consistent modelling of the EMS constraint, a common structural VAR framework being applied to both countries. In the short run, the German interest rate innovations impact on the other countries' interest rates. He obtains that the domestic French and Spanish central banks react mainly to exchange rate depreciation and the German interest rates. Another interesting conclusion is that the French and Spanish monetary policy shocks are a major source of their respective exchange rate variance, which is somewhat puzzling because one would expect the non-German participants in the EMS to stabilise the exchange rate. One possible explanation for this result is that Kim's identification does not disentangle French and German monetary policy shocks from risk premium shocks. As a matter of fact, he uses market short-term rates as instruments of monetary policy but, as we know, in periods of EMS crises, accounting for a substantial share of the variance of these rates during the 1990s, they rocketed because of shocks to the risk premium on currencies that the market expected to be devalued. During these periods of crisis the central banks increased their domestic short-term rates to respond to market pressure on the exchange rate. Some of the monetary policy shocks identified when taking market rates as central banks' monetary policy instrument might be misleading.

[4] The purpose of Montalvo and Shioji (1997) is different. They focus on the transmission of German monetary policy to the monetary policy of other EMS, first identifying German monetary policy shocks with a purely German model and then introducing the series of monetary policy shocks into models of other economies just as others did with the raw series of interest rate or exchange rates. This is not completely satisfactory as it is the level of the German interest rate which puts pressure on domestic monetary policy, whether it comes from German monetary policy or not.

An alternative is to use an administratively set interest rate as the tool of monetary policy. For instance, Bernanke and Mihov (1996) show that the Lombard rate was a better proxy for Bundesbank policy than the call rate. Their choice of using the Lombard, based on institutional and historical study of the German monetary policy, finds *ex post* support in econometric analysis as the monetary policy shocks and the patterns of responses of macroeconomic variables to it are more satisfactory than when using the call rate.

Following Bernanke and Mihov (1995 and 1996), I propose a model of French monetary policy in which the intervention rate is the tool of the BdF,[5] basing this choice on investigation of the procedures of BdF on the market for bank liquidity. Actually, the intervention rate, which is the floor of this market, remained at a standstill during the EMS crisis. Nevertheless, in the model I propose the BdF reacts to exchange rate pressure and its German counterparts in a way consistent with the EMS context. Moreover, use of the intervention rate will probably serve better to isolate purely domestic monetary policy shocks from both the German influence and the risk premium shocks.

My line of reasoning can be summarised as follows. Previous structural VAR modelling of monetary policy showed that the key to successful identification is careful treatment of any kind of shock that could raise the interest rate without constituting a change in the stance of monetary policy. With this method it has been possible to solve most of the puzzles associated with VAR analyses of monetary policy. In the case of France, the major risk over the last few years has been that of misinterpreting certain sudden increases in the interest rate resulting from shocks *to* the German interest rate or from the increased risk premium of the French franc. This risk should therefore receive all due consideration in the identification of French monetary policy shocks. Only when this is properly modelled, can the possibility of a purely domestic monetary policy and its transmission channels to domestic objectives be tested. This is the purpose of Section 3. But, before setting out the model, I will briefly describe the macroeconomic and institutional environment of French monetary policy over the last decade.

[5] See De Arcangelis and Di Giorgio (1998) for another 'procedural approach' to monetary policy identification within the EMS.

2.3. *The case of France over the last decade*

Here I have chosen to limit analysis to the period subsequent to 1987, which marks profound changes in the macroeconomic background and operating procedures of French monetary policy. All in all, in many respects the last decade shows a marked departure from the previous state of affairs.[6] It is one of stable inflation, market-oriented operating procedures employed by monetary policy in liberalised financial markets and an *ex post* quasi-fixed exchange rate to the DM. The latter is probably seen by the BdF as its major achievement.

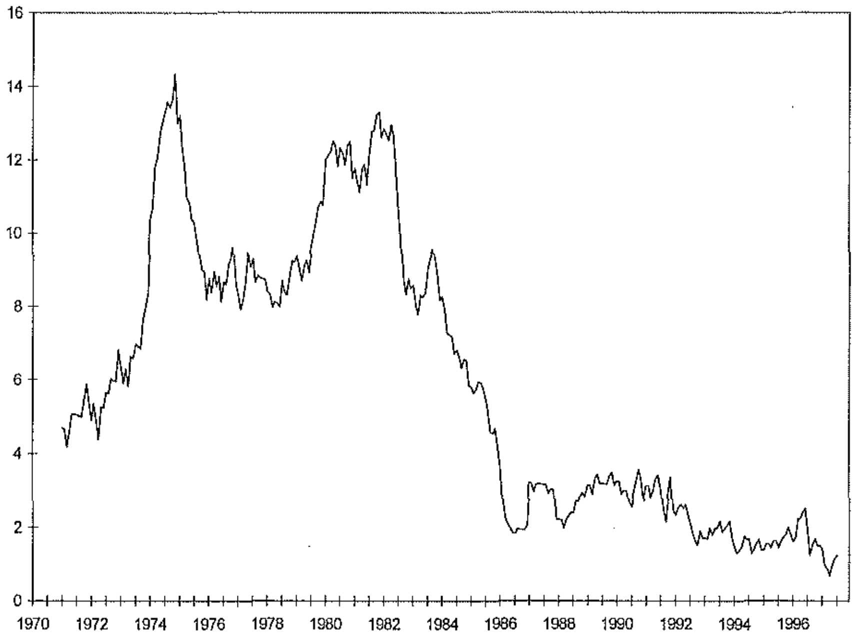
This section proposes identification strategies capable of solving this simultaneity problem in the case of French monetary policy. To begin with, I shall briefly describe some important features of French monetary policy over the last decade, beginning with the policy of competitive disinflation, which began in 1983 and was largely completed during the first three or four years of application (Figure 1). Since 1987, the variance in French inflation has been very weak, not exceeding 3.5% in annual terms despite a period of sustained growth in the late 1980s. Secondly, the official EMS parity rate of the franc has not been realigned since 1987, in spite of a number of speculative attacks. BdF defence of the franc appears *ex post* to have been effective.

Thirdly, a major reform of French financial markets took place in the mid-Eighties, profoundly changing the operating procedures of French monetary policy. Before this reform, monetary policy was carried out through administrative credit rationing (*encadrement du crédit*), within highly segmented financial markets. At that time, the BdF would set a yearly target for the aggregate volume of credit, and make sure that the credit of all the commercial banks was consistent with the target. 1987 was the official end date of the *encadrement du crédit* policy (in practice terminated in 1984), and it was also the date when the administrative procedure of fixing daily the day-to-day interbank market rate was abandoned. Ever since, this rate has fluctuated freely in the course of the day. The new intervention procedures of the BdF on the interbank market and the money market have not evolved since 1987. The BdF operates with two interest rates, which constitute a spread within which the

[6] In this respect, the above mentioned literature which estimates a common structure on a period starting between the mid 1970s and the early 1980s usually ignores the impact of these changes on monetary policy.

FIGURE 1

FRENCH INFLATION

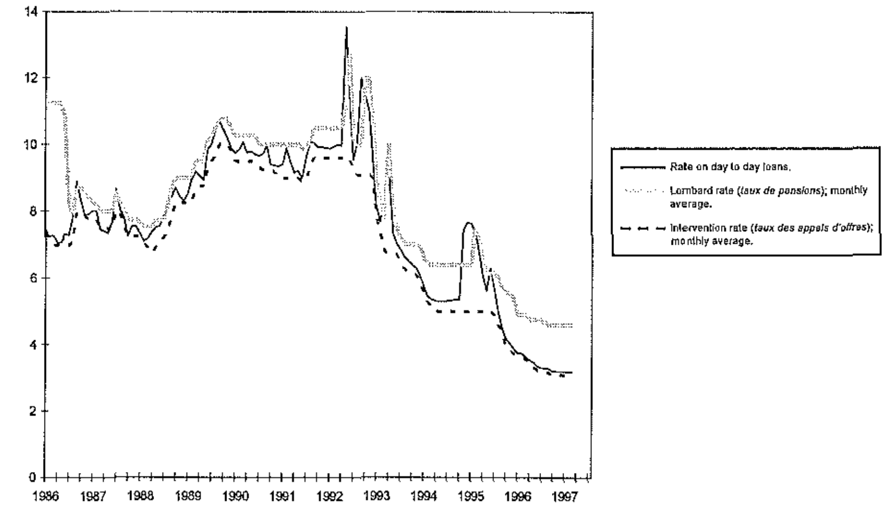


day-to-day rate balancing supply and demand of liquidity fluctuates (Figure 2).

The first rate is the one at which the BdF provides liquidity to the market, through repurchase tenders held weekly. This rate is called the intervention rate or the tender rate (*taux des appels d'offre*) and it is the floor of the market rate at which the BdF takes eligible securities, public or private, as collateral for the liquidity it provides to the main market operators. The second rate, which is fully settled by the BdF, is that of repurchase agreements (*taux des prises en pension*). It usually has a maturity of 5 to 10 days, but the BdF may reduce its maturity to 24 hours when the French franc (FF) is under pressure. The procedure of repurchase agreements is *de jure* accessible daily for banks in need of liquidity. As this rate exceeds the intervention rate by 50 to 100 basis points, banks resort to the latter procedure only when the market rate remains above the rate of repurchase agreements for several days.

FIGURE 2

FRENCH INTERBANK MARKET INTEREST RATES



Direct interventions on the market and modification of the compulsory reserve ratios have also been used since 1987, but their role is of very limited importance.[7] The repurchase tenders are obviously the main source of central bank money, their share in the total amount lent by the BdF to the banks fluctuating around 80%, so the intervention rate probably impacts as much as the day-to-day rate on bank liquidity.

Altogether, the decade starting in 1987 can be seen as a period of stable inflation and stable intervention procedures of the BdF on the interbank liquidity market. *Ex post*, it was a period that saw a quasi-fixed exchange rate of the franc against the DM. These features allow

[7] The BdF can proceed with interventions in the interbank market, by repurchasing (or 're-selling' when it wants to reduce the liquidity of the market) papers supplementary to those held through the two standard official procedures, or by open market operations. Repurchase agreements are generally made at the rate of the market, for durations of one to two days. However, market procedures represent a marginal dimension over the whole range of interventions by the BdF. Eventually, the BdF still has the possibility of modifying the compulsory reserve ratio. This potential tool, hardly ever used, has fallen to a very low level. The major changes in the compulsory reserve ratio during the period took place in October 1990, when the ratio on time deposits fell from 3 to 0.5% and in May 1992 when the ratio on demand deposits fell from 4.1 to 1.0%.

a stable structure for a model of monetary policy to be imposed on the data.

3. The model

3.1. *Choice of variables*

VAR models of monetary policy are limited in the number of variables they can include. The minimum is to use three variables as in Gerlach and Smets (1995), who use prices and GDP as the final objectives of monetary policy and a short-term interest rate as the tool of monetary policy. Usually, VAR models also include some of the key variables of the transmission mechanism such as exchange rates, long-term interest rates, and money or credit aggregates.

In the case of France since 1987, a monthly model cannot fail to include prices, industrial production, a short-term French interest rate and the exchange rate to the DM, much like the four variables used by Smets (1997) except for the exchange rate, which he defines with respect to the ecu, and the variables used by Kim (1998), who also uses a monetary aggregate. Due to the constraint of limiting the number of variables, I choose not to include such an aggregate. Indeed, I assume domestic money to be only secondary in the policy objectives of the BdF during the period,[8] considering it more important to include in the model a variable that could be used as an instrument to overcome the simultaneity between the exchange rate and monetary policy interest rate.

Here, I cannot follow Smets (1997), who uses the German interest rate and the US-DM exchange rate, as I choose not to rule out the possibility of direct impact of the German rate on the French interest rate. Kim (1998) allows for such a direct impact, using a Sims and Zha approach where innovations in the exchange rate react to all other innovations in the model while innovation in monetary policy instrument is prevented from responding to prices and output innovations, which can be observed only with a time-lag. This approach does not work on the

[8] Evidence in favour of the exclusion of monetary aggregates is shown in Section 4.

post-1987 sample, which is not surprising if one considers that real sector variables, such as prices and output, play only a minor role in the 'within the month' adjustments between exchange rate and interest rates.

I then looked for an additional instrument variable among the variables most closely correlated to the exchange rate, especially in the short run. An obvious possibility is to use the interventions on the foreign exchange markets. Although in principle secret, they can be proxied by the variations in the BdF currency reserves. Figure 3 plots the latter and the exchange rate to the DM. It appears that the correlation of this proxy for interventions on the foreign exchange market and the exchange rate differs before and after the 1993 widening of the EMS bands from ±2.25% to ±15%. Before the EMS reforms, the BdF intervened heavily, with a climax in July 1993 when intervention reached 250 billion francs, the net currency reserves falling from around 100 to minus 150 billion francs. In contrast, after the widening of the EMS bands, the interventions became insignificant even when the exchange rate deviation from EMS central parity reached 6% in 1995. This change in BdF intervention strategy implies that it cannot be used in a model estimated between 1987 and 1996.

The other way to defend a currency is to increase the domestic interest rates, which in turn raises the question of which interest rate should be used in the model. It is clear from Figure 2 that the day-to-day rate (DD) and the intervention rate behave differently in the short run, many sudden jumps in the DD rate occurring during an EMS crisis or before a major French election as witnessed by the Maastricht referendum of September 1992, the parliamentary elections in the spring of 1993, the EMS crisis of summer 1993 and the presidential election of 1995.[9] In fact, being a market rate, the DD rate appears more influenced by market pressure than the intervention (INT) rate. Thus the spread between DD and INT rate also carries information on market pressure on the franc.

Figure 4, showing this spread and the exchange rate, confirms that such was indeed the case before, during and after the EMS crises of 1992 and 1993, which is why I propose to distinguish two parts of the DD rate in the model.

[9] It is worth noting that early election of the lower chamber of Parliament in June 1997 did not move the markets, probably because of EMU prospects.

FIGURE 3

EMS TENSIONS AND FOREX MARKET INTERVENTION BY THE BDF

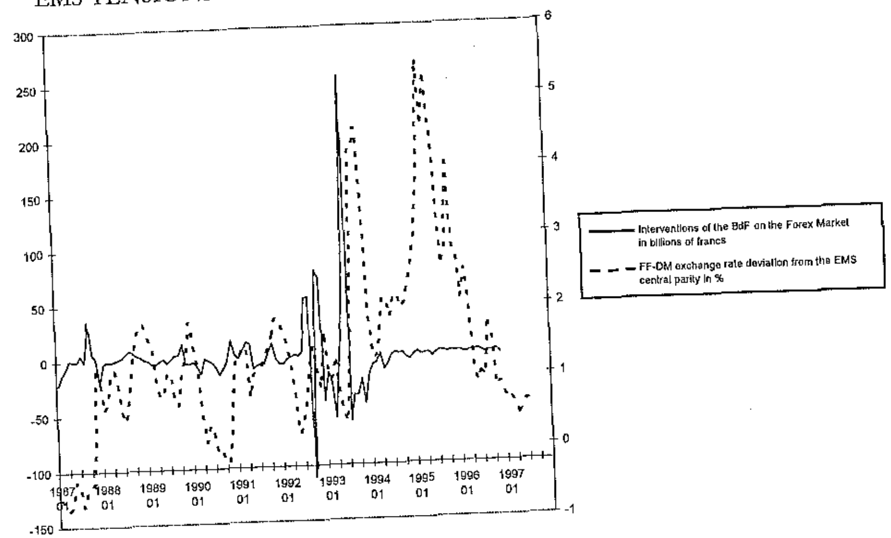
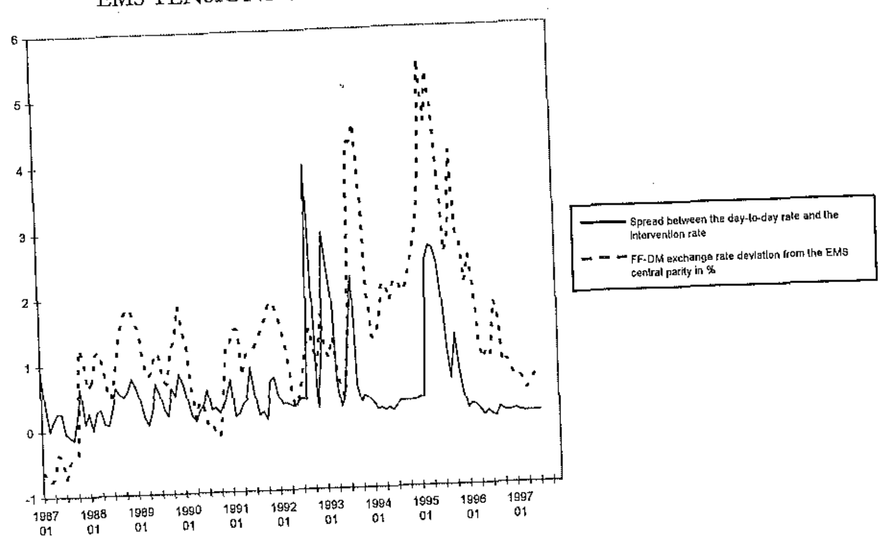


FIGURE 4

EMS TENSIONS ON THE FRENCH INTERBANK MARKET



Firstly, the intervention rate is considered as the BdF's operating tool for monetary policy, use of an interest rate of bank liquidity as such a tool now being the most widespread assumption in empirical

studies of European monetary policy (Gerlach and Smets 1995, Sims 1992 and others including the references mentioned above). However, the use of a market rate is no straightforward matter. For instance Bernanke and Mihov (1996) find that in Germany shocks to the Lombard rate can better be understood as monetary policy shocks than shocks to the call rate. Secondly, I use the spread between the DD rate and the intervention rate as a proxy for the demand pressure on the interbank market. Actually, the spread may also embed information on the domestic demand for money, but, as we shall see, the BdF does not respond to domestic money demand. So this potential determinant of the spread is probably of secondary importance.

Finally, the leadership of Germany in the EMS justifies including the German short-term interest rate in the model, as is the case in Kim (1998) and the more structural models of French monetary policy. For instance Mefisto directly models the spread between the French interest rate and the German interest rate as the operating instrument of French monetary policy. I may also put the German short-term interest rate in the model because it is a major determinant of the French interest rate, but this inclusion requires some caution. The model should in particular be able to distinguish between shocks to the risk premium on the franc over the DM and purely French monetary policy shocks.

Altogether, my VAR models of French monetary policy include at least five endogenous domestic variables: the consumer price index (CPI); industrial production (IP),[10] the intervention rate (INT), the spread between the DD rate and the intervention rate (S_DD) and the exchange rate of the DM quoted in French francs (DM). In addition, the model may also include the German short-term interest rate.

3.2. *Identification*

Let the true auto-regressive representation of the structural model be:

$$B_0 Y_t + B_1 Y_{t-1} + \ldots + B_p Y_{t-p} = \varepsilon_t ,$$

or

$$B(L)\, Y_t = \varepsilon_t ,$$

[10] I use monthly variables, either from monthly bulletins or from statistical supplements issued by the Banque de France.

with Y_t the vector of endogenous variables, L the lag operator and $B(L)$ a polynomial of order p. The ε_t vector consists of six structural shocks to the economy which are assumed to be serially uncorrelated and orthogonal to one another, so that their covariance matrix, D, is diagonal. The estimated VAR reduced form of the model is

$$Y_t = A_1 Y_{t-1} + \ldots + A_p Y_{t-p} + u_t ,$$

where the estimated residuals, u_t, are not orthogonal and have a covariance matrix Ω. Comparison between the estimated and structural AR forms give the following relationship between the structural shocks and the residuals:

$$B_0 u_t = \varepsilon_t$$

This implies that Ω can be diagonalised into D, with $\Omega = [B_0]^{-1}$ D $[B_0]^{-1}$. Estimation of B_0, called A_0, allows orthogonal structural shocks to be obtained. These structural shocks are therefore interpretable without confusion due to simultaneity. A_0 cannot have more than 10 off diagonal free parameters, so that at least 10 constraints have to be imposed in its estimation. I propose the following form for A_0.

System (I):

$$\begin{pmatrix} u_{CPI} \\ u_{IP} \\ u_{S\_DD} \\ u_{INT} \\ u_{DM} \\ u_{G\_SIR} \end{pmatrix} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 0 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 0 & a_{34} & a_{35} & a_{36} \\ 0 & 0 & (a_{43}) & 0 & a_{45} & a_{46} \\ a_{51} & a_{52} & (a_{53}) & a_{54} & 0 & a_{56} \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix} \times \begin{pmatrix} u_{CPI} \\ u_{IP} \\ u_{S\_DD} \\ u_{INT} \\ u_{DM} \\ u_{G\_SIR} \end{pmatrix} + \begin{pmatrix} \varepsilon_{CPI} \\ \varepsilon_{IP} \\ \varepsilon_{PREMIA} \\ \varepsilon_{M\_POLICY} \\ \varepsilon_{DM\_DEMAND} \\ \varepsilon_{G\_SIR} \end{pmatrix}$$

The pattern of this system is close to that of the Kim and Roubini (1997) identification, except that I use the German call rate instead of the US Federal funds rate. Moreover, I do not use the price of oil or a price of commodities in this model since it has not had such an important role over the last decade. The key difference with Kim and Roubini (1997) and with Kim (1998) is to use two domestic interest rates to overcome the problem of simultaneity between monetary policy shocks and exchange rate shocks.

This identification relies partly on standard assumptions. There is a block recursive structure between 'sluggish' real economy variables and both information variables and policy variables, which should be modelled as interacting instantaneously (Leeper, Sims and Zha 1996). Within the real economy variables, I assume recursivity between demand and supply shocks. The DM exchange rate belongs to the information sphere, thus taking into account the innovations of every other variable. In contrast, the money supply function of the BdF depends solely on currently observable exchange rate innovations and DD rate innovations. Finally, only what is generally the short-term money demand is missing from the model, replaced by the spread (S_DD) equation, which proxies the market pressure on the interbank market interest rates. This spread is mainly influenced by the risk premia on the franc so that its innovation should react to exchange rate innovation and French interest rate innovation. I also assume that its innovations depend on CPI and IP innovations, which are usually assumed to be arguments of a short run domestic money demand.

Not all these supposed relations between innovations in the endogenous variables should receive equal emphasis. The high frequency of variables suggests that the impact of the sluggish variables on the exchange rate or on the spread do not deserve the same attention as the impact between financial market variables. For example, the sign of the correlation between IP innovations and the DM innovations can be positive or negative over the sample of estimation without bringing the whole model into question. In contrast, the cross impacts between interest rates (including the spread), and exchange rate innovations deserve scrutiny because such variables do indeed react rapidly. The consistency of estimates of System (I) should be assessed mostly with respect to the bottom right-hand block. Within this block, I constrain the impact of the spread on the exchange rate to be nil ($a_{53} = 0$). This is for two reasons. Firstly, it helps solve the simultaneity problem between the spread and the exchange rate. Secondly, as the two innovations are positively correlated, it seems more likely that the depreciation of the franc causes the French market interest rates to increase rather than the opposite.

In contrast, both the intervention rate and the spread react to exchange rate innovations. In addition, I rule out the possibility that, on average, the BdF changes its intervention rate because of its spread with the DD rate, so that $a_{43} = 0$.[11] This identification scheme basically introduces a hierarchy in the BdF short term operating procedures. The defence of the exchange rate is the key short-term objective of the central bank, pressure on French market interest rates coming only second. This somewhat artificial hierarchy allows for a very simple solution to the simultaneity problem between exchange rate and interest rate.

On the basis of this common structure, I estimate four models, each differing in the modelling of German interest rate impact on French monetary policy. The first model assumes that the BdF only reacts to the exchange rate and not to the German interest rates. This is a benchmark model, which corresponds to what has been assumed in many previous VAR analyses of French monetary policy (Sims 1992, Barran, Coudert and Mojon 1996 and others). In this model, the final impact of a German rate increase might be a French rate increase, but this would work through the exchange rate. The shortcoming of this is the possibility that in the space of a month transmission between rates occurs without any trace on the exchange rate. The inclusion of a German interest rate in the model should then be considered, and here I take it in three forms. In the second model, the German rate is considered as a genuine endogenous variable (as in Kim 1998). This model requires that the innovation of the German rate over French variables be interpretable. Although there are spillovers between the two major participants in the EMS, each being a key trading partner for the other, it is undeniable that the German rate does not depend on the French economy.

In the third model, the German rate is added to the model as an exogenous variable, while the fourth model has a block recursive structure *à la* Cushman and Zha (1997), so that it impacts on the French variables without the opposite being true. In the third model, the German rate has an instantaneous impact on all the variables of the model. In the fourth model, the German rate depends only on its own lags, and its innovations can only impact on the three fast-

[11] Although this eleventh restriction lead to a one degree over-identification of the model, it is necessary for numerical convergence of the estimations.

reacting variables. This differs only slightly from the second model, which assumes that the contemporaneous German rate impacts on innovations in all the other variables.

The identified monetary policy shocks and their impact on the French economy are presented in the next section.

4. Results

4.1. *Short run identification*

Table 1 gives the estimates of the instantaneous cross-impact between rapidly adjusting variables in the four models[12] and the short run elasticity involving sluggish variables in Model 3. The estimated coefficients refer to System (I) mentioned above. For instance, in Model 1, an exchange rate innovation of 1% results in an increase of 37.38 basis points (coefficient a_{35}) in the DD spread.

We observe in every model except Model 1, which does not take the German interest rate into account, that a depreciation of the franc raises the intervention rate, and the DD spread so that, altogether, the DD rate reaction is much higher than that of the intervention rate. Limiting the EMS constraint to the exchange rate, as in Model 1, leads to reversing the causality between the exchange rate and the intervention rate. Actually, models 2, 3 and 4, which include the German rate explicitly, show that its innovation has no impact on the exchange rate (coefficient a_{56}). Thus, using the German rate as an instrument for the exchange rate (*à la* Clarida and Gertler 1996) would not be efficient. In-

[12] The autoregressive part of the model is estimated on levels, as is the most general form (see Bernanke and Mihov 1996), between January 1988 and December 1996, with a parsimonious lag structure (1, 2, 5, 8, 10 and 12) in order to gain degrees of freedom. Model 3, where the German interest rate enters as an exogenous variable, contains its lags 0, 1 and 4. The null hypothesis of no other lags was not rejected by the likelihood ratio test introduced by Sims (1980). All the results are available from the author upon request.

Finally, the S_DD was halved in September 1992, from 3.8 to 1.9. This is because it happened exactly 8 months before the biggest decrease in the intervention rate, by nearly 100 basis points, in May 1993. The eighth lag of S_DD is negative and significant in the intervention rate equation. This 'coincidence' made probably the most important 'exogenous' monetary shock of the period disappears.

stead, the German rate innovation triggers an increase of about 20 basis points in Models 2 and 3 (coefficient a_{46}) in the intervention rate, a limited response due to the fact that the intervention rate is less volatile than the German call rate.[13] Surprisingly, the DD rate is hardly affected by the German rate in the course of one month (the decrease in the DD spread, coefficient a_{36}, almost cancels the increase in the intervention rate, coefficient a_{46}). Therefore, on average, shocks to the German rate led to no increase or decrease in tensions on the market rate for franc liquidity. It is also worth noting that an increase in the intervention rate increases the DD spread (coefficient a_{34}). This can be interpreted as the market rate for liquidity, i.e. the DD rate, overshooting changes in the intervention rate. Finally, the instantaneous impact of the intervention rate on the exchange rate (coefficient a_{54}) is not significant. At least, it is not of the wrong sign in model 2 and 3. One interpretation of this result would be that the market considers the intervention rate moves to be credible only after some delay.

These results give a picture of what the BdF operating strategy could have been during the last decade: a strategy of targeting the intervention rate except for innovations in the German short-term interest rate and depreciation of the franc. In contrast, the DD rate appears to be settled by the market. In this respect, it is worth noting that the DD rate reproduces almost exactly the other market rates. In fact, the spread between the 1, 3, 6 and 12 months PIBORs and the intervention rate are all very similar to the DD spread.

Finally, the estimated short run elasticities involving sluggish variables are also call for comment. They are given only for Model 3, but are very similar across models. It is interesting to note that the impact of industrial production and price innovations on the DD spread is positive. This is all the more striking as models which include a money aggregate (not reported to save space) do not exhibit such positive impacts in what are usually interpreted as short run money demand functions. In terms of the SVAR identification of monetary policy, the short run money demand function in France since 1987 is better modelled by a market interest rate than by a money aggregate.

[13] Using the call rate as the German short-term rate seems more appropriate than using the Lombard or discount rate. As a matter of fact, the call rate is the opportunity cost for not holding DM when franc devaluation is expected.

TABLE 1

SIMULTANEOUS RELATIONS BETWEEN THE VARIABLES

Model 1	Coeff.	T-stat.	Signif.
a_{34}	0,010	0,06	0,95
a_{35}	37,384	8,68	0,00
a_{36}			
a_{45}	−21,235	−1,16	0,24
a_{46}			
a_{54}	0,036	1,63	0,10
a_{56}			

Model 2	Coeff.	T-stat.	Signif.
a_{34}	0,788	3,71	0,00
a_{35}	40,927	8,03	0,00
a_{36}	−0,284	−2,16	0,03
a_{45}	12,101	1,17	0,24
a_{46}	0,188	4,49	0,00
a_{54}	−0,014	−0,67	0,50
a_{56}	0,001	0,26	0,80

Model 3	Coeff.	T-stat.	Signif.
a_{34}	0,226	1,08	0,28
a_{35}	35,304	8,28	0,00
a_{36}	−0,467	−2,13	0,04
a_{45}	15,952	1,16	0,25
a_{46}	0,203	3,10	0,00
a_{54}	−0,033	−0,87	0,38
a_{56}	−0,001	−0,46	0,64

Model 3	Coeff.	T-stat.	Signif.
a_{21}	1,27	3,36	0,00
a_{31}	30,93	1,86	0,06
a_{32}	0,57	0,19	0,85
a_{51}	−0,66	−1,85	0,06
a_{52}	0,03	0,60	0,55

Model 4	Coeff.	T-stat.	Signif.
a_{34}	0,079	0,35	0,72
a_{35}	37,115	8,23	0,00
a_{36}	−0,229	−2,59	0,01
a_{45}	1,762	0,18	0,85
a_{46}	0,083	2,63	0,01
a_{54}	0,000	0,01	0,99
a_{56}	−0,001	−0,41	0,68

The coefficients refer to system (I).

To put it in a nutshell, this part shows that it is possible to identify a short run reaction function of the BdF in a SVAR framework, over the last decade. In particular, it seems preferable to use the intervention rate, which is the floor rate of the interbank market for liquidity, as the BdF's operating tool. Within the short run horizon we have been working with, this EMS constraint appears either through the defence of the exchange rate (coefficient a_{45}) or and through the direct impact of the German rate on the French rate (coefficient a_{46}). It appears preferable to model the latter impact explicitly, as it is very significant and less than one. Therefore, Model 1, which ignores the German rate, should not be used to represent French purely domestic monetary policy shocks. Model 2 is also excluded because it implicitly assumes that French variables of the model determine the German rate. The next part of the paper will use Model 3, where the German rate is an exogenous variable, to simulate monetary policy shocks. Model 4, in which it is endogenous in the Model, but only to itself, i.e. not depending on French variables, will be used to decompose the variance of the variables into each identified structural shocks.

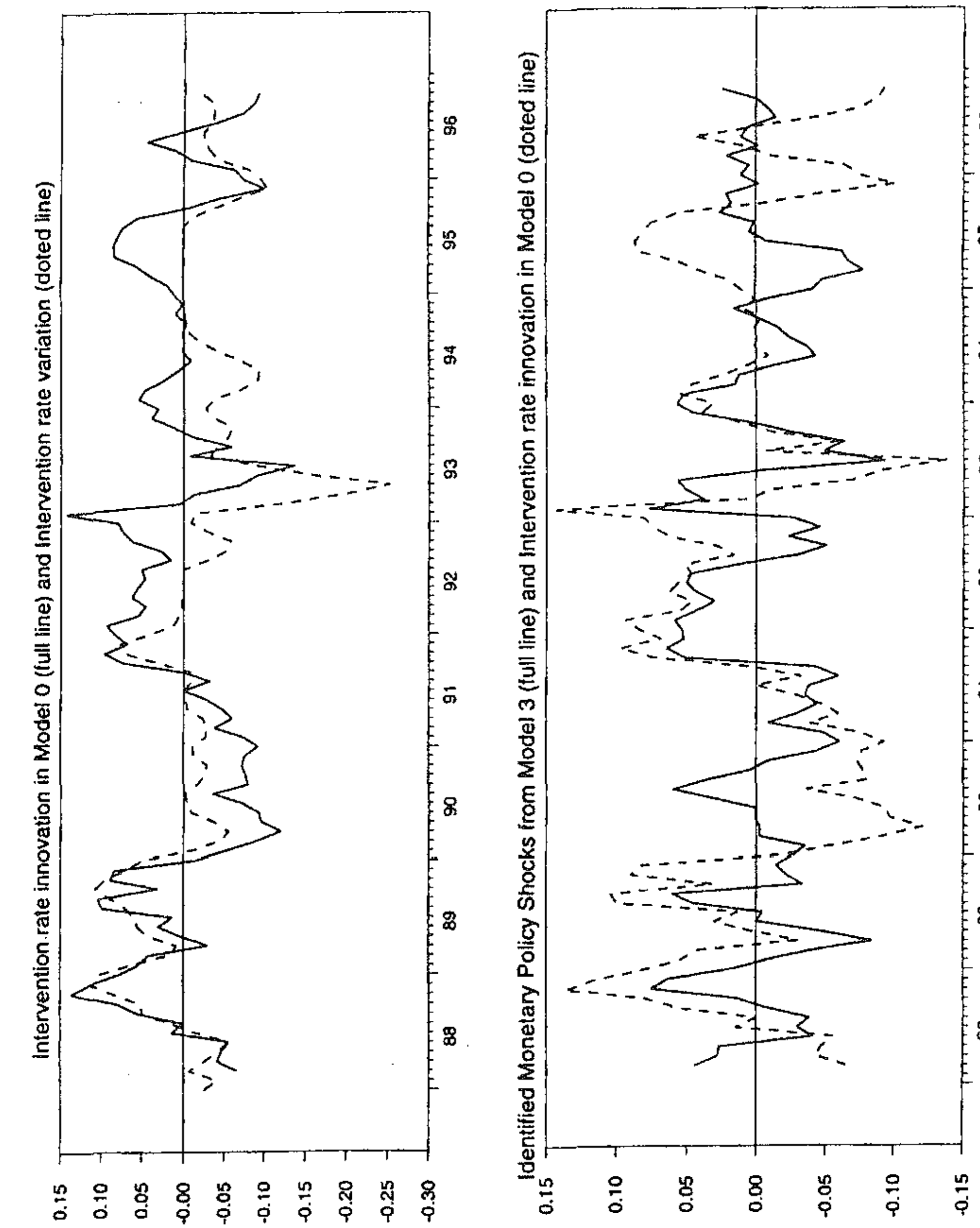
4.2. *Identified monetary policy shocks*

This part provides insights into the SVAR identification of monetary policy shocks. Having shown that the intervention rate can be interpreted as the operating instrument of monetary policy, I go on to compare the identified monetary policy shocks obtained from different models. The first monetary policy model considers first differences in the intervention rate as changes in the stance of monetary policy. The second model, called Model 0, is a three-variable standard VAR containing the intervention rate, the CPI and IP. It shows what could be considered as monetary policy shocks in a Model that ignores the EMS constraint. The series of shocks which are smoothed through a 5-period moving average are displayed in Figure 5.

Figure 5 shows why it can be worthwhile to distinguish between changes in the interest rate and identified shocks. In fact, if we look at the variation in the intervention rate (dotted line), French monetary policy appears very tight at the end of the Eighties and very loose between mid-1992 and mid-1994, and again after the autumn of 1995. This is very different from the picture presented by the identified shocks, which condition monetary policy on the state of the economy. Thus, French monetary policy was relatively loose in 1990, considering that the economy was booming during this period. Thus the FMP was at that time looser than the average 'leaning against the wind' policy of the whole period: it was not so loose in the latter half of 1992 or in 1994, and it was relatively tight in 1995 – all periods

FIGURE 5

MONETARY POLICY SHOCKS



when either the economy was depressed or inflation was decreasing. The next section shows how the model decomposes the intervention rate variance between these possible determinants.

The bottom Figure 5 presents the series of structural shocks identified with Model 3 and with Model 0. Correlation between the two series of monetary policy shocks only amounts to 0.49. The difference between Model 0 and Model 3 is that the former does not take into account the German interest rate, the DD spread and the exchange rate. In other words, some of the variance of Model 0 shocks actually follows from German leadership within the EMS. For instance, in the last six months of 1989 the German rate was rapidly rising, so that the monetary policy shocks identified in Model 0 (which does not take the German rate into account) appear tighter than the 'purely domestic' French monetary policy shocks in Model 3. But the most striking differences occur in 1990 and 1995. 1990 is characterised by the lowest exchange rate of the whole period, and by a decreasing German interest rate, so that there is no EMS constraint at all, which is why monetary policy identified in Model 0 appears inappropriately loose. The story for the period around the first half of 1995 is just the opposite. If we take the depreciation of the franc (Figure 3) into account, monetary policy is much looser (Model 3 shocks) than if it is ignored (Model 0 shocks). Finally, it is worth noting that the decrease in the intervention rate over the last 18 months of the sample (see Figure 2) is not a deviation from the Model 3 reaction function of the BdF (the dotted line in the bottom box of Figure 5 remains nil). Thus this decrease in the French rate does not correspond to a loosening of the purely French monetary policy. The intervention rate simply shadows the German rate.

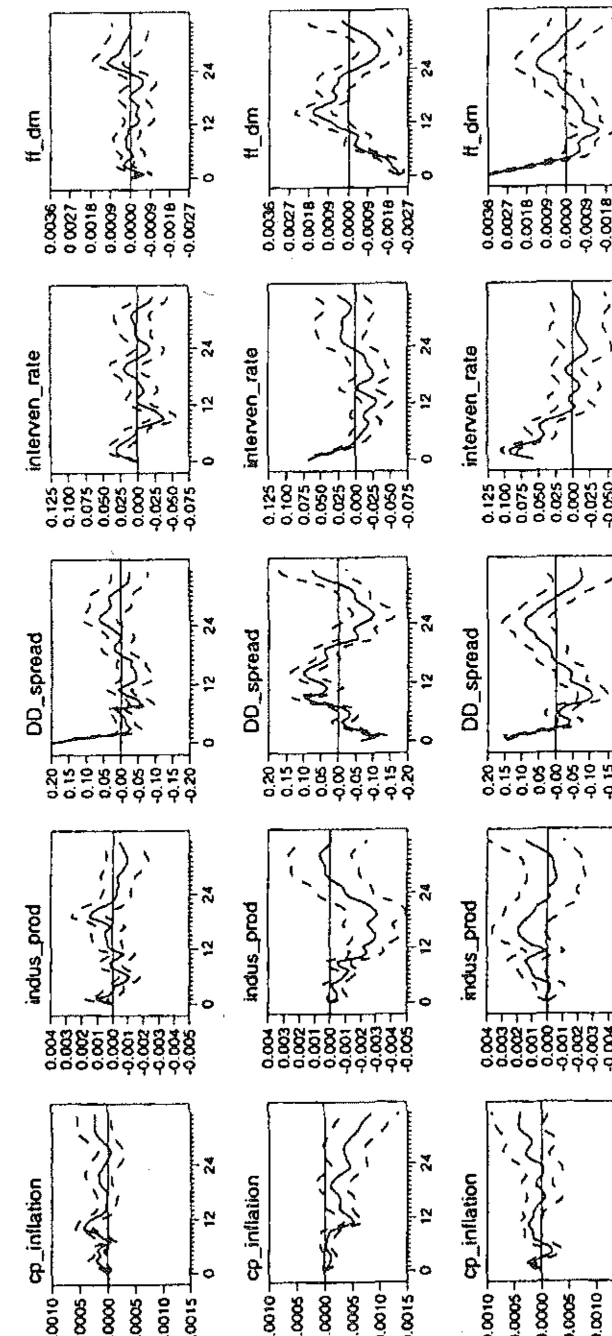
The next section will further analyse the impact between purely domestic monetary policy shocks by simulating their impact on the French economy.

4.3. *French monetary policy in action*

Figure 6 shows the impulse responses of the economy to the three exogenous shocks identified within the information and policy operating procedure sphere obtained from Model 3. First of all, the reaction function of the BdF is consistent with what could be ex

FIGURE 6

RESPONSES TO SHOCKS ON DD_SPREAD 1st LINE
INTERVENTION RATE 2nd LINE
FF_DM X rate 3rd line



pected. The intervention rate rises significantly after a demand shock on the interbank market (line 1 column 4 of the graph) and after shock in the demand for DM (line 3 column 4 of the graph). Yet, the pattern of responses appears much more lasting in Model 1, when the German interest rate is not taken into account. The size of what the model would designate as a purely domestic money supply shock is very small, only amounting to a few basis points in the intervention rate, yet its impact on all the variables of the model (given by line 2 of the graphs) corresponds to the textbook image of monetary policy: the exchange rate appreciates, prices decrease from the start, and industrial production decreases only temporarily. Finally it reduces the DD spread due to appreciation of the franc.

Moreover, the exchange rate depreciation shock also has a standard impact on the simulations obtained from both models (line 3 of the graphs), leading to higher prices and stimulating industrial production although the French interbank interest rates rise. Finally, the structural shocks associated with the DD spread equation do not impact on the exchange rate.

Forecast error variance decomposition confirms that the contribution of purely domestic monetary policy to the determination of prices and output is very small. Table 2 gathers the variance decomposition of the variables from Model 4, which allows the impact of the German interest rate to be accounted for. The exchange rate is the only variable influenced by monetary policy shocks (see column Monetary policy) but, contrary to Kim's finding (1998), the influence of the German rate on the exchange rate is as high as that of the FMP shocks although this might derive from the fact Kim uses a longer period when several realignments of the franc occurred. Moreover, the French interest rate has shown much greater volatility than the German rate in terms of realignments.

Finally, and paradoxically, what I have identified as purely domestic monetary policy shocks explain very little about the actual variance of the intervention rate. In fact, the intervention rate is determined mostly by the exchange rate over a short horizon and up to 77% by the German rate after a year. The German rate also has an appreciable impact on French prices and French industrial production.

Altogether, the purely domestic monetary policy shocks identified show impact on output, prices and the exchange rate, output and

prices decreasing after an adverse monetary policy shock while the exchange rate appreciates. Nevertheless, the contribution of FMP shocks to the fluctuations of the real economy was very limited during the period of estimation, which is not surprising as French monetary policy is usually considered to have been passive, with the sole objective of avoiding realignments in the EMS. Nevertheless, this is an important result given the prospect of foregoing monetary policy when joining the EMU: France will lose an instrument which could have been effective, but which she has not been using since 1987.

TABLE 2

FORECAST ERROR VARIANCE DECOMPOSITION FROM MODEL 4

Shocks to	German rate	Prices	Industrial Prod.	Reserves demand	Monetary policy	DM demand
explain prices variance						
At horizon						
0	0	100	0	0	0	0
12	14	44	24	7	5	6
24	18	34	31	5	4	8
36	13	30	40	4	4	9
explain industrial production variance						
At horizon						
0	0	3	97	0	0	0
12	7	9	76	3	3	2
24	6	8	61	4	5	15
36	12	7	54	5	6	16
explain DD spread variance						
At horizon						
0	3	0	0	71	0	26
12	9	4	20	32	2	32
24	11	6	18	27	4	34
36	10	7	16	26	5	36
explain intervention rate variance						
At horizon						
0	3	0	0	0	96	1
12	78	3	5	3	8	3
24	91	1	4	1	2	1
36	92	1	4	1	2	1
explain DM exchange rate variance						
At horizon						
0	0	3	0	0	0	97
12	4	6	9	1	14	66
24	10	6	13	2	17	51
36	16	7	12	3	18	45

5. Conclusion

This paper analyses French monetary policy since 1987, which marks both the last realignment of the franc in the ERM and the completion of major reforms of the French financial system. In particular, these reforms radically changed the operating procedures of French monetary policy, the BdF foregoing administrative control of the total credit for a more market-oriented policy. The DD rate has become a market rate, which the central bank influences indirectly by setting the intervention rate and the Lombard rate. The paper focuses on the dynamics of the interbank market interest rates and on the German leadership in the EMS in order to identify purely domestic French monetary policy shocks.

A new structural VAR identification is implemented in which the intervention rate is the operating tool of monetary policy and the spread between the DD rate and the intervention rate is a proxy for other sources of disturbances, mainly risk premium of the franc but also liquidity demand shocks. Using information from the two French interest rates helps solve the problem of simultaneity between interest rates and exchange rates. The short run identification also underlines the role of the German short-term interest rate and the exchange rate against the DM.

Over the last decade, the short run reaction function of the BdF was to raise its intervention rate in the case of a German short-term rate innovation or when the franc depreciated. Over the longer horizon, the intervention rate was fully determined by the German interest rate.

Finally, monetary policy shocks identified to deviations from this short run reaction function do not account for a substantial share of fluctuations in prices and industrial production. The absence of impact of a purely domestic French monetary policy demonstrates that joining the EMU means losing something that has not been used during the last decade.

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