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Looking for French Monetary Policy (a Structural VAR Approach)

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RÉSUMÉ

L'objectif de ce document de travail est d'étudier la mise en oeuvre de la politique monétaire française au cours des dix dernières années. La France a entamé une profonde mutation de ses marchés financiers au milieu des année 1980. Deux aspects de ces réformes ont particulièrement transformé le cadre de la politique monétaire française. D'une part, parallèlement à l'abandon de l'encadrement du crédit, le marché monétaire et le marché interbancaire ont été réorganisés de sorte que la mise en oeuvre de la politique monétaire repose davantage sur des mécanismes de marché. Désormais, le taux d'intérêt interbancaire est un véritable taux de marché. D'autre part, l'abandon du contrôle des changes et la libre circulation des capitaux ont aiguisé la contrainte du S.M.E. sur la formation des taux d'intérêt français ainsi que la sensibilité de ces derniers aux aléas de marchés financiers globalisés.

Ce document de travail propose une étude empirique de la politique monétaire française dans ce nouveau contexte.

Mesurer l'impact de la politique monétaire sur l'économie est un exercice difficile. Il faut en effet commencer par déterminer quand la politique monétaire est mise en action. Pour cela, il ne suffit pas d'observer les variations des taux d'intérêt manimulés par la banque centrale. Une même augmentation de taux d'intérêt ne traduit pas la même intention de la Banque de France si elle se fait dans un contexte d'attaque sur le franc ou dans une période calme du S.M.E., dans une période de tensions inflationnistes ou en période de déflation. C'est pourquoi les économistes considèrent que seuls les *chocs exogènes* du taux d'intérêt manié par la BdF sont des inflexions de politique économique. Ces chocs exogènes sont définis comme les écarts du taux d'intérêt à la réaction moyenne de ce taux à son environnement macroéconomique national et international.

Ce document de travail utilise des modèles VAR structurels pour mettre en oeuvre deux démarches d'identification des chocs exogènes de politique monétaire :

une approche macroéconomique, d'une part, c'est-à-dire la construction d'une fonction de réaction de la Banque de France (BdF);

une approche procédurale, d'autre part, c'est-à-dire l'observation de la mise en oeuvre institutionnelle de la politique monétaire. L'analyse des procédures d'intervention de la banque centrale sur le marché interbancaire conduisent à distinguer les chocs d'offre des chocs de demande sur ce marché.

Ces deux démarches d'identification désignent des inflexions de la politique monétaire française depuis 1987. C'est un résultat pertinent pour l'analyse des canaux de transmission de la politique monétaire et de leur insertion dans des marchés financiers globalisés. Chacune des démarches permet d'identifier des chocs de politique monétaire pour lesquels les hypothèses d'identification ne sont pas rejetées par les données. En particuliers, nous constatons que la seconde démarche d'identification, dont l'application à la politique monétaire française est inédite, donne des résultats encourageants. Nous

montrons que le marché interbancaire est en phase avec les tensions macroéconomiques françaises.

Nous utilisons ensuite les modèles estimés pour étudier l'impact de variables financières internationales, telles que le taux d'intérêt allemand ou le taux d'intérêt américain, sur la transmission de la politique monétaire française. Il apparaît que l'environnement international de la politique monétaire est déterminant. En effet, la transmission de la politique monétaire est réduit dès lors que le modèle estimé inclut certaines variables exogènes à l'économie française comme le taux d'intérêt américain ou le taux de change Dollar D-Mark. On montre ainsi que l'intégration internationale croissante des marchés financiers réduit la marge de manoeuvre de la politique monétaire.

Notre dernier résultat est d'ordre méthodologique : la faible corrélation entre les chocs exogènes de politique monétaire obtenus par l'approche macroéconomique et ceux obtenus par l'approche procédurale. Poser des hypothèses économiques explicites lors de l'identification des chocs de politique monétaire dans les modèles SVAR est nécessaire, mais cela ne suffit pas à garantir un point de vue unique sur les infléxions de cette politique.

SUMMARY

The aim of this paper is to identify French monetary policy shocks over the last decade. France undertook reforms of financial markets in the middle of the eighties. The two major changes of financial markets with respect to monetary policy were the end of its implementation through « encadrement du crédit » and the move toward complete free circulation of capital. Two major macroeconomic achievements could be observed since these changes took place. First, the French franc has not been devalued against the D-Mark since the 12th of January 1987. Second, inflation has remained stable and low since the mid-eighties. Hence the interest in a better understanding of French monetary policy during this particular period.

The identification of monetary policy shocks is the preliminary stage toward this end. As a matter of fact, it is essential to disentangle exogenous monetary policy shocks from the endogenous developments of macroeconomic variables. For instance, 1% increase in the interest rate targeted by the central bank does not mean the same in a context of high or low inflation. This is why economists consider that only exogenous shocks of the interest rate targeted by the central bank can be interpreted as a monetary policy shocks.

Vector Auto-Regressive models (VARs) seem to be the adequate econometric tool to identify such exogenous policy shocks. This paper uses them to focus on two aspects of French financial markets reforms which are essential to monetary policy.

First, do the new procedures of the implementation of monetary policy make the stance of Banque de France (BdF) monetary policy more readable? France abandoned its « encadrement du crédit » by which the central bank provided liquidity at low cost to commercial banks, as long as they respected the pre-determined volume of credit they could distribute. It turned to a more market-oriented management of banks liquidity. Since then, the BdF has relied on two interest rates, the tender rate and the repurchase agreement rate, to form a corridor in which the market rate for liquidity settles. Can these procedures, which have been working since 1987, be analysed to measure French monetary policy?

Second, does the free circulation of capital leave the BdF any room for manoeuvre? The free circulation of capital should enhance financial integration. The latter, combined with the peg of the exchange rate to the D-Mark, reduces the scope for autonomous changes in French interest rates. How do these constraints on French interest rates influence monetary policy?

The results are threefold. First, one of the procedural approaches seems relevant to identify French monetary policy shocks over this period of estimation. Second, the differences in the monetary shocks constructed with the two identification schemes add to the growing concerns (Cochrane 1995, Rudebush 1996) about the use of VARs to simulate monetary policy shocks. Third, the impact of monetary policy shocks on the French economy is highly dependant on including some international financial variables in the model.

Looking for French Monetary Policy
(A Structural VAR Approach)[1]

For the graphs that are not available on this file, you can receive a copy of them, in mailing your request to colombel@cepii.fr

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INTRODUCTION

The aim of this paper is to identify French monetary policy shocks over the last decade. France undertook reforms of financial markets in the middle of the eighties. The two major changes of financial markets with respect to monetary policy were the end of its implementation through « encadrement du crédit » and the move toward complete free circulation of capital. Two major macroeconomic achievements could be observed since these changes took place. First, the French franc has not been devalued against the D-Mark since the 12th of January 1987. Second, inflation has remained stable and low since the mid-eighties. Hence the interest in a better understanding of French monetary policy during this particular period.

The identification of monetary policy shocks is the preliminary stage toward this end. As a matter of fact, it is essential to disentangle exogenous monetary policy shocks from the endogenous developments of macroeconomic variables. In this respect, Vector Auto-Regressive models (VARs) seem to be the adequate econometric tool. VARs are increasingly used to identify macroeconomic shocks. Their success stems largely from their ability to decompose macroeconomic variables into structural shocks and then to simulate reactions of an economy to exogenous shocks.

This paper uses the VAR identification tool to focus on two aspects of French financial markets reforms which are essential to monetary policy.

[1] Une part importante du travail présenté ici a été réalisée au Financial Market Group de la London School of Economics.

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The next section of the paper briefly introduces VAR models and surveys their applications to monetary policy analysis. It opposes two approaches commonly used to identify exogenous monetary policy shocks. On the one hand, referred to « macroeconomic approach » an explicit reaction function of the central bank to its macroeconomic environment is built. The innovations of this reaction function are considered exogenous shifts in the stance of monetary policy. On the other hand, the « procedural approach » relies on the analysis of the practical implementation of monetary policy in the market for liquidity. The identification of monetary policy is then reduced to the identification of supply shocks on a particular market. Section 2 presents the estimations identifying French monetary policy using these two approaches. The analysis of the shocks obtained is the subject of Section 3. The impact of financial integration is tested in Section 4 of the paper. This is done by comparing the impact of monetary policy shocks in models which either include or ignore proxies for foreign influence, such as German or US interest rates, or the US Dollar D-Mark exchange rate. Finally, the conclusion resumes the major results of the paper.

1. VAR MODELS AND THE QUEST FOR EXOGENOUS MONETARY POLICY SHOCKS

Since Sims (1980), VARs have been increasingly used to analyze monetary policy. Their success stems largely from their ease of use. Indeed, VARs make it possible to decompose macroeconomic variables into structural shocks (refereed to as Structural VARs) and to simulate the reactions of an economy to these shocks (see Appendix 1 for a more profound insight into VAR modelisation). For instance, Blanchard and Quah (1993) decompose the time series of unemployment and output into supply and demand shocks. The identification of supply and demand shocks relies on the assumption that only supply shocks have a lasting impact on output.

The implementation of such simulations rests on hypotheses regarding the functioning of the economy, which could be either implicit or explicit, when identifying shocks. This means constructing shocks that are orthogonal to each other and interpreting them using economic theory. It is then possible to build alternative VARs corresponding to a different set of economic hypotheses.

As far as the analyses of the monetary policy are concerned, the development of structural VARs is motivated mainly by the resolution of the price puzzle. Indeed, in several OECD countries, it may be observed that simulations from unconstrained VAR (Sims(1986), Sims (1992), Barran, Coudert and Mojon (1995), Dale and Haldane (1995)), of a shock in interests rates, interpreted as a strengthening of monetary policy, lead to a durable increase in prices. The resolution of the price puzzle in Structural VARs simulations where identification hypotheses of monetary policy shocks are more sophisticated (Gordon and Leeper (1994), Sims and Zha (1995)),or where the set of variables entering the VAR differs, (Christianno, Eichenbaum and Evans (1993), Barran, Coudert and Mojon 1996)), highlights the crucial character of the identification hypotheses. The possibility to modulating simulated impulse response functions through the choice of the identification scheme once again puts forward the economic justification necessary for any chosen identification (Cochrane 1995). We are then back to basic problems of identification which have been largely investigated in traditional econometrics[3].

Two approaches have been explored to identify monetary policy shocks:

- the first one typically builds its identification by making assumptions on the inclusion or non inclusion of some macroeconomic variables in the information sets of the central bank and of private agents;

- the second one observes the practical implementation of the monetary policy, that is to say of procedures of intervention by the central bank in the interbank market, in order to distinguish supply from demand shocks in this market.

1.1. The macroeconomic approach

The macroeconomic approach consists of trying to distinguish money supply shocks from money demand shocks, using macroeconomic data. For instance, a parallel move of money and short term interest rate innovations is more likely to be a move along the money demand curve, while a move of these two innovations in opposite directions would rather characterize a move along the money supply curve.

In practice, the identification hypotheses are usually based on the necessary delays for the acquisition of information about some variables. This allows some variables to be excluded from either money demand or money supply functions. Typically, commodity prices which are observable daily can enter the money supply but production prices, released only after a lag, cannot.

Thus, Sims (1986) proposes a money demand that depends instantaneously and positively on real GDP and prices but negatively on short interest rates. Similarly, the money supply establishes, in the course of the period, a positive link between money and the short term interest rate. The other variables of the model, unemployment and the investment rate have no instantaneous impact on the money supply and money demand

[3] SVAR practitioners would insist on the fact that they do not impose any constraint on the dynamics of the model, which is an important difference with traditional macro-econometrics.

functions. The monetary policy shock is then defined as the part of the residual of the interest rate equation which is orthogonal to the innovation of the money equation. Sims justifies this money supply function by the fact that there is a delay in the publication of macroeconomic statistics. Gordon and Leeper (1994) extend this approach. They propose improving the specification of the money supply function by introducing proxy variables for expectations of inflation, which are observable by the central bank without delay. Thus, the money supply function includes an index of raw material prices and the long term interest rate.

Sims and Zha (1995) further improve this approach by introducing several indices of prices into the model. They distinguish two spheres in the economy. In the first sphere, monetary policy is decided and prices are flexible. For instance, prices of raw materials, which are set daily by auctions, are contemporaneously determined with monetary policy. In the second sphere, which is viscous because of menu costs, the GDP deflator, the intermediate goods prices index and wages are included. Thus, the money supply function is going to take some account of price innovations in raw materials, but, contrary to the identification scheme of Gordon and Leeper (1994), these prices are themselves a function of contemporary innovations of all the other variables of the model. In fact, the model estimated by Sims and Zha differs from that estimated by Gordon and Leeper essentially by the distinction of this second sphere, labelled viscous. In addition to the prices of GDP, intermediate goods and wages, the model includes the number of bankruptcies in this second group of variables, as a proxy variable for supply shocks. This variable is a key both to the estimation of the model and to the analyses of the impact of monetary policy on the economy. As a matter of fact, it is the number of bankruptcies which explains the largest share of GDP variance. The share of the variance of GDP explained by money supply shocks is then reduced considerably in comparison with the results of Gordon and Leeper. The recessive effects of adverse shocks of monetary policy are interpreted by Sims and Zha as a reaction by the central bank to the inflationary effect of recessive supply shocks, identified with positive shocks in the number of bankruptcies.

This example illustrates the key dimension of the choice of variables to be included in the VAR; especially, the instrumental variable choice used for the identification and the interpretation of money supply and money demand shocks. The results of Sims and Zha allow the symmetrical results obtained by Gordon and Leeper to be questioned. This example shows at least that VAR models are not econometric instruments independent of economic hypotheses necessary for their implementation.

The validation of the identification scheme thus embodies a crucial character. From this point of view, Sims and Zha have recourse to two criteria as did Sims (1986) or Gordon and Leeper (1994). They produce the statistics of the coefficients obtained in simultaneous relationships between innovations. But beyond this, they claim that validation by conformity of impulse response function to priors on monetary policy impact is legitimate: essentially, the resolution of the price puzzle[4] and the temporary nature of the impact of monetary policy on GDP.

Gerlach and Smets (1995) analyze the monetary policy of the G7 with a SVAR model including output, prices and a short term interest rate which represents monetary policy. They use two long term constraints and a short term one. They assume that neither prices, nor the interest rates have a long term impact on output and that the interest rate has no immediate impact on output. Also, in the case of France, De Bandt (1990) proposes three identification schemes supported by economic theory in a VAR which includes a monetary or credit aggregate, an interest rate, prices and output. The three identification schemes differ with respect to the variable for which the innovation is exogenous. In the 'monetary' model, it is the monetary aggregate, while in the 'real' model it is output and in the 'classic' model it is a real interest rate.

1.2. The procedural approach

This second approach consists in trying to avoid controversies of macroeconomic theory in the identification of monetary policy shocks. In order to do so, different authors justify their identification strategy by their knowledge of the implementation procedures of monetary policy. Bernanke and Blinder (1992) attempt to show that, except for the period 1979-1982, the Fed implemented monetary policy by targeting the rate on federal funds (FFR). The Fed organizes its open market operations in order to target this interest rate, which is equivalent to leaving the level of non-borrowed reserves to evolve freely. At the other extreme, Christianno and Eichenbaum (1992) assume that the Fed aims to target a certain level of non-borrowed reserves. According to Bernanke and Blinder, money supply shocks are innovations in the FFR over the other variables of the VAR model. As they consider that this interest rate level operational objective is predetermined, they can identify monetary policy shocks assuming recursivity between the variables entering a VAR model, where the FFR is introduced in the first position (see appendix 1). Innovations in non-borrowed reserves, or in monetary aggregates if a stable monetary multiplier is considered (Goodfriend (1987)), will be interpreted as money demand shocks. According to Christianno and Eichenbaum, it is exactly the opposite interpretation that prevails, in a VAR model where non-borrowed reserves are placed before the interest rate.

Strongin (1992) is the first to detach his analysis from a « single variable » representation of monetary policy. He proposes to decompose innovations in reserves between reserves demand shocks emanating from banks and supply shocks consequent to monetary policy impulses decided by the Federal Reserve. He uses two reserves measures which he assumes react differently to demand for and supply of reserves. Strongin asserts that the Fed can not refuse to accommodate reserves demand emanating from banks, a point also made by Goodhart (1994) in a more global analysis of monetary policy. Thereby, the Fed can only transmit its monetary policy by seeking to establish the degree

[4] The price puzzle is the observed increase in prices after an adverse monetary policy shock simulated with unconstrained VAR. Sims (1992), Dale and Haldane (1995), Barran Coudert and Mojon (1995) observe this phenomena in some of the G5 countries.

of dependence of banks with respect to the discount window. Strongin supposes therefore that the Federal Reserve takes the ratio of borrowed reserves to non-borrowed reserves as its *operational target*. He identifies monetary policy shocks to the share of innovations of Non-Borrowed Reserves, which is orthogonal to total reserves innovations. A synthetic representation of these three procedural approaches is proposed by Bernanke and Mihov (1995). They have established an homogeneous framework (see Appendix 2) to represent identification schemes of the monetary policy, relying on interpreting the Federal Reserve procedures of intervention in the money market.

In this paper, we just want to make the point that such an approach to the identification of money supply shocks might be fruitful if correctly adapted to the case of French monetary policy. In effect, it extends the possibilities identifying monetary policy shocks at a stage where alternative « macroeconomic » identification schemes lead to different impacts of monetary policy (Cochrane 1995). More generally Rudebush (1996) questions the use of VAR models to analyze the monetary policy. He criticizes the fact that the different authors analyze monetary policy with different models, which implies that what they assume monetary policy shocks to be different [5]. This is acknowledge here. Yet the implementation procedures of French monetary policy have been more stable than its macroeconomic environment over the recent years. In this respect, procedural identification of French monetary policy deserves to be developed.

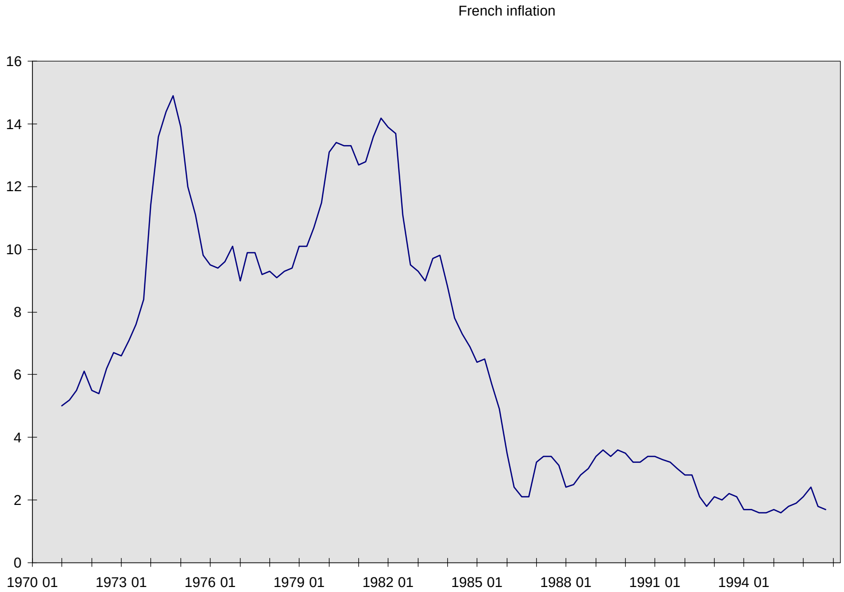
Hence, the next two sections will estimate both « macroeconomic » and « procedural » identification schemes, and compare the supposed monetary policy shocks obtained from them.

2. THE IDENTIFICATION OF FRENCH MONETARY SHOCKS POLICY SINCE 1987

After having presented two potential strategies to identify money supply shocks, this section will try to apply them to French monetary policy in the course of the last ten years. The aim is to implement the tests on a sufficiently homogeneous period. They are several reasons why French monetary policy has been homogeneous since 1987. First, the « *désinflation competitive* » policy, begun in 1983, was mainly accomplished during the first three or four years (**Figure 1**). Since 1987, the variance of French inflation has been very weak. Inflation has not exceeded 3.5% in annual terms since then, and this, despite a sustained growth period in the late 1980's. Secondly, the intervention procedures of the BdF on the interbank market and on the money market have not evolved since 1987, two years after the wave of reform of the French financial system, and especially of its money market. Thirdly 1987 is also the official end date of the « *encadrement du crédit* » policy (stopped in practice in 1984) and the date since which the procedure of the « *fixing* » has been abandoned (ever since, the rate of the interbank market has been fluctuating freely in the course of the day). Finally, free circulation of capital has been effective and the central parity of the exchange rate to the D-Mark, within the EMS, has not been changed since the 12th of January 1987.

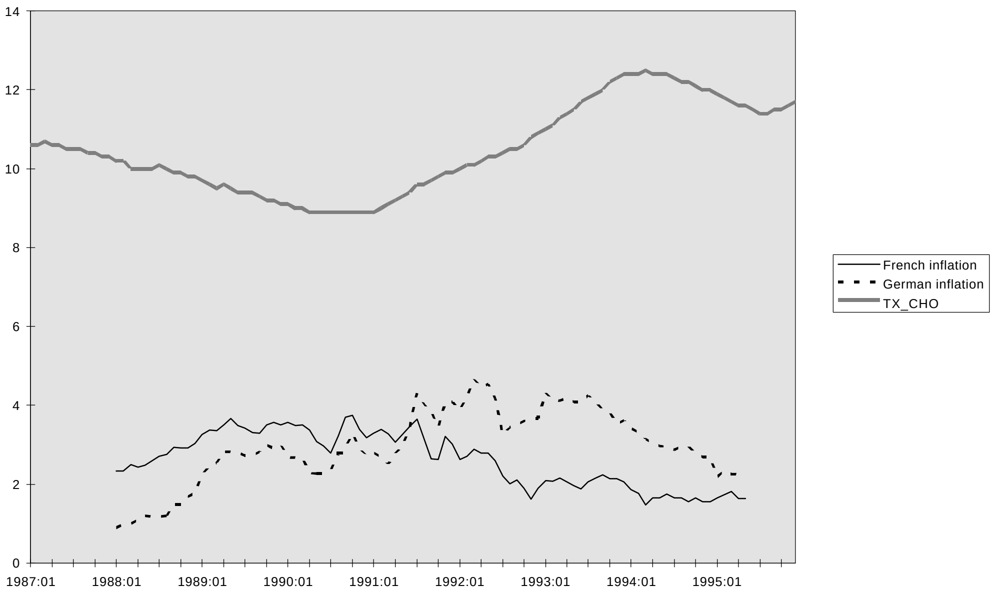
[5] Yet, Sims (1996) dismisses Rudebush(1996) critics. He stresses that the different sets of instruments can lead to different dates for monetary policy shocks without necessarily meaning that alternative identification schemes contradict one another.

Figure 1



Two prominent aspects of the later part of this period have been the repetition of attacks against the EMS, that have strongly disturbed the French money market, and the occurrence of strong macroeconomic fluctuations **(Figure 2).** One objective here will be to account for the links between these two aspects and monetary policy.

Figure 2



2.1. The macroeconomic approach

2.1.1. Macroeconomic identification scheme of French monetary policy

In order to overcome the simultaneity problem associated with the identification of monetary policy shocks, the macroeconomic approach leads to specifying and estimating money demand and money supply functions between the innovations of the first stage estimation of the VAR. In the French monetary policy context, the simultaneity problem lies mainly with the exchange rate and the money market interest rate. Identification requires an instrument for the exchange rate to be found, which could be excluded from the money supply function. In their SVAR analysis of German monetary policy, Clarida and Gertler (1996) used the VAR residual of the Federal Funds rate as an instrument for the USD-DM exchange rate, and excluded it from the money supply on the grounds that the Bundesbank cared about the impact of the US interest rate on the exchange rate, but not about the US interest rate itself.

In looking for an instrument for the FF-DM exchange rate, macro-econometric models are a possible source of inspiration. Indeed, the preceding section pointed out that VAR no longer pretend to be more economic theory-neutral than is the macro-econometric framework. For example, MEFISTO (1993), the quarterly model of the French financial system elaborated at the BdF, establishes a money supply function defined as a reaction function. This reaction function is estimated as a vector error correction (VECM). The long term relationship (or cointegrated vector) characterizes a link between the spread (Spread_F-G) between the French money market the German money market interest rates, as the endogenous variables, and :

- the inflation spread between these two countries,
- the spread between German and US short rates.
- Around this long term relationship, the Spread_F-G depends on
- the increase of the German short term rate,
- the increase smoothed over two periods of French inflation,
- the increase of currency reserves of the BdF,
- the residual of the long term relationship, and
- a dummy variable for Germany reunification.

This reaction function on the French monetary policy authority, shows that it is strongly, perhaps exclusively, determined by external factors. Potential instruments for the FF-DM exchange rate are numerous. Yet, the reaction function of the BdF estimated in MEFISTO suggests that some of such instrument variables (relevant to the study of French monetary policy) are not endogenous to the French economy which might not be consistent with VAR modelling.

There is a broad agreement as to which variables should be included in the money demand function. Either, traditional econometric studies of the stability of the French money demand function (Poncet and Ren (1991), Frochen and Voisin (1985)), or SVAR identification scheme approximation of the money demand function (Sims (1986), Sims and Zha (1995), Gordon and Leeper (1994)), would include GDP, an aggregate price index and the short term interest rate.

<u>The formulation of money supply and money demand functions</u>

Following the consensus, the simplest expression of money demand is used, as in the studies quoted in the preceding section and the literature on money demand function estimations. Subsequently, a first expression of money demand using residuals of a suitable VAR model make the residuals of the monetary aggregate equation (u_{AG_M}) depend on residuals from real GDP(u_{GDP}), prices (u_P) and interest rate (u_{TMP}), equations (See Table 2.1.-1).

The money supply, in the French context and considering that the present identification strategy is based on very short term links, has to relate to the exchange rate to the DM. The 'foreign influence variables' are potential instruments for the exchange rate and can be introduced in the model, if necessary, to achieve identification. On top of this, it is possible to test whether it is relevant or not to make the money supply depend on residuals in money demand, GDP or prices equations. The SVAR models mentioned in the section 1, (Gordon and Leeper 1994, Sims 1986, Sims and Zha 1995), based their identification on the existing delays in the publication of macroeconomic variables. As a matter of fact, the policy maker could form expectations about macroeconomic variables before they are officially disclosed, but prefer to wait before changing the stance of monetary policy.

As in Sims and Zha, it is also necessary to make the exchange rate appear in what could be called the « flexible » sphere of the model.

Table 2.1.1 : Macroeconomic identification scheme

money demand	$u_{AG\_M} = a\, u_{GDP} + b\, u_P + c\, u_{TMP} + \varepsilon^D$
	with *a priori* a and b positive and c negative
money supply	$u_{TMP} = d\, u_{EX\_DM} + e\, u_{AG\_M} (+ f\, u_{GDP} + g\, u_P) + \varepsilon^S$
	with *a priori* d and e, f and g positive
exchange rate	$u_{EX\_DM} = h\, u_{TMP} + j\, u_{AG\_M} + k\, u_{GDP} + l\, u_P$ $+ m\, u_{FOREIGN\_VARIABLE} + \varepsilon^X$
	with a priori h and k negative and j and l positive, the sign of m should depend on the foreign variable included in the model

e^D, e^S *and* e^X *are the identified structural shocks of money demand, money supply and Francs demand.*

2.1.2. The VAR estimation

Based on the macroeconomic approach to identification, our first model includes industrial production, the consumer price index (CPI), the reserves money, the interbank market interest rate or overnight rate (TMP), and the DM / FF exchange rate expressed in FF to the DM (3.4 FF for one DM)[6] as endogenous variables[7]. The variables are entered in logs of levels except for the interest rate. A parsimonious lag structure is retained, with lags 1, 2, 3, 6 and 12, in order to keep sufficient degrees of freedom[8]. We consider the model as an unconstrained cointegration vector and therefore do not estimate the model under an explicit cointegration form.

The dummy variable for speculative crises of the EMS and three of its lags are included as exogenous variables because they improve the specification of the model. Not only are they significant in the TMP and the exchange rate equation, but their inclusion greatly improves the significance of reserves money and the exchange rate in the TMP equation as well as the significance of prices, industrial production and the TMP in the exchange rate equation. These features of EMS dummy inclusion are observed across different monetary aggregates (successively M1, M2 and M3 instead of reserves money) and when unemployment is used in model instead of industrial production.

Subsequently, five 'foreign influence' variables were successively tested in the model:

- the German overnight rate,
- its spread with respect to its French counterpart (TMP),
- the US short term rate,
- its spread with its German counterpart, and,
- the US-DM exchange rate.

Except for the US-DM exchange rate, which is explained statistically by industrial production, all appeared as exogenous to the model while they explain significantly the exchange rate and the TMP. Yet, such foreign influence variables may be introduced into the model in order to use their residual as an instrument for the FF-DM exchange rate, in the identification of monetary policy shocks.

[6] So that an increase in the exchange rate is equivalent to a depreciation of the Franc.

[7] Data are presented in the DATA APPENDIX.

[8] Statistical criteria, applied with consecutive lags, provide no clear optimal number of lags. The five parsimonious lags structure strongly improves the cross explanatory powers of the variables. The Fisher tests, which show it, are available on request.

2.1.3. The econometric evaluation of the identification scheme

The identification of monetary policy shocks was worked out from residuals of the first stage estimation of the VAR, where each variable is regressed, using OLS, on the lags of all variables. These residuals are not orthogonal to each other. Yet the correlation between the exchange rate and the money market interest rate equations residuals is almost nil, suggesting that there might not be a problem of simultaneity between these two variables. As this low correlation might come from movements of both the demand and supply of French francs, the next step is to specify money demand, money supply and the exchange rate as a demand function for Francs. Following the Shapiro and Watson (1992) identification strategy and its application to the identification of German monetary policy shocks by Clarida and Gertler (1996), we proceed through two stages least squares, which allow potential non-convergence of FIML estimations[9] to be avoided. This relies entirely upon exclusion restrictions placed on the contemporaneous impacts between the residuals.

Residuals of prices, industrial production and the 'foreign influence' variable, when it is included in the VAR, are instruments for the exchange rate and the reserves money residuals which are the explanatory variables for money supply. Then, the residuals of the money supply thus estimated are added to the instruments set for the estimation of money demand, which is a function of prices, industrial production and the TMP. The residuals of this second regression are added to the instruments set, which is used to estimate the exchange rate residuals as a function of all the other residuals of the VAR.

The inclusion of a 'foreign influence variable', can best be justified by its role as an instrument of the exchange rate in the identification scheme. The Federal Funds rate (FFR) residual shows the highest correlation to the exchange rate residual, and it is on this basis that the FFR is included in the VAR on which the identification scheme described above is estimated.

The results of the three estimated equations are given in the box. It is remarkable that the exchange rate residuals do not impact significantly on the money supply function. Overall, it is comforting that the significant coefficients in these three equations show the expected sign. The impact of interest rate residuals on money demand residuals is negative, and both industrial production residuals, interpreted as supply shocks, and the Federal Funds rate residuals lead to an appreciation of the exchange rate. The fact that TMP residuals lead to a depreciation of the exchange rate can be understood if increases in the interest rate mainly occurred in periods of exchange rate tensions.

[9] Actually, FIML estimations were carried out, and their results are quite similar to the ones presented here.

Table 2.1.2 : Macroeconomic approach Identification scheme

Money supply	(2SLS with u_{FFR_US} , u_P and u_{IP} as instruments)				
u_{TMP} =	9.85 u_{RES}	- 67.34 u_{EX_DM}			
	(7.1)	(82.08)			
Money demand	(2SLS with e_{TMP} , u_P and u_{IP} as instruments)				
u_{RES} =	4.11 u_P	+ 0.71 u_{IP}	- 0.05 u_{TMP}		
	(4.52)	(0.65)	(0.019)		
Exchange rate	(2SLS with e_{TMP} , e_{RES} , u_{FFR_US} , u_P and u_{IP} as instruments)				
u_{EX_DM} =	0.07 u_P	- 0.06 u_{IP}	- 0.008 u_{RES}	- 0.005 u_{FFR_US}	+ 0.003 u_{TMP}
	(0.25)	(0.03)	(0.008)	(0.0018)	(0.0007)

The standard error of the coefficients are given in brackets. Res stands for Reserves which is the monetary aggregate we have retained at the VAR estimation stage. The first stage of estimations is an OLS on lags 1 2 3 6 and 12 of Industrial production, prices, exchange rates, reserves, US federal funds rate and the day to day french interbank market rate between January 1987 and March 1995.

In our perspective, these estimations permit monetary policy shocks to be considered previous to exchange rate shocks, and to money demand shocks. Henceforth, this paper analyses the money supply shocks obtained from a recursive *'Cholesky'* identification scheme, where the interest rate is placed before the exchange rate and money demand, and where prices and industrial production innovations do not enter into the information set of the central bank[10].

As each of the 'foreign influence' variables appeared as exogenous in the first stage estimation of the model, another VAR, with the same five French variables as above and with a 'foreign influence' variable as exogenous, was estimated. More precisely, the contemporaneous values and the lags 1, 2, 6 and 12 of the foreign variable were added to the constant and the EMS-crises dummies among the exogenous variables of the model. Then, the 'foreign influence' variable can no longer be used as an instrument of the exchange rate in the identification of monetary policy shocks. With five endogenous variables the 2SLS identification (obtained with the same sequence of estimation as the one described in Table 2.1-2 except for the withdrawal of the foreign influence variable innovation from the set of instruments) reproduces coefficients of the exchange rate and money demand in the money supply rule which are not significant.

[10] Actually, a model was estimated, in which prices and industrial production are placed before the money market interest rate. Yet, the two series of money supply shocks obtained from the two models are highly correlated (0.98). It seems that the Banque de France does not react to Prices and Industrial Production innovations within one month, and that the interest rate should be placed before prices and industrial production in the model.

Table 2.1.3 : Macroeconomic Approach Identification Scheme with Exogenous Foreign Influence Variables

	no foreign Influence	US FFR	German MMR	US - DM Exchange rate	Spread FFR - GMMR	Spread TMP - GMMR
Money demand equation						
u_{TMP}	0.07 (0.016)	-0.050 (0.016)	0.026 (0.0135)	0.10 (0.035)	-0.045 (0.015)	
Exchange rate equation						
u_{IP}	-0.105 (0.047)	-0.054 (0.035)	-0.083 (0.040)	-0.153 (0.075)	-0.061 (0.034)	-0.05 (0.04)
u_{RES}	0.0044 (0.001)			0.069 (0.02)		0.035 (0.008)
u_{TMP}	0.029 (0.010)	0.0012 (0.0007)	0.003 (0.001)	0.007 (0.002)		

The standard errors of the coefficients are given in brackets, only significant coefficients are shown, and, henceforth, the money supply estimations are not presented. The first stage of estimations is an OLS on lags 1 2 3 6 and 12 of Industrial production, prices, exchange rates, reserves and the day to day french interbank market rate between January 1987 and March 1995.

Also, like in the 6-variables model presented above, the exchange rate equation exhibits a negative and significant impact of supply shocks (i.e. industrial production innovations) on the exchange rate (i.e. an appreciation), while interest rate innovations, also significant, lead to a depreciation of the exchange rate, and reserves money innovations lead to a depreciation when significant (Table 2.1.-3). Yet the interest rate coefficient in the money demand equation depends on the ‘foreign influence’ variable included in the model. It is negative and significant when the US FFR or its spread with respect to its German counterpart is included, and positive or non-significant otherwise.

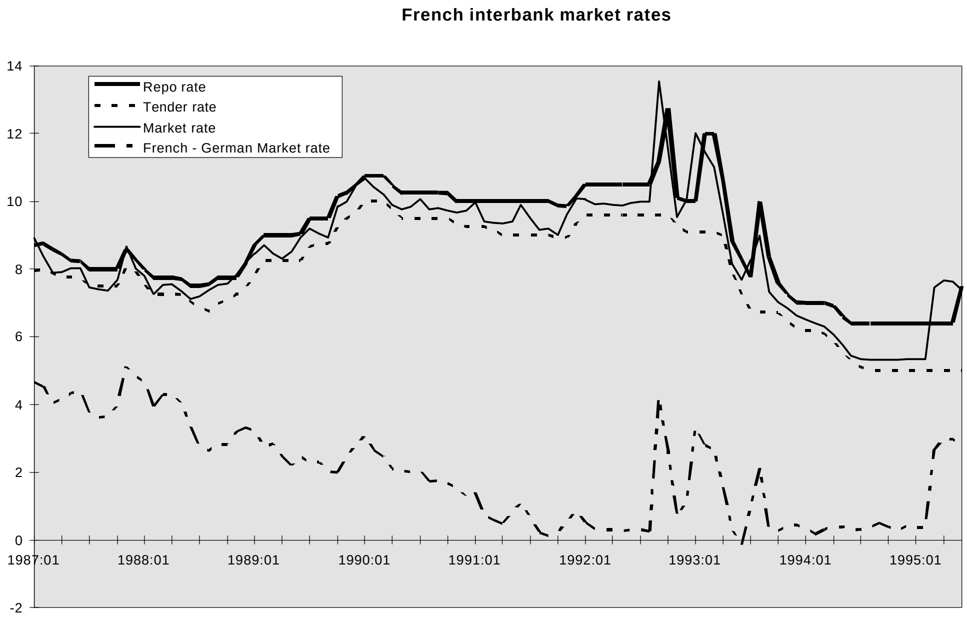
Altogether, the estimations of money demand, money supply and exchange rate equations on the innovations of the relevant macroeconomic variables from a VAR model show that the money supply innovation occur before exchange rate innovations and money demand innovations by more than a month. In contrast, exchange rate and money demand are influenced by interest rate innovations within one month. This is true whether or not we introduce a ‘foreign influence’ variable, as an instrument for the exchange rate, within the endogenous variables of the model, and even if such a variable is not introduced as an exogenous variable in the model. Thereupon, impulse response functions can be drawn from a Choleski decomposition of the covariance matrix of the first stage estimation of a VAR (see Appendix 1) in which variables enter in the following order: the money market interest rate (TMP), the prices index, the industrial production index, the reserves money, and the exchange rate.

2.2. The procedural approach

2.2.1. Procedures in the implementation of the French monetary policy since 1987

Current procedures of the French monetary policy are well defined. The Banque de France (BdF) operates with two interest rates which constitute a spread within which the day-to-day rate, which balances supply and demand of liquidity, fluctuates (**Figure 3**). The first rate is the one at which the BdF provides liquidity to the market, through weekly held repurchase tenders. This rate is called the intervention rate or the tender rate (*taux des appels d'offre*, TAOF) and it is the floor of the market rate at which the BdF takes eligible securities, public or private, as collateral for the central currency it provides to the main market operators. The second rate, which is fully settled by the BdF, is the rate of repurchase agreements (TPEP). It usually has a maturity of 5 to 10 ten 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 is superior to the intervention rate by 50 to 100 basis points, banks resort to this second procedure only when the market rate remains above the rate of repurchase agreements for several days.

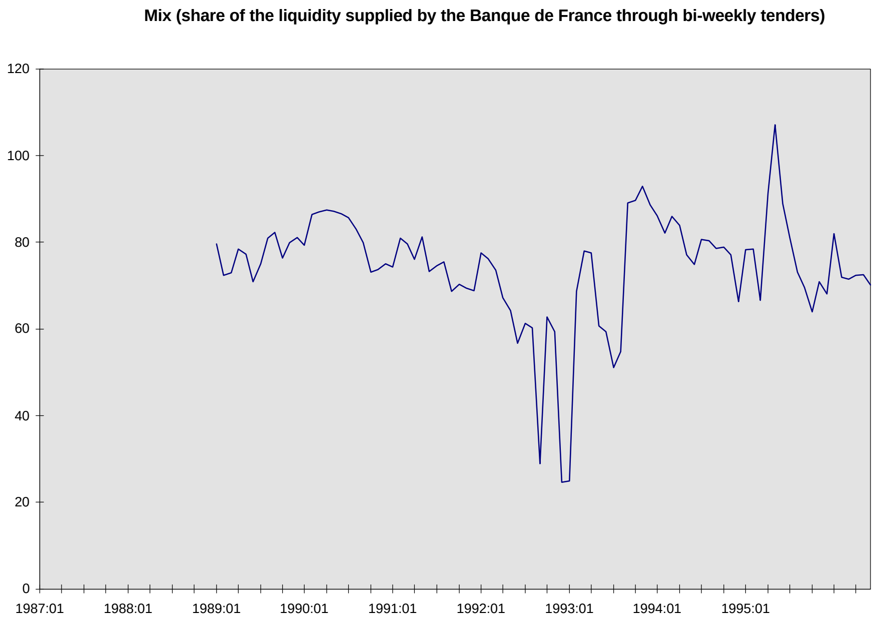
Figure 3



The BdF can also proceed with interventions in the interbank market, by repurchasing (or 're-selling' when it wants to reduce the liquidity of the market) supplementary papers to those held through the two standard official procedures, or by open market operations. Repurchase agreements are generally done at the rate of the market, for a duration of one to two days. However, market procedures represent a marginal dimension over the whole range of interventions by the BdF.

The proportions of the different types of liquidity supplied by the BdF to the banks is shown in **Figure 4**. The repurchase tenders are obviously the major source of central bank money, but their share in the total lent by the BdF to the banks fluctuates a lot.

Figure 4



Finally, the BdF still has the possibility of modifying the compulsory reserve ratio. This potential instrument, hardly ever used, has fallen to a very low level (1% on demand deposits and Certificates of Deposit and 0,5% on time deposits of less than a year). Yet, it constitutes an instrument adapted to manage liquidity tensions due to international influences.

The following procedures have been used since 1987: repurchase tenders, repurchase agreements, direct intervention in the market and modification of the compulsory reserve ratios, have been used since 1987. It is to be noted that the compulsory reserve ratio declined substantially (from 5.5% until October 1989 and 3% since then), probably because of free capital mobility, instituted in July 1990.

<u>Procedural identification of French monetary policy shocks</u>

The different identification schemes are now defined based on hypotheses about intervention procedures of the BdF in the French interbank market. In order to do so, some of the potential relationships between the variables of the interbank market are presented. Following Strongin(1994) we will test systematically the robustness of the procedural identification scheme by introducing macroeconomic variables, in addition to 'money market variables' into the model. It is assumed a recursive order within the block of macroeconomic variables to avoid under-identification within this block of variables (Sims and Zha (1995)). The order of recursivity is defined according to the relative flexibility between the variables. The most flexible are ranked at bottom because they appear more susceptible to react in a contemporary manner than less flexible variables.

2.2.2. The 2 variables procedural identification schemes estimations

To begin the analysis, it was decided to test the simplest identification schemes that were apparent, they being both simple and symmetrical. As it was possible to collect interest rates entirely fixed by the BdF and the rate of the interbank market, it was natural to test for the impact on the economy of shocks of the part of one of the rates which is orthogonal to the other. First, it was assumed that the BdF does not observe structural demand shocks in the course of one period, while banks observe structural supply shocks. Second, the exact opposite was assumed.

Third, we estimate a model with a long term constraint such that the long term impact of a supply shock of liquidity on the market rate is nil[11].

These identification strategies of French monetary policy are genuine. Besides, the variable which represent demand is an interest rate, instead of being reserves or monetary aggregates. We feel that this interest rate is a better proxy for the several forces (domestic demand for money and arbitrage around the EMS) which put pressure on the interbank market.

Table 2.2.1 : Two variables procedural identification schemes

	n°1 scheme	n°2 scheme	n°3 scheme
structural shocks impact on the call rate	$u_{TMP} = ae^{S} + e^{D}$	$u_{TMP} = e^{D}$	$u_{TMP} = ae^{S} + e^{D}$
structural shocks impact on the pension rate	$u_{TAOF} = e^{S}$	$u_{TAOF} = be^{D} + e^{S}$	$u_{TAOF} = be^{D} + e^{S}$
			long term constraint

e^{D} *and* e^{S} *are the identified structural shocks of money demand and money supply.*

<u>Estimation</u>

[11] This specification is for a model estimated in difference, i.e. an innovation in the rate of increase of the tender rate does not have a lasting impact on the increase of the market rate.

Our first procedural models contain only two variables, the interbank market rate and the tender rate. The model, is estimated in differences, with 4 lags[12], and it includes the spread between the two rates. As a matter of fact, each rate is integrated of order one, and tests do not reject their spread so as to be stationary. Moreover, the VAR which includes only the two rates is unstable as shown by dramatic long-term multipliers between the rates. The model can therefore be interpreted as an explicit (1,-1) Vector Error Correction Model, with a one-for-one long term relationship between the two rates, which is obvious in **Figure 2**. Moreover, in this model (as in all « procedural » models), no dummies are included for EMS crises as such crises should be captured by the model as demand shocks on the interbank market. In other words, we attempt here to compute demand and supply shocks independently from their underlying macroeconomic determinants.

Three models are estimated: the two recursive models and a model where the long term impact of the tender rate on the market rate is constrained to be equal to one (see Table 2.2.-1). In the three models, the free parameter estimated in the second stage SVAR estimation is highly significant, with Student statistics close to 9. In the first model, where the tender rate is previous to the market rate, the latter increases by 172 basis points within the period when the former increases by 100 basis points. In the opposite model, the tender rate increased by 16.5 basis points within one month when the market rate increased by 100 basis points. In the third model, the instantaneous impact of a market rate of 100 basis points increase of the tender rate, amounts to 33.6 basis points while, the instantaneous opposite cross impact falls to 424 basis points.

This last instantaneous multiplier of -4.24 is far too big, possibly due to convergence imperfections in the non-linear estimation process. The third model is rejected on these grounds. Besides, the tender rate is much less volatile than the market rate, probably because the Banque de France smoothes the former far more than the latter. The second recursive model, where the market rate comes second (i.e., where demand shocks can react to supply shocks within one month) is preferred to the first recursive model[13].

2.2.3. The 3 variables procedural identification schemes

These identifications of monetary policy shocks can probably be more elaborated. Mainly because, they rely on possibly strong assumptions such as the « blindness » of banks to supply shocks or the « blindness » of the central bank to demand shocks.

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[12] The three statistical criteria, Hannan-Quin, Akaike and Shawrtz give different results as to the optimal number of Lags. 4 lags allows degrees of freedom to be kept and secures well behaved residuals.

[13] A fourth model was estimated in which three macroeconomic variables are added to the two rates. This permits the anteriority of one of the interest rates with respect to the other to be relaxed. This model produces immediate cross-elasticities between the two rates which are very similar to the ones obtained in the 3-variables procedural model (see table 223), and supply shocks which are almost perfectly correlated to the ones obtained through the Choleski decomposition of the 2-variables procedural model with the tender rate placed first.

Therefore, a second step is to introduce another variable in connection with interventions of the BdF on the interbank market: the ratio of the central banks loans to banks distributed at the bi-weekly tenders over the total of central bank loans to banks (MIX). This ratio (called MIX after the paper of Strongin (1994)) represents the will of the central bank to distribute liquidity to banks at the floor rate of the interbank market. In particular, if the MIX reacts differently to money supply and to money demand shocks, can be used as an indicator for identification. A manner of representing this approach is to add a third structural shock to our system. Thus, in addition to the structural supply shock and the structural demand shock, we add a third structural shock, which is interpreted as a shock of the BdF preference in the nature of the liquidity acquired by banks on the interbank market. Table 2.2.-2 proposes the general structure of identification schemes involving these three interbank market variables. On the basis of this scheme, three constraints have to be imposed (be they short term or long term) on the cross impacts between the variables.

Table 2.2.2 : Three variables procedural identification schemes general framework

structural shocks impacts on the call rate	$u_{TMP} = \alpha_1 \varepsilon^S + \alpha_2 \varepsilon^P + \varepsilon^D$
structural shocks impacts on the pension rate	$u_{TAOF} = \beta_1 \varepsilon^D + \beta_2 \varepsilon^P + \varepsilon^S$
structural shocks impacts on the MIX	$u_{MIX} = \gamma_1 \varepsilon^D + \gamma_2 \varepsilon^S + \varepsilon^P$

$\varepsilon^D, \varepsilon^S$ *and* ε^P *are the identified structural shocks of money demand, money supply and preference on the nature of liquidity acquired by banks.*

Estimation

The second procedural model includes three interbank market variables. The MIX is added to the two interest rates. The MIX ratio (the share of central money provided by the BdF to the market through bi-weekly tenders) fluctuated between 50 and 90 % from 1989 and until June 1996, except in September and December 1992 and January 1993, when it fell to bellow 30 %, and in May 1996 when it peaked to 107 %, at a moment when the Banque of France withdrew an exceptional 31 billions French francs from the interbank market (see **Figure 4)**. The model is estimated from 1989 onwards because the amount of liquidity supplied through tenders is not available before this date.

The VAR is estimated with four lags[14]. The two interest rates still enter in an explicit (1,-1) VECM form, while the MIX is included as a percentage and the four other variables as logarithms of levels.

We then estimate numerous just-identified models, combining long run and short term restrictions in order to identify three orthogonalized structural shocks. Each model

[14] see footnote n°10.

would combine three constraints. This paper presents the results from the model which exhibit both significant estimated coefficients and reasonable magnitudes of instantaneous and long run multipliers. In this model, the tender rate can react to the interbank market rate within one period, yet the opposite is also true. The market rate also have a simultaneous impact on the mix. In other words, the model which is not rejected econometrically corresponds to the following restrictions:

1) MIX shocks have no immediate impact on the tender rate;

2) tender rate shocks, i.e. money supply shocks, have no immediate impact on the MIX;

3) MIX shocks have no immediate impact on the interbank market rate.

Table 223 gathers the estimated parameters in four versions of the model, which may include only the three interbank market variables or add to them prices, industrial production and the FF-DM exchange rate as well as dummies for the three outliners of the MIX mentioned above: September and December 1992, and January 1993, or no such dummy. The coefficients are quite stable across versions of the model. In particular, the immediate elasticity of the tender rate to money demand shocks is much smaller than the one of the market rate to money supply shocks. Also, as one would expect, the immediate elasticity of the mix to demand shocks is reduced if dummies for outliers of the mix are included in the VAR and when the model includes the exchange rate.

All together, these results suggest that the Banque de France reacts to money demand shocks both by increasing its tender rate and by reducing the share of central money provided to the market at this floor rate. Besides, restrictions **1)** and **2)** of the identification scheme can be interpreted as a ‘single way’ in which the central bank manages the interbank market. The BdF changes either the tender rate or the mix but never combine changes of both in a single period. This might appear strange as the central bank may want to compensate a tender rate increase by increasing the MIX, i.e. the share of central money provided to the market at the floor rate of the market. Nevertheless, such a strategy might reduce the impact of tender rate innovations on the market rate. Simulations show that the central bank carries out such compensation for five months, but only one month after the occurrence of money supply shocks[15]. Lastly, it can be observed that a shock to the MIX leads to an increase of both rates.

Table 2.2.3 : Three variables procedural approach: instantaneous impacts of structural shocks on the residuals of the interbank market variables

Model	impact of structural money supply shocks on market rate	impact of structural money demand shocks on tender rate	impact of structural money demand shocks on the mix
3 variables, no dummy	1.24	0.09	-10.72

[15] Most models where the instantaneous impact of the tender rate on the mix was not constrained to zero show an impact much lower than that of the market rate. Moreover this impact is not significant. Therefore this constraint does not appear particularly illegitimate. The results of the other identification schemes estimated on this 3-variables procedural model are too long, and cannot be included in this paper. They are available from the author on request.

	(0.20)	(0.10)	(1.98)
3 variables, with dummies	1.18 (0.23)	0.22 (0.080)	-8.64 (1.91)
6 variables, no dummy	0.83 (0.30)	0.29 (0.07)	-7.47 (1.62)
6 variables, with dummies	0.51 (0.39)	0.36 (0.06)	-7.14 (1.46)

The models are estimated through FIML, following Hamilton p.332, on the residuals on a VAR with 4 consecutive lags, between April 1989 and March 1995.

3. COMPARISON OF INTEREST RATE SHOCKS IDENTIFIED TO MONEY SUPPLY SHOCKS

3.1. Analysis of the 'money supply shocks'

Macroeconomic

The correlation between the identified monetary policy shocks are greater than 0.86 for five of the six models (Table 311). The shocks obtained when the spread between the French money market rate and its German equivalent is included in the model show a correlation as low as 0.33. But for the other five models, the impulse response functions will be triggered by basically the same monetary tightening.

The pattern of the monetary policy shocks for the six models can be seen in **Figure 5**. The major periods of monetary policy tightening were between September 1988 and January 1989, during the autumn of 1989, around May 1991, around October 1991, around October 1992 and the three first months of 1993. The periods of loose monetary policy were around early 1988, April 1990, January 1991, May 1992 and from March to November 1993. It should be borne in mind that the model includes a Dummy for the EMS crisis. Also, **Figure 3** shows that, though the EMS was under pressure in 1993, the French money market interest rates show the most important downward movement of the whole period of estimation.

Table 3.1.1 : Correlation between the identified monetary policy shocks obtained with different foreign influence variables in the macroeconomic model[16]

	NONE	US_FFR	G_MMR	USD_DM	S_AL_US	S_FR_AL
NONE	1.00	0.96	0.87	0.94	0.91	0.43
US_FFR	0.96	1.00	0.87	0.93	0.97	0.43
G_MMR	0.87	0.87	1.00	0.86	0.92	0.35
USD_DM	0.94	0.93	0.86	1.00	0.89	0.41
S_AL_US	0.91	0.97	0.92	0.89	1.00	0.33
S_FR_AL	0.43	0.43	0.35	0.41	0.33	1.00

Procedural

Figure 6 shows the supply and demand shocks obtained from the two interest rate VAR, in the two interest rates version, and, when the VAR also includes prices, industrial production and FF-DM exchange rate, in doted lines[17]. The shocks are different from the ones obtained through macroeconomic identification (supply shocks identified in the macroeconomic model with no foreign variables are shown in the second box of the graph). Actually, the correlation between a 'procedural identified' supply shock and a « macroeconomic identified shock » is 0.33 for the 5-variables model, and 0.27 for the 2 interest rates model. This should be compared to the correlations between macroeconomic-identified shocks and procedural identified <u>demand</u> shocks, which amount to 0.22 in the 5-variables model and 0.18 in the two interest rates model. This raises

[16] The equivalent cross-correlation between supply shocks obtained with procedural models are very similar.

[17] This 5-variables 'procedural' model is estimated with the same parsimonious lag structure as the 'macroeconomic' models, i.e. with lags 1, 2, 3, 6 and 12.

concerns about this method of interpreting some VAR-constructed disturbances as being monetary policy supply shocks.

The most striking differences between the two series of supply shocks occurs in early 1988, mid-1990, early, mid-1993 and end 1994 when the macroeconomic-identified supply shocks suppose a comparatively loose monetary policy. The top box of the graph also shows that the 2 interest rates model produces supply shocks (the plain line), which lead the shocks found with the 5 variables model (the doted line).

The 3-variable procedural model build shocks only after 1989. Over this shorter period, the correlations of the money supply shocks of the different 3-variable procedural model with the ones from the 2-variable procedural model are quite high, around 0.7 or superior. In contrast, they are very low, between 0.1 and 0.2, with respect to the macroeconomic model money supply shocks. These results confirm a gap between the two approaches and raise further the issue of which of the two kinds of shocks, constructed from a procedural or from a macroeconomic model best represent monetary policy stance. One way of evaluating the constructed supply shocks is to compare their adequacy to historical knowledge on French monetary policy over the period.

Yet, the study of Banque de France annual reports is very disappointing in this respect. As a matter of fact, the BdF remains very reticent about its own interventions and describes the major evolution of intervention rates as resulting from a 'favorable' or 'unfavorable' 'internal' or 'external' environment.

4. Impact of international financial integration on the transmission of monetary policy

In this section the impact of interest rate shocks, which were identified to be money supply shocks, on the variables of the model are simulated. The results depend strongly on the inclusion of a foreign influence variable in the model. That is why the results for 6 different models are presented. One of them does not include any 'foreign variable' while the others include successively the variables introduced in section 2[18].

Macroeconomic

The results of the simulations show (**Figure 7**) the money supply shocks in the first column of the small graphs, and impact on other variables of the model in the following columns. Each of the six lines corresponds to the model where the foreign variable indicated over each graphs is included as exogenous. The major result is that the impact of adverse money supply shocks on prices and real activity depends very much on the inclusion or non-inclusion of a 'foreign influence' variable. As a matter of fact, the

[18] Investigating interest rates linkages in Europe has been undertaken in a literature of its own. Garcia-Herrero and Thornton (1996) show for instance that the leadership of German interest rates can not be proved while Henry and Weidmann (1994), who use high frequency eurorates conclude that there is a dominance of German rates over French ones, especially after reunification. The purpose of this paper differs from that in this literature, which concentrates on the relations between European and US interest rates. We just want to provide a first insight on the influence of foreign interest rates on the transmission of French monetary policy.

strongest impact of money supply shocks on industrial production is obtained in the first model, where no foreign influence variable is included. A forty basis points initial increase in the TMP rate leads to approximately a fifty basis points decrease in industrial production two years later. Prices also decrease progressively towards a quarter of a percentage point. A decrease of reserves and an appreciation of the exchange rate are also be observed.

In contrast, in the models where the German money market rate (third line), its spread with its US equivalent (sixth line), or the USD-DM exchange rate (fifth line) were included show little or no significant impact of money supply shocks on industrial production, prices and reserves and a much reduced appreciation of the exchange rate. One possible interpretation of these results is that interest rate increases, which have had strong adverse impact on the economy since 1987, are caused by international financial integration. Then, the responses of the domestic French economy to monetary policy shocks, conditional on this international context, is strongly reduced. In other words, there has been no autonomous French monetary policy since 1987. This is not surprising, since France remained in the EMS during the whole period of estimation and even tried to stick to former narrow bands after they officially broaden to 15 % in August 1993. Yet, the non-impact of French interest rate innovations on the economy is not trivial. For instance Smets (1996) tests and rejects a French monetary policy of which the exchange rate would be the unique operational target.

Besides, we show that the French monetary policy is neutralized not only by Germany short rates, but also by the USD-DM exchange rate, or by interest rates driving this exchange rate.

Procedural

The same simulation exercise (**Figure 8**) in the first procedural model (with the two money market interest rates) is then carried out. The impact of money supply shocks on industrial production is smaller than the one observed in the macroeconomic identification model. Impacts on prices and on the exchange rate are of comparable magnitudes. The difference in the impact of monetary policy shocks on industrial production and prices between the model including foreign variables, and the model which does not (in the first line of boxes) is not as strong as in the macroeconomic models. Yet, the inclusion of the US Federal Funds rate (second line of graphs) or of the spread between the US FFR and its German counterpart (sixth line of graphs) strongly alter the form of the responses of prices and of industrial production to money supply shocks.

This procedural model also allows the impact on the economy of a demand shock in the interbank market to be simulated. This is shown in **Figure 9**. It is observed that demand shocks on the interbank market correspond to a booming economy. Yet, this result might largely come from depressed demand in the interbank market around 1992 and 1993, as can be seen in the second box **Figure 6**.

Lastly, **Figure 10** presents some of the simulations from the 3-variables procedural model for prices, industrial production and the exchange rate. The results are difficult to interpret. The impact of the money supply shocks, obtained as orthogonolized residuals of the tender rate, on prices, industrial production and the exchange rate is almost nil. This is still observed when four out of five foreign variable are included as exogenous variables in the model. The exception is the spread between the French and the German interbank market rates, for which the identification scheme identified above is rejected. Besides, the impacts of 'money demand', assumed to be the orthogonalized residuals of the market rate, behave like restrictive money supply shocks. They trigger a decrease in prices and output, and an appreciation of the exchange rate. This last effect is much reduced if one of the four 'well behaved' foreign variables is included in the VAR. The impact of a shock to the MIX is also puzzling. Indeed, it leads to an increase in the interest rates and in output, but to a decrease in prices.

This last simulation exercise suggests that the 3-variable procedural model decomposes the variables of the French interbank market into shocks which are difficult to interpret. It might be the case that money supply shocks in this model should be represented by the orthogonalized market rate residual. In fact, it is coupled with a strong decrease in the MIX that raises the average price at which banks can access liquidity. The downward impact on prices and the appreciation of the exchange rate can then be better understood. Moreover, it is again found that the impact of French monetary policy is much reduced, if conditional on some foreign influence.

CONCLUSION

This paper has tried to propose improved ways of identifying money supply shocks in France. It uses a structural VAR approach in which it tests the impact of international financial integration on the transmission mechanism of French monetary policy. Two methods are employed. The first method, called macroeconomic, is simply to estimate macroeconomic relations, a money supply function, a money demand function and an exchange rate equation for the residuals from a standard VAR. The second method, called procedural, focuses on the dynamics of the interbank market and tries to disentangle supply forces from demand forces in this market. Each method leads to different money supply shocks.

The procedural method also shows that using only two interest rates to disentangle money supply from money demand is satisfactory, and that the interbank market reflects the state of the economy. Indeed, both the money supply and money demand shocks have the expected impact on the economy. Besides, the identification strategy using three variables from the interbank market leads to shocks which are more difficult to interpret.

French monetary policy has been influenced by international financial integration. This is shown within the structural VAR methodology in both kinds of identification schemes. Including some foreign variables as exogenous in the VAR, in particular the USD-DM exchange rate, the US short rate or the spread between the US and the German short term rates reduces, and/or makes the impact of money supply shocks on the economy disappear. One interpretation is that movements in interest rates affect the economy but are fully driven by determinants in the international financial markets.

Yet, these results should be taken with extreme caution. As a matter of fact, the paper also stresses one of the weaknesses of the VAR, however structural they may be. Even if structural VAR allow progress to be made in separating money supply-linked, interest rate increases from their money demand counterpart, it is still puzzling that shocks from the macroeconomic identification and the procedural identification schemes are different. Further research in this area would be welcome. It is also expected that deeper VAR analysis of the transmission channel of monetary policy would benefit from the kind of identification schemes of money supply shocks we have proposed.

APPENDIX 1 : A HISTORICAL SUMMARY OF VAR ANALYSES OF MONETARY POLICY

The first use of VAR models in studying monetary policy was already linked to identifying monetary policy. More precisely, Sims (1972) uses the possibility to test Granger causality in VAR models in order to shed some light on the *post hoc ergo procter hoc*[19] paradox, introduced by Tobin (1970). A VAR model does not *a priori* make a difference between endogenous variables and exogenous variables and it thus allows the Granger causality to be tested properly, that is to assert whether one variable contains information on another without assuming the exogenous character of the causing variable.

Sims has been the main promoter of this attribute of VAR, notably in the breadth of his 1980 article, « Macroeconomic and Reality », where he questions the core of traditional macro-econometric modeling. There again, as eight years earlier, the main advantage of using VAR rests on the equal status of all variables that enter the model. Sims disapproves of traditional macro-econometric models for relying on identification hypotheses whereby some of the variables have an exogenous status. Indeed, these models do not allow hypotheses of alternative economic theories to be tested because the passage from the reduced form to the structural form depends on identification assumptions. Sims's purpose was welcomed at the time of the rise of the rational expectations theory, itself incompatible with most of identification assumptions used in macro-econometric models.

The fact that reduced forms in macro-econometric models deliver good estimates stems from the correlations that exist between macroeconomic variables. It is therefore relevant to exploit the existence of these correlations with minimum assumptions. Sims proposes to use VAR models so that econometricians have only to choose the variables to be included in estimations and the number of their lags. Once the autoregressive form (AR) is estimated, its inversion into its moving average form (MA) is used to represent the response of each variable of the model to an innovation in another variable, that is to say to the error of each of the equations of the VAR model.

Let the true AR representation of the structural model between the k variable which form the vector Y_t be :

$$B_0Y_t + B_1Y_{t-1} .+ ... +B_pY_{t-p} = \varepsilon_t \text{ , or } B(L)\ Y_t = \varepsilon_t\ ^{20},$$

with p lags enough to represent the relationships between the k variables. ε_t are k structural shocks of the economy which are assumed to be serially uncorrelated and orthogonal to one another, so that their covariance matrix, D, is diagonal.

The MA form of this model is obtained by inverting B(L). We then can write

[19] The latin way to put that anteriority does not mean causality, or « Christmas cards do not make Christmas ».

[20] L is the lag operator and B(L) is a polynomial of order p.

$$Y_t = B(L)^{-1} \varepsilon_t = \sum_{i=0}^{\infty} MA_i \varepsilon_{t-i}$$

The MA matrices give the impact of any structural shocks on any variable i periods later.

For example, say a monetary policy model includes three variables: the monetary base, prices and unemployment. The estimation of a VAR model including these three variables allows the impulse response function of unemployment to a shock in the reserves money to be constructed. More exactly, the MA representation sets each variable as a linear combination of three series of errors associated to each of the three equations of the model. The error of the reserves money equation is an innovation, that is to say the part of the reserves money which is orthogonal to lags of the reserves money, the unemployment and prices. The MA representation of the model is used to calculate the impulse response of unemployment to this innovation[21], assimilated to a monetary policy shock. So doing, these simulations are consistent with rational expectations since it is the difference with the average reaction function in the past which is taken into account.

Nevertheless, if VAR estimation rests effectively on a minimum hypothesis, simulations necessitates proceeding with an identification. Indeed, errors of the different equations have no reason to be orthogonal to one another.

As a matter of facts, the estimated AR reduced form of the model is

$Y_t = A_1 Y_{t-1} + ... + A_p Y_{t-p} + u_t$ where the estimated residuals, u_t, are not orthogonal to one another. The MA form, obtained from the inversion of the estimated AR form, give the impact of a residual u_t on the variables of the model as follows :

$Y_t = A(L)^{-1} u_t$.

The fact that u_t are not orthogonal (their variance-covariance matrix, Ω, is not diagonal) to one another make the interpretations of simulated shocks difficult. In the example above, the residual of the money equation shock might be the sum of a structural shock on money and of the endogenous within a period response of money to the other variables. Proceeding to simulations from a VAR, i.e. interpreting the Impulse Response Functions, requires the decomposition of estimated residuals, u_t, into orthogonalized structural shocks, ε_t.

The relations between residuals and structural shocks can be deduced from the comparison of the estimated and the structural AR forms:

$u_t = [B_0]^{-1} \varepsilon_t$[22]

[21] The cumulated sum of the third row and first column elements of the MA matrices.

[22] Therefore, the relations between the u_t are the same as the contemporaneous relations between the genuine variables composing Yt.

It implies that Ω can be diagonalised into D, with $\Omega = [B_0]^{-1\,'} D [B_0]^{-1}$. From a statistical point of view, a standard variance-covariance matrix is transformed into a diagonal variance-covariance matrix. The structural shocks obtained are orthogonal to one another by construction.

Sims (1980) has recourse to an algebraic property of variance-covariance matrices to get orthogonal shocks[23]. There is a unic $[B_0]^{-1}$ matrix which is lower triangular. The economic meaning of this triangular decomposition is to assume that variables of the model follow a recursive order. The first variable of the model has an instantaneous impact on all others, and it is influenced by shocks on the other variables with a lag. The second variable of the model is influenced only by the first variable, but influences all others and thus of continuation. The fact that these recursivity constraints carry only on instantaneous relationships between variables while their dynamics are not constrained can appear as a relatively weak assumption. In fact, analyses of monetary policy carried out with more elaborate VAR have shown that the identification hypotheses largely determine impulse response function patterns. This therefore suggests the use of a VAR model whose hypotheses of identification are acceptable economically.

Among ulterior developments of VAR models for analyzing monetary policy, this paper is interested mainly in attempts of identification non-dependent of recursivity between economic variables. These VAR, which have recourse to an identification more adaptable according to economic theory are called structural VAR (SVAR). This second generation of VAR consists in researching a decomposition of the variance-covariance such that the obtained square root matrix ($[B_0]^{-1}$) is not necessarily triangular inferior.

Bernanke (1986) questions identification by recursivity and underlines the lack of theoretical support in testing the robustness of result which consists in validating patterns of impulse response functions by changing the order of the variables before undertaking a Choleski decomposition (see Appendix 1). Thus, Bernanke (1986) and Sims (1986), identify monetary policy shocks by setting the existence or the non-existence of simultaneous impacts between variables. It is an identification by addition of short term constraints. Later, following Blanchard and Quah (1989), who propose to identify SVAR by setting long term constraints between variables derived from economic theory-inspired long term multipliers, Gerlach and Smets (1995) use the long term neutrality of money to identify monetary policy shocks in the G7 countries.

Be it with short term or long term constraints, identification in SVAR models is done exactly in the same terms as identification in a model of simultaneous equations in traditional econometrics. The possibility of identification depends on an order condition and on a rank condition. The order condition requires that enough constraints are added to the coefficients of the model. The rank condition supposes that these constraints form a system that is both linear independent and compatible with non-linear constraints obtained from the first estimation stage of the VAR. More precisely, the FIML estimation of a SVAR containing n variables sets n(n+1)/2 quadratic constraints which come from the

[23] The uniqueness of the triangular factorisation of a positive definite symmetric matrix. In the VAR context, authors refer to the Choleski decomposition of the variance covariance matrix.

n(n+1)/2 fundamental elements of Ω. On the top of which at least (n(n-1))/2 constraints, *a priori* linear, must be added to make identification feasible [24].

APPENDIX 2 : THE BERNANKE-MIHOV FRAMEWORK OF PROCEDURAL IDENTIFICATION OF MONETARY POLICY

Bernanke and Mihov use five money market variables to identify monetary policy shocks : the federal fund interest rate(FFR), total reserves (TR), non-borrowed reserves (NBR), borrowed reserves (BR) and the interest rate that is applied to them (DISC). A block of 4 of these variables, and a block of 3 macroeconomic variables, (GDP, price of GDP and price of raw materials) forms a non-constrained VAR model. The identification of money supply shocks is deduced through placing hypotheses on relationships between innovations over the VAR of variables of the monetary market (respectively $u_{FF}, u_{TR}, u_{BR}, u_{DISC}$ and u_{NBR},). Bernanke and Mihov then link four of those innovations with three structural shocks, the money supply shock, the money demand shock and a shock on the preference of the banks on the borrowed or non-borrowed form of their reserves (respectively e^S, e^D and e^B). The VAR innovations and the structural shocks are related as follows :

(1. 1) $$u_{TR} = -a u_{FF} + e^D$$

(1. 2) $$u_{BR} = b(u_{FF} - u_{DISC}) + e^B$$

(1. 3) $$u_{NBR} = f^B e^B + f^D e^D + e^S$$

Equation **(1. 1)** establishes that innovations of reserve demand by banks react negatively to innovations of the price of these reserves, and positively to structural demand shocks. Equation **(1. 2)** establishes that demand for borrowed reserves at the discount window is modulated by the relative cost of these reserves and accessible liquidity in the market. Finally, **(1. 3)** describes the behavior of the central bank. The latter is supposed to observe, in the course of one period, structural shocks in demand for reserves and in demand for discount-window borrowing. One can then form hypotheses on a reduced form reaction function of the central bank by posing constraints on coefficients f^B and f^D.

An accounting equation can be added to this system, as total reserves is the sum of borrowed reserves and non-borrowed reserves. Moreover, they assume that innovations of the borrowed reserves discount rate are nil. The relationships between 3 innovations of the VAR and 3 structural shocks in the matrix form can be written as follows:

[24]. See Hamilton (1994) page 295 or Bruneau and De Bandt (1996) for a survey on Structural VARs.

$$\textbf{(1. 4)} \quad \begin{pmatrix} u_{TR} \\ u_{NBR} \\ u_{FF} \end{pmatrix} = \begin{pmatrix} -\left(\frac{\alpha}{\alpha+\beta}\right)\left(1-\phi^{D}\right)+1 & \frac{\alpha}{\alpha+\beta} & \left(\frac{\alpha}{\alpha+\beta}\right)\left(1+\phi^{B}\right) \\ \phi^{D} & 1 & \phi^{B} \\ \left(\frac{1}{\alpha+\beta}\right)\left(1-\phi^{D}\right) & -\left(\frac{1}{\alpha+\beta}\right) & -\left(\frac{1}{\alpha+\beta}\right)\left(1+\phi^{B}\right) \end{pmatrix} \begin{pmatrix} \varepsilon^{D} \\ \varepsilon^{S} \\ \varepsilon^{B} \end{pmatrix}$$

Inverted, this system allows a monetary policy shock to be calculated as a linear combination of innovation of the VAR model.

$$\textbf{(1. 5)} \quad \varepsilon^{S} = -\left(\phi^{D} + \phi^{B}\right)u_{TR} + \left(1+\phi^{B}\right)u_{NBR} - \left(\alpha\phi^{D} - \beta\phi^{B}\right)u_{FF}$$

The three innovations provide three variances and three covariances to estimate 7 unknown parameters: the variance of each of the structural shocks (their covariances are assumed to be nil for the shocks to be orthogonal), and the four parameters of the model α, ϕ^{D}, β and ϕ^{B}.

Without supplementary hypotheses, this system is under identified by one degree. However, it establishes a general framework on the basis of which it is possible to form supplementary hypotheses in order to lift the under-identification.

For example, Bernanke and Blinder (1992) make the hypothesis that the Fed seeks to fix the level of the federal fund rate. This implies that the Fed accommodates fully demand for reserves shocks and demand for borrowed reserves shocks, so that $\phi^{D} = 1$ and $\phi^{B} = -1$. We then have money supply shocks which are proportional to innovations in the Federal Funds rate:

$$\textbf{(1. 6)} \quad \varepsilon^{S} = -\left(\alpha - \beta\right)u_{FF} .$$

Christianno and Eichenbaum consider that innovations of non-borrowed reserves translate exclusively monetary policy impetuses (i.e.,$\phi^{D} = 0$ and $\phi^{B} = 0$). So that:

$$\textbf{(1. 7)} \quad \varepsilon^{S} = u_{NBR} .$$

Bernanke and Mivhov then describe Strongin (1992) approach through making three hypotheses: the Fed is constrained in the short term to accommodate shocks of demand for reserves ($\phi^{D} = 1$); he is not preoccupied with the impact of shocks on borrowed reserves ($\phi^{B} = 0$); and finally, innovations of demand for reserves do not depend on innovations of the interest rate (α=0). The monetary policy shock becomes then:

(1. 8) $$e^{S} = -\left(f^{\,D}\right)u_{TR} + u_{NBR}\,.$$

Bernanke and Mihov use developments around the system **(1.4)** to propose other identification schemes which might be relevant in the case of the US monetary policy.

DATA APPENDIX

All the data are monthly series, available from January 1987 until the middle or the end of 1995. They are gathered from various publications of the Banque de France, or from International Financial Statistics published by the I.M.F.

VAR models induce limitation of the number of variables to be included in the model. In addition to variables used for the identification of monetary policy, we will retain three variables:

- a variable representative of the activity level,
- a variable for domestic prices, (eg, the consumer price index) and,
- the exchange rate to the Deutsche mark.

The use of monthly variables induces a representation of macroeconomic activity relying on indicators. The retained variables include the industrial production, whose monthly index is often used in this literature; and the unemployment rate, whose fluctuations over the period appear to be largely determined by the business cycle. As a matter of fact, the rate of unemployment decreased from 11% in 1987 to 9% in 1991, before it rose back to 12,5% in 1994 (**Figure 2**).

Exogenous variables to be included as instruments for the exchange rate and or to test for the role of the international influence of French monetary policy are:

- *the index of raw material prices,*
- the USD-DM exchange rate,
- the German or the US money market rate,
- the spread between German and US short term interest rates, and,
- a dummy variable for speculative attacks against the EMS.

This dummy variable is constructed in the following ways: it takes the value 0 except when the spread between German and French short rate suddenly increases over some threshold (**Figure 3**), when it takes the value 1. Four speculative attacks against the French franc appear clearly on the graph of this spread, most of the time around an election in France: March 1995, August 1993, January 1993 and September 1992.

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FIGURES

Figure 5
Smoothed money supply shocks identified with the macroeconomic models :

The model either includes no foreign variable or successively the US federal term, the German money market rate, the spread between the French and the German short rates, the US-DM exchange rate and the spread between the German and the US short term rates as an exogenous variable.

Figure 6
Smoothed shocks identified with the procedural models :

In box 1 and 2, the plain line corresponds to the model with only the two interest rates (tender rate and market rate), and the dotted line to the model where the industrial production, the prices and the exchange rate FF-DM are also included.

In box 3, 4 and 5, the plain line corresponds to the model with only the two interest rates (tender rate and market rate) and the MIX, and the dotted line to the model where the industrial production, the prices and the exchange rate FF-DM are also included.

Figure 7
Macroeconomic model
Responses of the economy to shocks in the TMP (money supply shocks)

The first line corresponds to the model with the foreign variable. Following lines correspond to models where the US federal funds rate, the German money market rate, the spread between the French and the German short rates, the US-DM exchange rate and the spread between the German and the US short term rates were successively included as exogenous.

The shocks are given in the first column.

Figure 8
2-variable procedural model
Responses of the economy to shocks in the Tender rate (to interbank market supply shocks)

The first line corresponds to the model with no foreign variable. Following lines correspond to models where the US federal funds rate, the German money market rate, the spread between the French and the German short rates, the US-DM exchange rate and the spread between the German and the US short term rates were successively included as exogenous.

The shocks are given in the first column.

Figure 9
2-variable procedural model
Responses of the economy to shocks in the TMP rate (to interbank market demand shocks)

The first line corresponds to the model with no foreign variable. Following lines correspond to models where the US federal funds rate, the German money market rate, the spread between the French and the German short rate, the US-DM exchange rate and the spread between the German and the US short term rates were successively included as exogenous.

The shocks are given in the first column.

Figure 10

3 first lines for the model with no foreign variables,

3 last lines for the model which includes the spread between the US and the German interbank market rates

Impact of shocks to the Tender rate (first and fourth line)

interbank market rate (second and fifth line and

the mix (third and sixth line) on the

Tender rate (column 1), the TMM col.2), the mix (col.3), the prices (col.4), the IP (col.5), and the ex.r (col.6)

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