

Essays on Monetary Economics

by

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Abstract

Chapter 1: We contrast the impact of monetary policy shocks on long interest rates in the United States, Great Britain, Germany and France. Monetary policy is defined as actual central bank actions - such as changes in discount rates or minimum reserve requirements - which were implemented with the intention of affecting economic conditions in a non-transitory fashion. We use the change in the three month interest rate on the day of the policy announcement as a measure of the unanticipated policy content of the action. We then regress the change of long rates on the day of the policy action on our measure of unanticipated policy. There are two main results. First, there is a statistically significant response of long rates to monetary policy in the "conventional" direction - upward for contractions, downward for expansions - for all countries. Second, the magnitude of the response varies greatly across countries. It is much greater for the U.S. and the U.K. than for France and Germany. However, the difference seems to have declined in recent years, with the French sample exhibiting a clear structural break in 1986-87, the years of financial liberalization.

Chapter 2: The method used in Chapter 1 is extended for the purposes of estimating the dynamic response of various macroeconomic variables to monetary policy shocks. We construct "actions-based policy indices" for the U.S., the U.K., Germany and France in which the monetary shock content of periods in which policy actions happened is equated to the sum of the three month rate responses to policy actions in each period, and zero shock content is assigned to periods in which no policy action occurred. These indices are then used as exogenous inputs in a VAR containing major macroeconomic variables. The validity of this approach is based on a set of assumptions which we believe are weaker than those of standard VAR-based approaches. On the other hand, our method overcomes the principal problems of the "narrative approach" to policy identification - potential endogeneity of the events identified, failure to quantify the magnitude of the shock, and a very small set of policy events. Our main results are as follows. First, we confirm the qualitative results of the standard VAR literature regarding the effects of monetary policy shocks on output, money and short interest rates. Second, inclusion of a commodity price index in our VAR resolves the "price puzzle" noted by Sims (1992) for the United States, but not for the three other countries. Third, the puzzling exchange rate dynamics noted by Eichenbaum and Evans (1993) are less apparent for the U.S., while the evidence from the European countries in our sample is ambiguous. Fourth, the dynamic response of long interest rates to an unanticipated monetary contraction/expansion resembles that of short rates, except that the return to normal levels following the initial jump is more sluggish.

Chapter 3: I study the response of real and nominal interest rates and inflationary expectations in the United Kingdom to monetary policy shocks. In analogy to the method of Chapter 1, I use nominal and index linked bonds to derive a market based measure of inflationary expectations for horizons up to twenty five years. The monetary policy index of Chapter 1 is used as a measure of monetary policy shocks. There are two main findings. First, a contractionary shock, defined as an unanticipated increase in the three month interest rate, is associated with significant increases in real and nominal interest rates at all horizons up to twenty years. The second, and more surprising, finding is that contractions are associated with an increase in inflationary expectations over horizons up to fifteen years. One interpretation consistent with efficient markets might be that monetary policy actions reveal the monetary authorities' superior information to the private sector. However, the size of the effect and its prevalence even for long-term inflationary expectations make this explanation unconvincing. I thus conclude that we have a puzzle that is as yet unsolved.

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Introduction

The effectiveness of monetary policy has long been an important topic for macroeconomists. In this thesis we explore this theme on a variety of fronts. Chapter 1 answers an important policy question that is of much current interest. Chapter 2 makes a major methodological contribution to the literature on identification of monetary policy shocks and contains some new empirical results. Chapter 3 confirms the existence of a significant empirical puzzle from a new perspective.

Chapter 1, "Long Rates and Monetary Policy: Is Europe Different?" asks a question that has been of great topical interest in recent years, namely the ability of monetary authorities to affect long term interest rates. We adopt an historical approach to identifying monetary policy shocks. We look at all changes in Central Bank intervention rates or minimum reserve requirements and then exclude actions which constituted within day policy responses or coincided with other major news. The key insight of the chapter is that the unanticipated content of a policy action can be captured by considering the change in the three month interest rate on the day of the action. There are two main findings. First, there is a significant response of long rates to unanticipated monetary policy in the expected direction, upwards for contractions and downwards for expansions for all of the four countries we study (U.S., U.K., Germany and France). Second, the magnitude of the response differs greatly across countries.

While Chapter 1 looked at the static effects of monetary policy on a single variable, the long term interest rate, Chapter 2 addresses a question that has a long history in economics, namely the dynamic effects of monetary policy on a whole range of economic variables. The methodological contribution of this chapter is the means by which the identification of monetary policy shocks is achieved. If one assumes that central banks do not, in general, act on information unavailable to market participants, then our measure of unanticipated policy from Chapter 1 - the jump in the three month rate on the day of a policy announcement - reflects the truly *exogenous* content of that action. Aggregating these daily shocks gives a monthly policy index that can be viewed as measuring the structural errors from a monetary policy reaction function for monthly data. We find this approach at identification to be superior to the standard VAR-based approach since the assumptions underlying identification are substantially weaker. The empirical results of this chapter are also of considerable interest. The effects of monetary policy shocks on output and money confirm earlier evidence and are in line with expectations. By contrast, the evolution of prices following monetary policy shocks is puzzling. For all four countries (U.S., U.K., Germany and France) a monetary contraction is followed by increases in the price level. The inclusion of an additional variable in the system that some had suggested

might explain this behavior partly resolves the puzzle for the U.S. but not for the other three countries. The other major empirical result of the chapter concerns the dynamics of exchange rates. For the United States we find that the exchange rate evolves almost exactly as predicted by the textbook Dornbusch model following a policy shock. This finding contradicts the results in a much publicized recent paper by Eichenbaum and Evans.

Chapter 3, "Monetary Policy, Real Interest Rates and Inflationary Expectations: Evidence from the U.K." takes up issues from both of Chapters 1 and 2. In Chapter 1 we learned that unanticipated monetary expansions are associated with declines in long term nominal interest rates, while contractions are associated with increases. However, as we noted in that chapter, an unambiguous inference concerning the direction of the change of long term real interest rates, the variable of primary interest, can only be made if one makes an assumption concerning the direction of the change of inflationary expectations following a policy shock. In Chapter 2 we learned that, contrary to expectations, the price level tends to rise following contractionary monetary policy shocks. Chapter 3 makes use of evidence from the United Kingdom index linked bond market to infer inflationary expectations over very long time horizons. I then see how real and nominal interest rates and inflationary expectations respond to monetary policy shocks. There are two principal findings. First, confirming the results of Chapter 1, a contraction is associated with significant increases in both nominal *and real* interest rates at all horizons up to twenty years. Second, following contractionary shocks inflationary expectations tend to *increase* significantly over horizons up to fifteen years. This surprising result confirms the evidence from Chapter 2. I interpret it as providing some support for the view that monetary authorities have superior information about the state of the economy than the private sector and this superior information is then revealed through policy actions. However, the magnitude of the effect is so strong that this explanation cannot possibly be the whole story. Since alternative explanations rely on bond market inefficiencies I conclude that we have a major puzzle.

Chapter 1

Long Rates and Monetary Policy: Is Europe Different ?

(joint with Jeromin Zettelmeyer)

I. INTRODUCTION

The past eighteen months have been trying economic times for France and Germany. By January of this year industrial production in West Germany had fallen more than 13% below its previous peak, the steepest decline in industrial production since World War II. The recession in France has been less severe but came after two years of sluggish growth and already very high unemployment. The unemployment rate in France now stands in excess of 12%, a post-war peak. Yet the central banks of both countries, the Deutsche Bundesbank and the Banque de France, have been slow and reluctant to cut short term interest rates in order to stimulate economic activity. While in Germany this reluctance initially resulted from the fact that inflation rates were still relatively high (inflation topped 4.5% in the spring of 1992, by now it has fallen to a little over 3%), there also seems to have been a general skepticism regarding the ability of monetary policy to affect long term interest rates through reductions in short rates. For instance, the June 1993 report of the Bundesbank reads: "The recommendation expressed in some quarters that monetary policy in Germany be used more strongly, via a drastic cut in short term interest rates, to overcome the sluggishness of business activity fails to recognize the significance a credible anti-inflation policy has not only for the exchange and capital markets but also for future economic development. It was mainly because it was believed that monetary policy makers would succeed in bringing down the rates of inflation to acceptable levels that long-term interest rates declined by more than 2 percentage points between the middle of last year and March 1993. The subsequent further decrease in money market rates did not bring any response on the part of the rates at the long end of the financial market; they temporarily even rose slightly ... What is required of monetary policy makers in this situation is to proceed cautiously so as to avoid setbacks on the capital market."¹ Similarly, the Banque de France pointedly avoided making use of the wider exchange rate margins after the July 1993 EMS crisis by lowering short rates at a faster

¹ Deutsche Bundesbank, Monthly Report June 1993, p. 14-15.

pace. In fact, the summer events seem to have added to its caution. Almost three months passed after the widening of the margins before the Banque reduced its intervention rate below its July level, waiting for two cuts in the Bundesbank's discount and lombard rates before taking its own action.²

The objective of this chapter is to examine and compare the effect of monetary policy on long term interest rates in four countries: the United States, the United Kingdom, Germany and France. Our main questions are: first, whether there is a significant response of long rates to monetary policy in the "conventional" direction, namely, downwards for expansions and upwards for contractions. Second, we ask whether there are major differences in the way in which long rates respond to policy across the four countries, and if so, whether these differences are robust across time and types of policy actions.

Our approach to answering these questions is as follows. Any model incorporating rational expectations and arbitrage between long and short interest rates - i.e., any model in which long interest rates are a forward-looking variable - will have the following three properties. (i) If long nominal interest rates react at all to a monetary policy action, they will jump following the policy announcement; the rest of the dynamics (if there is any) will merely consist in some slow adjustment to a long run steady state value. Thus, it is sufficient to focus on the impact effect of monetary policy on long rates. (ii) Only unexpected monetary policy actions should affect nominal long interest rates. (iii) Transitory shocks to the level of money should have only negligible effects on long term interest rates.

If the above three properties are assumed, the two questions we are interested in can be made precise in a very simple fashion. First, we would like to test the null hypothesis that *unexpected, non-transitory monetary policy shocks* do not prompt jumps of long nominal interest rates in the "conventional" direction (i.e. nominal long rates either don't react at all, or they react "perversely", jumping up for expansions and down for contractions). Second, we would like to compare the magnitude of the average jump across countries. Both questions can be answered by regressing the immediate reaction of long nominal rates following a policy announcement on an index of unexpected monetary policy shocks for each country, and performing the usual t-test. Should we reject the null (i.e. we find a statistically significant response of nominal interest rates to policy in the "conventional" direction) we can even go on to make an inference about the effect of unanticipated monetary policy on long *real* rates, as long as we are willing to make one additional assumption - namely, that

² The *taux de pensions sur appel d'offres*, the Bank's main intervention rate, was cut from 6.75%, its level since early July, to 6.45% on the 22nd of October.

expansionary monetary policy will generally increase, and never reduce inflationary expectations, while contractionary policy will do the reverse. Then, from the Fisher relationship, we know that if we observe a fall in the long nominal rate as a result of a monetary expansion (or an increase in the long nominal rate following a contraction) then the real long rate must also have decreased (increased), by a *greater* amount.³

As it stands, the method sketched above is not yet useful, because it presupposes that for each country we have an index of unexpected monetary policy shocks at our disposal. We are thus left with two problems to resolve: first, how to define and quantify “non-transitory” monetary policy actions and second, how to determine to what degree these actions were unexpected.

Regarding the problem of identifying non-transitory monetary policy events, our approach is akin to that of Romer and Romer (1989) in that we define monetary policy as actual policy actions (such as changes in discount or intervention rates or in minimum reserve requirements) undertaken with the *intention* of affecting economic conditions in a non-temporary fashion (say over a business cycle horizon).⁴ On the other hand, we differ from Romer and Romer in the way we attempt to ensure that our events are uncorrelated with contemporaneous economic information. Rather than restricting ourselves to certain kinds of contractionary events,⁵ we focus on very short time periods - namely, reactions of the long rate to a monetary policy announcement on the same day - and make sure that the policy action was not an endogenous response to information released *on that day*. These issues will be discussed in more detail in Section II.1. below.

Next, we resolve the issue of quantifying the unexpected portion of these actions by taking the jump in a three month money market rate following the policy announcement as a proxy for the magnitude of the unexpected shock. The idea is that the three month rate is sufficiently *short* term that the monetary authorities may be thought of controlling it (even those who doubt the ability of policy to control long interest rates would agree that a central bank can set money market rates in the short run). On the other hand the three month rate is sufficiently *long* that it will not react to a policy action that was anticipated - on the day

³ Note that the inference from the response of nominal to the response of real rates is possible if *and only if* nominal interest rates are found to react in the conventional direction. If we observe an increase in the nominal long rate following a monetary expansion, we can make no inference - this may be consistent with long real rates falling or rising, because the expected inflation effect may lead to a “perverse” reaction of long nominal interest rates even if real rates fell after an expansion, or increased after a contraction.

⁴ For the more detailed definition of what we counted as a monetary policy action, see Section II.2. below.

⁵ See Romer and Romer (1989), p. 134 and Section II.1. below.

before the action, the three month rate should incorporate all expectations of policy actions over the next three months. Thus, changes in the three month rate on the day of a policy announcement enable us to extract the "unexpected policy" content of quite different types of actions, say changes in minimum reserve requirements, or a change in a discount rate.

Summing up, our method involves two steps: for each country, we use information from central bank reports and newspapers to draw up a list of days on which monetary policy announcements happened - ruling out instances when policy actions reacted to within day news and also days in which other major news hit bond markets. We then regress long rate changes on those days on changes in the three month interest rate on the same day.

Our main qualitative results are as follows. For all countries, unexpected monetary policy shocks are associated with movements of nominal long rates in the "conventional direction". In other words, the relationship between changes in the three month interest rate on the day of a policy announcement and long interest rate changes on the same day is positive and significant. Second, the coefficient on the changes in short rates is much smaller in the case of France and Germany than in the case of the U.S and the U.K. (even though it is still highly significant). Finally, while the *ranking* of the coefficients is more or less robust across time periods, there is strong evidence that in recent years the coefficient has increased for France and, to a lesser extent, for Germany. The differences across our sample of countries seem to have become *less* pronounced since the late eighties. We thus conclude that the skepticism by the French and German monetary authorities described above is not borne out by our results - even though it is true that substantial differences in the response of long rates to monetary policy have existed, and to some extent do still exist across countries.

Below, we begin by explaining our methodology in more detail and go on to explain the criteria employed in including certain central bank actions in our set of policy events and excluding others. Section III presents our estimation results, followed by a conclusion. The appendix contains a detailed documentation of our set policy events, an example of a model which will generate the basic assumption (i) - (iii) presented above (as well as some stronger implications which turn out to be consistent with our results), and a description of our data sources.

II. METHOD

1. A procedure for assessing the effect of monetary policy on long rates

Consider the following three propositions:

- (i) Long interest rates (nominal and real) are unaffected by transitory shocks to the money supply.⁶
- (ii) If long nominal rates are affected at all by shocks to the money supply, they will jump when the money supply announcement is received by bond markets.
- (iii) Long nominal rates only jump, if at all, to the extent that the money supply announcement was unanticipated.

In the appendix, we give an example of a simple model of monetary policy and interest rate dynamics which will generate these propositions. Because this model embodies a nominal rigidity - namely, inflation inertia - it will in addition have some Keynesian implications (monetary authorities can influence long real interest rates in the short run). However, as argued in the introduction, the three properties above are quite general and in no way depend on the specific Keynesian features of the model. We thus feel justified in assuming them in the remainder of the chapter.

Once (i) to (iii) have been assumed, the first question motivating this chapter - "can central banks influence long interest rates?" - can be given a precise meaning. "Is there a statistically significant immediate response of long interest rates to unexpected, non-transitory policy shocks?" In other words, the concern of the central banks cited at the beginning of the chapter is transformed into a null hypothesis, which states that the immediate response of long nominal rates to unexpected non-transitory policy actions is zero, or goes the wrong way. We try to reject this hypothesis by testing a linear inequality in the usual fashion, i.e. by running a regression of long rate responses on an index of non-transitory unexpected policy for each country and applying a t-test. Should we reject, we can go a step further and interpret our results as evidence for a short-run effect of monetary policy on long *real* rates, as long as we are willing to assume that expansions are associated with increases in inflationary expectations and conversely for contractions. Finally, note that the second question asked in the introduction - "are there major differences in the long rate response to policy across

⁶ In practice, we viewed monetary events as transitory when there was a clear expectation that they would be reversed within a few weeks.

countries?" - will be answered as a by-product, by comparing regression coefficients for the four countries we study.

We are now left with the question of how to construct an appropriate policy index. Two major methodological problems need to be addressed. The first is the standard problem of endogenous right hand side variables. Suppose we take some observable measure which we know is affected by monetary policy, such as short term interest rates, or some monetary aggregate. In general, these will also move in response to shocks to money demand, as well. Even if we regress changes in long rates on some more direct measure of policy such as changes in the discount rate (or use these as instruments in a regression of long rate changes on short rate changes), the policy actions might themselves be the result of the policy maker's endogenous response to news on output or inflation. Either way, our policy measure will be correlated with the error term, resulting in biased and inconsistent estimates.

The second problem we face is that according to property (iii) above, only unanticipated monetary policy actions should affect the long rate. Thus, even if we were able to identify policy actions which are uncorrelated with contemporaneous economic information, simply regressing the change in the long rate on, for instance, changes in the discount rate would tend to underestimate the effects of policy, if the discount rate changes were to some extent anticipated.⁷ The same problem would arise if we regressed the change in the long rate on the change in an appropriately instrumented overnight rate since the overnight rate will respond to both anticipated and unanticipated actions.

We have attempted to provide a solution for both problems in the following way. The problem of endogeneity becomes less and less acute as one increases the frequency of one's data. Over a given month it may be impossible to determine to what extent a change in the short rate is due to, say, a discount rate increase and how much comes from shifts in money demand. During the moment at which the action takes place, however, we may be confident that any change in the short rate is entirely due to the action. Similarly, policy itself is less likely to be an endogenous response to within-period economic information the smaller the length of the period we are considering. We therefore utilize the highest frequency data available for long interest rates, namely daily data, and identify days on which monetary policy actions took place. Monetary policy events that happened on the same day as other significant economic events or news to which either financial markets or the authorities

⁷ To avoid misunderstandings, we should clarify that anticipated monetary policy actions may still have an effect on the long rate, but the long rate will respond at the moment that the action becomes anticipated rather than at the time the action takes place.

might have reacted, are excluded.⁸ In all other cases, we assume that monetary policy was based on information about the economy which was at least one day old, which seems quite a weak assumption.

We solve the problem of determining the unanticipatedness of an action by using a very simple market measure. While a three month treasury bill rate (or some other three month rate) is sufficiently short term that the monetary authorities may be thought of as determining it, any changes in this rate on a day to day basis will be, to a first approximation, unanticipated.⁹ We therefore take the change in the three month treasury bill rate on the day on which a policy action was announced as our measure of unexpected monetary policy. Note that this measure enables us to quantify the unexpected policy content of completely different types of actions, such as discount rate changes, minimum reserve changes and quantitative constraints on bank borrowing from the central bank.

A potential shortcoming of this approach is that the three month treasury bill rate may move on the day of an action either if the event is to some extent unexpected or if the action happens somewhat earlier than anticipated, since then the changed instantaneous interest rate will prevail for a longer period over the next three months. However, if the three month treasury bill rate moves only because an anticipated action happens, say, two weeks before it was expected to happen, we should expect no response from the long rate. Thus, events of this type would lead us to underestimate the true response of long interest rates to unanticipated policy shocks. If this effect is relevant, it should thus strengthen our results, provided we find a significant response of long rates to policy.

⁸ In practice, the problem of a within day policy reaction has mostly arisen in the case of Britain, where monetary policy is ultimately in the hands of one person (the Chancellor of the Exchequer) and rapid responses to, for example, poor trade figures are relatively common. For the United States, Germany or France such rapid reactions are less frequent although we also excluded some events because of within day policy responses for the US and France. The most notable was the reduction in the US discount rate in July 1992 that came less than an hour after the publication of very disappointing employment figures. The yield on the 30 year Treasury bond fell 11 basis points within 2 minutes of the publication of the unemployment numbers as the markets anticipated a response from the Federal Reserve and then barely moved when the discount rate was actually reduced.

⁹ Just as arbitrage should hold between short and long bonds, it should also hold between overnight and ninety day paper. Thus, if the three month rate is above the overnight rate there must be an expectation that three month rates will rise over the course of the next day in order to generate a small capital loss and thus equate expected holding period returns. However, even if the overnight rate is a full point lower than the three month rate this will only generate an expectation of a one basis point change in the three month rate, compared to typical reactions on the day of our policy events of twenty basis points or more. We thus feel safe in assuming that all of the change in the three month rate is unexpected.

In summary, our method is to identify the days on which there was a non-transitory monetary policy action (to be defined in more detail below) without any other confounding influences and then regress the reaction of long rates to changes in the three month interest rate on these days.¹⁰

We would like to close with a remark on the relationship between our method and that of the influential Romer and Romer (1989) paper, to which we are heavily indebted. The similarity between our method and that of Romer and Romer lies in the general way in which we record policy actions. As will be explained in more detail in the next section, we follow them in employing an historical approach, which uses information from Central Bank reports and newspapers and focuses on the intentions of policy-makers. We differ from Romer and Romer, however, in the way in which we attempt to ensure that the policy decisions whose effects we want to study are not endogenous responses to contemporaneous economic variables. Romer and Romer attempt to ensure exogeneity by considering only contractionary policy shocks which are a result of policy makers' worries about "trend inflation".¹¹ Their argument is that such "anti-inflationary shifts in policy" are contemporaneously uncorrelated with other shocks to output, their left hand side variable of interest. In other words, they treat contractionary policy actions as if they were exogenous Fed taste shocks. We are not convinced that limiting oneself to policy actions triggered by inflation worries implies that monetary policy is not, in general, a reaction to within month economic information (their study is based on monthly data). By contrast, considering very short time periods and excluding exceptional cases of within-day policy responses by checking the circumstances of a policy decision in the contemporaneous financial press seems a safe method to avoid policy endogeneity on that day.

2. Definition of monetary policy actions and practical problems

The above discussion still leaves the question of what central bank actions should be part of our basic catalog of monetary policy events for each country. Departing from a set of all published central bank actions, such as changes in discount or other central bank interest rates, open market operations, changes in minimum reserve requirements, rediscount quotas etc., we selected "monetary policy events" according to two criteria. First, we want central

¹⁰ Another way of thinking about this, of course, is that we are regressing changes in long rates on changes in the three month rate using daily data, instrumenting with a policy index which assigns a 1 to the days on which a monetary policy action happens.

¹¹ Romer and Romer (1989), p. 134.

bank actions to reflect policy intentions rather than a passive accommodation of money demand movements. The rationale behind this distinction is that the signal to noise ratio on days corresponding to passive central bank actions is likely to be much smaller than on days corresponding to “policy driven” actions. For example, suppose that market interest rates fall because of a reduction in money demand, and that the central bank subsequently lowers the discount rate to keep some distance between the two rates. Since this merely shows the intention of the central bank to accept a level of market rates as it resulted from the money demand shift, it is unlikely to lead to a further reduction in rates. The inclusion of this instance into our data set would thus merely add noise. In practice, the distinction between “policy driven” and “passively accomodating” actions is not always completely sharp, which is why we give an overview of typical cases we excluded under this criterion below, and discuss each excluded case individually in the appendix.

Our second criterion is “non-transitoriness”, which is clear from assumption (i) above. Under this criterion, we excluded instances in which it was clear at the time of the announcement that the policy action would probably be reversed within a few months.

In the following, we list typical cases in which actions of the monetary authorities did *not* meet our definition of a non-transitory monetary policy shock. The first three are cases of actions which failed our “policy-drivenness” criterion, while the last two failed our “non-transitoriness” criterion.

- (i) An increase in activity leads to an increase in market interest rates to which the monetary authorities react by raising central bank rates “in order to bring the discount rate closer to the interest rate level in the money market” or “in order to reduce the subsidy character of the discount rate”.¹²
- (ii) An increase in activity leads to upward pressure on market interest rates and an increase in liquidity needs by the banks to which the monetary authorities react by lowering reserve requirements/raising rediscount quotas.
- (iii) A capital inflow leads to an increase in bank liquidity which the monetary authorities attempt to offset by increasing minimum reserve ratios.
- (iv) The monetary authorities attempt to fend off a speculative attack by temporarily increasing interest rates.

¹² See, for example, Bundesbank Annual Report (1984), p 22.

- (v) Any action by the monetary authorities affecting short interest rates which was accompanied the explicit intent of leaving long interest rates unaffected and/or the announcement of future offsetting actions to this effect (for example, a decrease in minimum reserve requirements limited to a certain period).

Actions undertaken with the primary objective of affecting domestic economic conditions such as stimulating activity or combating inflation were always counted as non-transitory monetary policy shocks. On the other hand, non-transitory actions which were motivated by external policy considerations - such as a balance of payments deficit - but conflicted with domestic objectives, were labeled “external” and recorded as a separate category (the reasons for making this distinction will become apparent in the following section). A detailed description of which actions were classified as “external” is contained in Appendix A1.

III. ESTIMATION RESULTS

The result of our efforts to define monetary policy actions for each country is a set of 61 events for the United States, 86 for the U.K., 90 for Germany and 54 for France, where data availability problems restricted us to a smaller sample period (1977-93 rather than 1965-93, as for the other countries - see Appendix A3).¹³ In the following, we now make use of the policy indices based on these events to answer the central questions of this chapter: how do long interest rates react to unexpected monetary policy shocks? Are there major differences between the four countries discussed above?

Before we present our results, we need to briefly address a conceptual issue: even if the structure of our economies were completely invariant across our sample period, there is no reason to expect that the reaction of long rates to a given unexpected policy shock should necessarily be the same at all times. This is because the perceived “permanence” of the shock might differ across situations and types of actions, in spite of our efforts to exclude transitory policy shocks.¹⁴ For example, contractions might be believed to be less permanent than expansions and thus generate a smaller reaction of the long rate. Similarly, the expected permanence of domestically motivated actions might differ from that of actions which were

¹³ The starting point of 1965 was chosen because bond yield data was unavailable for Germany before the early sixties.

¹⁴ In Appendix A2 we study how the “permanence” of a shock to the money supply affects the reaction of long nominal and real interest rates in the context of a specific model.

undertaken solely for external reasons.¹⁵ Finally, the perceived permanence of certain types of actions might vary across periods, say because of differences in the credibility of various central bank governors or governments.

After discussing the scatter plot and basic regression for each country, we thus split up the data according to type of action (domestically versus externally motivated, expansionary versus contractionary) and according to "policy phases", i.e. sequences of historically related contractions and expansions. From the discussion above and our model in the appendix, the main candidate for explaining significant differences between regression coefficients upon splitting the sample are differences in the perceived permanence of some policy action.¹⁶ In several instances, we shall, however, go beyond this interpretation to tell an informal story which might plausibly explain some empirical finding.

1. Basic regression and scatter plots

Table 1 summarizes the results from our basic regression for each country (change in long rate on change in three month rate upon announcement of a monetary policy action):

Table 1

	United States	Great Britain	Germany	France ¹⁷
Coefficient	0.412	0.279	0.101	0.087
Std errors	(0.042)	(0.024)	(0.010)	(0.021)
N	61	86	90	54

There are two points to note from the table. First, the coefficient on the change in the three month rate is positive and highly significant in all countries. The null hypothesis of no positive response of long rates to unanticipated monetary policy shocks is rejected at very high significance levels ($p < 0.001$ in all cases). Second, there is a large difference in the

¹⁵ For example, an exclusively externally motivated action might be regarded as relatively temporary because economic agents think that it could be rapidly undone following changes in the external environment (say a devaluation or a change in the exchange rate regime). On the other hand, there are situations where one would expect the perceived permanence of an externally motivated action to be higher than that of a corresponding domestic action, say if a strong national commitment to maintain the exchange rate is combined with the perception of a permanent tightening abroad. Whether the distinction is relevant and which way the difference in perceived "permanence" goes may also depend on the country under consideration.

¹⁶ In addition to structural breaks, for the case of splitting the sample into historical phases.

¹⁷ Preliminary results based on Eurofranc money market rates (see Appendix A.3).

magnitude of the coefficients across countries ranging from around 0.1 for France and Germany to over 0.4 in the United States. This difference is perhaps consistent with differences in beliefs of Central Bankers (and, to some extent, the general public) in the four nations regarding the effects of monetary policy on long rates. The Chairman of the Fed and the Chancellor of the Exchequer/Governor of the Bank of England tend to be characterized by a much greater belief in their ability to influence long rates than their Continental counterparts.¹⁸ On the other hand, the above results contradict Continental skepticism in that there *is* a fairly tight *positive* statistical relationship between short and long rate movements following monetary policy shocks.

In the above regressions, we excluded instances in which monetary policy actions were undertaken on the same day by foreign Central Banks in the case of the U.S. and Britain, but not for Germany and France. Since during the eighties many policy actions were coordinated between EMS Central Banks, we would have lost too many data points for these countries (13 for France). However, we need to address the concern that the response of long rates to monetary policy in France might have been driven by the dozen instances in which the Bundesbank tightened or relaxed on the same day (for Germany, there is no corresponding worry). Running the basic regression on the 13 instances on which other Central Banks also acted, we obtain a coefficient of 0.062 (S.E. 0.029) for the days on which the French acted with others and 0.097 (S.E. 0.028) for days on which the Banque de France acted alone. An F-test confirms that the two are not significantly different (p value 0.594). More importantly, the claim that French long rates only move in response to German actions but not when the Banque de France acts alone is clearly rejected.

While the above regression results are useful in summarizing average responses, one might also ask just how often long and short rates jumped in the same direction following a policy shock for each of our countries. Table 2 gives the number of instances in which unanticipated monetary contractions or expansions, as measured by the direction of the jump of the short rate, led to "perverse" reactions in the long rate.

¹⁸ However, one might have expected that since British monetary policy is much more erratic than in other countries, that changes in short rates there would be treated with almost complete indifference by the bond markets. The data, however, reject this view.

Table 2

	U.S.	Britain	Germany	France
No. of "perverse" long rate reactions	6	17	8	8
"perverse" reactions as % of total actions	9.8%	19.8%	8.9%	14.8%

Beyond the summary statistics presented in Tables 1 and 2, it might be interesting to know the precise magnitude of the "perverse" reactions and the circumstances under which they occurred, and whether we have other outliers in the set of long rate reactions we are studying. These questions are best answered by looking at scatter plots, which we now present.

a) United States

Figure 1 is a scatter plot of the change in the ten year bond rate against the change in the three month interest rate on all the sixty one monetary policy action dates that we have identified for the United States. The points marked with their dates in this and all following scatter plots are those days on which the residual from the OLS regression is greater than ten basis points and/or those days in which the short rate moved by more than 0.5%.

The location of the points identifying a "perverse" response to monetary policy shows an interesting asymmetry. Five out of six instances involve reductions in the short rate associated with an increase in the long rate; on only one occasion did increases in the short rate prompt a fall in the long rate. However, on the five occasions associated with points in the northeast quadrant the rise in the long rate was very small - less than five basis points - whereas the only perverse response in the other direction was very large indeed. It corresponds to the tightening that took place on November 1st 1978 in response to increasing inflation and the sliding dollar. The discount rate was increased from 8.5% to 9.5%, a supplementary reserve requirement equal to 2% of time deposits of \$ 100,000 or more was established and the Fed increased "its currency "swap" lines with the central banks of West Germany, Japan and Switzerland to \$ 15 billion from \$ 7.4 billion".¹⁹ The response of the currency, stock and bond markets to these measures was extremely favorable: the dollar rose by 7% and the Dow Jones by 4%, while the yield on the 10 year bond fell by 29 basis points. Contemporary comment on this movement did not attribute it to a change in inflationary expectations but rather to the bursting of a bubble. The Wall Street Journal claimed that "speculators ... were panicked into buying to cover enormous short positions they had set up by selling borrowed

¹⁹ Wall Street Journal, November 2nd 1978.

bonds during the market's prolonged slide".²⁰ According to Merrill Lynch's director of research for government securities, "the government securities market acted in a totally unpredictable fashion ... how else can one explain such a rally on the very day that a quantum jump in the discount rate and other key short term rates occurs?"²¹

The only other major outlier for the US is the tightening that took place in May 1994 when the discount rate was raised from 3% to 3.5% and the target for the Federal funds rate was increased from 3.75% to 4.25%. While an increase in the rate had been predicted for several weeks the half point rise reassured markets that the Fed was dealing with the prospect of increasing inflation in a serious manner and led to a bond market rally with the ten year bond yield falling 20 basis points. However, the yield on the three month treasury bill was unchanged as a move to 4.25% had been expected in either one or two steps in the very near term anyway.

The remaining points marked with their dates on the scatter plot represent those days with the greatest reaction from the bond markets, but are not outliers in that the short and the long rate moved in the same direction. Almost all these points are from the Volcker tightening in 1979-81 and from the Volcker easing in late 1981-1982. While ten year bond yields typically rose or fell by more than 30 basis points on these days, they were accompanied by very large changes in the short rate as well. The one exception to this was the October 8th 1982 reduction in the discount rate from 10% to 9.5%. The move was preceded the day before by "reports that the Federal reserve would tolerate money supply growth above its previously announced targets" leading to expectations that a "cut [in the discount rate] could come at any time"²² and a strong rally in government bonds. When the cut came there was only a modest further rally in bond prices as it was by then widely anticipated.²³ Since the move had become apparent the day before, we considered that to be the day of the policy action. The very large fall in bond yields (down by 60 basis points) relative to the short term rate (down by 42 basis points), reflected the fact that this was perceived as a long term shift in Federal Reserve policy that had implications beyond a mere near term cut in the discount rate.

²⁰ *ibid.*

²¹ *ibid.* One might have thought that reduced inflationary expectations is a plausible explanation.

²² *New York Times*, October 8th 1982.

²³ Three month rates fell by 9 basis points and ten year rates by 13 basis point on the day of the announcement.

b) Great Britain

Figure 2 shows the change in the ten year bond rate against the change in the three month interest rate on the eighty six monetary policy action dates that we have identified for Great Britain. Again, the points marked with their dates are those days on which the residual from the OLS regression is greater than ten basis points and/or those days in which the short rate moved by more than 0.5%. While the relationship between long and short rate jumps is obviously strong and positive, it is also apparent that in general, the points do not lie as close to the regression line as in the case of the United States. There are many more instances in which the residual exceeds ten basis points.

The scatter plot shows that seven out of the seventeen instances of “perverse” long rate reactions occurred during Great Britain’s brief period of ERM membership, when the Bank of England was trying to expand at a time when the Bundesbank was seeking to tighten. A further four instances were during 1988, when the monetary authorities attempted to offset the effects of movements in the exchange rate with base rate changes, which they viewed as a means of maintaining an unchanged monetary stance. Furthermore, on no occasion when long rates and short rates moved in the opposite direction did the long rate change by more than 8 basis points.

The greatest outliers in terms of the absolute value of the residual are the three points marked 8201, 8210 and 8208 in the south west quadrant and the point marked 8208 on the y-axis. The move to an easier monetary policy by both the Federal Reserve and the British monetary authorities sparked an enormous bond rally on both sides of the Atlantic during 1982. During the course of the year the yield on ten year bonds in Britain fell from in excess of 16% to a little over 10%, while short rates fell from about 15% at the start of the year to 9% by October. Coming after a prolonged period of very restrictive monetary policy that persisted even as the United Kingdom suffered its worst recession since the Depression (until the most recent one), the markets were heartened every time there was news of a further easing of policy. The only exception came when base rates were cut for the second time in the space of ten days in August 1982 and rather than declining the yield on ten year bonds increased by 26 basis points. This reaction was merely attributed to “profit taking”. While in most instances one would want a more substantive explanation for such a large price movement one should bear in mind that even after this increase yields were more than a full point below the level they had been just ten days previously and over two points lower than five weeks before.

c) Germany

The scatter plot for Germany (Figure 3) is similar to that of the U.S. in that very few data points lie in the “wrong” quadrants. As in the case of the U.S. and the U.K., most of these instances involve reductions in the short rate that are not associated with a similar movement in long rates rather than increases in the short rate that do not prompt increases in the long rate.

While cases of jumps in the opposite direction were rare (8 out of 90, see Table 2), there are 11 instances when *long* rates jump (although only in two cases by more than 2 basis points) but short rates do not move at all - a phenomenon we practically never encountered in the case of the U.K. and the U.S. In the graph, these are identifiable as a collection of dots on the central vertical axis. Our interpretation for this phenomenon is to note that in the case of Germany we used a three month interbank rate, based on a substantial bid-offer spread, as opposed to the U.S. and the U.K., where we used the three month T-Bill rate.²⁴ This rate appears much less volatile on a day to day basis than the T-Bill rate, typically exhibiting no change over several days, but then jumping by at least 5 basis points whenever it does move. Thus, we have some instances when long bond yields react more sensitively to small policy shocks than the three month rate.

Five points in the plot merit discussion. The far-out point in the north-east quadrant constitutes the largest jump in both short and long rates in our sample. It corresponds to the May 30th, 1973 increase in both the discount and the lombard rate by a full percentage point. According to the *Frankfurter Allgemeine Zeitung (FAZ)*, the move came as a “great surprise” to markets.²⁵ Discount and lombard rates had been raised by a full point less than four weeks earlier, on May 3rd, this yields the second “7305” point in the plot.

Finally, note the three outliers below the regression line in the bottom left quadrant. Here, a comparatively small reduction in the short rate (at least in the 10/81 and 09/92 cases) triggered exceptionally large reactions of the long rate.

²⁴ Like France, Germany lacks a liquid money market between banks and non-banks. The yield of short term government paper in Germany is essentially pegged by the Bundesbank and thus does not constitute a market rate. See Deutsche Bundesbank (1987), pp. 29-30. Thus, the only three-month rate available for our sample period is the 3-month interbank middle rate (Bundesbank ST 0107). The spread involved, according to the quotes in the *Frankfurter Allgemeine Zeitung*, is typically 0.25-0.5 points for the 60s and 70s and 0.15-0.3 points for the 80s and 90s, compared to a typical T-Bill spread in the U.K. of six basis points.

²⁵ *FAZ*, June 1st, 1973.

Figure 3

Changes in long rate vs changes in 3 month rate: Germany

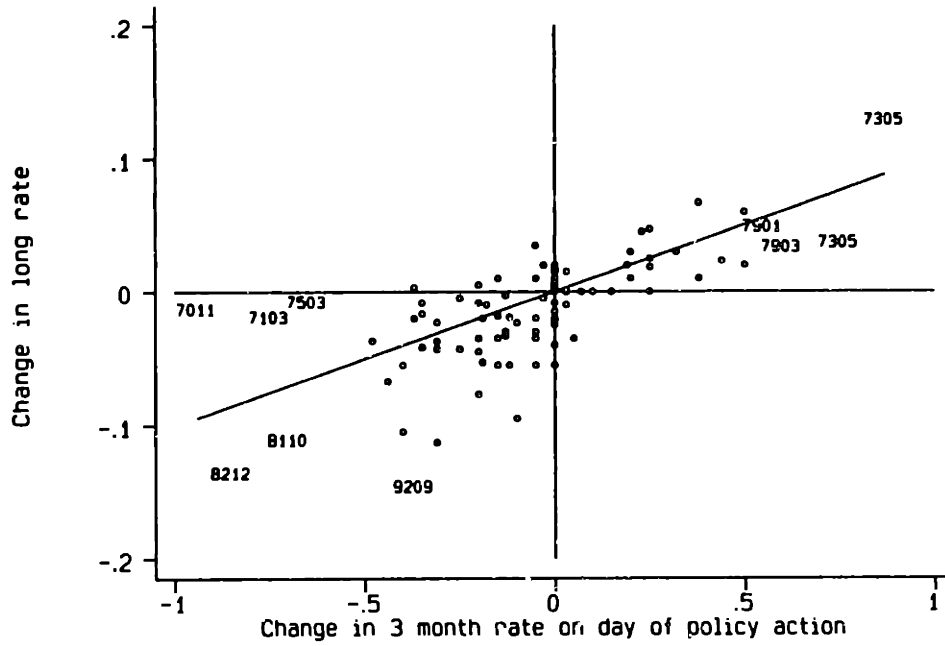
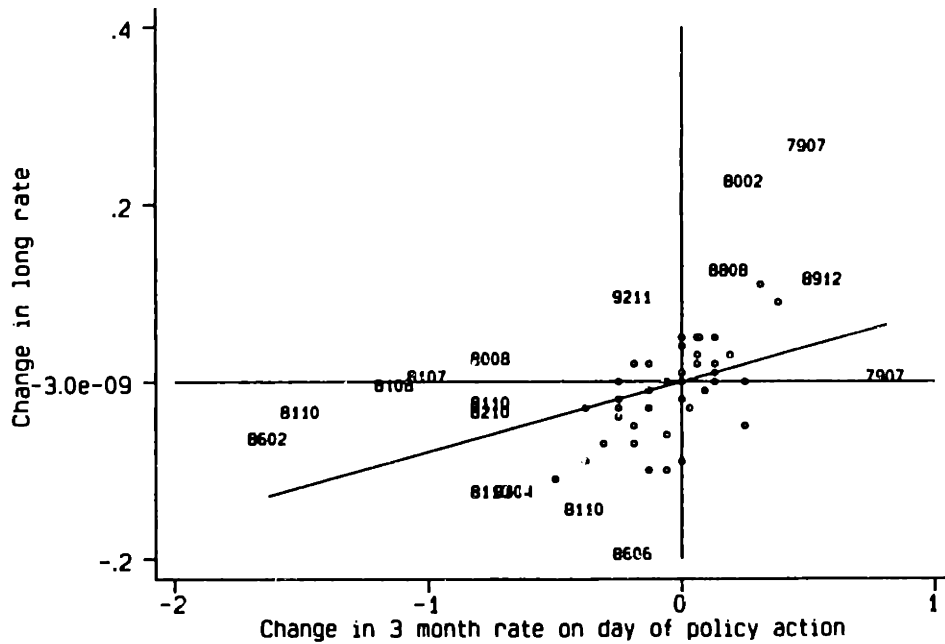


Figure 4

Changes in long rate vs changes in 3 month rate: France



The common feature of the October 1981 and September 1992 reductions is that they represent the first easings, after periods of exceptionally tight monetary policy and while the economy was moving into a deep recession. In both cases, the actions were perceived as first steps in a long series of future interest rate reductions. The December 2nd, 1982 event, on the other hand, features a large fall in both long and short rates, prompted by an exceptionally large reduction in the discount and lombard rates (both declined by a full point). Like the second May 1973 contraction, it was preceded by a similarly large action in the same direction shortly before (October 21st), which might have made the December event especially surprising.

d) France

The French scatter plot (Figure 4) shows somewhat greater dispersion than that of the other three countries. As for the other countries, a majority of points with conflicting movements of short and long rates (five out of eight) are associated with short rate declines rather than increases. Also, as in the case of Germany, a few data points (5 out of 54) show a reaction in the long rate but no movement at all in the short rate. We note that the short rate we used for France is an interbank rate, as in the case of Germany, for similar reasons: until 1985, there was no French money market except for an interbank market.²⁶

We discuss three sets of outliers - a total of ten events. First, there are two instances in which small increases in the short rate prompt a relatively large long rate response. Both are part of the early eighties tightening (July 1979 and February 1980). Another common element is that they were both very much in line with the direction of monetary policy abroad, both in the U.S and in Germany, where similar policy actions took place during the same months.

Second, there are six instances of exceptionally weak long rate responses to substantial reductions in the short rate (at least two thirds of a point). All of these come from the early eighties. The August 1980 reduction in short rates occurred as one of the last actions of Barre's 1980 attempt to lower interest rates, at a time when the mini-recession was already being overcome in the U.S. and the Fed might have been expected to tighten again soon (it did in September). On the other hand, the July and August 1981 reductions represent the first attempts of the new socialist government to relax interest rates, following the Franc crisis of May-June. Note that the October 1981 and October 1982 reductions have a larger impact on long rates; by this time the French were attempting to ease at a time at which the Fed and

²⁶ see Patat (1987), Section 1.7.2.

the Bundesbank were cautiously shifting policy in the same direction. By contrast, the July and August 1981 reductions, which prompted no long rate response, are entirely unilateral and precede German and American actions later in the year.

Finally, there is one action - the June 1986 intervention rate decline - in which long rates fell exceptionally following a relatively modest decline in short rates. This event is last in the sequence of 1986 interest rate declines initiated by Bérégovoy and continued by Balladur. We have no explanation of why this event is unusual, however, the long rate data is not very reliable in this particular instance.²⁷

2. Regressions distinguishing between types of policy action

a) Domestic versus external actions

We begin by distinguishing between internally and externally motivated policy actions. Since for the United States there were only two instances of externally motivated actions that were inconsistent with domestic policy objectives, we only consider Great Britain, Germany and France. Table 3 summarizes our results.

Table 3

	Great Britain		Germany		France	
	Internal	External	Internal	External	Internal	External
Coefficient	0.313	0.205	0.106	0.084	0.075	0.317
Std errors	(0.031)	(0.033)	(0.010)	(0.040)	(0.020)	(0.069)
N	62	24	81	9	47	7
Chow test	F=4.466	p=0.038	F=0.839	p=0.362	F=2.746	p=0.103

The interesting feature of Table 3 is the difference in results across countries. For Britain, the coefficient for domestically motivated actions is significantly higher than that for externally motivated actions, while the opposite is true for France. The distinction does not seem to matter much for Germany.

²⁷ This is one of two instances (the other being April 1986) where *Le Monde* did not quote the bond prices we otherwise used and we thus had to resort to the change in yield of a single different long bond (11% 1985).

Above, we emphasized that, on a priori grounds, we might expect purely externally motivated actions to result in a systematically different response of long rates than domestically motivated actions for a given country, but that we had no priors as to which of the two might be larger. Nevertheless, once we consider the nature of external policy shocks in our British and French samples, the diametrically opposed results are fairly easy to interpret. For Britain, there were many instances of sterling weaknesses which fell short of being speculative attacks and were thus counted as non-transitory, yet they were typically accompanied by ministerial statements maintaining that the actions were undertaken solely for external reasons and were hoped to be temporary. Thus, many of them were probably judged to be more transitory by the market than typical domestically motivated actions.²⁸ For France, one should note that the seven "externally motivated" actions all come from the same time period, namely the tightenings in 1988-89 (five events) and late 1991 (two events), while the 47 domestically motivated actions are spread over the entire sample (1977-1993). As we shall see below, there is a large structural break in the French sample around 1986-87, which we attribute to changes in operating procedures and financial liberalization. Thus, it is probably more appropriate to compare the coefficient of 0.317 for externally motivated actions to the coefficient for domestic actions in the post-liberalization period (1987 onwards), namely 0.188 (S.E.=0.046, N=23). Thus, quite a large difference remains (significant at the 25% level), even though it is less drastic than before. It is fairly intuitive given the background of French monetary policy of that time: about half of the "domestically motivated" actions of the period were attempts at relaxing interest rates *against* the current trend in German monetary policy. Given the experiences during 1986-87 and in early 1988, when the French tried to lower interest rates twice and each time ended up with a currency crisis after about half a year, these relaxations might have been given a smaller chance of "permanence" than the externally motivated actions, in which the French followed the Bundesbank. We shall come back to these issues when we split the sample in different policy phases below.

b) Contractions versus expansions

Table 4 summarizes our regression results from splitting the sample into contractionary and expansionary actions.

²⁸ Also note that the removal of a single data point (April 1976) reduces the coefficient on externally motivated policy actions further to just 0.15, implying an even stronger contrast between typical external and domestic actions than is suggested in the table.

Table 4

	United States		United Kingdom		Germany		France	
	Contr.	Exp.	Contr.	Exp.	Contr.	Exp.	Contr.	Exp.
Coefficient	0.348	0.620	0.251	0.343	0.089	0.107	0.221	0.065
Std errors	(0.044)	(0.086)	(0.023)	(0.048)	(0.011)	(0.016)	(0.066)	(0.020)
N	32	29	32	54	35	55	14	40
Chow test	F=8.31	p=.006	F=3.07	p=.083	F=0.73	p=.396	F=8.64	p=.005

All countries except for France, which we shall discuss separately below, exhibit a higher coefficient on expansions than on contractions, significantly so for the U.K. and the U.S. Ignoring France for the time being, we have two potential explanations for this result. First, as suggested above, monetary contractions may be perceived as less permanent than expansions. The second explanation is that there is an asymmetry in the response of inflationary expectations to contractions versus expansions. When a central bank expands in the depths of a recession, this is not perceived as being an inflationary action and so the nominal rate falls by as much as the real rate. However, when a central bank contracts, its main justification for doing so is to reduce or prevent inflation. If a contractionary action is credible, nominal rates will thus rise by less than real rates.

As in the case of domestic versus external policy shocks, the French result is partly an artifact of the small number of contractionary instances and their unequal distribution over the sample. Nine out of the 14 contractions are from the 1988-89 and 1991 tightenings, while the rest come from the 1979-80 contraction. A separate comparison of contractions and expansions for the post- and pre-financial liberalization periods confirms the result for the latter period (i.e. pre-1987) but not for the former.²⁹ We interpret this in a similar way as the contrast between responses to externally and domestically motivated actions discussed above: between 1977 and 1987, most contractions reflected common policy with France's neighbors, whereas most of the expansions did not and most of them were short-lived, with a

²⁹ The coefficients become: 0.253 (S.E. 0.0463) for the post-liberalization contractions, 0.184 (S.E. 0.055) for the post-liberalization expansions; 0.204 (S.E. 0.138) for the pre-liberalization contractions and 0.052 (S.E. 0.055) for the pre-liberalization expansions. The Chow test gives a p value of 0.39 for the post liberalization sample and a p-value of 0.051 for the pre-liberalization period. Thus, we cannot reject the null of no structural break at any conventional significance level for the post-liberalization period.

median duration of about 6-8 months before the next tightening (usually prompted by a Franc crisis). This asymmetry no longer holds in the post-financial liberalization period.

3. Regressions distinguishing according to policy phase

Table 5 summarizes our results from splitting the sample into major policy phases for each country and trying to compare analogous phases for different countries. We only ignored a "phase" for a country when it consisted of very few data points (3 or less) *and* there were no analogous phases for any other country.

There are several interesting points to be noted from the table. First, our earlier finding about the differences in coefficients between the US (highest), the UK (second highest) and Germany (lower than both) is robust in the sense that their ranking rarely changes across phases. Moreover, there is a considerable amount of constancy in the estimated coefficients in the different subsamples for all the countries. For example, the coefficient in a subsample is significantly different at the 5% level from its coefficient for the whole sample in only three instances for the United States, in two cases for the U.K and three for Germany.

For all three countries the coefficient during the 1981-82 expansion is significantly in excess of that for the rest of the sample at less than the 1% level, presumably reflecting the anti-inflation credibility these countries earned in the previous contraction. By contrast, this phase for France coincided with the first Socialist government of the Fifth Republic, which did not have a strong anti-inflationary reputation and thus the coefficient is rather low.

For France, the point estimates are mostly higher for the phases after 1988 than for the phases before. We pick 1987 as the candidate year for a structural break. This is when Balladur's financial liberalization package, and a major change in central bank operating procedures (scrapping of the last remains of encadrement and increased emphasis on controlling aggregate demand through interest rates) came into effect. A Chow test rejects the hypothesis of no structural break quite strongly ($p=0.014$).

It is also interesting to note that during the United Kingdom's brief interlude of ERM membership (phase 14) it had a negative, but insignificant, coefficient.³⁰ Recall that this coefficient refers to the British efforts to expand between early 1991 and early 1992, at a time when Germany was tightening. Finally, note that in the most recent expansionary phase

³⁰ In fact, this is one of only two instances (out of 16 "phases") where the UK coefficient was not significantly different from zero at the 5% level (the other being the 1966-67 expansion, for which we only have three data points)

Germany has a higher point estimate than for any other phase. While we have only ten data points for this episode and so would not care to draw too strong conclusions from it, a Chow test rejects the null of no structural break at the 0.2% level. Thus, the recent record of long rate reactions to monetary policy in Germany cannot, according to these results, be used as evidence supporting a pessimistic view of the link between short rate cuts and long rate reductions.

Table 5

Policy "Phase"	U.S.		U.K.		Germany		France	
	N	Cf. (S.E.)	N	Cf. (S.E.)	N	Cf. (S.E.)	N	Cf. (S.E.)
1: 1965-66 contractions	3	0.48 (0.20)			3	0.05 (0.04)		
2: 1967 expansions	2	0.56 (0.37)	3	0.11 (0.07)	9	0.12 (0.03)		
3: late 60's contractions ³¹	6	0.50 (0.08)	5	0.23 (0.04)	7	0.14 (0.03)		
4: 1970-71 expansions			4	0.08 (0.04)	7	0.05 (0.03)		
5: ~1973 contractions	5	0.25 (0.04)	5	0.25 (0.10)	7	0.09 (0.02)		
6: 1974-75 expansions	7	0.35 (0.11)	3	0.17 (0.07)	11	0.06 (0.03)		
7: 1975-76 UK contraction			6	0.31 (0.05)				
8: ~1978 US&UK contract.	5	0.15 (0.37)	4	0.14 (0.03)				
9: 1979-80 contractions ³²	6	0.35 (0.04)	3	0.31 (0.08)	7	0.08 (0.02)	5	0.21 (0.14)
10: 1981-82 expansions ³³	7	0.65 (0.18)	9	0.76 (0.13)	10	0.17 (0.03)	10	0.06 (0.03)
11: mid 80's expansion ³⁴	6	1.29 (0.27)	9	0.33 (0.06)				0.07 (0.05)
12: UK postcrash expansion			3	0.53 (0.14)				
13: 1988-89 contractions ³⁵	3	0.49 (0.20)	7	0.20 (0.08)	7	0.17 (0.07)	7	0.26 (0.05)
14: 1990-92 expansions ³⁶	5	0.34 (0.14)	8	-0.11 (0.11)			5	0.30 (0.24)
15: unification contr. 90-92					3	0.10 (0.15)	2	0.23 (0.22)
16: 1992-94 expansions			3	0.29 (0.06)	10	0.31 (0.09)	10	0.15 (0.07)
17: 1994 U.S. contraction	4	1.49 (0.73)						

³¹ late 1967-early 1969 for the U.S. and the U.K., early 1969-early 1970 for Germany.

³² until May 1981 for the U.S., until September 1981 for the U.K.

³³ for France, this refers to the time after the change in government, i.e. it excludes the Barre government's attempts to ease in 1980. It encompasses three sets of attempts to expand, interrupted by Franc crises.

³⁴ for the U.K., this refers to August 1983 to July 1985, for the U.S. to November 1984 to August 1986, and for France to the three consecutive attempts to lower interest rates between February 1986 and July 1988.

³⁵ begins in September 1987 for the U.S. and in August 1987 for the U.K. and is continued in 1988 after an interruption due to the stock market crash. For France and Germany, the contraction begins in mid 1988.

³⁶ December 1990 to July 1992 for the U.S., February 1991-May 1992 for the U.K. and April 1990 to October 1991 for France.

IV. CONCLUSION

The answer to the question posed in the title of this chapter (referring to continental Europe, as represented by France and Germany) is: "Yes, but not *that* different". In the following, we briefly review the main results of this chapter.

Our main finding is that long nominal rates typically responded to monetary policy shocks in the "conventional" direction - up for contractions, down for expansions - in all four countries we studied. For every country, the coefficient on our measure of unanticipated monetary policy - reactions in the 3 month interest rate following a monetary shock - turned out positive and highly significant. If one is willing to assume that inflationary expectations rise with expansions and fall with contractions, this is evidence that, for all countries in our sample, non-transitory monetary policy actions have at least a short run effect on long real interest rates in the "conventional" direction, as predicted by a standard Keynesian model (see Appendix A2). This basic finding appears at odds with past skepticism on the side of the Bundesbank and the Banque de France regarding the ability of monetary policy to reduce long rates by lowering short interest rates.³⁷

However, we do find that the response of long nominal interest rates to unanticipated monetary policy actions has historically been much lower for France and Germany than for the United States and Great Britain. Based on the full samples, the average response of long rates to a one percentage point movement in the three month rate was 0.4 percentage points for the U.S., 0.28 for Britain and only around 0.1 for Germany and France. This ranking is preserved over most subsamples across time. On the other hand, the difference in response seems to have become less pronounced in recent years. There is a clear structural break in the French sample at the time at which financial liberalization and a major change in central bank operating procedures were carried out (1986-87). The response of the long rate to monetary policy also appears higher in Germany for the last expansionary policy phase than for earlier phases.

Finally, we find it interesting that three of our four countries display stronger responses of long rates to expansions than to contractions. The exception is France, which gives the

³⁷ Note that our results do not invalidate the German or French skepticism *per se*, since it is based on policy actions actually undertaken by these monetary authorities. Thus, the fact that our results show such a tight relationship between short rate changes and long rate reactions might merely reflect the wise choice of timing or magnitude of realized policy actions; it does not necessarily follow that actions beyond those undertaken would have shown a similar effect (we thank Stanley Fischer for this observation). However, our results certainly reject the claim that past long rate responses to monetary policy actions constitute evidence in favor of the skeptical view, as suggested by the Bundesbank quote in the introduction.

opposite result for the pre-1987 period, but no significant difference between expansions and contractions for the more recent period.

As we went along, we have attempted to interpret our findings and relate them to the different historical experience of the countries we are studying. Yet, we have no comprehensive explanation for what we regard as our most puzzling result: the differences in the response of long interest rates to monetary policy, measured by changes in the three month rate on policy days, between the U.S. and U.K. on the one hand and France and Germany on the other. Indeed, giving a full answer is beyond the scope of this chapter, and we thus confine ourselves to some very speculative remarks.

The first one is, rather obviously, the means and ends with which monetary policy is conducted across the four countries. We view this approach as a non-starter: if we were forced to split our group along these lines, we would end up with the U.S. and Germany in one camp and France and the U.K. in another. In the U.S. and Germany, the central banks are both fairly independent, display a reasonable amount of consistency in their policy actions and to some extent even operate in similar ways, using the discount rate to signal major shifts in policy and open market operations to tighten and relax on a more short term basis. The central banks of Britain and France on the other hand historically display more shifts in policies (in France, at least until about 1983), suffered more from external disturbances and both used quantitative restrictions at some stage to limit the growth of credit (the "encadrement" in France and the "corset" in Britain).

Suppose we disregard the apparent similarity of our results for France and Germany on the grounds of the relatively high standard errors for France and the structural break in the French sample. Restricting ourselves to the comparison between the U.S. and the U.K. on the one hand and Germany on the other, does the difference in monetary policy objectives in Germany and the others help in interpreting our results? Specifically, could inflation-targeting in Germany, as opposed to the U.K. or U.S., be part of the explanation? The answer is again no. Credible inflation targeting implies that long run inflationary expectations should be relatively unaffected by expansionary or contractionary policy actions. Thus, the offsetting effect through changes in expected inflation (i.e. higher expected inflation for an expansion, lower for a contraction) should be smaller for a country like Germany. If differences in inflation-targeting across countries are important, one would thus expect a *larger* response of long rates to a given unexpected policy action in Germany than in the U.S. or U.K.

The second candidate is the nature of bond markets across our sample of countries. This, at least, gives us the right split: bond markets in Britain and the U.S. are much more developed and liquid than on the continent, where bank credit is relatively more important.³⁸ However, it is not clear why this should cause bond prices to react more to policy actions than in markets with fewer bonds and smaller trading volumes.

The third candidate, finally, is the money markets. Again, these are much more liquid and open to the general public in the U.S. and the U.K. than on the continent, where non-financial institutions hardly hold positions in these markets. Thus, while we were able to use yields on the very liquid three month Treasury Bills for the U.S. and Britain, we depended on interbank rates for France and Germany. This may help to explain our results as follows: since the three month interbank rates are less sensitive to small shocks than the Treasury Bill rates (see Section III.1.c. and footnote 24 above), they are probably a less precise indicator of expectations than the U.S. or the U.K. rates. For France and Germany, our index might thus under- or overstate policy shocks. This would introduce an element of measurement error into our right hand side variables, which would bias downwards the estimated coefficients.

While this interpretation fits nicely with the observation that in France long rates appear more responsive to monetary shocks after 1986/87, when financial liberalization took place and the French created a money market more akin to those of the U.S. and the U.K., at present it remains no more than a conjecture. However, it is clear that if this explanation is correct, it would strengthen our first set of conclusions - regarding the ability of continental central banks to influence long rates - and weaken our second one - regarding the presence of major differences in response to unanticipated policy between countries. In any case, we believe that this weighting of our results is suggested by the apparent increase in the responsiveness of long rates in France and Germany in recent years.

³⁸ See, for instance, Patat (1987), pp. 247-273 and Deutsche Bundesbank (1987), p. 29.

V. APPENDIX

1. Monetary policy actions in four countries

a) The United States, 1965-1994

Monetary policy actions in the United States usually take one of the following three forms: open market operations, changes in reserve requirements and changes in the discount rate. Changes in reserve requirements or changes in the discount rate are decided upon by the seven member Federal Reserve Board of Governors. Upon a change an announcement is made that communicates the reasoning behind the action. Open market operations are carried out by the Federal Reserve Bank of New York following a directive issued by the Federal Open Market Committee, which consists of the seven members of the Federal Reserve Board and five representatives from the regional Federal Reserve banks. The committee meets approximately every five to six weeks and then, about six weeks later, the full text of the directive is made public. However, the effect of the decisions made at the committee meeting are felt throughout the intervening six weeks and one cannot identify a single impact of the meeting on the markets. For example, in April 1974 a month characterized as a monetary policy dummy by Romer and Romer the stock and bond markets were aware of the timing of the FOMC meeting yet in the few days following the markets moved upwards as they guessed incorrectly that the FOMC would ease policy. For this reason, although open market operations are in many instances more significant than discount rate changes we have taken as our candidate policy actions only changes in discount rates and reserve requirements, the timing of which is always unambiguous. Since the beginning of this year (1994) the FOMC has changed its policy and now announces changes in its target for the Federal Funds rate immediately after the FOMC meeting at which the change was approved. Thus, in the future a more complete set of monetary policy actions will be possible.

In the period from 1965-1993 there were 92 changes in discount rates or reserve requirements and four changes in the federal funds rate target announced in 1994. We read the motivation behind these actions given by the Board in their annual report and then checked these statements against the contemporaneous statements made by the Board and the accompanying press comments in the New York Times and in some cases the Wall Street

Journal.³⁹ In almost all instances our prior evaluation of the action was confirmed by the newspapers. Of the 96 actions we excluded 31 as not being policy actions. The majority of these were the discount rate changes in the early to mid 70's which the Fed usually described as being "intended to bring the discount rate into better alignment with short term rates".⁴⁰ A further four actions were not counted since they represented within day policy reaction to another significant event e.g. the publication of unemployment or inflation figures, and so could not be regarded as exogenous. Of the remaining 61 actions, just two were classified as externally motivated - one prompted by the devaluation of sterling in 1967 and the other by the dollar weakness in 1978. We now describe why we classified each of the 96 actions as we did.

1965 to Fall of 1966 - the Credit Crunch

Discount rate raised from 4 to 4.5% in 1 step⁴¹

1965 was the fifth year of sustained and unusually vigorous expansion. "The economy was in greater danger of damaging inflation than it had been since the current long upswing began in 1961".⁴² With the stimulative effects of the buildup in Vietnam also being felt the Federal Reserve tightened policy gradually throughout 1965. In February and March the FOMC voted "to move toward attaining somewhat firmer conditions in the money market in an effort to moderate the rapid growth of bank reserves."⁴³ With continued evidence of rapid growth the Fed raised the discount rate in December, the purpose of which it described as being "to reinforce efforts to maintain price stability".⁴⁴

In the early part of 1966 the economy continued to expand rapidly and monetary policy remained directed at reducing demand, however, towards the end of the year the pace of expansion had moderated considerably and "monetary policy therefore shifted toward less restraint".⁴⁵ Although there were no changes in discount rates during the year, reserve requirements were increased twice during June and August in order to "reinforce the

³⁹ Whenever the New York Times did not appear.

⁴⁰ New York Times (NYT), May 11th 1973.

⁴¹ For ease of orientation, in the following sections we give the movements of the discount rate (or corresponding central bank interest rates for other countries) for each of the policy phases described.

⁴² 1965 Fed AR, p 3.

⁴³ *ibid.*, p 15.

⁴⁴ NYT, December 7th 1965.

⁴⁵ 1966 Fed AR, p 3.

operation of other instruments of monetary policy in containing inflationary pressures".⁴⁶ Open market operations during these months were similarly intended "to restrain bank credit expansion".⁴⁷ We have thus counted both the discount rate increase and the two increases in reserve requirements as domestically motivated policy actions.

Fall of 1966 to October 1967 - modest easing

Discount rate reduced from 4.5 to 4% in 1 step

With some signs of a moderation in growth apparent in the fall, policy shifted with the October and November 1966 FOMC directives seeking "to permit somewhat less firm conditions in the money market" and "to relax monetary restraint somewhat in the light of both the outlook for slower economic growth and persisting lack of expansion in bank credit".⁴⁸ Throughout the first three quarters of 1967 this easier policy continued with a reduction in reserve requirements in February and a cut in the discount rate in April. The "reduction in the discount rate was in keeping with the general Federal Reserve policy objective of assuring adequate credit availability to provide for orderly economic growth."⁴⁹ Both actions are considered to be domestically motivated policy actions.

November 1967 to December 1969 - tightening

Discount rate raised from 4 to 6% in 6 steps

Following the pause in growth in the first half of 1967 economic activity in the second half of the year "was expanding vigorously". The Federal Reserve Board consequently undertook "moves in the direction of monetary restraint ... in an effort to resist the domestic inflationary pressures".⁵⁰ The first discount rate increase came in November 1967 and accompanied the devaluation of sterling from \$ 2.80 to \$ 2.40. While the discount rate increase was certainly consistent with policy moves in the ensuing months at the time the only motivation given was "to protect the dollar in the wake of Britain's financial crisis".⁵¹ This action has thus been considered externally motivated. The Board increased discount rates twice more during the spring of 1968 in order to "restrain intensifying inflationary

⁴⁶ *ibid.*, p 91.

⁴⁷ *ibid.*, p 10.

⁴⁸ *ibid.*, p11.

⁴⁹ 1967 Fed AR, p 75.

⁵⁰ *ibid.*, p12.

⁵¹ NYT, November 19th 1967.

pressures",⁵² while the wording of the FOMC policy directives displayed a similar intent. A modest easing followed a fiscal restraint package in the summer, but as it became apparent that activity was continuing to expand strongly monetary policy was tightened once again towards the end of the year. This tighter stance was maintained throughout 1969, with a further increase in the discount rate to 6% taking place in April, alongside an additional increase in reserve requirements. These moves were taken in order "to contribute to a reduction of inflationary pressures in the economy".⁵³ With the exceptions of the single discount rate decrease and the sterling motivated increase, we have counted all discount rate increases and the increase in reserve requirements as being domestically motivated policy actions.

January 1970 to August 1972 - encouraging expansion

Discount rate reduced from 6 to 4.5% in 8 steps

The contractionary measures undertaken in 1968 and 1969 succeeded in slowing the economy considerably and GNP declined slightly in 1970. "To help stimulate economic activity ... monetary policy during 1970 shifted from the posture of restraint that had prevailed during much of 1969 to a posture designed to assure adequate expansion in monetary and credit aggregates and an easing in over-all credit conditions."⁵⁴ A similar stance remained in the following year - "in 1971 monetary policy encouraged further substantial growth in bank reserves, money, and bank credit in helping to stimulate economic recovery from the mild recession of 1969-70".⁵⁵ Throughout this period open market operations were intended "to foster financial conditions conducive to the resumption of sustainable economic growth",⁵⁶ and these operations resulted in a substantial decline in short term interest rates. However, the discount rate changes always followed changes in prevailing market rates and their purpose was always described as being "to bring the [discount] rate into closer alignment with short term market interest rates".⁵⁷ Thus, we only have one clear cut policy action for this period namely the reduction in reserve requirements in August 1970.

⁵² 1968 Fed AR, p 10.

⁵³ 1969 Fed AR, p 10.

⁵⁴ 1970 Fed AR, p 7.

⁵⁵ 1971 Fed AR, p 3.

⁵⁶ *ibid.*, p 147.

⁵⁷ *ibid.*, p 68.

September 1972 to summer of 1974 - fighting inflation

Discount rate raised from 4.5 to 8% in 8 steps

The U.S. economy grew in excess of 7% from the fourth quarter of 1971 to the final quarter of 1972 and continued to expand rapidly in early 1973. Further inflationary pressures came from the devaluation of the dollar in February 1973, the increases in food and raw material prices throughout 1973 and the oil price shock at the end of 1973. Against this background “monetary policy, which had begun to tighten in late 1972, became progressively more restrictive through the summer of 1973.” There was some abatement in this tighter stance in the immediate aftermath of the oil crisis, but following the lifting of the embargo, policy was tightened once more in the spring of 1974.

However, “tightening actions were initiated mainly through open market operations and other instruments of monetary policy, rather than through the discount rate. Throughout the period, adjustments in that rate tended to lag behind advances in other interest rates.”⁵⁸ In many instances the Board tended to favor “a modest move to bring the discount rate into better alignment with short term market rates without precipitating further advances in those rates or in bank lending rates”.⁵⁹ Thus, we have only five policy actions for this period of which three are changes in reserve requirements.

Late summer of 1974 to November 1976 - combating the recession

Discount rate reduced from 8 to 5.25% in 7 steps

In the second half of 1974 and in the early part of 1975 concern moved from the inflationary pressures to the weakness of real activity in the economy. “To help counter this weakness, the System made use of all its major policy instruments: open market operations.... reductions in reserve requirements and cuts in the discount rate.”⁶⁰ The first cuts in discount rates were intended to be a “signal of a less restrictive monetary policy and ... to have a constructive impact on short term interest rates”,⁶¹ whereas later cuts merely served to “bring the discount rate into better alignment with short term rates”.⁶² During this period we have counted seven domestic policy actions, of which four are discount rate changes.

⁵⁸ 1973 Fed AR, p 116.

⁵⁹ *ibid.*, p118.

⁶⁰ 1974 Fed AR, p 43.

⁶¹ 1975 Fed AR, p 142.

⁶² *ibid.*, p 144.

August 1977 to Spring of 1980 - renewed restrictiveness

Discount rate raised from 5.25 to 13% in 14 steps

The economic expansion continued at a rapid pace through the end of 1978, but this growth "was accompanied by a serious intensification of inflationary pressures."⁶³ While the discount rate was raised twice during 1977 and on a further three occasions in the first half of 1978 the Fed was keen to stress in four of the five cases that it "did not regard the increase as a monetary policy action, but rather as a technical move to bring the discount rate into better alignment with other short term interest rates."⁶⁴ Indeed, on one notable occasion the discount rate increase was opposed by Mr. Miller, the chairman of the Federal Reserve Board, since he did not want to signal a tightening of policy. In the fifth instance we have counted the action as an externally motivated dummy - according to the New York Times "the Board said it raised the key interest rate because of the recent disorder in world foreign exchange markets ... it hoped the need for the higher rate would be temporary."⁶⁵

In contrast, in the second half of 1978 open market operations, discount rate increases and increases in reserve requirements were all undertaken in order "to counter continuing domestic inflationary pressures"⁶⁶ and to strengthen the weakening dollar. While these measures succeeded in slowing down the economy the second oil price shock and continuing rapid growth in monetary aggregates led to a renewed tightening that started in the late summer of 1979. In the months from July 1979 to February 1980 the discount rate was increased on five further occasions from 9.5% to 13% in order "to highlight the System's continuing policy to resist inflation".⁶⁷ During this period six of the fourteen increases in the discount rate have been considered domestic policy actions.⁶⁸

⁶³ 1978 Fed AR, p 5.

⁶⁴ 1977 Fed AR, p 144.

⁶⁵ NYT, January 7th 1978.

⁶⁶ 1978 Fed AR, p 94.

⁶⁷ 1980 Fed AR, p 81.

⁶⁸ We excluded two actions from this latter period which would otherwise have been included since they came on the same day as inflation reports and GDP announcements to which the bond markets reacted prior to the discount rate changes.

May to July 1980 - market led declines in rates

Discount rate reduced from 13% to 10% in 3 steps

In the second quarter of 1980 the U.S. suffered its most severe post war contraction. According to the Fed short term interest rates “fell sharply in the spring [due to] ... a steep decline in economic activity”.⁶⁹ Consequently, “from late May to late July, the Board approved three reductions of 1% in the basic discount rate ... All of these actions were technical in nature: they were designed to bring the discount rate into closer alignment with short term market rates ... and were not intended to signal a change in the general course of monetary policy”.⁷⁰ However, while the Fed persisted with its anti-inflationary rhetoric on at least one occasion the interpretation of Wall Street economists at the time was different. Commenting on the second discount rate reduction, one said “this action shows that the Fed is deeply concerned about the economy”.⁷¹ We have therefore counted this as being a domestic policy action, while excluding the other two.

September 1980 to May 1981 - reasserting control

Discount rate raised from 10 to 14% in 4 steps

The 1980 mini-recession was very short lived and by the fall the Federal Reserve moved to tighten policy once more. The discount rate was raised three times in late 1980 and again in the spring of 1981. The early increases were taken “against the background of an unexpectedly sharp recovery in economic activity and the persistence of intense inflationary pressures”.⁷² While the latter increase was prompted by an acceleration of M1 in April 1981, which required a move “to underscore the System's determination to curb excessive monetary expansion and thereby exert a restraining influence on inflationary expectations.”⁷³ We have thus counted all four changes as domestically motivated policy actions.

⁶⁹ *ibid.*, p 3.

⁷⁰ *ibid.*, p 82.

⁷¹ NYT, June 13th 1980.

⁷² *ibid.* p 82.

⁷³ 1981 Fed AR, p 78.

October 1981 to December 1982 - getting out of the recession

Discount rate reduced from 14% to 8.5% in 9 steps

At the end of 1981 two one percentage point reductions in the discount rate were undertaken. The Federal Reserve was keen to emphasize that these were actions were simply “a technical response to developments in the money market and that [they] did not signal a change in policy”.⁷⁴ However, while the press agreed with this evaluation in the case of the first change the second reduction was widely perceived to be an easing of policy and we have thus counted it a policy action.

With the weakening of activity in 1982 the content of official policy statements changed. In addition to seeking “to maintain the financial discipline necessary to achieve further progress toward price stability”, the Federal Reserve also mentioned the desire “to foster conditions conducive to the development of a sustained recovery in economic activity.”⁷⁵ To attain the latter goal the Board approved seven half point discount rate reductions between mid-July and mid-December 1982. All these have been considered policy actions with the exception of one when the Fed no longer cited “slower growth of the money supply” as being the reason for the cut but merely said they were bringing “the discount rate into better alignment with other short term interest rates”.⁷⁶ The other six reductions were all described as being taken “against a background of ... indications of persisting sluggishness in economic activity”.⁷⁷

Fall of 1984 to summer of 1986 - continued moderate easing

Discount rate reduced from 8.5% to 5.5% in 8 steps

As growth slowed to only about 2% in 1985 and 1986 and inflation continued to decline the Federal Reserve adopted a policy of cautious easing. In the two FOMC meetings prior to the 1984 discount rate reductions the Committee voted for “a directive that called for a somewhat reduced degree of restraint” and then the following month “some further reduction in the degree of restraint”.⁷⁸ The 1985 reduction “was taken against the background of relatively slow growth in overall economic activity”.⁷⁹ Further discount rate reductions took place in 1986. These actions were “judged to be consistent with the

⁷⁴ 1981 Fed AR, p 79.

⁷⁵ 1982 Fed AR, p 3.

⁷⁶ NYT, August 27th 1982.

⁷⁷ 1982 Fed AR, p 75.

⁷⁸ 1982 Fed AR, pp. 133 and 141.

⁷⁹ 1985 Fed AR, p 70.

accommodative monetary policy that had been implemented for some time through open market operations and ... was deemed appropriate in the context of relatively slow growth in overall business activity".⁸⁰ We have thus counted all reductions, with the exception of one which the Fed merely described as "a technical change",⁸¹ as being policy actions.

September 1987 to February 1989 - modest tightening

Discount rate raised from 5.5% to 7% in 3 steps

Signs of increasing inflation emerged during 1987 and 1988 as the economic expansion continued. With the exception of a few months following the October 1987 crash when policy was eased moderately, open market operations throughout this period were "characterized by a tendency toward greater restraint".⁸² While open market operations were the chief instrument of policy the three increases in the discount rate were "expected to result in firmer conditions in money markets"⁸³ and to act "as a signal of the System's intent to deal effectively and in a timely way with potential inflationary pressures".⁸⁴ All three increases are thus counted as domestic policy actions.

Summer of 1989 to summer of 1992 - modest and then more aggressive easing

Discount rate raised from 7% to 3% in 7 steps

By the summer of 1989 the rate of growth appeared to be slowing down and with the threat of rising inflation receding the Federal Reserve sought to support the "expanding economy while trying to hold in check, and eventually reduce, the rate of price inflation"⁸⁵ - to this end the July 1989 FOMC directive "called for some slight easing in the degree of pressure on reserve positions".⁸⁶ Following the Iraqi invasion of Kuwait in August 1990 the oil price surged and by mid-autumn "the risk of an appreciable economic contraction was growing. At that point, the Federal Reserve began to move forcefully toward a more accommodative stance".⁸⁷ The Board eased further in the early months of 1991 and "with the stance of policy seemingly conducive to supporting the upturn in activity that began in

⁸⁰ 1986 Fed AR, p 82.

⁸¹ NYT, April 19th 1986.

⁸² 1987 Fed AR, p 3.

⁸³ 1988 Fed AR, p 69.

⁸⁴ 1987 Fed AR, p 73.

⁸⁵ 1990 Fed AR, p 3.

⁸⁶ 1989 Fed AR, p 107.

⁸⁷ 1990 Fed AR, p 3.

spring, a more neutral money market posture was maintained through the spring and early summer."⁸⁸ However, the recovery seemed to stall in the summer and as fears of a double dip recession became widespread the "Federal Reserve resumed its easing of money market conditions in the second half of 1991".⁸⁹ All reductions were clearly domestically motivated policy actions, but two have been excluded as they came on the same day as large increases in the unemployment rate were announced.

February to May 1994 - gentle firming

Federal funds rate target raised from 3% to 4.25% in 4 steps - discount rate raised to 3.5%

The recovery from the 1990-91 recession was unusually slow, but by the end of 1993 the economy was growing rapidly, registering a 7.5% annual growth rate in GDP in the fourth quarter. The Fed therefore began to tighten modestly in the early months of 1994 to prevent any potential pickup in the rate of inflation. The tightening steps came in the form of four increases in the target for the Federal Funds rate and, accompanying the last increase, a half point increase in the discount rate. In the past changes in FOMC directives were made public about six weeks after the event, however on these occasions the Fed broke with eighty years of tradition and announced at the time that the target had been increased. Mr. Greenspan said the announcement had been made "so as to avoid any misunderstanding of the committee's purpose, given the fact that this is the first firming"⁹⁰ since 1989. Justifying the last move the Fed said "These actions ... substantially remove the degree of monetary accommodation which prevailed throughout 1993."⁹¹ All four actions have been counted as domestic policy actions.

b) Great Britain, 1965-1994

The identification of monetary policy actions in Great Britain is more difficult than for the United States and Germany (see below). In general, the Bank of England is characterized by less openness than the Bundesbank or the Federal Reserve Board, when it comes to justifying and explaining its actions. When the Radcliffe Committee recommended the publication of the Bank of England Quarterly Bulletin as a means for the Bank to provide

⁸⁸ 1991 Fed AR, p 3.

⁸⁹ *ibid.*, p 3.

⁹⁰ NYT, February 5th 1994.

⁹¹ Wall Street Journal, May 18th 1994.

comment on monetary developments, the Bank was initially very reticent as it felt that it might cause it "to show [its] hand more fully than [it] thought desirable".⁹² Furthermore, the absence of independence constrains comment by the Bank to be "consistent with ministerial utterances".⁹³ For this reason we had to rely more on newspaper reports than for other countries.

After compiling 179 potential policy actions from the OECD country report for the U.K. and the Bank of England Quarterly Bulletin, we checked each instance in the Financial Times in order to establish (i) if there was any contemporaneous statement from either the Bank of England or the Chancellor of the Exchequer as to the motives of the action, (ii) how the Financial Times interpreted their statement and the action, (iii) the exact timing of the action - sometimes changes in rates were signaled through operations in the money markets one or two days before - and (iv) the reaction of long and short rates to the news. We were able to eliminate 93 actions. Many of these 93 "actions" were during the period in the 1970's when the Bank of England's minimum lending rate (MLR) was determined by a formula related to the previous week's treasury bill auction. While the Bank could still influence the MLR through open market operations it tended to let short rates be market-determined and many of the changes in MLR were not even reported on the front page of the Financial Times. The other principal reason for not counting an action was because it accompanied another major event or was part of a within day policy reaction. For example, many changes in interest rates were announced by the Chancellor along with his Spring Budget or Autumn Statement which also included fiscal announcements that might be expected to have an independent influence on interest rates. Others came within hours of poor trade figures to which the markets were also reacting. Of the remaining 86 actions, we considered 24 to be externally motivated. The classification of each of the 179 potential policy actions is now explained.

June 1965 - moderate easing

Bank rate reduced from 7% - 6% in 1 step.

The Bank rate had been increased twice in 1964 from 4% to 7% in response to growth approaching 6% p.a. The downward adjustment in June 1965 represented a modest relaxation. It was accompanied by a small increase in hire purchase restrictions designed to

⁹² Radcliffe Committee (1959), paragraph 859.

⁹³ *ibid.*

partially offset the easing.⁹⁴ Nevertheless, the move was intended as an easing of policy that was justifiable on domestic grounds.

July 1966 - tightening

Bank rate raised from 6% - 7% in 1 step

The seaman's strike of the early summer of 1966 resulted in a sterling crisis as the markets became concerned over the British balance of payments situation.⁹⁵ The authorities imposed a set of very restrictive measures, including increases in special deposits and tighter hire purchase restrictions. While the immediate cause of the tightening was a sterling crisis, the authorities were also concerned with the strength of the economy and the measures were undertaken to cool the economy as well as to restore confidence in the pound. We have thus counted this as a domestic policy action.

January 1967 to May 1967 - easing

Bank rate reduced from 7% - 5.5% in 3 steps

During the second half of 1966 the economy slowed down sharply and the authorities cautiously reduced rates in 3 half point steps over a period of four months in early 1967. The first reduction was on their own initiative and is clearly a domestic policy action. While the second and third reductions were taken after reductions in the U.S. and the continent they nevertheless accorded with domestic objectives and have thus also been classified as domestic actions.

October to November 1967 - sterling devalued

Bank rate raised from 5.5% to 8% in 3 steps

Renewed weakness in the balance of payments position led to pressure on sterling and prompted the authorities to raise the Bank rate twice in October and early November. However, these measures were not sufficient to deter the speculators and in mid-November sterling was devalued from \$ 2.80 to \$ 2.40. The government sought to offset the inflationary consequences of this move by raising the Bank rate by a further 1.5% to 8%. The first two are counted as externally motivated actions, while the third one could not be considered as there was another major event that day.

⁹⁴ Hire purchase restrictions are restrictions on the terms of consumer credit which retailers of durable products may extend to their customers. They constituted an instrument of monetary policy during the 1960s.

⁹⁵ It seems that exporters were more dependent on the services of British seamen than were importers and so the strike was expected to result in a net deterioration in the trade position.

March to September 1968 - the external situation improves

Bank rate reduced from 8% to 7% in 2 steps

Several good sets of trade figures during 1968 gave the authorities the opportunity to reduce interest rates somewhat from the high post devaluation levels. While the fiscal stance was very restrictive during the year the interest rate declines certainly represented a modest easing of monetary conditions and thus both have been counted as domestic policy actions.

February 1969 -restrictive stance restored

Bank rate raised from 7% to 8% in 1 step

By the end of 1968 fresh fears arose over the pace of economic expansion. Imports remained stubbornly high and consumer spending had failed to ease despite restrictive fiscal measures taken in the previous budget. In light of this, measures were undertaken to restrict demand further including a one percentage point increase in the Bank rate. This is a particularly clear case of a domestic policy action.

March 1970 to September 1971 - attempting to discourage dollar inflows

Bank rate reduced from 8% to 5% in 4 steps

Measures taken the previous year were successful in slowing the economy, but inflation continued to rise, approaching 10%. Moreover, this period coincided with considerable dollar weakness and large capital inflows for all European countries. The authorities dealt with these problems by reducing the Bank rate twice in early 1970 and on a further two occasions in 1971, while increasing Special deposit requirements to avoid excessively loose monetary policy. These actions were combined with massive fiscal stimuli in the fall of 1970 and in the 1971 and 1972 Budgets which had the aim of raising the growth rate to 5% p.a. While the authorities clearly wanted to pursue a very expansionary policy they were at the same time worried about inflation. Faced with this situation it was their belief that fiscal policy was a more appropriate instrument. The reductions in the Bank rate were chiefly designed to counteract the speculative inflows that arose from the dollar weakness and thus are regarded as being externally motivated.

June 1972 to December 1972 - trying to slow the Barber boom⁹⁶

Bank rate raised from 5% to 9% in 6 steps

The unsustainable fiscally induced expansion of 1971-1972 soon led to further sterling weakness and rising domestic interest rates. The Bank rate was raised in June to 6% at a time when market rates had already risen considerably. In October, the Bank rate was replaced by the Minimum Lending Rate, which was fixed each Friday, depending on the average Treasury Bill auction rate of the previous day. This was regarded in the press as a move towards a more market oriented formula, while at the same time leaving the authorities with the ability to signal changes if they so desired.

The MLR was first fixed at 7.25%, which merely validated the increases in interest rates that had previously taken place. Two weeks later it increased further to 7.5%, but without a signal from the authorities. In late November and early December further strong growth in the money supply prompted the Bank to initiate two further 0.25% increases by lending to the discount houses for a full week at the MLR.⁹⁷ These two small increases were not deemed sufficient and in late December the "Bank took drastic action to forestall renewed inflationary growth in the money supply".⁹⁸ It called for a further 2% of special deposits and signaled a 1% increase in the MLR to 9%. Of these six changes, we have counted the last three as domestic policy actions.

January to June 1973 - market led declines in rates

Minimum lending rate reduced from 9% to 7.5% in 6 steps

Following the previous year's sharp tightening slightly easier conditions prevailed in the money markets and the Bank did not resist the six quarter point declines in the MLR. However, it did not actively signal these declines instead choosing to follow the market. We have thus not counted any as policy actions.

⁹⁶ This period is always referred to as "the Barber boom" after the Chancellor of the Exchequer at the time, Mr. Anthony Barber.

⁹⁷ The minimum lending rate was given by the previous day's average Treasury Bill rate of discount plus 0.5% rounded up to the nearest 0.25%. Thus action by the Bank of England to lend at the MLR would prompt similar bids at the Treasury Bill auction and hence a higher MLR at its fixing the following day.

⁹⁸ Financial Times, December 22nd 1972.

July to November 1973 - renewed restrictions

Minimum lending rate raised from 7.5% to 13% in 4 steps

The balance of payments had been moving heavily into deficit as the economy had grown exceptionally fast in the early part of the year. Rising interest rates overseas provoked a sharp fall in sterling in the early summer and this was the immediate cause of the first two increases to 11.5%. At this stage, according to the Bank of England Quarterly Bulletin the emphasis was on maintaining "the momentum of expansion at a reasonable pace", while it claimed that the "expansion of investment in industry now seems firmly established ... higher interest rates are therefore unlikely to have great impact on investment plans".⁹⁹ The next increase took place in November when the Bank of England overrode the formula and raised the MLR to a record 13% by administrative action.

Commenting on its action the Bank said "the restrictive monetary measures in July had been undertaken with the effect of relative interest rates on the capital side of the balance of payments primarily in mind. The measures in November were prompted rather more by the general state of the economy and the domestic monetary situation".¹⁰⁰ However, the latter measures were put into effect on the same day as some terrible trade figures were announced and so cannot be treated as exogenous. Thus, we have only counted the first two moves as externally motivated actions.

January 1974 to April 1975 - post oil shock recession

Minimum lending rate reduced from 13% to 9.75% in 13 steps

1974 was the year of total meltdown in Britain. The year started with the coal miners forcing Prime Minister Edward Heath out of office after the three day working week was introduced.¹⁰¹ There was only a caretaker minority Labour government in office from February until the second election of the year in October. The stock market declined by 70%, inflation rose to over 25% and long dated gilt yields increased to over 17%. The three declines in the MLR from 12.75% to 12% in January and April were the direct result of the Bank of England's "moves to relieve pressure on the banking system by releasing special deposits".¹⁰² The other declines in rates were not actively encouraged by the Bank but were

⁹⁹ Bank of England Quarterly Bulletin (henceforth BoE Bulletin), September 1973, p 278.

¹⁰⁰ BoE Bulletin, December 1973, p 401.

¹⁰¹ In an effort to reduce the bargaining power of the striking miners, the Conservative government imposed a three day working week on industry.

¹⁰² Financial Times, April 6th 1974.

“acceptable to the authorities”.¹⁰³ Thus, we have counted only three of the thirteen changes as policy moves.

May to October 1975 - confronting stagflation

Minimum lending rate raised from 9.75% to 12% in 3 steps

While 1974 had been a wretched year for Britain, 1975 was only a little better. According to the OECD “declining output and employment, strong inflation, and the large current external deficit posed major policy dilemmas in 1975”.¹⁰⁴ The one percentage point increase in the MLR in July was described by the Bank of England as follows: “short term interest rates abroad ... had begun to turn up ... The UK authorities, therefore, encouraged a rise in domestic short term rates”.¹⁰⁵ By October, however, the second one percentage point “rise in domestic interest rates also seemed desirable on internal grounds in order to ... maintain appropriate restraint on the growth of the money supply”.¹⁰⁶ We have therefore counted this latter action as a domestic policy action and the former as being externally driven.

November 1975 to March 1976 - following international rates down

Minimum lending rate reduced from 12% to 9% in 10 steps

Easier rates in the U.S. led to a similar decline in short term interest rates in Britain. This move was generally welcome to the Bank of England, however on a couple of occasions it stepped in to slow the pace of decline. In all instances the Bank followed the market and so none of these are considered to be policy actions.

April to October 1975 - sterling weakness and continuing high inflation

Minimum lending rate raised from 9% to 15% in 4 steps

1976 was another year of poor economic performance. “Total output in the UK has been stagnant since the spring; all components of demand have been weak. The recent course of unemployment has been erratic, but the trend has remained upward. The rate of price inflation has failed to slow down.”¹⁰⁷ Furthermore sterling displayed considerable weakness

¹⁰³ Financial Times, April 19th 1975.

¹⁰⁴ OECD Economic Surveys, United Kingdom, February 1976, p 23.

¹⁰⁵ BoE Bulletin, September 1975, p 211.

¹⁰⁶ BoE Bulletin, December 1975, p 334.

¹⁰⁷ BoE Bulletin, December 1976, p 409.

throughout the year, falling by about 15% between the end of February and the end of May and then by a further 15% in the months to the end of October.

All four increases in the MLR during this period were clear policy actions. However, the first two in April and May that raised the rate from 9% to 11.5% were intended as a means of restoring confidence to the foreign exchange markets, while the latter two in the Fall were also aimed at controlling money supply growth. Commenting on the earlier moves the F.T. said "officials made it clear that the move was made purely for external reasons and it is hoped that it will be temporary in nature",¹⁰⁸ while the latter moves were taken both "in response to the sterling crisis and to control the money supply".¹⁰⁹ While the authorities "hoped" that the first two increases would be temporary, it seems that this perception was not shared by the bond markets with long bond yields rising by 60 basis points at the time of the April increase in the MLR. We have nevertheless counted the former two as externally driven, and the latter two as domestic actions.

November 1976 to October 1977 - confidence returns

Minimum lending rate reduced from 15% to 5% in 21 steps

Following the signing of the letter of intent with the IMF in December 1976 there was a marked improvement in financial confidence. This improved confidence led to steady falls in interest rates at both the long and the short end. However, in many instances the authorities stepped in to slow the pace of the decline. There was only one clear instance of the Bank leading the market downwards, when it suspended the MLR formula on March 10th. During the latter part of this period the Bank was intervening heavily to prevent an appreciation of sterling and the market led declines in short rates were simply the counterpart to this exchange rate target. Thus we have counted only one of these twenty one changes in the MLR as a policy action.

November 1977 to February 1979 - tightening

Minimum lending rate increased from 5% to 14% in 8 steps

"By October [1977], when minimum lending rate had fallen to 5% and the reserves had risen by \$ 3bn in a month, it became clear that the exchange rate could no longer be kept down without putting seriously at risk the prospect of staying within the sterling M3

¹⁰⁸ Financial Times, April 24th 1976.

¹⁰⁹ Financial Times, September 11th 1976.

target".¹¹⁰ Concern over the inflationary consequences of holding down the exchange rate prompted the Bank to allow it to float more freely and at the same time initiate a 2 percentage point increase in the MLR in November.

The economy was more buoyant in 1978 than at any time since the oil crisis. Growth in sterling M 3 in the twelve months to mid April was in excess of 16% against a target range of 8-12%. "In response to this growing evidence of excessive monetary growth, the MLR was raised by 1% to 7.5% in the Budget, and to 9% in two stages in the first half of May."¹¹¹ The first increase of 1978 was accompanied by a suspension of the formula for determining the MLR. The second and third ones followed a "signal by the Bank that it would not resist the upward pressure on interest rates that had developed in the markets".¹¹² In mid May the formula for the MLR was abandoned and it was announced that in future the MLR would be fixed by the authorities. In the subsequent months the authorities raised the MLR three times from 9% to 14%. Each time market rates had already risen somewhat, yet the MLR was raised further in an attempt to "establish a new level for interest rates".¹¹³ The first of these increases was announced in combination with a restrictive fiscal package and so could not be included. We thus have four instances of exogenous domestic policy actions in this sequence.

March to April 1979 - reluctant interest rate reductions

Minimum lending rate reduced from 14% to 12% in 2 steps

In the spring the authorities intervened heavily in the foreign exchange markets to hold down sterling. However, concern that this would cause them to lose control over monetary aggregates led them to permit rates to fall in two steps in March and April. In both instances the MLR was only reduced to bring it into line with money market rates, thus neither instance has been counted as a policy action.

June to November 1979 - the advent of Mrs. Thatcher

Minimum lending rate 12% to 17% in 2 steps

The new Conservative government elected in May 1979 represented a sharp break from the policies of previous governments. Its aims were to reduce the size of the government

¹¹⁰ BoE Bulletin, December 1977, p 415.

¹¹¹ BoE Bulletin, June 1978, p 153.

¹¹² Financial Times, May 5th 1978.

¹¹³ Financial Times, February 8th 1979.

sector, to achieve a sustained reduction in inflation and the abandonment of demand management policies through the pursuit of a consistent medium term financial strategy.

The first hike in the MLR from 12% to 14% accompanied the post election Budget and despite much previous anti-inflationary rhetoric came as a surprise to the markets. The second hike was more expected as interest rates in the US had begun to rise under Paul Volcker, the new Fed Chairman. Nevertheless, the three percentage point increase was in excess of market expectations and in addition, the monetary authorities reaffirmed their target of 7%-11% growth for £ M3 without a revision of the base despite growth that had far exceeded this rate in the previous months. We have thus included both as domestically motivated policy actions.

July 1980 to March 1981 - cautious easing

Minimum lending rate reduced from 17% to 12% in 3 steps

There was considerable confusion as to whether the Bank of England's stance during this time was restrictive or expansionary. Conflicting signals were given by different indicators - £ M3 was growing in excess of 25% p.a., short term interest rates in Britain were below those in the U.S., but set against this was the soaring exchange rate, the deep recession and inflation that fell from 23% to 8% between the first and second halves of 1980. Furthermore, the rapid growth in the broad monetary aggregates was not matched by more narrow measures and was in large part due to reintermediation that took place after the removal of the "corset".¹¹⁴ While it is clear that the authorities wanted to ease policy somewhat they were keen not to give up their hard earned reputation for toughness. Thus the day before the first cut *Lex*¹¹⁵ proclaimed that the market was anticipating "a good four point cut in the MLR",¹¹⁶ it then took nearly nine months for these expectations to be realized. When they came these actions certainly represented an easing of the policy stance, however the latter two could not be counted since they accompanied the 1980 Autumn Statement and the 1981 Budget.

¹¹⁴ The corset is the name given to a variety of quantitative restrictions that were in place in the 1970's. The major result of these restrictions was the development of non-bank intermediaries which then satisfied firms' borrowing requirements. This resulted in official figures understating the true growth of broad monetary aggregates, until the removal of the corset.

¹¹⁵ *Lex* is the influential column of the Financial Times, that can be taken as an indicator of "City" opinion.

¹¹⁶ Financial Times, July 3rd 1980.

September to October 1981 - reaffirming the authorities' toughness on inflation

Base rates increased from 12% to 16% in 2 steps

On 20th August 1981 publication of the MLR was discontinued. Instead the authorities sought to keep short rates within an undisclosed band through the use of open market operations. In practice the dealing of the Bank in the money markets are fairly transparent and so almost all subsequent changes in bank base rates¹¹⁷ were previously signaled by changes in the Bank of England's intervention rates in the money markets. The two increases in base rates during the fall of 1981 were partly prompted by weakness in sterling as U.S. rates remained high. Nevertheless, as rates were increased the Bank stressed that in addition to external considerations it sought "to reaffirm its commitment to fighting inflation".¹¹⁸ The second change coincided with the Autumn statement and so has not been counted. The first change we have classified as a domestically motivated action.

November 1981 to November 1982 - relaxing

Base rates reduced from 16% to 9% in 13 steps

The continued weak economy and declining inflation prompted an easing of policy which the authorities combined with a strong anti-inflationary rhetoric: "These generally satisfactory monetary developments provided the basis for a gradual but progressive decline in short term interest rates... This general reduction in nominal interest rates followed a fall in the rate of inflation, and did not imply a corresponding reduction in real interest rates or in the anti-inflationary stance of monetary policy".¹¹⁹ In the contemporaneous Financial Times reports, however, the policy actions are clearly interpreted as cautious steps towards easing. Except for three occasions in which there is a clear indication that the authorities were merely following market rates downward, we have counted thus counted all reductions as domestic policy actions.

November 1982 to January 1983 - sterling weakens

Base rates increased from 9% to 11% in 2 steps

In mid-November weakening oil prices had led to considerable sterling weakness and to increases in interbank rates. The Bank seemed to try to resist the general upward movement in interest rates but after Barclays raised its base rate the Bank accepted the need

¹¹⁷ Clearing bank base rates correspond to the prime rate in the United States.

¹¹⁸ Financial Times, September 15th 1981.

¹¹⁹ BoE Bulletin, September 1982, p 343.

for higher rates. This increase reassured the foreign exchange markets for a period of time, but throughout December sterling remained under pressure and three month interbank rates rose to a full percentage above base rates. The Bank again tried to resist the increase in rates but finally gave in after the clearing banks again raised base rates early in January. Neither of these changes have been counted as policy tightenings as in both cases they were led by the clearing banks rather than the Bank of England.

March 1983 to March 1984 - sterling recovers and policy is eased further

Base rates reduced from 11% to 8.5% in 5 steps

By March the oil price had begun to stabilize and sterling with it, leading to downward pressure on money market rates. "The authorities took the view that the underlying monetary situation called for caution so that any immediate fall in short term interest rates should be limited."¹²⁰ However, by mid-April it had permitted two half point cuts in base rates. Market rates declined further following the June general election and with "the recovery not yet firmly established"¹²¹ the authorities did not want to convey too harsh an attitude and thus indicated a desire for a further half point decline in base rates. In the subsequent months rates drifted lower with little guidance from the authorities. Of the cuts only the second and third followed explicit signals from the Bank and have been counted as policy actions.

May to July 1984 - sterling under pressure again

Base rates raised from 8.5% to 12% in 4 steps

Rising interest rates in the U.S. due to the extraordinarily rapid pace of the recovery, combined with unexpectedly fast growth in £ M3 and the announcement of a national dock strike led to a sudden loss of confidence in sterling and rates were raised from 9.25% to 12% in five days in July. All increases in rates during this period were led by the markets and subsequently endorsed by the authorities. Thus we have not counted any as policy actions.

August to November 1984 - moderate easing

Base rates reduced from 12% to 9.5% in 5 steps

While in the previous round of interest rate increases the market had led the Bank, on the way back down the Bank initially encouraged the movement by giving a "clear signal that

¹²⁰ BoE Bulletin, June 1983, p 171.

¹²¹ BoE Bulletin, September 1983, p 340.

was stronger and earlier than many had been expecting"¹²² and, except for the final decline, each subsequent cut in rates followed a signal from the Bank. We thus regarded the first four reductions as domestic policy actions.

January 1985 - sterling weakens again

Base rates raised from 9.5% to 14% in 3 steps

Continued dollar strength combined with renewed fears of a weakening oil price led to strong pressure on sterling and a general hardening of interbank rates. Of the three increases the first and third were market led, while the second was the result of the Bank displaying "firm official action",¹²³ when it reintroduced the Minimum Lending Rate for a day for the first time since its publication had been discontinued. This action was intended to reassure the markets but fears over the outcome of the OPEC meeting led to a further two point rise in interbank rates the following Monday, which resulted in another two point rise in base rates, which the Bank later endorsed. Only the second increase has been classified as a policy action and one which was externally motivated.

March to July 1985 - the pressure eases

Base rates reduced from 14% to 11.5% in 5 steps

The recovery of sterling following the January crisis led to market pressure for lower interest rates. The Bank "responded cautiously, but the pressure was sufficiently strong at times for them to feel confident that modest falls in rates would be sustainable. Accordingly, the Bank acquiesced in [the] reductions".¹²⁴ With the exchange rate remaining stable the "authorities judged that the monetary situation justified a modest reduction in short term interest rates"¹²⁵ and thus signaled two further base rate cuts in July. We have counted these latter as policy actions, while the former two were merely following the market.

January 1986 - renewed sterling weakness

Base rates increased from 11.5% to 12.5% in 1 step

The collapse in oil prices led to renewed sterling weakness and upward pressure on interest rates. "In the light of the persisting market pressure, and of the policy concerns

¹²² Financial Times, August 9th 1984.

¹²³ BoE Bulletin, March 1985, p 30.

¹²⁴ BoE Bulletin, June 1985, p 184.

¹²⁵ BoE Bulletin, September 1985, p 365.

described above, on January 8th the Bank signaled a rise in the general level of interest rates".¹²⁶ While the Bank justified this move by referring to the continued high level of pay settlements (the policy concerns alluded to in the quote) it was mainly externally motivated.

March to May 1986 - internationally led interest rate decline;

Base rates reduced from 12.5% to 10% in 4 steps

The oil price decline led to a decline in worldwide inflationary expectations and an easing of international interest rates. This climate enabled the British monetary authorities to permit declines in domestic interest rates without conveying the impression of monetary laxity to the financial markets. While they were generally content to see rates fall, at times they intervened to prevent rates falling too fast and on each occasion that base rates declined it was after pressure from within the markets rather than the result of active policy. Thus we have not counted any of these as policy actions.

October 1986 - sterling weakens

Base rates increased from 10% to 11% in 1 step

The 7% decline in the exchange rate from the summer to the fall of 1986 led the authorities to conclude that "a rise in interest rates would be appropriate to offset the easing of monetary conditions... but policy considerations did not call for a sharp increase from their already high level".¹²⁷ They consequently signaled a one percentage point rise in mid October, which we have classified as an externally motivated action.

March to May 1987 - trying to hold down sterling

Base rates reduced from 11% to 9% in 4 steps

While the Bank initially resisted any early falls in base rates by March it "signaled it was ready to see borrowing costs fall"¹²⁸ in a move which "surprised financial markets".¹²⁹ In the following weeks it was faced with the same dilemma - on the one hand it did not want to see interest rates fall too fast with the economy already growing strongly, while on the other it was "reluctant to see a sharp and unsustainable exchange rate appreciation damage the re-

¹²⁶ BoE Bulletin, March 1986, p 27.

¹²⁷ BoE Bulletin, December 1986, p 475.

¹²⁸ Financial Times, March 10th 1987.

¹²⁹ *ibid.*

emergence of industrial confidence".¹³⁰ The solution was considerable intervention in the foreign exchange market to hold down sterling combined with modest further cuts in interest rates. Since these interest rate movements were in the opposite direction to those deemed appropriate on domestic grounds we have counted them as being externally motivated.

August 1987 - slowing the boom

Base rates increased from 9% to 10% in 1 step

The easing of sterling over the summer gave the authorities the opportunity to raise interest rates to a level they deemed more appropriate to domestic monetary conditions without putting undue upward pressure on the exchange rate. The Financial Times greeted the move thus: "fears of rising inflation and an overheating economy prompted the Bank of England to push up interest rates in a surprise move".¹³¹ This is an unambiguous domestic policy action.

October to December 1987 - post Crash easing

Base rates reduced from 10% to 8.5% in 3 steps

Following the October crash there was a co-ordinated worldwide easing of monetary policy. While the reductions were, as ever, couched in terms of merely offsetting the contractionary effects of the crash they nevertheless did represent a substantial non-transitory easing of policy and thus are counted as domestically motivated actions.

February 1988 - slowing the boom again

Base rates increased from 8.5% to 9% in 1 step

With the realization that the Crash had not had any lasting impact on the real economy, the authorities were once again faced with the previous year's dilemma - a desire for tighter monetary conditions on domestic grounds was hampered by the strength of sterling. Some slight sterling weakness enabled interest rates to be increased in February. "The purpose of this move was to maintain the counter-inflationary stance of policy and to emphasize that excessive domestic cost increases would not be validated through currency depreciation".¹³² We thus have a clear domestic policy action.

¹³⁰ BoE Bulletin, August 1987, p 344.

¹³¹ Financial Times, August 8th 1987.

¹³² BoE Bulletin, May 1988, p 181.

March to May 1988 - sterling too strong again

Base rates reduced from 9% to 7.5% in 3 steps

The UK authorities had attempted to keep sterling at a rate of about DM3 since the previous summer as a prelude to eventual ERM entry. However, the scale and persistence of the strength of sterling meant that the authorities could no longer continue to hold it down through exchange rate intervention. Thus on March 7th sterling was allowed to rise and the tightening of conditions that this represented was offset by several half point reductions in interest rates. Just as in the previous year since these moves were not in the direction that was deemed desirable on domestic grounds we have counted them as being externally motivated.

June 1988 to October 1989 - severe tightening

Base rates raised from 7.5% to 15% in 11 steps

Once sterling began to weaken sentiment changed sharply and financial markets began to focus more on the poor domestic inflationary outlook. While rates were raised rapidly from 7.5% in early June to 10.5% six weeks later, markets were disappointed at the authorities failure to give a firm lead - each increase merely validated earlier increases in market rates. In August rates were increased twice more to 12%. The first of these increases took the markets by surprise and longer dated bonds actually strengthened moderately on the announcement. The subsequent increase and the November rise both followed within hours of the publication of appalling trade figures, each one showed a record deficit. In May 1989, rates were raised again in response to sterling weakness. "The Chancellor insisted that previous increases had done enough to cool domestic demand and this move was intended to stem the fall in the exchange rate."¹³³ The final of the series of rate increases was again externally motivated - the Chancellor "ordered a 1% rise in British bank base rates in immediate reaction to a similar jump in official German lending rates".¹³⁴ Of these eleven increases we have counted two as domestically motivated actions, three as externally motivated and on five occasions they have not been counted at all - twice because the authorities were following the markets and three times because the move coincided with another major event.

¹³³ Financial Times, May 26th 1989.

¹³⁴ Financial Times, October 6th 1989.

October 1990 to present - confronting the depression

Base rates reduced from 15% to 5.5% in 14 steps¹³⁵

This period could perhaps be divided into two - pre and post ERM membership. Throughout the three and a half year period the authorities were keen to ease monetary policy as the United Kingdom suffered its deepest recession since the 1930's. However, during the early period interest rate cuts were cautious as policy was constrained by ERM membership and the upward pressure on German rates due to reunification. Following withdrawal from the ERM the authorities were able to cut rates rapidly. While policy during the ERM period was constrained, we nevertheless regard interest rate changes as being policy actions. For example, following one half point cut the Treasury said that "the cut had been made because it fitted in with domestic monetary conditions and the pound's resilience in the ERM".¹³⁶ While the Bank of England commented "the successive cuts in interest rates, together with the trend in sterling, amounted to a significant easing in monetary conditions".¹³⁷ Of the interest rate reductions we have excluded just the two which accompanied the Chancellor's Autumn statements in 1992 and 1993.

c) Germany, 1965-1994

Identifying monetary policy actions for the Federal Republic of Germany was aided by the fact that the Annual and Monthly Reports of the Deutsche Bundesbank, unlike the corresponding publications by the Bank of England, provide clear and fairly detailed explanations of the motivation behind policy actions. Departing, as in the case of Britain and the U.S., from the full set of publicly announced monetary actions, we could thus use the Bundesbank reports to eliminate some actions which clearly did not meet our criteria, and obtain a preliminary idea of the intentions behind the remaining policy events. As a check of the Bundesbank's interpretations, which could have been misleading due to their ex post nature, we cross-read the Bundesbank reports with the account of Giersch et al. (1992). We found them to be broadly consistent, certainly for the events which we eliminated off-hand as non policy-driven or transitory.

¹³⁵ Base rates were raised from 10% to 12% on September 15th and then to 15% for a few hours on September 16th before sterling exited from the ERM. We have not commented on these increases in the text, since they were clearly an unsuccessful attempt to fend off a speculative attack.

¹³⁶ Financial Times, March 23rd 1991.

¹³⁷ BoE Bulletin, August 1991.

This first screening left us with 110 potential policy actions. For these, we then went through past issues of the *Frankfurter Allgemeine Zeitung (FAZ)* in order to check (i) the *contemporaneous* Bundesbank statement regarding the motive of the action, (ii) the timing, i.e. exactly when the news regarding the action hit bond markets, and finally (iii) the reaction of long and short rates to these news. Using the contemporaneous information about the intentions behind policy actions, we eliminated a further 20 events as not constituting monetary policy in our sense, and classified 9 out of the remaining 90 events as externally motivated. We now explain how we arrived at these results. As for Great Britain, we find it useful to structure our account by distinguishing various “phases” or regimes of monetary policy.

1965-66 tightening

Discount rate raised from 3 to 5% in three steps

According to the Bundesbank's Annual Report, “credit policy in 1965 was directed to checking domestic inflationary tendencies and to averting major danger to external equilibrium”.¹³⁸ Against the backdrop of a cyclical peak, which was reinforced by procyclical fiscal policy which Giersch et al. (1992) attribute to the Federal election in September 1965,¹³⁹ the Bundesbank tightened, raising discount and lombard rates twice in 1965 and again in May of 1966, in addition, it raised money market intervention rates in January of 1966. This gives us four candidate policy events.

According to the *FAZ*, the reason given by the Bundesbank for the January 21st increase in Bank rates (the first change in the discount rate since 1961), is indeed “to curb excess demand and the danger of further price increases” (*FAZ*, January 22nd, 1965). The primary motivation for the August 12th increases was to counteract capital outflows, however, the Bundesbank also called this step consistent with its “fundamentally restrictive line” given “the development of prices and wages” (*FAZ*, August 13th, 1965). The January 6th increase in money market intervention rates is not accompanied by a Bundesbank statement and not discussed in the Annual Report, however, banks seemed to view it as a change in operating procedure rather than a further policy tightening (*FAZ*, January 7th, 1965). We thus have sufficient doubts about the intentions of this event to drop it from our list. Finally, the large Bank rates increase on May 26th, 1966 (discount rate up by one percentage point and the

¹³⁸ Bundesbank Annual Report (henceforth quoted as BB AR) (1965), p 1.

¹³⁹ Giersch et al., (1992) p. 143.

lombard rate up by 1.25 percentage points) was clearly intended as an anti-inflationary measure in view of "continuing domestic price and cost increases" (*FAZ*, May 27th, 1966).

Fighting the 1967 recession

Discount rate decreased from 5 to 3% in four steps

The year 1967 witnessed the largest downturn in production and employment since the war, with the unemployment rate rising sharply from 0.5% in the third quarter of 1966 (about average since the early sixties) to 1.6% in the fourth quarter and almost 3% in the first quarter of 1967. From late December onwards, the Bundesbank relaxed cautiously. Intervention rates were lowered by one percentage point on December 29th. Over the next eight months, discount and lombard rates were brought down in 5 steps from their initial levels of 5 and 6.25% to 3 and 3.5%, respectively, in addition, minimum reserve requirements were lowered four times.

The Bundesbank annual reports for 1966 and 1967 leave no doubt that the purpose of these actions was "strengthening domestic demand" and "counteracting the recession".¹⁴⁰ They are corroborated by the *FAZ* reports accompanying each of the various actions. We have thus included all monetary measures described above as policy actions.

Curbing the 1969/70 boom

Discount rate raised from 3 to 7.5% in four steps

Fueled by easy domestic monetary conditions and a strong surge in export demand, recovery from the 1967 recession was much faster than expected. In 1968, the economy was back to 7.1% real growth (after - 0.3% in 1967), followed by 8% in 1969. The producers' price index, which had risen by 0.8% on average between 1962 and 1968, increased by 2.2% in 1969 and almost 6% in 1970.

The reaction of monetary policy to these events was familiar from the early sixties. From March 1969 onwards, discount rates were raised from 3% to 6% in three steps and minimum reserve ratios were raised twice. The need to check inflation is stated as the primary objective in each of these cases. As in 1961, foreign capital attracted by the increases in interest rates put pressure on the D-Mark and finally forced its revaluation by 9.3% on October 27, 1969. The revaluation in turn prompted capital outflows, giving the Bundesbank some flexibility to tighten further. On March 6th, 1970, discount and lombard

¹⁴⁰ BB AR(1966), p. 13; (1967), p. 1.

rates were raised to the unprecedented levels of 7.5 and 9.5%, respectively, motivated by "continuing cyclical tensions and the ensuing dangers for prices" (Bundesbank statement as reported in *FAZ*, March 7th, 1970). All actions were classified as domestic policy.

Discouraging dollar inflows, 1970-72

Discount rate lowered from 7.5 to 3% in seven steps

The further tightening of monetary policy in Germany in early 1970 coincided with a shift in policy stance in the United States, where monetary policy eased markedly. The resulting differential in market interest rates was associated with large capital inflows which the Bundesbank initially attempted to sterilize through open market operations, increases in minimum reserve requirements and cuts in the rediscount quota (March-August 1970).¹⁴¹ As explained earlier, none of these actions, which were an attempt to sustain the high German level of interest rates as far as possible, constitute monetary policy events in our sense.

The Bundesbank was finally forced to lower interest rates. Between mid July 1970 and April 1971, the discount rate was brought down in 4 steps from 7.5 to 5%, with corresponding decreases in the lombard rate. The floating of the D-Mark on May 10th, 1971, gave the Bundesbank some relief until the desire to limit the appreciation of the currency prompted a further decrease in Bank rates on the 13th of October. Two further declines followed in December 1971 and February 1972, after the signing of the Smithsonian agreement.

Both the *FAZ* reports and the Bundesbank Annual leave no doubt that the Bank rate declines before May 1971, when the Bundesbank tried to maintain internal monetary conditions as tight as possible given the external constraints, should be regarded as "externally motivated" in the sense we defined above. The October and December decreases are different in that there was no conflict between external and internal objectives, given the stagnation of demand from the second quarter of 1971 onwards and the desire to offset the contractionary effects of the Smithsonian revaluation (*FAZ*, October 14th and December 23rd, respectively), they were thus included as regular policy actions. The February 1972 action, finally, resembles the pre-May 1971 adjustments in that it is exclusively motivated by the desire to curb capital inflows.

¹⁴¹ BB AR(1970), p. 15-17.

Getting tough on inflation, 1972-73

Discount rate raised from 3 to 7% in six steps

In spite of the Bundesbank's efforts to bring the level of German interest rates in line with rates abroad, foreign capital inflows continued through most of the first half of 1972. After a sterling crisis in June 1972 triggered a new wave of speculative inflows, the Bundesbank came to believe that "a deliberate policy of low interest rates does not prevent speculative inflows of foreign funds - not, at all events, under the conditions obtaining in 1972, when confidence in the Deutsche Mark was greater than in the US dollar or the pound sterling despite the downward trend in the value of money in Germany".¹⁴² In addition, the monetary stance, with discount and lombard rates "at a level which previously had been considered appropriate only during phases of sharply slackening business activity" was regarded as increasingly inconsistent with domestic conditions, with demand picking up and inflation increasing again "from the spring onwards".¹⁴³ Chancellor Brandt finally yielded to Bundesbank pressure and agreed to the introduction of capital controls with effect from July 1st.

Thus protected, the Bundesbank gained "more scope for restrictive monetary policy".¹⁴⁴ From early October 1972 to January 1973, discount and lombard rates were increased in 4 steps, from 3 and 4% to 5 and 7%, respectively. There was a pause in tightening due to a new (and this time final) crisis of the Bretton Woods system in early 1973, which eventually led to the "block floating" of the D-Mark and other European currencies vis à vis the dollar (March 19th). In May - June, a further set of restrictive actions followed, with discount and lombard rates raised in two steps to 7 and 9% and accounting rules for reserve requirements changed in a way which amounted to tightening even further. The anti-inflationary intention of these actions is clearly corroborated by the contemporaneous Bundesbank statements as reported in the *FAZ*, we have thus counted each of them as a monetary policy action.

¹⁴² BB AR(1972), p. 20.

¹⁴³ BB AR(1972), pp. 18, 11.

¹⁴⁴ BB AR(1972), p. 20.

Easing during the 1974/75 recession

Discount rate lowered from 7 to 3.5% in seven steps

By the late summer of 1974, the signs of a recession were evident. In October 1974, the Bundesbank "taking account of the changed economic and monetary situation" and the "decline in inflationary expectations" decided to make a "cautious adjustment", decreasing discount and lombard rates by half a point each.¹⁴⁵ Two months passed before the Bundesbank took further action. Beginning with a further reduction in Bank rates on December 19th, the Bundesbank lowered discount and lombard rates in 7 steps from 6.5/8.5% to 3.5/4.5% (September 1975). In addition, rediscount quotas were increased in January and minimum reserve ratios were lowered in two instances. The motivation in all these cases, according to the Bundesbank statements quoted in the *FAZ*, was domestic easing; thus, all measures have been included as domestically driven monetary policy actions.

1977 Bank rate reductions

Discount rate lowered from 3 to 3.5%, lombard rate from 4.5 to 4%

The year 1977 witnessed a number of Bundesbank actions which appear expansionary: rediscount quotas are raised in March, August, and June 1978, minimum reserve requirements reduced in May and August, and Bank rates decreased in two instances. While one might think that these actions were motivated by the desire to provide new fuel to the recovery, which slowed down in 1977, a closer look at the contemporaneous Bundesbank statements reveals that this is not so. All measures involving provision of liquidity by easing quantitative constraints are justified as "satisfying money demand increases consistent with the monetary target (of the Bundesbank)".¹⁴⁶ On the other hand, while the lowering of Bank rates in two instances were aimed at stabilizing the Dollar, according to Bundesbank statements quoted in the corresponding *FAZ* reports (July 15, 1977 and December 16, 1977), the Bundesbank also stated that these measures did not conflict with internal objectives. Thus, the former actions are not included as policy events but we have included the latter.

¹⁴⁵ The first quote is from the Bundesbank's Monthly Report (Dec. 1974), p. 12; the second and third quotes are from the *FAZ*, October 25th 1974.

¹⁴⁶ See the *FAZ* reports on March 4th, 1977; May 20th 1977; August 26th, 1977; June 30th, 1978. The quote is from the first report, but similar statements are found in the others.

1979-1980 tightening

Discount rate increased from 3 to 7.5% in five steps

As early as October and December 1978, the Bundesbank tightened quantitative restrictions in a way which appears to signal a change in policy stance. However, the purpose seems to have been to neutralize foreign capital inflows; the two actions thus do not constitute policy in our sense (*FAZ* reports on the 20th of October and 15th of December 1978). On the 18th of January 1979, however, the Bundesbank does seem to undertake a cautious step towards tightening when it increased the lombard rate by 1/2 percentage points with the objective of "dampening money expansion" given the "strong upward trend in activity" (quotes are from Bundesbank President Otmar Emminger's statements according to *FAZ*, January 19th). The January signal is followed by an increase in the discount and lombard rates by a full percentage point each on March 29th, motivated by a "dangerous increase in inflationary potential" (Emminger according to *FAZ*, March 30th). In three further steps, which are similarly motivated, discount and lombard rates are raised to 6 and 7%, respectively, by November 1979.

In February and April 1980, two further increases follow after Karl Otto Pöhl takes over from Emminger as President of the Bundesbank. This time, the measures appear to be triggered by external developments. On February 28, Pöhl explains the tightening is aimed at preventing "a further increase in the interest rate differential between the United States and Germany and the current capital exports", while the "risks for domestic activity" are apparently viewed as undesirable side effects.¹⁴⁷ The April increases to 7.5/9.5% are aimed "mainly to counteract capital outflows since the beginning of the year" but Pöhl also states that the measures are consistent with the unchanged "priority for inflation fighting" recognized by the Bundesbank and the fact that "a cyclical decline in activity is not discernible".¹⁴⁸ We have thus included the April increase as a regular policy event while the February increase belongs in the "externally motivated" category.

Attempts at relaxation constrained by high US interest rates, 1980/81

Lombard rate reduction from 9.5 to 9% and some easing of quantitative restrictions

After the mid-year review of its monetary target, the Bundesbank attempted to relax in the late summer of 1980: "as monetary expansion was slightly below the envisaged target ...

¹⁴⁷ *FAZ*, February 29th, 1980.

¹⁴⁸ *FAZ*, May 2nd, 1980.

and as there were also increasing signs in the summer of a slowdown in economic activity and (at least temporarily) a slackening of price rises, the Bundesbank began to boost monetary growth by a gradual relaxation of its liquidity and interest rate policies. However, owing to the external constraints the room for maneuver available to monetary policy was so restricted from the start that a radical change of stance was out of question".¹⁴⁹ The lowering of minimum reserve ratios on August 21st is interpreted by the Bundesbank in its annual report as a step towards cautious relaxation, however, at the time it was explained to the public as a technical measure designed to maintain the current degree of pressure on the money market while making life a little easier for banks (cf. *FAZ* report on August 22nd), we have thus not included it as a policy event. Two further steps - a half point decrease of the lombard rate on September 18th and an increase in rediscount quotas on October 16th are given a clearer contemporaneous motivation as steps towards relaxation, and they have been included.

Further steps proved impossible after the D-Mark came under pressure again in October. A reduction in minimum reserve requirements in January was a response to an increase in money demand (*FAZ*, January 23rd) and thus does not constitute policy in our sense. The freezing of lombard credit and its replacement by a "special lombard" at 12% in February 1981, apparently to stabilize the D-Mark,¹⁵⁰ emphasizes the failure of the Bundesbank's attempt at relaxing single-handedly. We regard it as externally motivated policy action.

Easing, late 1981-early 1983

Discount rate lowered from 7.5 to 4% in four steps

"Improvements in the current account, declining interest rates in the United States, exchange rate corrections in the European Monetary System and the [more restrictive] budgetary decisions of the Federal Government"¹⁵¹ finally gave the Bundesbank some scope for easing in the Fall of 1981. It began by lowering the "special lombard rate" in five steps between October 1981 and May 1982 from 12% to 9%, the level of the old lombard rate, which was then reintroduced. Discount and lombard rate reductions, as well as reductions in minimum reserve requirements, followed after the summer. Between August 1982 and March 1983 Bank rates were lowered from 7.5/9% to 4/5%, thus reattaining their early 1979 levels.

¹⁴⁹ BB AR(1980), p. 28.

¹⁵⁰ BB AR(1980). p. 34 and *FAZ* report, February 20

¹⁵¹ Pöhl on October 8th, 1981, according to *FAZ*.

Apart from some adjustments of the rediscount quota which were designed to offset capital outflows, all of these measures, according to both contemporaneous statements of the Bundesbank and the Annual Reports, were designed to promote domestic recovery. Which have thus included them as monetary policy actions.

Stabilizing the exchange rate: monetary policy in 1987

Discount rate lowered from 3.5 to 2.5% in two steps

After a small upward adjustment of the lombard rate in September 1983 chiefly designed to dampen monetary expansion, the Bundesbank's relatively easy stance was maintained essentially without change during the slow recovery of the economy in the mid-eighties. Small adjustments in Bank rates in 1984 (increase in the discount rate from 4 to 4.5%) and 1985 (increase in the lombard rate from 5.5% to 6% in January and lowering of both rates by half a point in August) represent adjustments to market rates rather than an attempt at influencing them.¹⁵² Slightly more noteworthy Bundesbank measures take place in 1987, when the Bundesbank lowers both Bank rates in January in order to stabilize the dollar. In view of Pöhl's statements about the "less favorable economic outlook" at the time, it seems that the lowering of rates was also consistent with internal objectives; we have thus included it as a regular policy action.¹⁵³ Two further reductions in Bank rates are carried out in November and December 1987, again the primary motivation seems to have been external, in response to US and other European intervention rate reductions following the stock market crash. However, the first case seems to have had a domestic rationale as well ("calming financial markets"),¹⁵⁴ whereas the Bundesbank sounds unenthusiastic about the December action, which was viewed as "half-hearted" in the financial community.¹⁵⁵ We have thus placed the latter in the "externally motivated" category.

Curbing the boom, 1988-89

Discount rate raised from 2.5 to 6% in six steps

The downward movement in Bank rates was reversed in the Summer of 1988. The discount rate was increased by half a point in two instances (June 30th and August 25th) and the lombard rate by half a point on July 28th. The first of the discount rate increases was

¹⁵² BB AR(1984), p. 22; AR(1985), p. 22. Giersch et al., p. 194.

¹⁵³ FAZ report, January 23rd, 1987.

¹⁵⁴ FAZ report, November 6th, 1987.

¹⁵⁵ FAZ report, December 5th, 1987.

justified by domestic conditions ("strong growth in domestic activity and accelerating money growth", see *FAZ* report on July 1st), while the second is presented as both a measure to strengthen the D-Mark and to "preempt inflationary dangers" (*FAZ*, August 26th 1988). Both are thus considered policy actions. On the other hand, the lombard increase was primarily motivated as an adjustment to market interest rates and thus does not constitute monetary policy in our sense.

Further tightening followed at the end of the year and throughout 1989. On December 15th, the Bundesbank announced a fairly restrictive M3 target (5%, as compared with 7% realized M3 growth in 1988) and simultaneously increased the lombard rate by half a percentage point. Further increases in discount and lombard rates followed in late January, April, June and October. All contemporaneous Bundesbank statements emphasize the boom in economic activity and inflationary pressures, with a cautious tone at the beginning and a more blunt one during the later instances.¹⁵⁶ We have classified all as (domestically motivated) policy actions.

Unification tightening, 1990-92

Discount rate raised from 6 to 8.75% in four steps

Against the backdrop of "highly expansionary fiscal policy"¹⁵⁷ and a consumption boom in both parts of Germany, which had been integrated into one monetary area in July of 1990, the Bundesbank went into a round of unilateral tightening from the Fall of 1990 onwards. The lombard rate was increased by half a point on November 1st; discount rate and further lombard rate increases followed in January, August and December 1991 and finally - to the dismay of the rest of Europe, which by then was in a deep recession - in July 1992 (discount rate increase only).

Not all of these seem to have been driven by unambiguous contractionary intentions, however. According to both *ex post* and contemporaneous Bundesbank statements¹⁵⁸ the lombard rate increase of November 1990 represented an adjustment to market interest rates and did not constitute a change in the direction of policy. The January increase, however, is characterized as just that in the 1990 Annual Report (p. 42) and as a measure to "combat price increases at an early stage" in the contemporaneous statement by Pöhl.¹⁵⁹ The motives

¹⁵⁶ *FAZ* report, December 16th, 1988; January 20th, April 21st, June 30th and October 5th, 1989.

¹⁵⁷ BB AR (1990), p. 26.

¹⁵⁸ BB AR (1990), pp. 42 and *FAZ*, November 2nd, 1990, respectively.

¹⁵⁹ *FAZ*, February 1st, 1991.

behind the August increase appear ambiguous; the Bank states that the move is prompted by a desire to regain control over the money market, but Helmut Schlesinger, its new President, also emphasizes the objective of "further tightening" monetary policy.¹⁶⁰ The December 1991 and July 1992 rises on the other hand are accompanied by fairly explicit statements about inflation-fighting.¹⁶¹ We thus concluded that all rate increases except for the initial lombard increase should be viewed as tightenings.

Relaxation, 1992-94

Discount rate lowered from 8.75% to 4.5% (by May 11th) in 9 steps

Massive capital inflows during the September 1992 crisis of the European Monetary System finally forced the Bundesbank to half-heartedly cut interest rates. Accompanying statements by Schlesinger left no doubt, that these cuts were triggered externally "and would not have been possible from a domestic perspective".¹⁶² More than four and a half months passed before the Bundesbank cut its key rates again, on February 4th, 1993. This time, a domestic motivation is clearly present; Schlesinger's accompanying statement refers to "the state of economic activity".¹⁶³ The same appears true of the reductions that follow in March, April, July, September and October 1993 and in February, April and May 1994, even though the rhetoric is not always as explicit.¹⁶⁴ Only one case does not seem to be primarily domestically motivated, namely the lombard rate decline coinciding with a new EMS crisis in late July. However, a Bundesbank source quoted in the *FAZ* on July 30th emphasizes that the measure is consistent with the Bundesbank's domestic policies.

We thus have classified all 1993-94 reductions and a decrease in minimum reserve requirements in January 1994 as domestic policy actions, even though data incompleteness has prevented us from including the May 11th, 1994 reduction in our regression. The September 1992 event, on the other hand, clearly belongs in the category of externally motivated policy actions.

¹⁶⁰ *FAZ* August 16, 1991.

¹⁶¹ *FAZ* December 20th, 1991; July 17th, 1992.

¹⁶² *FAZ* September 16th, 1992.

¹⁶³ *FAZ* February 5th, 1992.

¹⁶⁴ For instance, the statement accompanying the March 1993 decrease just reads: "With this measure, the Bundesbank has continued its policy of gradually lowering interest rates" (*FAZ*, March 19, 1993) The statements accompanying the next decreases are very similar. See the reports in *FAZ*, April 23rd, July 2nd, September 10th and October 22nd, 1993; and April 15th and May 12th, 1994.

d) France, 1977-1994

In the case of France, data availability has limited the period we were able to study so far. Since the short rate we have used for France is not quoted on a daily basis before 1977, we limit ourselves to discussing monetary policy actions after that date.

Our procedure was similar to that employed for the countries discussed above. We set out with a list of candidate policy actions compiled from sources published by the Banque de France, primarily the annual reports of the Conseil National du Cr dit (hereafter quoted as CNC). We then used current newspaper reports (primarily *Le Monde* and to a lesser extent *Le Figaro*) to check the exact timing of these actions, obtain current statements by French policy-makers wherever possible, obtain a second opinion as to the motives of the actions and check that there was no other major event on that day that might have driven the movements of long and short rates.

Two issues complicated this procedure in the case of France. The first was how to treat the French dichotomy of "credit policy" versus "interest rate policy". Until 1984, French monetary authorities attempted to control the growth of internal credit primarily through a system of quantitative constraints, the "encadrement du cr dit", rather than through interest rates.¹⁶⁵ After some earlier experiences with quantitative credit constraints during the 1950's and 1960's, the encadrement was introduced in late 1972 against the backdrop of increasing inflation, in the hope that it would allow a tighter control of money growth and aggregate demand than conventional policy instruments.¹⁶⁶ In addition, there was the notion that this additional tool would allow policy makers to pursue separate external and internal objectives: "en deconnectant le volume des cr dits distribu s du co t du cr dit, l'encadrement permet de faire varier les taux d'int r t pour orienter dans le sens souhaitable les capitaux externes, sans que ces mouvements de taux se r percutent sur les conditions d bitrices internes".¹⁶⁷

For us, the question was whether or not to consider "credit policy" as monetary policy actions in our sense, i.e. whether to accept the notion that changes in the system of credit controls did not in themselves affect the level of interest rates. The quantitative constraints imposed by the French monetary authorities applied to credits financed by bank lending from the Banque de France but not to those financed through the money or capital

¹⁶⁵ An overview of French monetary operating procedures and their historical development up to 1987 is given by Patat (1987), pp. 309-346. See also Patat and Lutfalla (1990).

¹⁶⁶ CNC (1972), p. 21, CNC (1973), p. 20-26.

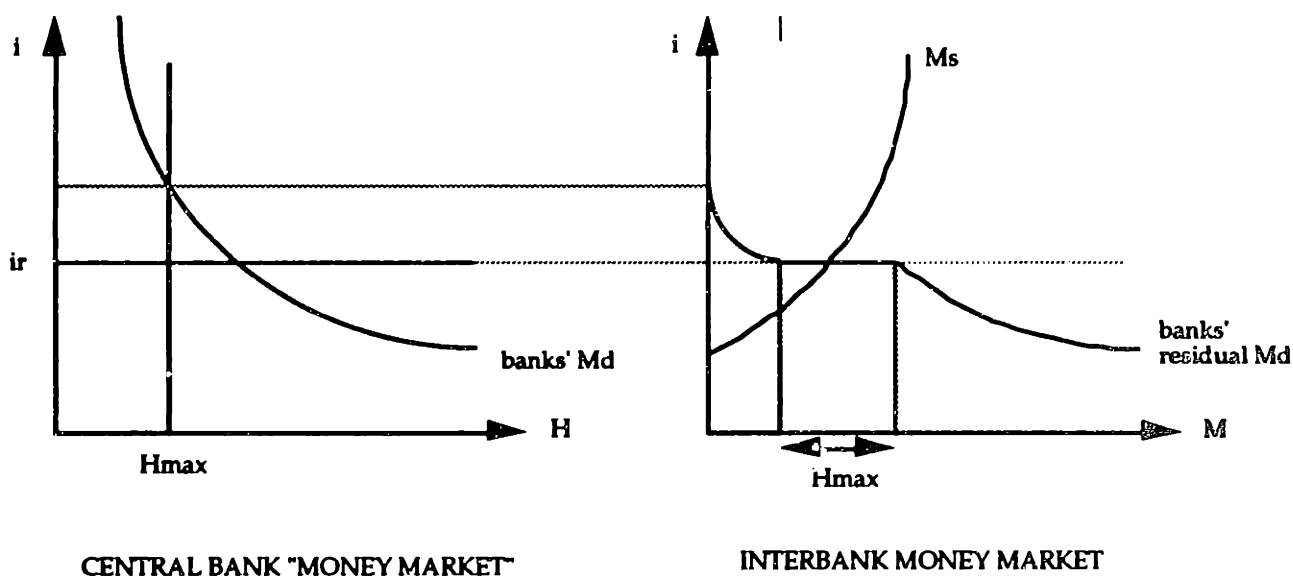
¹⁶⁷ Patat (1987), p. 331.

markets;¹⁶⁸ in general, one would thus expect the residual demand for money on the interbank market, and thus short interest rates, to be affected by changes in the “normes de progression” at which credit was supposed to grow. On the other hand, a sufficiently large window of central bank money at a fixed intervention rate might peg the money market interest rate and make it immune to changes in quantitative constraints in some range.¹⁶⁹ In the end, we decided to follow the Banque de France in not viewing quantitative credit controls as policy towards interest rates. First, we wished to remain true to our principle of defining monetary policy according to the intentions of policy-makers. The intentions behind changes in credit growth norms was never to affect interest rates but rather aggregate credit directly; French monetary authorities believed that they possessed a separate set of instruments to control money market rates. Our second reason was practical: the exact timing of the announcements of credit growth norms is difficult to identify, and very rarely discussed in bond market reports (except when combined with other monetary or fiscal measures).

This left us with studying the impact of monetary instruments which the Banque de France itself considered interest rate policy, primarily changes in the “taux directeurs”.

¹⁶⁸ Patat (1987), p. 330.

¹⁶⁹ A picture can help clarify this point. Think of the “encadrement” as implying an upper limit on the amount banks can borrow from the central bank in order to finance credit creation. Up to this limit, they can borrow at a fixed rate. This implies the following residual demand curve on the interbank money market:



Changes in the constraint H_{max} will shift the first portion of the residual money demand, extending or contracting its flat portion. Thus, changes in H_{max} will not affect money market interest rates as long as the interbank money supply curve still intersects the residual money demand curve in its flat portion.

Unfortunately for our purposes, the Banque de France ceased using the discount rate as an instrument from 1977 onwards, and instead began to rely on less spectacular, but much more frequent, intervention rate changes.¹⁷⁰ This poses a problem in two respects. First, many short run money market interventions follow money demand; it is much more difficult to establish which were driven by policy than in the case of the less frequent discount rate changes, which are generally accompanied by statements from policy makers. Second, until the mid-eighties, many intervention rate changes were not even reported by the financial press, leaving an ambiguity as to their exact timing and impact. While we checked all intervention rate changes which could not be dismissed offhand - that is, on the basis of the CNC reports - as clearly not policy-driven (about 100 for 1977-1993), we only counted events which were reported in the press, in addition to applying our usual criteria for establishing whether they were policy actions. This procedure left us with 54 events for this period, which we now review.

Cautious relaxation, 1977-78

Intervention rates lowered from 10 1/4 to 6 3/8% in 26 steps

Since mid-1976, a combination of inflationary pressure and external weakness of the franc had triggered a return to a more restrictive monetary stance, which was given additional emphasis after Raymond Barre replaced Jacques Chirac as Prime Minister in September. This stance was basically unchanged in the next two years, 1977-78, with both the 1977 and 1978 reports of the CNC emphasizing disinflationary objectives.¹⁷¹ However, monetary authorities did allow and, to some extent, encouraged the decline of money market rates over the next two years, as the external position improved and inflationary pressures began to subside: "mettant à profit la bonne tenue de la valeur externe du franc" ... "les autorités monétaires ont favorisé la baisse des taux sur le marché monétaire".¹⁷²

In view of the cautiousness of this process (most steps are 1/8 of a percent) and the continuing emphasis on a restrictive stance in the CNC reports - a view which was shared by the OECD reports of the time - we are reluctant to classify most of these declines as expansionary policy actions. Rather, the authorities seem to have lowered interest rates roughly in line with what they viewed were falling inflationary expectations, much the same process as occurred later in 1983-85. There are two exceptions, however. On August 31st,

¹⁷⁰ Unless otherwise indicated, the rates discussed below refer to "achats d'effets publics et d'effets privés de 1^{re} catégorie" i.e. purchases of high quality short public and private paper.

¹⁷¹ CNC (1977), p 11-12, CNC (1978), p. 11-12.

¹⁷² CNC (1978), p 61, 64.

1977 the discount rate was lowered as part of a stimulus package. The expansionary intentions of this measure are clear, and while it coincided with some other actions to increase employment, the stock and bond market report on that day only mentions the lowering of interest rates; we have thus classified it as a policy action.¹⁷³ The second action is a comparatively large decline in two intervention rates in early April, following the reappointment of Barre as prime minister, which seems to have been motivated by the same concern.¹⁷⁴

1979-early 1980 tightening

Intervention rates raised from 6 3/8 to 13 1/16% in 14 steps.

The restrictive stance of policy was strengthened after the European Monetary System came into effect on March 13th, 1979. After a first increase in late March, the Banque de France gradually tightened market intervention rates from May onwards: "à partir du mois de mai, en vue de contenir les tensions inflationnistes, les autorités monétaires de nombreux pays ont suscité un relèvement du loyer de l'argent. La Banque de France a fait de même et son taux d'intervention a gagné environ un point, par mois, de mai à septembre".¹⁷⁵ We checked all increases of intervention rates between May 1979 and March 1980. Out of a total of 14 increases, we eliminated three because they followed rather than led the market, according to *Le Monde's* money market column. One had to be discarded because there was other news on that day, and in five other cases the increase was not mentioned in the financial reports, leaving the timing of the announcement and the motivation unclear. In the remaining five instances, we counted the increases as domestic policy actions.

1980 relaxation

Intervention rates lowered from 13 1/16% to 10 13/16% in 8 steps

In view of the strong position of the franc within the EMS and declining interest rates in the U.S. towards the end of the first quarter of 1980, the Banque de France began to ease interest rates from April onwards. The decline was cautious and did not go very far. Inflation, which had picked up following the second oil shock, was still the main worry of monetary policy according to the CNC report for 1980, necessitating "le maintien des taux

¹⁷³ *Le Monde*, December 1st, 1977 (front page and financial markets report).

¹⁷⁴ *Le Monde*, April 2nd 1978 (money market report).

¹⁷⁵ CNC (1979), p 70.

d'intérêt à un niveau élevé".¹⁷⁶ However, the CNC report also suggests that the limited decline in interest rates was a result of policy; "contenir la hausse du taux d'intérêt" is mentioned as one of the policy objectives for the year.¹⁷⁷ The general impression one obtains from reading the report is that the Barre government wanted to keep tight control on money and credit creation through the *encadrement*, but on the other hand wished to avoid strangling economic activity through excessively high interest rates and spare the economy "des fluctuations erratiques de taux d'intérêt comme il a été observé sur certains marchés étrangers". We thus treated all eight steps towards relaxing interest rates as potential domestic policy actions, and checked them in *Le Monde*.

The current newspaper reports suggest that the first three instances, from April to June, followed falling money market rates in France prompted by declining U.S. rates. In one instance *Le Monde's* commentator François Renard even states that "la Banque de France semble avoir initialement freinée" the decline in market rates.¹⁷⁸ Of the remaining five instances, two could not be identified in the market reports. The remaining three were classified as domestically driven policy actions.

Mitterand's first 20 months 1981/82: attempts at easing interrupted by Franc crises

Three consecutive downward movements in intervention rates in the Summer of 1981, the Fall of 1981 and the second half of 1982

The downward movement in intervention rates initiated in 1980 came to a halt in the first half of 1981. At the end of February, intervention rates were even raised slightly following German tightening. In defense of the franc which had come under attack following the election of François Mitterand to the presidency of the Republic, rates were raised further to a record level of over 20% at the end of May, and remained there for the next six weeks. After the external situation had stabilized, the Banque de France began lowering intervention rates. These were lowered in 5 steps reaching 17% in late September, at which time the next currency crisis was triggered, which was this time resolved by devaluing the franc within the EMS on October 4th. A further cycle of relaxation from late October onwards was more successful in bringing down rates in view of a friendlier international environment (the Germans had begun to ease cautiously at about the same time); intervention rates were lowered in 12 steps from 17 3/4 to 14% by early March. After a further crisis in late March,

¹⁷⁶ CNC (1980), p. 48.

¹⁷⁷ CNC (1980), p. 33.

¹⁷⁸ *Le Monde*, April 20-21st, 1980.

the French authorities successfully defended the franc by raising rates again to 17% and, from April onwards, 16%, where they stayed for almost two months. The next EMS realignment on June 12th, 1982 gave the authorities room to initiate the next, - and, for the time being, last - attempt to lower interest rates, which were brought down in 14 steps from 16 to 12 1/2% by January 1983, when the movement was brought to an end following renewed pressure on the franc.

The objective behind most of these reductions seems to have been to lower the level of interest rates to the maximum extent possible given external constraints, in order to help the French economy recover. The CNC report for 1981 states that "les évolutions monétaires été marquées en 1981 par la priorité donnée dès l'été par le Gouvernement à la lutte contre le chômage",¹⁷⁹ where "évolutions monétaires" refers to both the monetary growth target, which was revised upward from 10% to 12% in June, and interest rates.¹⁸⁰ The CNC report for 1982 again mentions inflation-fighting as a primary objective, but subject to the constraint of not hampering the recovery ("sans faire obstacle pour autant à une reprise plus soutenue de l'activité économique").¹⁸¹ Its interest-rate policies are described as a continuation of the earlier year's efforts to lower rates.¹⁸²

Except for some instances of adjustments of 1/8 of a percent or less, we thus checked all intervention rate declines between the summer of 1981 and early 1983 as candidate monetary policy actions. After excluding four instances as not policy-driven, two because of the presence of other major economic news on the same day and ten because they were not mentioned in the market reports, we were left with nine explicit expansionary policy actions.

Passive Monetary Policy, 1983-85

A further devaluation of the franc within the EMS on March 21st, 1983 was accompanied by a conservative fiscal package which is often regarded as consolidating Mitterand's conversion to a restrictive economic policy stance.¹⁸³ Over the 14 months or so, intervention rates hardly changed, remaining at above 12%. From May 1984 onwards, the Banque de France again began to gradually lower interest rates. By November of 1985, the intervention rate on "appels d'offres" had reached 8.75%.

¹⁷⁹ CNC (1981), p. 11.

¹⁸⁰ *see* CNC (1981), p. 15.

¹⁸¹ CNC (1982), p. 13.

¹⁸² CNC (1982), p. 37-38.

¹⁸³ *see* for instance OECD, Economic Survey for France 1983-84, p 1.

We chose this point in time to mark the end of a “phase” in monetary policy because of the Banque de France’s emphasis on tightness and non-activism during 1983-1985. Stimulating growth or reducing unemployment (8.3% for 1983, 9.9% for 1984 and 10.2% for 1985) is not mentioned as an objective of monetary policy for any of these years.¹⁸⁴ The intervention rate declines are explained as following decreasing inflationary expectations; the claim is that policy attempted to maintain a constant degree of tightness on the money market by targeting real interest rates. For 1984, the CNC report states that “en raison du caractère encore partiel des progrès de l’économie française, les autorités monétaires n’ont amorcé une politique de baisse des taux d’intérêt qu’une fois confirmé le ralentissement de l’inflation”.¹⁸⁵ In the 1985 report, there is talk about “quelques assouplissements, sans toutefois remettre en cause la rigueur d’ensemble du dispositif”,¹⁸⁶ but these easings (assouplissements) refer to the relaxation of quantitative credit growth restrictions and not to interest rate policy. The 1984 statement is repeated in even stronger fashion: “en raison du caractère encore partiel des progrès de l’économie française, le recul des taux d’intérêt ne devait, d’une fin d’année à l’autre, qu’accompagner le mouvement de décélération des prix”. Moreover, the report emphasizes that, rather than attempting to influence long rates, monetary policy in fact *followed* the movement in bond yields: “En outre ... la baisse des conditions sur le marché monétaire s’est effectuée, tout au long de l’année, en liaison avec les évolutions observées sur le marché obligataire. Elle a été guidée, particulièrement au cours du 1er semestre, par la diminution rapide du taux de rendement des obligations”.¹⁸⁷

We conclude that none of the intervention rate decreases between January 1983 and November 1985 should be regarded as expansionary monetary policy. The decline seems to have followed long interest rates, rather than attempted to change them, and the movements were sufficiently gradual and in line with decreasing inflation to lend credibility to the Banque de France’s repeated claims that there was no expansionary intent behind these

¹⁸⁴ CNC (1984), p. 18 states: “les orientations de la politique monétaire n’ont pas été modifiées en 1984. Afin de contribuer à la réduction de l’inflation et au redressement des comptes extérieurs, les autorités se sont efforcées de obtenir, d’une part, un nouveau ralentissement de la progression des liquidités, d’autre part, un net freinage de la croissance du crédit interne”. One year later, the statement is almost literally the same: “L’orientation de la politique monétaire n’a pas été modifiée en 1985. Afin de contribuer à la réduction de l’inflation, les autorités se sont efforcées de obtenir, un nouveau ralentissement de la progression des liquidités.” (CNC (1985), p. 30).

¹⁸⁵ CNC (1984), p. 44. Loose translation: “Given that so far there has only been partial progress of the French economy, the monetary authorities only initiated a policy of lowering interest rates after the slowing of inflation was apparent”.

¹⁸⁶ CNC (1985), p. 23.

¹⁸⁷ Both quotes are from CNC (1985), p. 35.

actions. As the statements quoted imply, “progrès de l'économie française” in this period was apparently entirely identified with reducing inflation and external imbalance and not at all with the overcoming of the recession, in spite of more than 10% unemployment.

A first attempt to lower real interest rates after stabilization: February-June 1986

Intervention rate lowered from 8.5% to 7% in 5 steps

Even though the Banque de France largely maintains its anti-inflationary rhetoric the emphasis of its statements changes in 1986. Rather than merely following market rates, its declarations imply that it is pushing them down, using the scope achieved by its earlier policies: “le ralentissement de l'inflation et la bonne tenue du franc ont permis aux autorités monétaires d'accentuer la baisse des taux d'intérêt”.¹⁸⁸ The interpretation given by press commentaries at the time is increasing government concern that high real interest rates, “2 points supérieurs aux taux allemands”, are preventing investment from recovering.¹⁸⁹ This concern is voiced by the INSEE on May 12th.¹⁹⁰ On the other hand, the continuing caution of the government is emphasized and sometimes criticized in *Le Monde*.¹⁹¹ Indeed, the first decrease in intervention rates on February 20th is associated with an increase in reserve ratios in order to bring monetary growth back in line with the Bank's target,¹⁹² and so is the April 14th decrease, even though here the aim might have been to offset liquidity inflows following the devaluation of the franc within the ERM on April 6th.¹⁹³ Also, the increased concern with the level of real interest rates was interpreted as partly resulting from perceived “real” interest rates (i.e. nominal rates minus current change in the price level) jumping up as a result of the drop in oil prices and the weakening of the dollar.¹⁹⁴ Thus, the attempt to lower real interest rates was, in a sense, consistent with the government's targeting of real interest rates during 1983-1985.

In spite of these caveats, we classify the early 1986 intervention rate movements as domestic policy actions because there was an active attempt to reduce real interest rates on the part of

¹⁸⁸ Bulletin Trimestrielle, June 1986, p. 9.

¹⁸⁹ *Le Monde*, February 22nd, 1986, p. 33., May 17th, 1986.

¹⁹⁰ *Le Monde*, May 14, 1986.

¹⁹¹ See Paul Fabra's column in *Le Monde*, April 16, 1986, and the front page report in *Le Monde*, May 14, 1986.

¹⁹² Statement by the Banque de France quoted in *Le Monde*, February 22nd, 1986, p. 33. In its commentary, *Le Monde* reckons that the combination of increasing the reserve requirements and lowering interest rates was the result of a compromise between Bérégovoy and the Bank.

¹⁹³ See Balladur's statement as quoted in *Le Monde*, April 13-14th, 1986.

¹⁹⁴ See e.g. François Renard's comment on the April 28th decline in *Le Monde*, April 30th, 1986.

both Bérégovoy (Finance minister until mid-March) and Balladur (Finance minister from March onwards). This includes the April 14th reduction, which may have been prompted by foreign capital inflows but was certainly consistent with domestic policy objectives.¹⁹⁵ On the other hand, we ended up not using the May 15th reduction as a data point because it was included in a general liberalization package announced on that day, which affected bond market regulations and apparently had direct implications for bond price reactions on the 15th and 16th.¹⁹⁶

Defending the Franc, December 1986-January 1987

Intervention rate raised from 7 to 8% in two steps

A student strike protesting the Chirac government's plans for university reform in early December led to a franc crisis prompting speculation about a devaluation of the franc, which subsequently took place in an ERM realignment on January 12th, 1987. The government reacted to the pressure by first raising interest rates on 7 day pensions by up to 1.5 points and eventually raising the intervention rate on December 16th. This gave monetary authorities relief for about two weeks, after which renewed pressure on the franc led to a further increase in the intervention rate a 3/4 points and shortly thereafter the expected realignment.

Since it was clear at the time that the interest rate rises were prompted by a franc weakness which itself had acute rather than chronic character,¹⁹⁷ we regard neither of the hikes as non-transitory policy. This is in line with our treatment of speculative attacks above.

Second attempt to lower real interest rates, March-June 1987

Intervention rate lowered from 8 to 7.5% in two steps.

The increase in intervention rates prompted by the currency crisis was more permanent than had originally been assumed; in particular, expectations that the Banque de France would lower rates immediately after the EMS realignment¹⁹⁸ were frustrated. Only after the signing of the Louvre accord (February 22nd) did Balladur state an intent to return to lower levels of interest rates (March 2nd)¹⁹⁹ and intervention rates were indeed lowered on March 9th and June 29th.

¹⁹⁵ See the report and commentary in *Le Monde*, April 16th, 1986.

¹⁹⁶ See the market reports in *Le Monde*, May 16th and May 17th, 1986.

¹⁹⁷ *Le Monde*, December 10th, 1986, p. 44; December 18th, 1986, p. 30.

¹⁹⁸ See François Renard's money market column in *Le Monde*, January 11-12, 1986 and his report in *Le Monde*, March 4th 1987.

¹⁹⁹ *Le Monde*, March 4th 1987.

The current perception of the March action was as “premier pas vers une nouvelle baisse des taux d'intervention de la Banque de France”, with the objective of reducing the real interest gap relative to the Germans, which was perceived as being higher than ever.²⁰⁰ The objective of reducing real interest rates is not mentioned in a Banque de France statement accompanying the second decrease, which merely talks about the “absence of inflationary tensions”, the “stability of the franc on the foreign exchange markets” and the “reduction of the inflation rate differential with our large partners”. However, we know from a statement by Balladur at the time of the second reduction that the government was still worried about “exceptionally high” real interest rates.²⁰¹ We thus regard both as policy actions.

Defending the franc in the aftermath of the stock market crash

Intervention rate increased from 7.5 to 8.25% in one step

The stock market crash led to strains within the EMS, with a firming of the D-Mark relative to the Franc. In response, the Banque de France increased its intervention rate by three quarters of a point on November 5th. As in the preceding case one year earlier, we do not regard this measure as a policy action since it was a reaction to an acute franc crisis and Palais Brongniart²⁰² was perfectly aware of this.²⁰³

Third attempt to lower real interest rates, January-July 1988

Intervention rates reduced from 8.25 to 6.75% in 5 steps

Unlike its predecessor, the November 1987 currency crisis passed quickly without need for a realignment after the stronger currencies within the EMS lowered intervention rates. After only three weeks, the Banque de France began to cautiously lower intervention rates again, so that the pre-crisis level was restored by January 5th in three steps. Consistent with our interpretation of the earlier rise as a transitory increase, current commentators view these reductions as the expected return to the status quo ante following the successful defense of the franc.²⁰⁴ For the same reasons, we do not regard them as policy actions.

By contrast, the Banque de France's January 25th rate reduction by a further quarter of a point to a level below the pre-crisis intervention rate constitutes a new move in the direction

²⁰⁰ *Le Monde*, March 11th, 1987, March 4th 1987

²⁰¹ *Le Monde*, July 1st, 1987.

²⁰² The site of the Paris Bourse on Rue Vivienne.

²⁰³ See, for instance, *Le Monde's* money market column on November 8-9th, 1987.

²⁰⁴ See François Renard's comment in *Le Monde*, January 7th. 1988.

of lower real interest rates. *Le Monde* commented: "La Banque de France s'efforce en effet de faire baisser les taux d'intérêt français, les plus élevés du monde occidental en "réel" (hors inflation) notamment ceux a long terme."²⁰⁵ After the return of Pierre Bérégovoy as Finance Minister following the May 1988 presidential and parliamentary elections, intervention rates were lowered by a further quarter point on May 26th and by yet another quarter on July 8th. In both cases, the stated objective was to reduce the real interest differential separating France and "other countries": "Quand je considère les taux d'intérêt en France et ceux pratiqués dans les autres pays, j'estime que notre pays dispose d'une marge de baisse qu'il peut utiliser" (Bérégovoy quoted in *Le Monde*, May 27th, 1988). We therefore regard all three reductions as domestic policy actions.

Tightening under external pressure, August 1988-December 1989

Intervention rates raised from 6.75 to 10% in 7 steps

The "marge de baisse" was apparently quickly exhausted after monetary policy in Germany and the US tightened in the summer of 1988. After two Bundesbank rate increases in late June and late July, the Banque de France joined the Bundesbank and the Bank of England on August 25th, raising the intervention rate by a quarter of a point, back to 7%. Further increases followed in October and December 1988 and on four occasions in 1989 (January, July, October and December). With two exceptions (October 1988 and December 1989) all of these are joint with the Bundesbank and other European central banks.

Bérégovoy's earlier emphasis on reducing real interest rates and the fact that unemployment in France was still at 10.4% in August of 1988 leaves little doubt that the new tightening was not quite voluntary. This view is corroborated by Bérégovoy's and the Banque de France's statements accompanying the increases: according to *Le Monde*, "le porte-parole de la Banque de France reconnaissait que M. Bérégovoy avait dû "se résigner" à une telle mesure de protection du Franc" (August 28, p.20). In connection with the October 18th increase Bérégovoy's is quoted as saying that "Les taux d'intérêt baissent quand c'est possible, ils augmentent quand c'est nécessaire".²⁰⁶ Similar quotes can be found in *Le Monde*'s reports of the ensuing three rises. "Le diktat allemand" is a fairly characteristic headline, as is "Retour à la case départ".²⁰⁷ In the case of the July increase, the inconsistency with domestic objectives is slightly less clear; the accompanying statement by the Banque de France talks about "une

²⁰⁵ *Le Monde*, January 27th, 1988, front page.

²⁰⁶ *Le Monde*, October 23-24th 1988.

²⁰⁷ *Le Monde*, January 22-23rd, 1989; October 23-24, 1988; December 18-19, 1988.

étroite coopération monétaire européenne, pour éviter le développement des tensions inflationnistes".²⁰⁸ This contradicts earlier remarks by President François Mitterrand stating that if the Bundesbank increased rates again, the Banque de France would not necessarily follow. *Le Monde's* interpretation is that the French were forced into submission due to a franc weakness arising from the publication of unfavorable trade figures shortly before the Bundesbank's decision.

The October and December 1989 hikes are different in that by this time contractionary measures in France seem to follow domestic considerations as well. *Le Monde's* Renard views the objectives of the October tightening, which involved raising minimum reserve requirements as well as higher intervention rates, as "lutter contre le surchauffe en frenant la création monétaire".²⁰⁹ On the December increase, *Le Monde* writes: "M. Bérégovoy approuve totalement la hausse de ces taux, justifiée pour des raisons internes et externes".²¹⁰ We have thus classified the first five increases as external and the last two as domestic policy actions.

1990-91 relaxation

Intervention rates lowered from 10 to 8.75% in 5 steps

April 1990 marks a turning point in French policy towards interest rates: acting unilaterally, the Banque de France lowered intervention rates twice, by a total of 1/2 percentage point, within a period of less than four weeks. Interest rates were reduced further in November 1990, March 1991 and October 1991, in spite of the fact that by that time the Deutsche Bundesbank, after a pause of about a year, had continued to increase its rates to offset the inflationary effects of reunification.

The motivation for these declines, as expressed in Banque de France statements accompanying the actions and echoed by the press, were very similar in all instances: strong franc, declining inflation rates which had fallen below German inflation rates (by as much as 1.6% by October 1991), slowing growth both in monetary aggregates (emphasized by the Banque de France) and in output (emphasized in the press).²¹¹ The October 1991 action is also accompanied by comments very similar to those associated with the 1986-87 declines,

²⁰⁸ quoted in *Le Monde*, July 2-3rd, 1989.

²⁰⁹ *Le Monde*, October 8-9th, 1989.

²¹⁰ *Le Monde*, December 19th, 1989, see also the money market column in *Le Monde*, December 24-25th, 1989.

²¹¹ see *Le Monde*, April 1-2nd, 8-9th, 28th-29th-30th, 1990; November 5th, 1990; March 17-18th and 24-25th, 1991; October 19th and 20th-21st, 1991.

namely, that, in view of extremely low inflation rates, real interest rates were probably much too high.²¹² The general tone is that France, after achieving lower inflation rates than the Germans for almost two years, now finally deserves lower nominal interest rates as well. This goal is achieved (at the short end) in the second half of 1991, but not by nearly as much as the inflation differential.

"The Bundesbank's menacing shadow":²¹³ tightening, late 1991

Intervention rates increased from 8.75 to 9.6% in 2 steps

In spite of the fact that the Bundesbank's leading interest rates stood unchanged and was in fact widely expected to decrease soon, the franc came under pressure soon after the October 1991 reduction in French intervention rates.²¹⁴ On November 18th, the Banque de France was forced to increase intervention rates by half a point.²¹⁵ A further increase followed "avec résignation" after the Bundesbank surprised markets by raising discount and lombard rates further on December 19th. The motivation is the same, namely the determination of the Banque de France to maintain its EMS parity.²¹⁶

The collision of the two increases with domestic policy objectives was painfully clear: "ceci au plus mauvais moment", comments Renard in *Le Monde* after the December Bundesbank tightening.²¹⁷ We have thus classified both events as externally motivated tightenings.

1992-93 relaxation

Intervention rates lowered from 9.6% to 6.2% in 12 steps

After the Bundesbank's half-hearted attempt to save the EMS by finally lowering discount and lombard rates on September 14th, 1992, it took about six weeks before the Franc, which had been under heavy pressure, was considered strong enough by the French authorities to risk a careful easing in interest rates: intervention rates were lowered by 0.25% on November 2nd and by a further quarter point ten days later. Further reductions followed in April, May, June and early July, often in co-ordination with the Bundesbank. After the second EMS crisis in late July, French monetary authorities decided to pause rather than

²¹² *Le Monde*, October 19th, 1991.

²¹³ *Le Monde*, November 17-18th, 1991.

²¹⁴ *Le Monde*, November 17-18th, 1991.

²¹⁵ *Le Monde*, November 19th, 1991 carries the text of the accompanying Banque de France statement.

²¹⁶ *Le Monde*, December 24th, 1991. The quote is from Renard's article on p. 21, which also quotes an extract from the accompanying Banque de France statement.

²¹⁷ *Le Monde*, December 22-23th, 1991.

lower interest rates unilaterally, and only resumed the downward movement in interest rates after the Bundesbank had lowered its discount and lombard rates twice. Both the October 22nd and December 3rd reduction in intervention rates faithfully followed Bundesbank easings on the day before.

The motivation of these actions need hardly be dwelled upon: by 1992, France was in the deepest recession in its postwar history, and the Banque de France was eager to reduce rates, although strictly subject to avoiding a weakening of the franc. Current Banque de France statements and press comments lead us to confirm all reductions during 1992/93 as domestically motivated policy actions.²¹⁸

2. A Keynesian model of monetary policy and interest rate dynamics

a) Framework

Consider the following IS-LM model with a term structure equation and a Phillips curve:

- (1) IS curve $y = d - \phi R$
- (2) Money demand $m - p = ky - hi$
- (3) Fisher relation $i = r + \pi_{+1}^e$ $(\pi_{+1}^e \equiv p_{+1}^e - p)$
- (4) Money supply process $m = \gamma + m_{-1} + \varepsilon$ $(\varepsilon_{+1}^e = 0)$
- (5) Term structure equation $r = R - \frac{R_{+1}^e - R}{R}$
- (6) Phillips curve $\pi = \pi_{-1} + \theta(y - y^*)$

where y , m and p are the logs of output, money supply, and the price level respectively, r and R represent short and long real interest rates, i is the short nominal interest rate, and π denotes inflation. Non-subscripted variables are current values, π_{-1} denotes last period's value, x_{+1}^e denotes this period's expectation of x next period and x^* denotes the steady state value of x .

²¹⁸ see *Le Monde*, November 3rd and 13th, 1992, April 18-19th, 20th, 24th and 25-26th, 1993; May 4-5th, 7th, 9-10th, 15th, and 16th-17th, 1993; June 1st, 20-21st and 23rd, 1993; July 3rd and 4-5th, 1993, October 24-25th, 1993 and December, 5-6th, 1993.

All equations are quite standard. In the IS relationship, short run equilibrium output depends on an autonomous demand component d and, through investment, on the long real interest rate. (2) is the standard demand for real balances, (3) is the Fisher equation relating nominal and real interest rates. Equation (4) describes the money supply process: there is a core rate of money growth of γ , which the authorities may vary at will, in addition there are one off money supply level surprises, which are captured by the ε term. We are interested in how changes in each of these affect long and short real and nominal interest rates. Equation (5), expresses the arbitrage between holding returns on short and long bonds (which, for simplicity, we assume to be perpetuities). The return on a short bond is simply the short interest rate, while the holding return on a long bond consists of both its coupon and the expected capital gain or loss.²¹⁹

Finally, we have a Phillips curve relating current inflation to past inflation and current output. There are two ways of thinking about this relationship. The first is as an old fashioned expectations-augmented Phillips curve with adaptive expectations, a concept still popular with many undergraduate textbooks.²²⁰ Of course, we prefer not to take this view since we shall work with rational expectations below. The second interpretation of the equation is as summarizing a stylized fact, namely inflation inertia, which might in principle be explained by models with nominal rigidities, such as overlapping wage contracts.²²¹ Whatever interpretation one takes, this equation is the source of rigidity and slow adjustment in our model and thus crucial for our dynamics.

As the model stands, its dynamics are rather intractable. It yields a 4x4 difference equation system in the variables R (or y), r , Δr and π (or $m-p$), without much chance of solving for its roots and saddlepath analytically. We thus take two steps towards simplification, one of them somewhat substantial and another one which we consider to be less important. Our major simplifying assumption is to write the IS curve in terms of the short rather than the long real rate:

$$(1') \quad y = d - \phi r$$

²¹⁹ Note that (5) is not quite as innocuous as it seems, since it expresses the equalization of returns on real (i.e. indexed or goods-denominated) bonds, which may not exist in many countries. However, it is standard use in the class of dynamic Keynesian models on which our illustrative model is based (for instance, Blanchard (1981)). See also Blanchard and Fischer (1989), p. 560, footnote 24 for a brief discussion.

²²⁰ See, for instance, Dornbusch and Fischer (1994), Chapter 16.

²²¹ The standard wage rigidity models of the late seventies (Fischer (1977) and Taylor (1979)) yield sticky prices, but not *inflation* inertia. However, some progress has recently been made, see Fuhrer and Moore (1992).

We had some qualms about this step because, after all, it is the supposed transmission of monetary policy to output through the *long* rate that motivates this chapter. However, we do not believe that the qualitative features of interest rate reactions to a monetary shock - our main objective of study in this model - are much affected by the simplification. On the other hand, we eliminate feedback from the long rate to the rest of the model, which makes it much easier to study the dynamics of the system.

The next step is to condense all equations except for (5), the term structure, into a system in inflation and real short rates only. Substituting (1') and (3) into (2), we obtain:

$$(7) \quad m - p = kd - (h + \phi k)r - h\pi_{+1}^e \quad \text{or}$$

$$(7') \quad r = \frac{1}{(h + \phi k)} \{ kd - (m - p) - h\pi_{+1}^e \}$$

Similarly, substituting (1') into (6) yields the Phillips curve in terms of real interest rates rather than output:

$$(6') \quad \pi = \pi_{-1} + \beta(r^* - r)$$

where $\beta \equiv \theta\phi$ and, since we are not interested in IS shocks in this chapter we set $d = d^*$.

Taking first differences in (7') and using (6') after lagging forward gives:

$$(8) \quad r - r_{-1} = \frac{1}{(h + \phi k)} \{ -(m - p) + (m - p)_{-1} - h\beta(r^* - r_{+1}^e) \}$$

We now make our second simplification. Below, we shall be concerned with very short time periods; our work is based on daily data. As we let the time periods in our model become very short, the within period response of inflation to changes in the interest rate, β , will go to zero (since θ in equation (6) goes to zero). Similarly, one would expect the interest elasticity of money demand to decline.²²² Thus the term $(r^* - r_{+1}^e)$ will have a second order impact on changes in the short real rate, since it is multiplied by $h \cdot \beta$. In economic terms, we ignore the effect increased inflationary expectations over the next twenty four hours has on reducing real money demand, and hence lowering current real short interest rates. We thus drop the term, which greatly simplifies our dynamics. So (8) becomes

$$(8') \quad r - r_{-1} = \frac{1}{(h + \phi k)} \{ -(m - p) + (m - p)_{-1} \}$$

²²² The difference between short and longer run interest elasticities of money demand is empirically well established, see Goldfeld and Sichel (1990).

Lagging forward and using (4), we can rewrite (6') and (8') as:

$$(9) \quad \begin{aligned} \pi_{+1}^e &= \pi + \beta(r^* - r_{+1}^e) \\ r_{+1}^e &= r + \frac{1}{\alpha}(\pi_{+1}^e - \gamma) \end{aligned}$$

where $\alpha \equiv h + \phi k$ is the sum of the direct interest elasticity of money demand and the indirect effect of interest rates on money demand through their impact on output. Solving the system for π_{+1}^e and r_{+1}^e , we get:

$$(10) \quad \begin{aligned} \pi_{+1}^e &= \frac{1}{\alpha + \beta} \{ \alpha \pi + \beta \gamma + \alpha \beta (r^* - r) \} \\ r_{+1}^e &= \frac{1}{\alpha + \beta} \{ \pi - \gamma + \alpha r + \beta r^* \} \end{aligned}$$

It is perhaps worth noting at this point that while r^* is a deep parameter of the model, the steady state level of inflation π^* is just given by γ , the growth rate of the money supply, as can be seen from writing the first equation in (10) for the steady state.

The only thing that remains is sorting out the dynamics of the long real interest rate. Rearranging (5) gives a nonlinear expression for R_{+1}^e :

$$(11) \quad R_{+1}^e = R(1 + R) - rR$$

We linearize (11) about R^* . Taking a first order Taylor approximation gives

$$(12) \quad R_{+1}^e = R^* + R^{*2} - r^* R^* - R^*(r - r^*) + (1 + 2R^* - r^*)(R - R^*)$$

Using the fact that $R^* = r^*$ we get,

$$(13) \quad (R_{+1}^e - R^*) = -R^*(r - r^*) + (1 + R^*)(R - R^*)$$

From (10) and (13) we then obtain the linearized system:

$$(14) \quad \begin{bmatrix} \pi_{+1}^e - \pi^* \\ r_{+1}^e - r^* \\ R_{+1}^e - R^* \end{bmatrix} = \begin{bmatrix} \frac{\alpha}{\alpha + \beta} & \frac{-\alpha\beta}{\alpha + \beta} & 0 \\ \frac{1}{\alpha + \beta} & \frac{\alpha}{\alpha + \beta} & 0 \\ 0 & R^* & 1 + R^* \end{bmatrix} \begin{bmatrix} \pi - \pi^* \\ r - r^* \\ R - R^* \end{bmatrix}$$

One of the roots of this system is simply $1 + R^*$, which is clearly greater than one. This is the root that corresponds to R , which is a forward looking variable and so has to be solved forward. We denote the other two roots λ and μ . Theory suggests that these should both lie within the unit circle since both r and π are non-forward looking. In the technical section

below, we show that this is indeed the case; in addition, we show that λ and μ are complex-conjugate. In other words, the system is saddlepath-stable and displays damped oscillations while adjusting to the new steady state. An easy means to grasp the intuition for this is to consider a one-period transitory shock to the growth rate of money (or a permanent shock to the level). Because of inflation inertia, the consequence of a monetary expansion starting at steady state is that on impact real money balances increase and short nominal and real interest rates jump downwards. Next period, output is above its full employment level, so inflation increases, real money balances fall and short nominal and real interest rates begin to rise again. One can rearrange equation (10) to get

$$(10') \quad \begin{aligned} \pi_{+1}^e &= \pi + \frac{\beta}{\alpha+\beta} \left\{ -(\pi - \gamma) + \alpha(r^* - r) \right\} \\ r_{+1}^e &= r + \frac{1}{\alpha+\beta} \left\{ \pi - \gamma + \beta(r^* - r) \right\} \end{aligned}$$

From equation (10') one can see that the short real interest rate will continue to rise beyond its long run steady state value r^* so long as inflation exceeds its steady state level, γ , (which is unchanged). Moreover, since inflation cannot fall below γ unless r exceeds r^* , we know that the short real rate must overshoot its long run level. Thus, the system displays oscillations until the new steady state is reached.

We now ask how the reactions of inflation and short and long real interest rates depend on the degree of “permanence” of a monetary policy shock. We focus on three benchmark cases: first, a permanent shock to the growth rate of nominal money (γ jumps once and stays there), second, a permanent shock to the *level* of money, which we can alternatively think about as a transitory shock to the *growth* rate (i.e. *either* ε jumps once *or* γ jumps once and jumps back again next period), and finally a transitory shock to the level (ε jumps once this period and jumps again in the opposite direction next period). To avoid clutter, we shall limit ourselves to reproducing results and showing time paths graphically; all derivations are in the technical section below (A2.2).

Figures 5 and 6 show the response of inflation and long and short real interest rates to ε and γ shocks respectively. These are merely plots of the individual variables along the saddlepaths

derived in section A2.2 below, where we have set $\alpha = 0.8$, $\beta = 0.08$ and $r^* = R^* = 3\%$.²²³ In Figure 1, $\gamma = 3\%$. In Figure 2, $\gamma = 2\%$ before the money supply shock and 3% after the shock.

Figure 5: Response to ϵ shock: $\epsilon = 0.01, \alpha = 0.8, \beta = 0.08$

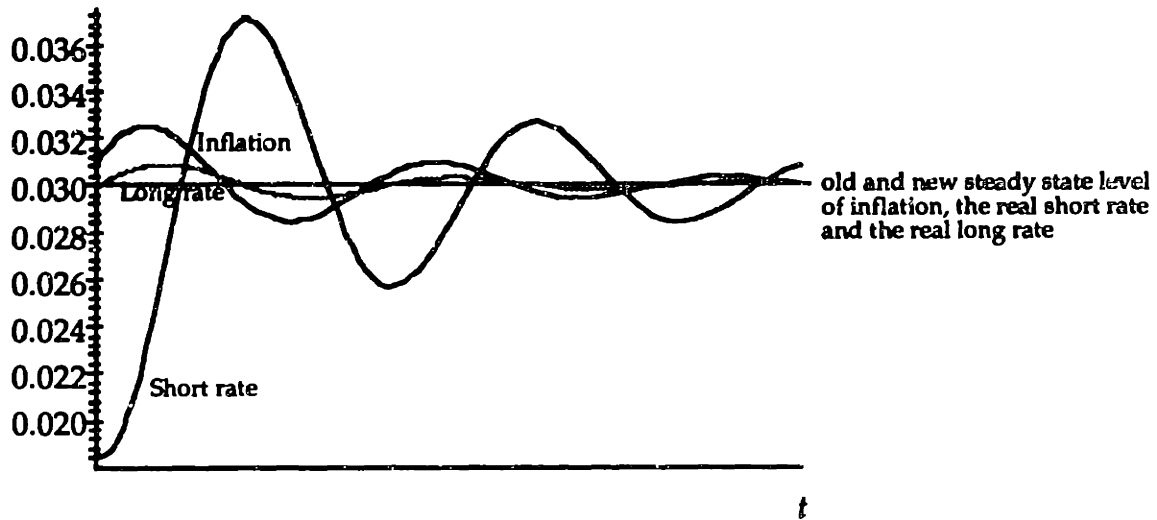
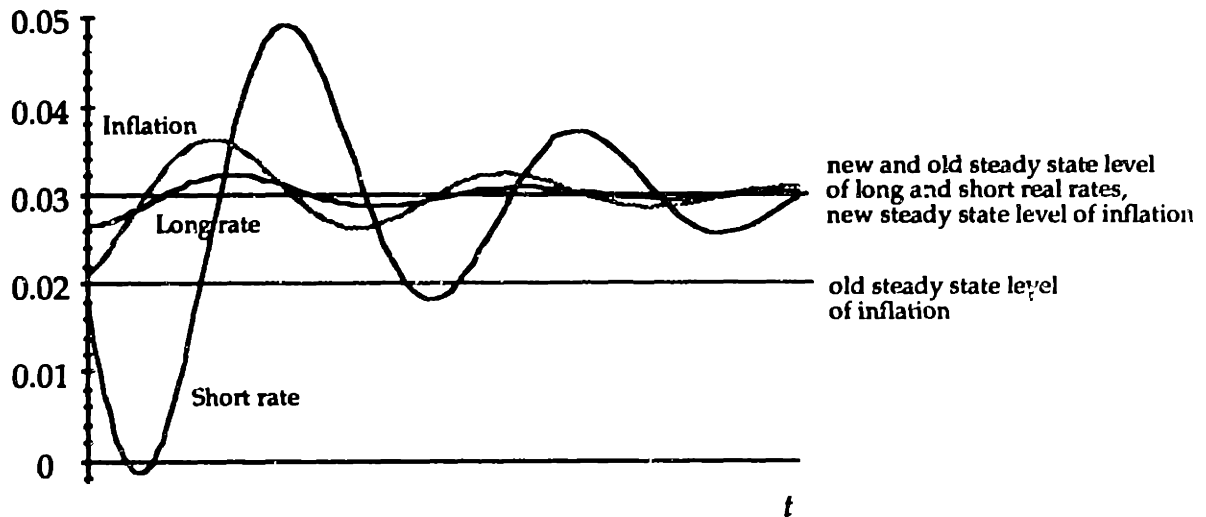


Figure 6: Response to γ shock: $\gamma = 0.01, \beta = 0.8, \alpha = 0.08$



²²³ We make no claim that our choices for α and β are particularly realistic. We chose them as follows: first, we wanted both to be smaller than one, to be consistent with our claim that the product $h\beta$ is second order. Second, we wanted $\alpha > \beta$ because this ensures that the inflation rate is still closer to the old than to the new steady state level after the initial jump (see Appendix A1.2.), which we thought was plausible. Finally, we

In order to see the difference between the two cases, consider the behavior of long real rates and inflation following the shock to the money supply at $t=0$. Take Figure 5 first. An increase in the level of the money stock by 1% produces very modest responses of the long rate and the inflation rate - a small upward jump for the latter and a very small downward jump for the former. (1 basis point for the parameters chosen above). Subsequently, we have damped oscillations which die out relatively quickly for the parameter values chosen. Now consider Figure 6, bearing in mind that the initial steady state level of inflation is now 2%, while the new steady state level of inflation is 3%. A permanent increase in the growth rate of money by 1% produces a large response of the long rate (34 basis points for the parameters chosen above), while, the inflation rate again jumps up very little and slowly adjusts to its new, higher steady state level. Finally, note that a purely temporary change in the money stock (not shown) reduces the short rate for one period, but has practically no effect on the long rate.

More formally, as we show in the technical section below, the change in the long real rate following an ε shock is given by:

$$\Delta R_{\varepsilon} = -\frac{\varepsilon R^* (\alpha + \beta) R^*}{(\beta + \beta R^* + \alpha R^*)^2 + \alpha \beta}.$$

and, following an increase in γ of $\Delta\gamma$, by:

$$\Delta R_{\Delta\gamma} = -\frac{\Delta\gamma R^* (\alpha + \beta)(1 + R^*)}{(\beta + \beta R^* + \alpha R^*)^2 + \alpha \beta},$$

Thus, for $\varepsilon = \Delta\gamma$, the change in the long real rate following a shock to the growth rate of money will exceed the change in the long real rate following a shock to the level of money by a factor of $(1 + R^*)/R^*$. Alternatively, consider any magnitude of ε and $\Delta\gamma$ and compare the ratios of long real rate to short real rate responses for the case of a change in the level and that of a change in the growth rate. Below, we show that the jump in the short real rate following an ε shock is given by:

$$\Delta r_{\varepsilon} = -\frac{\varepsilon}{\alpha + \beta}$$

and, following an increase in γ of $\Delta\gamma$, by:

wanted to get nice pictures in the sense of avoiding large negative real interest rates after the shock and high frequency oscillations.

$$\Delta r_{\Delta \gamma} = -\frac{\Delta \gamma}{\alpha + \beta}$$

Thus,

$$\frac{\frac{\Delta R_{\Delta \gamma}}{\Delta r_{\Delta \gamma}}}{\frac{\Delta R_{\Delta \epsilon}}{\Delta r_{\Delta \epsilon}}} = \frac{(1 + R^*)}{R^*}$$

Interpreting the two cases as benchmarks regarding the degree of “permanence” of a monetary policy, we can say that the change in the long rate relative to the change in the short rate resulting from a shock to the money supply is monotonically increasing in the “permanence” of the shock.

With respect to the change in *nominal* long rates, however, the predictions of the model are much less definitive. This is because, as the “permanence” of a monetary shock is increased, we get not only a larger response of the long real rate but also an increase in the long-run inflationary expectations. In the extreme case of a permanent increase to the growth rate, inflationary expectations over the horizon relevant for the long rate will go up by (almost) as much as the steady state inflation level. Thus, for a permanent shock to the growth rate the expected inflation effect may outweigh the real interest rate effect depending on the parameters α and β . By contrast, a permanent shock to the level (or a temporary shock to the growth rate) has no effect on long run inflationary expectations and thus the long nominal rate will show the same modest decline as the long real rate. The overall effect on long nominal rates may thus be ambiguous for certain parameter constellations and sufficiently “permanent” shocks.

Note, finally, that we can make an unambiguous prediction regarding the effects of *temporary* shocks to the *level* of the money stock: they will have no effect on the long nominal rate, since such shocks have no effect on either the long real rate or on expected inflation.

b) Technical Results and Derivations

The *characteristic equation* belonging to system (14) is:

$$\left(\frac{\alpha}{\alpha + \beta} - \lambda\right)\left(\frac{\alpha}{\alpha + \beta} - \lambda\right)(1 + R^* - \lambda) + \frac{\alpha\beta}{\alpha + \beta} \cdot \frac{1}{\alpha + \beta}(1 + R^* - \lambda) = 0$$

Thus, it is immediate that one of the roots is $1 + R^*$. The other two roots solve:

$$(A1) \quad \lambda^2 - \frac{2\alpha}{\alpha+\beta}\lambda + \frac{\alpha}{\alpha+\beta} = 0, \text{ with } \alpha > 0, \beta > 0$$

Thus the two roots are

$$(A2) \quad \begin{aligned} \lambda, \mu &= \frac{\alpha}{\alpha+\beta} \pm \sqrt{\frac{\alpha^2}{(\alpha+\beta)^2} - \frac{\alpha}{\alpha+\beta}} \\ &= \frac{\alpha}{\alpha+\beta} \left(1 \pm \sqrt{-\frac{\beta}{\alpha}} \right) \end{aligned}$$

Since $\alpha > 0, \beta > 0$, these roots are complex-conjugate. Moreover they lie within the unit circle, and thus are stable, if and only if:

$$\begin{aligned} \left(\frac{\alpha}{\alpha+\beta} \right)^2 \left(1 + \frac{\beta}{\alpha} \right) &\leq 1 \Leftrightarrow \\ \frac{\alpha}{\alpha+\beta} &\leq 1 \end{aligned}$$

which again is always satisfied since $\alpha > 0, \beta > 0$. Note that it is sometimes useful to rewrite these roots as $\lambda = X(\cos\theta + i\sin\theta), \mu = X(\cos\theta - i\sin\theta)$, where $X = \sqrt{\frac{\alpha}{\alpha+\beta}}$ and $\theta = \cos^{-1} \sqrt{\frac{\alpha}{\alpha+\beta}}$.

We are now in a position to derive the saddlepaths discussed in the text. Given two stable real roots λ and μ , the general form of the saddlepath is given by

$$\begin{aligned} \pi_t &= a_1 \lambda^t + a_2 \mu^t + \pi^* \\ r_t &= b_1 \lambda^t + b_2 \mu^t + r^* \\ R_t &= c_1 \lambda^t + c_2 \mu^t + R^* \end{aligned}$$

where $x_1 = (a_1, b_1, c_1)$ is a characteristic vector associated with λ and $x_2 = (a_2, b_2, c_2)$ is a characteristic vector associated with μ .

By making use of the fact that

$$[A - \lambda I]x_1 = [A - \mu I]x_2 = 0,$$

where

$$A = \begin{bmatrix} \frac{\alpha}{\alpha+\beta} & \frac{-\alpha\beta}{\alpha+\beta} & 0 \\ \frac{1}{\alpha+\beta} & \frac{\alpha}{\alpha+\beta} & 0 \\ 0 & R^* & 1+R^* \end{bmatrix}$$

we can solve for four of a_1, a_2, b_1, b_2, c_1 and c_2 in terms of each other, with the remaining two being given by the initial conditions for r and π .

$$\text{Solving we find } a_1 = \sqrt{\alpha\beta} i b_1, a_2 = -\sqrt{\alpha\beta} i b_2, b_1 = \left[\frac{(\alpha+\beta)(1+R^*) - \alpha - \sqrt{\alpha\beta} i}{(\alpha+\beta)R^*} \right] c_1 \text{ and}$$

$$b_2 = \left[\frac{(\alpha+\beta)(1+R^*) - \alpha + \sqrt{\alpha\beta} i}{(\alpha+\beta)R^*} \right] c_2.$$

We now look at the response of inflation, long real rates and short real rates to a permanent change in the rate of *growth* of money, γ , a permanent shock to the *level* of the money stock (an ϵ shock) and a transitory shock to the level of the money stock (ϵ jumps up this period and down next period), assuming in each case that we start from the steady state. We must first solve for the initial conditions and then use these to solve for a_1, a_2, b_1, b_2, c_1 and c_2 , which then gives us the saddlepath. We conclude by summarizing what our results imply for the behavior of short and long *nominal* rates.

a) Permanent shock to the growth rate

We consider first an increase in the growth of money from γ to $\gamma + \Delta\gamma$, so $m = \gamma + \Delta\gamma + m_{-1}$. Let $\pi_o^* = \gamma$ be the old steady state level of inflation and $\pi_n^* = \gamma + \Delta\gamma$ be the new steady state level of inflation. So $\pi_n^* = \pi_o^* + \Delta\gamma$. Thus from (6') and (8') we have

$$\pi = \gamma + \beta(r^* - r)$$

$$r = r^* + \frac{1}{\alpha}(\pi - m + m_{-1})$$

which gives

$$r - r^* = -\frac{\Delta\gamma}{\alpha + \beta}$$

$$\pi - \pi_o^* = \frac{\Delta\gamma\beta}{\alpha + \beta}$$

or $\pi - \pi_n^* = -\frac{\Delta\gamma\alpha}{\alpha + \beta}$

Thus the initial effect of the increase in the growth rate of money is to reduce the real short term interest rate, as real money balances are now higher, and to increase the inflation rate moderately above its previous (steady state) level but to leave it below its new steady state level.²²⁴

From the equations for the saddle path, setting $t = 0$, we find that

$$b_1 + b_2 = r - r^* = -\frac{\Delta\gamma}{\alpha + \beta}$$

$$a_1 + a_2 = \pi - \pi_n^* = -\frac{\Delta\gamma\alpha}{\alpha + \beta}$$

Using these and the expressions above we solve for a_1, a_2, b_1, b_2, c_1 and c_2 to get

$$a_1 = -\frac{\Delta\gamma\alpha}{2(\alpha + \beta)} - \frac{\Delta\gamma\sqrt{\alpha\beta}}{2(\alpha + \beta)}i$$

$$a_2 = -\frac{\Delta\gamma\alpha}{2(\alpha + \beta)} + \frac{\Delta\gamma\sqrt{\alpha\beta}}{2(\alpha + \beta)}i$$

$$b_1 = -\frac{\Delta\gamma}{2(\alpha + \beta)} + \frac{\Delta\gamma\sqrt{\alpha}}{2(\alpha + \beta)\sqrt{\beta}}i$$

$$b_2 = -\frac{\Delta\gamma}{2(\alpha + \beta)} - \frac{\Delta\gamma\sqrt{\alpha}}{2(\alpha + \beta)\sqrt{\beta}}i$$

$$c_1 = \frac{-\Delta\gamma R^* [\beta(\alpha + \beta)(1 + R^*) - \sqrt{\alpha\beta} R^* (\alpha + \beta)i]}{2\beta(\beta + \beta R^* + \alpha R^*)^2 + 2\alpha\beta^2}$$

$$c_2 = \frac{-\Delta\gamma R^* [\beta(\alpha + \beta)(1 + R^*) + \sqrt{\alpha\beta} R^* (\alpha + \beta)i]}{2\beta(\beta + \beta R^* + \alpha R^*)^2 + 2\alpha\beta^2}$$

substituting into the above equations for the saddlepath and simplifying gives

²²⁴ Our priors are that $\alpha > \beta$ so that the inflation rate is still closer to the old than to the new steady state level after the initial jump. In practice one might also expect there to be a lag between a reduction in the real interest rate and an increase in output and hence the inflation rate.

$$\pi_t = -\left(\frac{\Delta\gamma\alpha}{\alpha+\beta}\right)\left(\frac{\alpha}{\alpha+\beta}\right)^{\frac{1}{2}} \cos\theta t + \left(\frac{\Delta\gamma\sqrt{\alpha\beta}}{\alpha+\beta}\right)\left(\frac{\alpha}{\alpha+\beta}\right)^{\frac{1}{2}} \sin\theta t + \pi_n^*$$

$$r_t = -\left(\frac{\Delta\gamma}{\alpha+\beta}\right)\left(\frac{\alpha}{\alpha+\beta}\right)^{\frac{1}{2}} \cos\theta t - \left(\frac{\Delta\gamma\sqrt{\alpha}}{(\alpha+\beta)\sqrt{\beta}}\right)\left(\frac{\alpha}{\alpha+\beta}\right)^{\frac{1}{2}} \sin\theta t + r^*$$

$$R_t = -\left(\frac{\Delta\gamma R^*(\alpha+\beta)(1+R^*)}{(\beta+\beta R^*+\alpha R^*)^2+\alpha\beta}\right)\left(\frac{\alpha}{\alpha+\beta}\right)^{\frac{1}{2}} \cos\theta t - \left(\frac{\Delta\gamma R^*\sqrt{\alpha\beta}(\alpha+\beta)R^*}{\beta(\beta+\beta R^*+\alpha R^*)^2+\alpha\beta^2}\right)\left(\frac{\alpha}{\alpha+\beta}\right)^{\frac{1}{2}} \sin\theta t + R^*$$

To find the impact effect on the long rate we set $t = 0$ and solve for R_0 , which gives:

$$R_0 - R^* = -\frac{\Delta\gamma R^*(\alpha+\beta)(1+R^*)}{(\beta+\beta R^*+\alpha R^*)^2+\alpha\beta}$$

which is clearly less than zero. Thus, we find that an increase in the rate of growth money not only reduces the real short term interest rate but also reduces the real long term interest rate. The change in the long rate relative to the change in the short rate is given by:

$$\frac{\Delta R}{\Delta r} = \frac{R^*(\alpha+\beta)^2(1+R^*)}{(\beta+\beta R^*+\alpha R^*)^2+\alpha\beta} \equiv z_{perm}$$

b) Permanent shock to the level/transitory shock to the growth rate

We now consider a shock to the level of the money stock, so $m = \gamma + m_{-1} + \varepsilon$. From (6') and (8') we again have

$$\begin{aligned}\pi &= \gamma + \beta(r^* - r) \\ r &= r^* + \frac{1}{\alpha}(\pi - m + m_{-1})\end{aligned}$$

which gives

$$\begin{aligned}r - r^* &= -\frac{\varepsilon}{\alpha + \beta} \\ \pi - \pi^* &= \frac{\varepsilon\beta}{\alpha + \beta}\end{aligned}$$

Thus, the initial effect of the increase in the money stock is to reduce the real short term interest rate, as real money balances are now higher and to increase the inflation rate moderately above its previous (steady state) level. Note that these impact effects on the short term real interest rate and the inflation rate are exactly the same as those which arise when the growth rate of money increases by a similar amount. Bond market participants observe only the change in the short term interest rate and the change in the money stock, and must then infer whether or not it is simply a one off change in the level or a change in the growth rate.

From the equations for the saddle path, setting $t = 0$, we now find that

$$b_1 + b_2 = r - r^* = -\frac{\varepsilon}{\alpha + \beta}$$

$$a_1 + a_2 = \pi - \pi^* = \frac{\varepsilon\beta}{\alpha + \beta}$$

Once more using these and the expressions above we solve for a_1, a_2, b_1, b_2, c_1 and c_2 to get

$$a_1 = \frac{\varepsilon\beta}{2(\alpha + \beta)} - \frac{\varepsilon\sqrt{\alpha\beta}}{2(\alpha + \beta)}i$$

$$a_2 = \frac{\varepsilon\beta}{2(\alpha + \beta)} + \frac{\varepsilon\sqrt{\alpha\beta}}{2(\alpha + \beta)}i$$

$$b_1 = -\frac{\varepsilon}{2(\alpha + \beta)} - \frac{\varepsilon\sqrt{\beta}}{2(\alpha + \beta)\sqrt{\alpha}}i$$

$$b_2 = -\frac{\varepsilon}{2(\alpha + \beta)} + \frac{\varepsilon\sqrt{\beta}}{2(\alpha + \beta)\sqrt{\alpha}}i$$

$$c_1 = \frac{-\varepsilon R^* [\alpha(\alpha + \beta)R^* + \sqrt{\alpha\beta}(1 + R^*)(\alpha + \beta)i]}{2\alpha(\beta + \beta R^* + \alpha R^*)^2 + 2\alpha^2\beta}$$

$$c_2 = \frac{-\varepsilon R^* [\alpha(\alpha + \beta)R^* - \sqrt{\alpha\beta}(1 + R^*)(\alpha + \beta)i]}{2\alpha(\beta + \beta R^* + \alpha R^*)^2 + 2\alpha^2\beta}$$

substituting into the above equations for the saddlepath and simplifying gives

$$\pi_t = \left(\frac{\varepsilon\beta}{\alpha+\beta} \right) \left(\frac{\alpha}{\alpha+\beta} \right)^{\frac{1}{2}} \cos \theta t + \left(\frac{\varepsilon\sqrt{\alpha\beta}}{\alpha+\beta} \right) \left(\frac{\alpha}{\alpha+\beta} \right)^{\frac{1}{2}} \sin \theta t + \pi^*$$

$$r_t = - \left(\frac{\varepsilon}{\alpha+\beta} \right) \left(\frac{\alpha}{\alpha+\beta} \right)^{\frac{1}{2}} \cos \theta t + \left(\frac{\varepsilon\sqrt{\beta}}{(\alpha+\beta)\sqrt{\alpha}} \right) \left(\frac{\alpha}{\alpha+\beta} \right)^{\frac{1}{2}} \sin \theta t + r^*$$

$$R_t = - \left(\frac{\varepsilon R^* (\alpha+\beta) R^*}{(\beta + \beta R^* + \alpha R^*)^2 + \alpha\beta} \right) \left(\frac{\alpha}{\alpha+\beta} \right)^{\frac{1}{2}} \cos \theta t + \left(\frac{\varepsilon R^* \sqrt{\alpha\beta} (\alpha+\beta) (1+R^*)}{\alpha(\beta + \beta R^* + \alpha R^*)^2 + \alpha^2\beta} \right) \left(\frac{\alpha}{\alpha+\beta} \right)^{\frac{1}{2}} \sin \theta t + R^*$$

To find the impact effect on the long rate, we again set $t = 0$ and solve for R_0 , yielding:

$$R_0 - R^* = - \frac{\varepsilon R^* (\alpha+\beta) R^*}{(\beta + \beta R^* + \alpha R^*)^2 + \alpha\beta}$$

which is again less than zero. The change in the long rate relative to the change in the short rate is given by:

$$\frac{\Delta R}{\Delta r} = \frac{R^* (\alpha+\beta)^2 R^*}{(\beta + \beta R^* + \alpha R^*)^2 + \alpha\beta} \equiv z_{temp}$$

Thus the ratio of the response of the long rate to a change in the short rate when there is a permanent increase in the growth rate of money relative to an increase in the level of money is:

$$\frac{z_{perm}}{z_{temp}} = \frac{1+R^*}{R^*}$$

c) Transitory shock to the level

Finally, we consider a transitory increase in the level of the money stock that is expected to be reversed next period. In this case the change in the short interest rate for this period is the same as above, while next period it reverts back to its steady state level. The long

rate, by contrast, does not move at all since the move in short rates is expected to be reversed in the next period.²²⁵

d) The response of nominal rates

The effect on nominal rates is straightforward. In the case of an increase in the rate of growth of money, the effect on nominal short rates can be seen from combining (3) and the equations for the saddlepath derived above. Thus, we have:

$$\begin{aligned}\Delta i &= i - i_o^* \\ &= r + \pi_{+1}^e - r^* - \pi_o^* \\ &= r^* - \frac{\Delta\gamma}{\alpha + \beta} - \left(\frac{\Delta\gamma\alpha}{\alpha + \beta} \right) \left(\frac{\alpha}{\alpha + \beta} \right)^{\frac{1}{2}} \cos\theta + \left(\frac{\Delta\gamma\sqrt{\alpha\beta}}{\alpha + \beta} \right) \left(\frac{\alpha}{\alpha + \beta} \right)^{\frac{1}{2}} \sin\theta + \pi_n^* - r^* - \pi_o^* \\ &= -\frac{\Delta\gamma}{\alpha + \beta} - \left(\frac{\Delta\gamma\alpha}{\alpha + \beta} \right) \left(\frac{\alpha}{\alpha + \beta} \right)^{\frac{1}{2}} \cos\theta + \left(\frac{\Delta\gamma\sqrt{\alpha\beta}}{\alpha + \beta} \right) \left(\frac{\alpha}{\alpha + \beta} \right)^{\frac{1}{2}} \sin\theta + \Delta\gamma\end{aligned}$$

Therefore, the short nominal rate does not fall by quite as much as the short real rate since there is a modest immediate offsetting effect of increased inflationary expectations, resulting from the lower real interest rate for which holders of nominal short instruments must be compensated. Long run inflationary expectations will rise by the full amount of the increase in the growth rate of money and so the long nominal rate will change by the change in the real rate plus $\Delta\gamma$, i.e.

$$I_o - I_o^* = -\frac{\Delta\gamma R^* (\alpha + \beta) (1 + R^*)}{(\beta + \beta R^* + \alpha R^*)^2 + \alpha\beta} + \Delta\gamma,$$

which is of ambiguous sign.

For the case of an increase in the level of the money supply we have:

²²⁵ Strictly speaking the long rate must fall by a small amount, so that long bond holders suffer a capital loss when the long and short rate return to their normal level the following period, thus equalizing holding returns on the two assets. However, if the short rate falls by one percentage point for one day the long rate must decline by less than one fiftieth of a basis point to maintain the arbitrage relation.

$$\begin{aligned}
\Delta i &= i - i^* \\
&= r + \pi_{t+1}^e - r^* - \pi^* \\
&= r^* - \frac{\varepsilon}{\alpha + \beta} + \left(\frac{\varepsilon\beta}{\alpha + \beta} \right) \left(\frac{\alpha}{\alpha + \beta} \right)^{\frac{1}{2}} \cos \theta + \left(\frac{\varepsilon\sqrt{\alpha\beta}}{\alpha + \beta} \right) \left(\frac{\alpha}{\alpha + \beta} \right)^{\frac{1}{2}} \sin \theta + \pi^* - r^* - \pi^* \\
&= -\frac{\varepsilon}{\alpha + \beta} + \left(\frac{\varepsilon\beta}{\alpha + \beta} \right) \left(\frac{\alpha}{\alpha + \beta} \right)^{\frac{1}{2}} \cos \theta + \left(\frac{\varepsilon\sqrt{\alpha\beta}}{\alpha + \beta} \right) \left(\frac{\alpha}{\alpha + \beta} \right)^{\frac{1}{2}} \sin \theta
\end{aligned}$$

Thus, as for the permanent increase in the growth rate the decline in the nominal short interest rate is not quite as great as the decline in the real short interest rate. The effect on the long nominal rate is, by contrast, the same as the change in the long real rate, since to a first approximation the one off increase in the level of the money stock has no impact on long run inflationary expectations.

3. Data description

Our data is as follows:

United States:

Short term interest rate: the average of the yield on the 12 week, 13 week and 14 week treasury bills.

Long term interest rate: the average yield on the three treasury bonds maturing closest to ten years time (obviously, for the U.S. yields on much longer bonds are available, but we wanted to be consistent with the data available for France and Germany).

Great Britain:

Short term interest rate: the average of the three month yield on UK treasury bills, banks bills and sterling certificates of deposit. We took the average of three short interest rates since the yields on British treasury bills are usually only quoted to the nearest 1/16%. In practice, just using the treasury bill rate made little difference to our results.

Long term interest rate: the average yield on the three government bonds maturing closest to ten years time (again, for the U.K. yields on much longer bonds are available, but we wanted to be consistent with the data available for France and Germany).

Germany

Short term interest rate: from 1965 until the introduction of the Frankfurt Interbank Offered Rate (FIBOR) in 1988, we used the arithmetic mean between the bid and the offer quote of the Frankfurt three month interbank rate. From 1988 onwards we used the three month FIBOR.

Long term interest rate: from 1964 to mid 1978, the *FAZ* computed yields on government bonds of at least 8 years to maturity, organized by their coupon. We used the average of all those yields. From mid 1978 onwards, the *FAZ* computed average yields on government bonds organized by their term of maturity. We took the average between the 8 year and the 10 year government bond yield (which was the longest available) in order to be consistent with our earlier series.

France

All French data used has preliminary character.

Short term interest rate: the only three month rate available to us for France at the time of completing this draft was a Euro-Franc interest rate, which is quoted in *Le Monde* from 1977 onwards (only an overnight Paris money market rate is quoted). As in the case of Germany, we used the average of the bid and the offer rate. We intend to redo the French regressions after obtaining Paris three month rates for our sample period.

Long term interest rate. Neither *Le Monde* nor *Le Figaro* quote bond yields, we thus had to compute them ourselves from bond prices, coupons and maturities. We used the following bonds: for 1977-78, the average of the yields on the 3% and 5% perpetuities and the 6% 1967 bond, maturing in January 1983. From 1979 to July 1982, the yield on the 9.8% 1978 bond, maturing in August 1993. For August 1982 to 1986, the average of this yield and the yield on the 10.8% 1979 bond, maturing in January 1994. For 1987, the average of the yield on the 10.8% 1979 bond, maturing in January 1994, the yield on the OAT 10% 2000 bond, maturing in May 2000, the yield on the OAT 9.9% 1997 bond, maturing in December 1997 and the yield on the OAT 9.8% 1996 bond, maturing in January 1996. For 1988, the average yield of the three bonds we named last in the previous sentence. For 1989-91, the average of the yield on the OAT 10% 2000 bond, maturing in May 2000, the yield on the OAT 9.9% 1997 bond, maturing in December 1997. For 1992 to July 1993, just the yield on the OAT 10% 2000 bond, maturing in May 2000. From July 1993 onwards, the average between the yield on the OAT 10% 2000 bond and the yield on the OAT 8.5% bond, maturing in November 2002.

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Chapter 2

Identification and Effects of Monetary Policy Shocks -

An Alternative Approach

(joint with Jeromin Zettelmeyer)

I. INTRODUCTION

Since Sims' influential 1980 article advocating the use of Vector Autoregressions (VARs) in forecasting and policy analysis,¹ there has been a renewed debate regarding the most promising way of identifying monetary policy shocks. Three major approaches can be distinguished. The first is based on estimating an unrestricted VAR and subsequently using "minimum delay" assumptions - i.e. contemporaneous exclusion restrictions based on timing arguments - to relate reduced form errors to structural shocks, such as a shock to the money supply.² The most popular form of this approach is the Wold causal chain, in which a recursive structure among the contemporaneous endogenous variables is assumed.³ The second approach is the "structural VAR" approach which differs from the original VAR methodology in that identification is achieved through restrictions generated from economic models rather than based on timing assumptions.⁴ Thus, while both approaches implicitly or explicitly assume the validity of a specific structural model, the former emphasizes "simple, weak identifying assumptions"⁵ largely unrelated to competing economic models, while the latter rejects identification through such assumptions precisely because they lack "particular economic rationale".⁶

Finally, there is the "narrative analysis of intertentions" of Romer and Romer (1989), which relies heavily on the study of the historical circumstances underlying particular monetary policy decisions. Their idea is to restrict attention to contractionary policy actions which were a result

1. Sims (1980).

2. The clearest exposition of this is Sims (1987). The term "minimum delay restrictions" is taken from this piece.

3. For instance, Sims (1980), Sims (1986), Christiano, Eichenbaum and Evans (1994a), Christiano, Eichenbaum and Evans (1994b), Sims (1992).

4. Bernanke (1986), Blanchard (1989), Blanchard and Quah (1989), Blanchard and Watson (1986), Gali (1992), Shapiro and Watson (1988), Taylor (1986).

5. Sims (1986), p. 3.

6. Blanchard (1989), p. 1148.

of policy makers' worries about "trend inflation". The argument is that such "anti-inflationary shifts in policy" are likely to be contemporaneously uncorrelated with other shocks to output, their left hand side variable of interest. The dates of these policy actions can then be used as dummies in an autoregressive model of economic activity.⁷

One might argue that, ironically, the "narrative" approach comes closest to answering Sims' (1980) call for an empirical methodology largely free of the "incredible assumptions" characterizing traditional econometric models. Unlike the VAR-based methods, *no* structural model is assumed, not even implicitly. In one instance, Sims even refers directly to "historical analysis" as a means of separating the endogenous and exogenous components of policy.⁸ However, the Romer and Romer method can be criticized, on several counts.⁹ First and foremost, it is not clear to what extent the policy actions they identify are really uncorrelated with contemporaneous economic information. If periods are taken to mean quarters or even months, it seems too strong to assume that the described "anti-inflationary shifts in policy" did not constitute a reaction to within-period economic information.¹⁰ Second, their policy index is coarse relative to that of alternative approaches in that it provides no measure of the *intensity* of the policy shock. Finally, in order to avoid the even more severe endogeneity problems associated with monetary expansions, Romer and Romer restrict their study to (large) contractions, yielding only a very small set of recognized policy actions.

In this chapter, we propose a method for refining the "narrative" approach which removes these problems while largely preserving the "narrative approach's" agnosticism regarding the true structure of the economy. The basic procedure is as follows. First, like Romer and Romer, we use an historical approach to create a list of monetary policy actions - events such as intervention rate changes, changes in minimum reserve requirements etc. - which were undertaken with the intention of altering economic conditions. We make no claim that these events are exogenous or predetermined. Next, we take the jump in the three-month interest rate on the day of the policy event as a measure of the surprise associated with the event. The idea, which will be presented in more detail below, is that this measure is uncorrelated with both past and current (i.e. within-quarter or within-month) economic information, with only one exception:

7. The original paper Romer and Romer (1989) used a univariate autoregression in industrial production or unemployment (p. 152); since then, there have been multivariate extensions, see Eichenbaum and Evans (1992), Christiano et al. (1994b), p. 10.

8. "We may sometimes be able to separate endogenous components of variance in policy variables by careful historical analysis, in effect using a type of instrumental variables procedure for estimating a structural relationship between policy variables and the rest of the economy." Sims (1980), p. 12.

9. See also Christiano et al. (1994b).

10. Note that even the weaker claim (see footnote 7 above) that the Fed actions identified are uncorrelated with current economic information seems implausible if time-periods are defined as months or quarters.

instances in which monetary policy reacts to economic news *on the same day*. We argue that these occasions are rare, and attempt to exclude them individually.

The structure of the chapter is as follows. We begin with a methodological section which explains our approach in more detail and goes on to discuss practical issues involved in constructing our policy series for four countries: the United States, Great Britain, France and Germany. Next, we present and interpret the policy series resulting from our approach. Finally, we show the dynamic response of various macroeconomic variables to our measure of monetary policy shocks using several VAR specifications. Our results are contrasted with previous results based on existing methodologies. A final section concludes.

II. IDENTIFICATION

1. The approach

Suppose some endogenous variables in the economy react to unexpected monetary policy. A reduced-form model of the economy could then be written as follows:

$$Y_t = A(L) Y_{t-1} + \beta (m_t - E\langle m_t | Y_{t-1}, Y_{t-2}, \dots \rangle) + u_t \quad (1)$$

where Y_t is an $n \times 1$ vector of endogenous variables, m_t is some policy variable that can be set by monetary authorities, u_t is an $n \times 1$ vector of reduced-form errors, $A(L)$ is a matrix lag polynomial and β is an $n \times 1$ vector of coefficients. Our objective is to estimate the dynamic response of various endogenous variables to $m_t - E\langle m_t | Y_{t-1}, Y_{t-2}, \dots \rangle$.

The problem, of course, is that $m_t - E\langle m_t | Y_{t-1}, Y_{t-2}, \dots \rangle$ is not directly observable. The usual approach is thus to estimate the model subsuming $m_t - E\langle m_t | Y_{t-1}, Y_{t-2}, \dots \rangle$ into the error term, and then to impose a set of just-identifying restrictions to recover all "structural errors" which the reduced form error contains, including monetary policy shocks. However, since we are only interested in the latter, this approach really yields more than we need; on the other hand, its costs are considerable, since it involves an array of questionable identifying restrictions. We would rather have a method which yields no more than we want, but in return involves fewer assumptions.

We thus ask whether a method we proposed in Chapter 1 to measure the monetary surprises associated with monetary policy *events* can be adapted to construct an index of $m_t - E\langle m_t | Y_{t-1}, Y_{t-2}, \dots \rangle$, so that we can estimate all coefficients in (1) consistently and thus construct impulse responses for money surprises without further identifying assumptions.

Our earlier method comprised two major objectives.

First, we wanted to measure the *unanticipated* content of monetary policy action. To attain this objective, we used the jump of the three month rate on the day of a policy announcement as a measure of the surprise content of the action, excluding instances in which policy actions coincided with other major economic news (according to financial press reports). This procedure will be valid, if

- (i) *Sufficiently short interest rates (e.g. overnight rates) are affected by policy*
- (ii) *Arbitrage is effective between the overnight and the three month rate*
- (iii) *Any other news affecting the three month rate on the same day is negligible (except in the cases excluded).*

Assumptions (i) and (ii) are needed to ensure that the three month rate may move at all in response to a policy announcement. In addition, (ii) implies that the change in the three month rate on the day of the policy announcement will, to a first approximation, be unexpected.¹¹ Assumption (iii) ensures that the change in the three month rate does not reflect other shocks. We attempted to satisfy (iii) by excluding instances in which both policy actions and other economic news were mentioned in financial market reports.

Second, because we wanted to run a regression involving daily data, we wanted to ensure that the policy actions whose unanticipated content we were measuring was not an endogenous response to information *on that day*. To attain this objective, we went through reports of the policy actions we were studying, and excluded those which, according to these reports, were immediate reactions to economic news.¹²

This will achieve the desired result if

- (iv) *Within-day policy reactions only happen in exceptional cases, which are reported in the financial press.*

11. Just as arbitrage should hold between short and long bonds, it should also hold between overnight and ninety day paper. Thus, if the three month rate is above the overnight rate there must be an expectation that three month rates will rise over the course of the next day in order to generate a small capital loss and thus equate expected holding period returns. However, even if the overnight rate is a full point lower than the three month rate this will only generate an expectation of a one basis point change in the three month rate, compared to typical reactions on the day of our policy events of twenty basis points or more. We thus feel safe in assuming that all of the change in the three month rate is unexpected.

12. In practice, the problem of a within day policy reaction has mostly arisen in the case of Britain, where monetary policy is ultimately in the hands of one person (the Chancellor of the Exchequer) and rapid responses to, for example, poor trade figures are relatively common. For the United States, Germany or France such rapid reactions are less frequent although we also excluded some actions for the US and France because they constituted within day policy responses. A notable example was the reduction in the US discount rate in July 1992 that came less than an hour after the publication of very disappointing employment figures.

Now suppose we construct a money surprise index as follows. In time periods (i.e. typically months or quarters in a VAR estimation setting) in which we measure at least one monetary policy event using the method above, we take the sum of our measure over all events in the period to be the monetary surprise associated with the period. In time periods without measured events, we take the monetary surprise associated with the period to be zero. The question is: “assuming (i)-(iv) - i.e. assuming that each individual measure is indeed an accurate measure, in units of the three month rate, of the monetary surprise content associated with the underlying *event* -, will the resulting index lead to consistent estimation of (1)?”

In general, the answer is no - *unless* we make some additional assumptions. However, we believe that the additional assumptions needed are acceptable and that the total set of assumptions involved (i.e. (i)-(iv) plus two to come) is still considerably less restrictive than the identifying restrictions typically used in the VAR literature.

Two new problems arise when we extend the objectives addressed by our earlier method to the problem of estimating (1) consistently.

1. The problem of endogenous policy actions becomes much more severe if our data frequency is months or quarters, rather than days. Obviously we cannot address it in the same fashion as before - since monetary authorities will *generally* react to information from the last weeks or months, excluding events in which they did would leave us with no individual measures at all. Note however, that our measure of policy is a jump in the three month rate, which from assumption (ii) should be uncorrelated with any economic information known to market participants before the day of the policy event. Assuming that policy endogeneity on the actual day of the policy event has been successfully ruled out by our event-specific measure, the only way in which the event-specific policy measures could be correlated with u_t is if policy makers reacted to within-period news of which market participants were unaware. We must thus assume that this is not the case:

(v) *Monetary authorities do not act on information unavailable to market participants.*

Note that (v), in conjunction with (iii), makes (iv) redundant: If all news which the monetary authorities act on is also known to money markets, then instances of within-day policy reactions will automatically be excluded by excluding instances in which major news might have affected the three month rate on the day of a policy announcement.

2. The assumptions so far made insure that the event-specific measures on which our index is based will be uncorrelated with u_t . However, this is not the same as saying that the index itself is uncorrelated with u_t . The problem is that the index will contain entries of zero money surprise when in fact a non-zero entry may have been correct. This could arise either

because we are missing certain actions, or because we are missing the surprise associated with "acts of omission", i.e. days in which policy actions did not occur even though they were expected. For example, suppose that a recent acceleration of inflation leads to expectations of a contraction, but nothing happens. Presumably, the more inflation increased over the last quarter, the higher the associated surprise. Since this surprise is not reflected in our index, the shock we fail to record will then be absorbed into the error term, generating a contemporaneous correlation of u_t with a variable in Y .¹³ We thus assume:

(vi) Monetary surprises associated with non-actions and actions we missed are negligible.

Our view is that (v) is quite weak. Policy makers will usually obtain macroeconomic news (for example, quarterly GDP figures) slightly ahead of markets, but it seems very unlikely that policy would be systematically based on this informational advantage.¹⁴ We are less comfortable with (vi) a priori, but are encouraged by the findings of Chapter 3, in which the reactions of the three month rate to central bank council meetings in Germany are studied. There, I find that council meetings without policy actions led to a negligible three month rate response relative to council meetings with policy actions.

In summary, we propose to construct an index of monetary surprises following a four step procedure:

1. For a given country and sample period, write down a comprehensive list of all publicly known policy actions, such as changes in central bank interest rates, open market operations, changes in minimum reserve requirements, rediscount quotas etc.
2. Rule out policy actions which coincided with other major economic news that became known on the same day.
3. For the remaining policy actions, obtain the jump of a three-month interest rate on the day of the policy announcement.
4. For each period in which policy actions occurred, assign the sum of the jump in the three month rate obtained in 3. over all actions in the period as the "money surprise content" of the period. Otherwise, assign zero.

Under the assumptions made (and assuming that standard assumptions, such as covariance stationarity, are satisfied) using this index in place of $m_t - E(m_t | Y_{t-1}, Y_{t-2}, \dots)$ will allow us to consistently estimate model (1), because the assumptions jointly guarantee that the index is accurate and uncorrelated with the error term.¹⁵

13. For an extended discussion, see Chapter 3.

14. For example, in Britain we found many instances in which policy reacted almost immediately to a piece of publicly announced news, but not a single instance when policy was changed ahead of an important announcement, in a way that reflected knowledge of that announcement.

2. Constructing policy indices for the U.S., the U.K., France and Germany.

The indices used in this chapter are based on the policy actions identified in Chapter 1. This poses the potential problem that the criteria under which policy events were excluded in Chapter 1 were slightly stronger than suggested in the procedure above, in two ways. First, we excluded a small number of policy actions which were highly transitory, such as the monetary authorities fending off a speculative attack by temporarily increasing interest rates. In the context of this chapter, there is no compelling a priori reason why transitory measures should not be included in our policy index. Next, we excluded policy actions that, according to central bank reports and contemporaneous observers, were *not intended* to affect economic conditions, i.e. merely "followed the market" (for example, instances in which central bank rates were raised "in order to bring the discount rate closer to the interest rate level in the money market" or "in order to reduce the subsidy character of the discount rate"¹⁶). The rationale for doing this was that such actions were unlikely to carry a noticeable policy signal, exposing us to the danger of just picking up noise on that day (i.e. violating assumption (ii)). From the point of view of this chapter, however, ignoring certain policy actions because they did not reflect policy intention exposes us to the even greater danger of violating assumption (vi) - unless, of course, the presumption is correct that policy actions that merely "follow the market" do not constitute surprises.

In Chapter 3, I compare the impulse responses based on the reduced policy index for Germany from Chapter 1 to those based on a complete set of published policy actions, disregarding any intentions associated with these action. The resulting impulse responses are very similar; none of the qualitative conclusions change. We concluded that it seemed safe to base our work in this Chapter on the somewhat smaller policy action sets from Chapter 1. In future work, we shall extend these sets for the U.S., France and the U.K. in the same manner as Chapter 3 does for Germany.

We now describe the sources and specific problems associated with picking policy actions for each country. A comprehensive documentation of the policy actions we picked is contained in the appendix of Chapter 1. Summary tables of the actions picked and the policy surprises associated with them are contained in Appendix A1 below.

a) The United States, 1965-1994

Monetary policy actions in the United States generally take one of the following forms: open market operations, changes in reserve requirements and changes in the discount rate. Changes

15. For a more extended econometric analysis, see Chapter 3.

16. See, for example, Bundesbank Annual Report (1984), p 22.

in reserve requirements or changes in the discount rate are decided upon by the seven member Federal Reserve Board of Governors. Upon a change an announcement is made that communicates the reasoning behind the action. Open market operations are carried out by the Federal Reserve Bank of New York following a directive issued by the Federal Open Market Committee, which consists of the seven members of the Federal Reserve Board and five representatives from the regional Federal Reserve banks. The committee meets approximately every five to six weeks and then, about six weeks later, the full text of the directive is made public. However, the effect of the decisions made at the committee meeting are felt throughout the intervening six weeks and one cannot identify a single impact of the meeting on the markets.

For this reason, although open market operations are in many instances more significant than discount rate changes we have taken as our candidate policy actions only changes in discount rates and reserve requirements, the timing of which is always unambiguous. Since the beginning of this year (1994) the FOMC has changed its policy and now announces changes in its target for the Federal Funds rate immediately after the FOMC meeting at which the change was approved. Thus, in the future a more complete set of monetary policy actions will be possible.

In the period from 1965-1993 there were 92 changes in discount rates or reserve requirements and four changes in the federal funds rate target announced in 1994. We read the motivation behind these actions given by the Board in their annual report and then checked these statements against the contemporaneous statements made by the Board and the accompanying press comments in the New York Times and, in some cases, the Wall Street Journal.¹⁷ In almost all instances our prior evaluation of the action was confirmed by the newspapers. Of the 96 actions we excluded 31 as not being policy actions. The majority of these were the discount rate changes in the early to mid 70's which the Fed usually described as being "intended to bring the discount rate into better alignment with short term rates".¹⁸ A further four actions were not counted since they represented within day policy reaction to another significant event e.g. the publication of unemployment or inflation figures (see Chapter 1 for details on specific policy actions and Appendix A1 below).

b) The United Kingdom, 1965-1994

The identification of monetary policy actions in the U.K. is more difficult than for the United States and Germany (see below). In general, the Bank of England is characterized by less openness than the Bundesbank or the Federal Reserve Board, when it comes to justifying or explain-

17. The Wall Street Journal was used on days when the New York Times was not published.

18. New York Times (NYT), May 11th 1973.

ing its actions. When the Radcliffe Committee recommended the publication of the Bank of England Quarterly Bulletin as a means for the Bank to provide comment on monetary developments, the Bank was initially very reticent as it felt that it might cause it "to show [its] hand more fully than [it] thought desirable".¹⁹ Furthermore, the absence of independence constrains comment by the Bank to be "consistent with ministerial utterances".²⁰ For this reason we had to rely more on newspaper reports than for other countries.

After compiling 179 potential policy actions from the OECD country report for the U.K. and the Bank of England Quarterly Bulletin, we checked each instance in the Financial Times in order to establish (i) if there was any contemporaneous statement from either the Bank of England or the Chancellor of the Exchequer as to the motives of the action, (ii) how the Financial Times interpreted their statement and the action, (iii) the exact timing of the action - sometimes changes in rates were signalled through operations in the money markets one or two days before - and (iv) the reaction of the three month rate to the news. We were able to eliminate 93 actions. Many of these 93 "actions" were during the period in the 1970's when the Bank of England's minimum lending rate (MLR) was determined by a formula related to the previous week's treasury bill auction. While the Bank could still influence the MLR through open market operations it tended to let short rates be market determined and many of the changes in MLR were not even reported on the front page of the Financial Times. The other principal reason for not counting an action was because it accompanied another major event or was part of a within day policy reaction. For example, many changes in interest rates were announced by the Chancellor along with his Spring Budget or his Autumn Statement which also included fiscal announcements that might be expected to have an independent influence on interest rates. Others came within hours of poor trade figures to which the markets were also reacting. Our final list for the U.K. thus comprises a total of 86 actions (see Appendix).

c) Germany, 1965-1994

Identifying monetary policy actions for the Federal Republic of Germany was aided by the fact that the Annual and Monthly Reports of the Deutsche Bundesbank, unlike the corresponding publications by the Bank of England, provide clear and fairly detailed explanations of the motivation behind policy actions. Beginning, as in the case of Britain and the United States, with the full set of publicly announced monetary actions, we could thus use the Bundesbank reports to eliminate some actions which clearly did not meet our criteria, and obtain a preliminary idea of the intentions behind the remaining policy events. As a check of the Bundesbank's interpre-

19. Radcliffe Committee (1959), paragraph 859.

20. *ibid.*

tations, which could have been misleading due to their ex post nature, we cross-read the Bundesbank reports with the account of Giersch et al. (1992). We found them to be broadly consistent, certainly for the events which we eliminated off-hand as non policy-driven.

This first screening left us with 110 potential policy actions. For these, we then went through past issues of the *Frankfurter Allgemeine Zeitung* in order to check the contemporaneous Bundesbank statement regarding the motive of the action, the exact timing, i.e. exactly when the news regarding the action hit bond markets, and finally the possibility of confounding by other economic news on that day. After eliminating a further 18 events as "confounded" or not constituting monetary policy in our sense, we were left with a total of 92 actions for Germany (see Appendix).

d) France, 1978-1994

In the case of France, data availability has limited the period we were able to study so far. Since the three month rate used for France is not quoted on a daily basis before 1978, we limited ourselves to monetary policy actions which occurred from 1978 onwards.

Our procedure was similar to that employed for the countries discussed above. We set out with a list of candidate policy actions compiled from sources published by the Banque de France, primarily the annual reports of the Conseil National du Cr dit (hereafter quoted as CNC). We then used current newspaper reports (primarily *Le Monde* and into a lesser extent *Le Figaro*) to check the exact timing of these actions, obtain current statements by French policy-makers wherever possible, obtain a second opinion as to the motives of the actions and check that there was no other major event on that day that might have driven the movements of interest rates.

Two issues complicated this procedure in the case of France. The first was how to treat the French dichotomy of "credit policy" versus "interest rate policy". Until 1984, French monetary authorities attempted to control the growth of internal credit primarily through a system of quantitative constraints, the "encadrement du cr dit", rather than through interest rates.²¹ After some earlier experiences with quantitative credit constraints during the 1950's and 1960's, the encadrement was introduced in late 1972 against the backdrop of increasing inflation, in the hope that it would allow a tighter control of money growth and aggregate demand than conventional policy instruments.²² In addition, there was the notion that this additional tool would allow policy makers to pursue separate external and internal objectives.²³

21. An overview of French monetary operating procedures and their historical development up to 1987 is given by Patat (1987), pp. 309-346. See also Patat and Lutfalla (1990).

22. CNC (1972), p. 21, CNC (1973), p. 20-26.

23. Patat (1987), p. 331.

For us, the question was whether or not to include “credit policy” as monetary policy actions. We decided not to, for the following reasons. First, the timing of the announcements of credit growth norms is difficult to pinpoint, and very rarely discussed in financial market reports (except when combined with other monetary or fiscal measures). This made it practically impossible to identify the unanticipated policy component of “credit policy” following our scheme. Second, the official line of French monetary authorities was always that changes in the “encadrement” did *not* represent policy towards interest rates, which the Banque claimed to control separately. As we discuss in more detail elsewhere, a sufficiently large window of central bank money at a fixed intervention rate might indeed peg the money market interest rate and make it immune to changes in quantitative constraints in some range.²⁴

This left us with studying the impact of monetary instruments which the Banque de France itself considered interest rate policy, primarily changes in the “taux directeurs”. Unfortunately for our purposes, the Banque de France ceased using the discount rate as an instrument from 1977 onwards, and instead began to rely on less publicly visible, but much more frequent, intervention rate changes.²⁵ This poses a problem in two respects. First, many short run money market interventions follow money demand; it is much more difficult to establish which were driven by policy than in the case of the less frequent discount rate changes, which are generally accompanied by statements from policy makers. Second, until the mid-eighties, many intervention rate changes were not even reported by the financial press, leaving an ambiguity as to their exact timing and impact. While we checked all intervention rate changes which could not be dismissed offhand - that is, on the basis of the CNC reports - as clearly not policy-driven (about 100 for 1977-1993), we only counted events which were reported in the press, in addition to applying our usual criteria for establishing whether they were policy actions. This procedure left us with 61 events for this period (see Appendix).

III. THE EFFECTS OF MONETARY POLICY SHOCKS IN FOUR COUNTRIES

1. Indices of monetary policy shocks

a) United States

Figure 1 (page 22) shows our policy shock index for the United States. While we have a total of 61 policy events listed in the Appendix, the figure shows only 56 spikes, reflecting the fact

24. Chapter 1, Section A1,d).

25. Unless other wise indicated, the rates discussed below refer to “achats d’effets publics et d’effets privés de 1re catégorie” i.e. purchases of high quality short public and private paper.

that on three occasions two policy actions occurred within the same month and on a further two occasions the three month interest rate showed no response to the action.

The first spike in the figure represents the shock associated with the December 1965 discount rate increase, the most significant single monetary policy event during the famed “credit crunch” of 1965-66. A small easing of policy followed in the spring of 1967. Our figure then shows a sequence of contractionary shocks corresponding to the tightening of monetary conditions during 1968 and early 1969 in order to counter the boom associated with the Vietnam War.

Next, our measure identifies two large contractionary shocks in June and September 1973, the first one corresponding to two discount rate and one reserve requirement increase during the same month and the second one to a major increase in reserve requirements only. According to our measure, these shocks constituted the most important unanticipated events in a new phase of Fed tightening from early 1973 until the summer of 1974 - with a slight pause following the October 1973 oil embargo - that was prompted by rapid growth during 1972 and renewed inflationary fears exacerbated by the devaluation of the dollar (February 1973). While there was a further increase in the discount rate in April 1974 (the month of a Romer and Romer dummy), the action prompted practically no change in the three month rate, suggesting that the move had been fully anticipated.²⁶

In the second half of 1974 the concern of the Fed shifted from excessive inflation to the weak state of the economy and over the subsequent months reserve requirements and the discount rate were reduced in order to “help counter this weakness”.²⁷ The relatively modest response of our index during these months indicates that these moves had only small unanticipated components. By 1978 with the economy growing briskly and inflation accelerating the Fed once more moved to tighten the monetary reins. While the large spike appearing in January 1978 reflects a half point discount rate increase primarily driven by external motives,²⁸ the sequence of small contractionary shocks from mid 1978 onwards capture the shocks associated with four discount rate increases between August and November which reflected a shift in the domestic policy stance. Finally, we have a huge spike associated with the Volcker tightening of

26. The three month interest rate actually fell by a basis point on the day of the announcement. Note, however, that this is one of the cases where our restriction to *publicly announced* policy events may lead us to underestimate the unanticipated component of policy measures during that month. In particular, we cannot measure the unanticipated policy content of open market operations conducted during that month.

27. 1974, Fed AR, p. 43.

28. See accompanying Board statement as quoted in the New York Times, January 7th, 1978. See also Chapter 1, Appendix A1 a).

October 1979, which combined a discount rate increase of a full percentage point with an increase in minimum reserve requirements.

In early 1980 the U.S. suffered a severe but short lived recession. The discount rate was cut on three occasions and each time the Fed claimed to be merely accommodating changes in money demand resulting from the downturn in economic activity. Despite this rhetoric we have included the second reduction as a policy event since it was widely regarded at the time as illustrating "that the Fed [was] deeply concerned about the economy".²⁹ As can be seen from the figure, the action had a substantial unanticipated component.

The rapid recovery of the economy led the Fed to tighten once more and in a series of four moves the discount rate was raised from 10% to an unprecedented 14% by May of 1981. Each increase incorporated a large shock, but the first and the last elements of the sequence stand out in particular. While market interest rates had already risen considerably from their lows in the early summer of 1980, the September 1980 increase in the discount rate illustrated the Fed's intention to take rates to even higher levels; the result was a sharp jump in the three month rate (and longer term interest rates). The final increase in the discount rate from 13 to 14%, on the other hand, came after a five month pause, shocking commentators and financial markets and resulting in an increase in the three month rate in excess of the change in the discount rate. This suggests that some modest easing had been anticipated or even that the action might have led markets to expect further tightening.

In late 1981 the Fed began to ease. While it initially described its actions as being only "a technical response to developments in the money markets"³⁰ by 1982 it was also citing the "persisting sluggishness in economic activity"³¹ as reasons for its actions. While these moves were in response to a weak economic situation, they nevertheless contained very large unanticipated components, suggesting that the 1979-81 behavior of the Fed had led people to reassess its reaction function and conclude that it would not reduce rates even in the face of a severe downturn. Subsequent further reductions in rates in 1985 and 1986 contained much smaller unanticipated components, presumably because by then market participants had learned that even Mr. Volcker was prepared to cut rates in response to a slow growing economy.

In the face of an overheating economy, the discount rate was raised by a half point on three occasions during 1987-1989, with each instance provoking a small jump in three month interest rates. The response of the Fed to the 1990-91 recession was to reduce the discount rate from

29. New York Times, June 13th 1980.

30. 1981 Fed AR, p. 79.

31. 1982 Fed AR, p. 75.

7% to just 3%, the lowest level in over thirty years. Our index suggests that on only one occasion did their action have a major unanticipated component, namely in December 1991 when the discount rate was reduced from 4.5% to 3.5% the only instance in the series of reductions when rates were cut by a full point. The final three shocks in Figure 1 correspond to the recent tightening when the target for the Federal Funds rate was raised from 3% in February 1994 to 4.25% by May.

Two conclusions emerge from the above discussion. First, many major contractionary and expansionary actions of monetary policy in the last thirty years are clearly reflected in our index. Thus, according to our index, major contractionary or expansionary actions generally give rise to unanticipated shocks in the same direction as the action itself. In this sense, the limitations of the purely narrative approach, which fails to separate exogenous and endogenous components of a policy action explicitly, appear less severe in practice than they seemed to be in principle. Thus, four out of the five "Romer and Romer months" December '68, April '74, August '78, October '79 and August '88 also carry contractionary shocks according to our index (the exception being April 1974, which we discussed above).

On the other hand, our index also suggests that both within and across policy phases the size of the unanticipated components may often bear little relationship to the apparent magnitude of the associated action. For example, contrast the unanticipated components of the 1978 and the Volcker 1979 tightenings. From August to November 1978 the discount rate was raised four times from 7.25% to 9.5%, while in October 1979 the discount rate was increased from 11% to 12%. Our index suggests that while the cumulative increase in the discount rate was much greater in the 1978 series of increases the unanticipated component was far higher in the single October 1979 rate increase. Next, contrast the reaction to the October 1979 tightening to the Fed's first action after Volcker became Chairman, namely the August 1979 half percent increase in the discount rate. The latter showed hardly any reaction at all, reflecting the fact that some contractionary action after the change at the head of the Fed was readily predictable. Consequently, the difference between the shocks - 0.04 points for August versus 1.06 point for October - is much greater than one might infer from just comparing the magnitude of the associated discount rate increases. Similarly, the four months which incorporated contractionary shocks both according to Romer and Romer and according to our measure vary enormously in their unanticipated policy content according to our index, ranging from a tiny 4 basis point jump in the three month rate in December 1968 to the huge jump of October 1979. This confirms the earlier criticism that treating these events as dummies of quantitatively equal importance is likely to imply a large loss of information.

Finally, note that we have a few actions (see Appendix A1), where the shock associated with a contractionary action was actually expansionary, and vice versa. The clearest example is probably the recent March 1994 increase in the Federal Funds target from 3.25 to 3.5%, which was associated with a *fall* in the three month rate by 6 basis points. The interpretation is that the March action was less contractionary than had been expected, implying a (small) *expansionary* shock. Over the whole sample, the correlation between changes in the discount rate (and, very recently changes in the federal funds rate target) and changes in the T-bill rate is 0.757 for the U.S. Note that the analogous correlations are quite similar for the other countries: 0.861 for the U.K., 0.757 for Germany and 0.728 for France.

b) United Kingdom

Our unanticipated policy index for the United Kingdom is shown in Figure 2 (page 23). There were 73 months during the sample when the monetary authorities surprised the financial markets. A cursory inspection of the figure and comparison with Figures 1, 3 and 4 confirms one's priors that monetary policy in the United Kingdom is rather more volatile than in the other countries we have studied.

The first large spike is associated with a February 1969 increase in the Bank rate. Following the November 1967 devaluation of sterling, monetary policy eased moderately in 1968, however, some bad trade figures at the end of 1968 and rapid expansion prompted the Bank of England to raise the Bank rate by one percentage point. Next, we note four large expansionary shocks during 1970-71, which correspond to a time of great monetary and fiscal laxity in the United Kingdom. Despite continued high inflation, the Bank rate was reduced by 3 points during this period, partly to stimulate aggregate demand and partly to offset the large dollar inflows that all European countries were experiencing at this time.

In the summer of 1973, policy reverted to a more restrictive stance as the economy was growing very fast and the balance of payments moved heavily into deficit. The spike in July of 1973 corresponds to the large increases in the Bank rate that took place during that month. Following the oil price shock monetary policy turned somewhat easier in the early months of 1974 as can be seen by the small downward movement in our index for April 1974. However, with inflation in excess of 20% p.a., the Bank of England increased the minimum lending rate significantly in 1975-76, with several instances of rises of one and a half or even two percentage points. Our index suggests that these changes all had large unanticipated components.

While interest rates fell by over ten percentage points during 1977, this decline was prompted more by a restoration of financial confidence than an actively easier policy stance - indeed, the monetary authorities in many instances intervened to slow the pace of the decline and uttered

protestations that they did not want to see rates fall too fast. There is therefore only one small instance of an unanticipated monetary expansion recorded in Figure 2 for this period. As the economy was more buoyant in 1978 and monetary growth far exceeded its target range, the authorities once again turned to a tighter stance, with two instances in November 1977 and November 1978 when our index registers a monetary contraction in excess of one point. These correspond to increases in the minimum lending rate of 2% and 2.5% respectively.

Monetary policy was tightened still further following the election of the Conservative government in May 1979, with two significant tightenings taking place in June and November 1979, each of which had large unanticipated components. While the second rate increase had been widely foreseen, its magnitude (an increase in the minimum lending rate by a full 3 percentage points in a single day to a record 17%) had been underestimated. From the summer of 1980 onwards the direction of policy became easier, with the exception of a sharp tightening that took place in the autumn of 1981 as the authorities sought to reaffirm their toughness in the face of higher U.S. rates. After this, interest rates were lowered in a series of steps between November 1981 and November 1984, with some interruptions due to temporary sterling weaknesses. Some, but not all of these reductions implied substantial expansionary shocks.

During the period of 1985-88, monetary policy actions in Britain were largely dictated by movements on the foreign exchange markets. Thus in January 1985 and in January and October 1986 there are large increases in rates that are prompted by sterling weakness, while in early 1987 and early 1988 there are more moderate declines in rates that were the result of excessive sterling strength. Due to the unpredictability of the monetary authorities' actions during this time there were often large unanticipated components to these changes. The three further contractionary shocks in 1988 and 1989 were in response to the rapid growth in the economy and the associated increase in inflation.

The final phase in Britain has been the easing of policy since late 1990. Although policy was initially constrained by the ERM, monetary authorities managed to reduce interest rates by 5 points in the first eighteen months of ERM membership. However, the shock associated with these actions appears small relative to those associated with the reductions following sterling's withdrawal from the ERM in September 1992.³²

32. In the regressions that follow below, the ERM period was not excluded or given special treatment. This is clearly not quite right, since ERM membership probably constituted a regime-shift for monetary policy, which might imply that the covariance stationarity assumption underlying the regressions is violated. However, the ERM period is very brief (about 2 years), and it is not feasible to run a separate VAR on it. Excluding the ERM period means that we would have lost the interesting subsample following ERM membership as well.

Over the whole sample, the correlation between changes in interest rates directly controlled by the Bank of England and changes in the U.K. T-bill rate is 0.861.

c) Germany

Figure 3 (page 24) shows our unanticipated policy index for the Federal Republic of Germany. In the German case, a total of 90 actions between 1965 and April 1994 gives rise to only 70 spikes. In three instances two policy actions occurred within the same month, while in the remaining 17 instances the unanticipated component of policy, as measured by the change in the three month rate on the day of the policy announcement, was zero or negligible.

Note that for Germany there are many more instances in which the three month rate reaction to policy actions was literally zero than for the U.S. and the U.K. (18.9% for Germany versus 3.7% for the U.S. and only 2.3% for the U.K.). Some of this discrepancy might be due to the fact that monetary policy is more predictable in Germany than in the U.S. or the U.K. However, we attribute most of the difference to the fact that our policy index for Germany is based on an interbank rate (this is the only three month rate available over the entire sample period), which apparently is less sensitive to small shocks than the T-Bill rates we used for the U.S. and the U.K.³³

We now discuss the major policy shocks shown in Figure 3. 1965/66 witnesses two contractionary shocks associated with Bundesbank actions designed to curb a boom which apparently resulted from expansionary fiscal stimuli before the September 1965 federal election.³⁴ For the first half of 1967, the figure then shows a number of expansionary disturbances resulting from Bundesbank actions during the 1967 recession, at that time the largest economic downturn since the postwar recovery. The next three spikes are the result of lombard and discount rate increases which were part of a series of contractionary steps undertaken in 1969-70, after the quick recovery from the 1967 recession had given way to a renewed overheating of the economy. The major expansionary shocks of 1970-71 are associated with discount and lombard decreases partly forced by the easing of policy in the U.S. and the ensuing capital inflows, and partly a reaction to stagnating activity from the second quarter of 1971 onwards. The slow-down in growth turned out to be temporary, however, and by early 1972 growth was recovering, accompanied by unprecedented, and increasing, levels of inflation (5.3% in the first half and 6.1% in the second half).³⁵ After the introduction of capital controls in the summer of 1972, the Bundesbank felt sufficiently protected on the external flank to undertake major con-

33. See Chapter 1, Section III.1.c).

34. Giersch et al. (1992), p. 143 and Chapter 1, Appendix A1.

35. Cost of living index. See Bundesbank Annual Report for 1972, p. 13.

tractionary actions in the Fall and in January, which according to our index, had large unanticipated components. The large spike in November 1972 is the sum of two jumps in the three month rate which resulted from policy actions on the second and 30th of the month. Similarly, the large contractionary shock in May 1973 is due to two large discount/lombard rate increases on May 3rd and 30th, after the demise of the Bretton Woods system in March 1973 had allowed the Bundesbank to renew its attack on inflation unhindered by external constraints.

The Bundesbank's efforts toward stepwise easing during the 1974/75 recession are manifested in a sequence of less extreme, but still notable, expansionary shocks. The 1977 expansionary shocks reflect central bank interest rate declines aimed partly at stabilizing the dollar, partly at aiding economic recovery, which had slowed down in the first half of 1977. In early 1979, the Bundesbank moved to a contractionary policy stance which is reflected in two spikes of our policy measure corresponding to January and March 1979 central bank rate increases. Note that the first of these increases was very cautious relative to the second, both in magnitude (merely the lombard rate was increased in January, by half a point, as opposed to full point increases in both discount and lombard rates in March) and in the way it was presented to the public.³⁶ Yet their unanticipated content is about the same according to our measure, reflecting differences in the extent to which they were anticipated.

The sequence of roughly alternating expansionary and contractionary shocks between mid-1979 and early 1981 merits some discussion. Note first that until May of 1980, the Bundesbank was still increasing official rates, yet we have expansionary shocks in July 1979, an event to which we shall come back below, and especially in February 1980. The latter reflected a combination of sharp rises in both discount and lombard rates (by 1 and 1.5 points respectively) and the removal or relaxation of quantitative limits to Central Bank credit. Historically, this kind of "contradictory package" - is not infrequent (for instance, it happened twice in the preceding year) and is typically associated with a movement in market rates in the same direction as official rates. This time, the three month rate *fell* by 40 basis points. Our interpretation is that the increase in official rates had been largely anticipated in view of rising U.S. interest rates (see *FAZ*, 2/29/1980) but the abolition of the quantitative limit to the lombard credit facility, introduced only 6 months earlier, had not. Next, we have a substantial expansionary shock associated with the first reduction in official rates since 1977 (lombard rate reduced by half a point in mid September 1980). In view of a new round of tightening in the U.S., the Bundesbank was forced to abandon its efforts towards easing in February of 1981, when it took the drastic step of suspending lombard credit altogether, which implied a large contractionary shock, according to our measure.

36. Chapter 1, Appendix.

Between October 1981 and September 1983, the Bundesbank undertook a new series of steps intended to cautiously relax the monetary stance. According to our index, these involved two major shocks. The first corresponds to the turning point in the Bundesbank's policy stance, manifested in a reduction of the "special lombard" by a full point from 12% to 11% in early October. The second marks a one point reduction in lombard and discount rates in early December 1982, which was largely unanticipated, probably since a similar action by the Bundesbank had taken place only 5 weeks before.

Finally, note that both the Bundesbank's 1988-89 tightening and the 1991 "unification tightening", had fairly modest unanticipated components according to our measure. Only the April 1989 and the post-Maastricht December 1991 increase in discount and lombard rates constitute non-trivial shocks, with jumps of at least 20 basis point in both instances. Similarly, within the recent expansionary phase only the original September 1992 central bank rate decline and the October 1993 reduction (the first after the currency crisis of the summer) seem to have constituted surprises.

The above discussion suggests similar conclusions to the case of the U.S. On the one hand, we find that major policy actions involve shocks in the same direction as the measures themselves; on the other hand, the size of the unanticipated component, according to our index, often has little to do with the apparent magnitude of the associated action. The latter is most starkly illustrated by instances in which the unanticipated component of policy "went the wrong way".³⁷ Consider two examples. In July 1979, we have an expansionary impulse of 15 basis points associated with an *increase* in the Bundesbank's discount rate by one point and its lombard rate by half a point. According to our measure, the *unanticipated* policy impulse corresponding to this action was thus expansionary, even though the action itself had contractionary intent. Apparently, the measures fell short of what markets had predicted in that they did not involve direct restrictions of liquidity (FAZ, July 14th, 1979). Second, consider the unification-related increases in central bank rates in August and December 1991. Both seem of roughly the same order of magnitude - a full point discount rate increase in August with only a quarter point lombard increase; two half point increases in both rates in December. Yet, the August action was less contractionary than had been expected, whereas the December increase came as a shock to markets.³⁸ Thus, our measure of unanticipated policy shows a (very small)

37. As mentioned at the beginning of the section, there are 17 instances in which our measure of unanticipated policy showed no reaction on the day of the policy announcement. As explained in detail elsewhere Chapter 1, Section III 1.c in the case of Germany we have reason to mistrust our measure for the early part of our sample. For example, the fact that we register zero response of the three month rate in six out of seven instances during the 1969 contractionary phase is odd and may be a result of the thinness of the interbank money market or reporting specifics during this time. However there are a number of examples of zero or negative reaction to a monetary policy announcement during later periods of our sample which have clear economic interpretations.

expansionary shock associated with the August action, whereas the unanticipated component of the December action was fairly large and contractionary. The correlation between changes in central bank interest rates and changes in the three month rate was 0.757 for Germany over the entire sample.

d) France

Figure 4 (page 25) shows our index of monetary policy shocks for France. In view of the data problems described above and in Appendix A3, we were limited to the period after 1978. Even within this period, the index uses two data series, namely a Paris 3 month interbank rate from September 1981 onwards and a 2-month Eurofranc rate for the earlier policy dates - the only rate of about the right maturity currently available to us for 1978-1981. Thus, the fact that our index takes on exceptionally large values on some policy occasions during the earlier years may be influenced by the use of the shorter and thus more volatile rate. In view of this, our results for France have preliminary character.

As in the case of Germany and the U.S., the first impression one obtains from looking at the picture is that the textbook events of French monetary policy during these years are easily recognizable, i.e. they seem to have involved large unanticipated components. Following a small expansionary impulse associated with a decrease in intervention rates at the end of March, we register three major contractionary disturbances during 1979, when the Banque de France tightened along with the Bundesbank. The two expansionary impulses in 1980 correspond to a short-lived period during which the Barre administration, in view of the strength of the Franc within EMS and lower interest rates in the U.S, attempted to relax interest rates. Next, we have a series of expansionary shocks which correspond to the first Mitterand government's attempts of lowering interest rates from the summer of 1981 onwards. After the Franc had been devalued several times within the European Monetary System, economic policy as a whole in turned more conservative in France from March 1983 onwards, leading to a period of inaction on the monetary front that lasted until the end of 1985.³⁹ The three expansionary shocks in early 1986 were associated with a new attempt to bring down interest rates in view of recent successes in reducing inflation. Two more attempts of this type followed in early 1987 and the first half of 1988, each of them separated by Franc weaknesses which interrupted and temporarily reversed government policy towards easing. Next, we have a set of contractionary shocks which accompany a shift in policy stance across Europe, led by the Bundesbank, from August 1988 onwards. From April 1990 onwards the Banque de France embarks in a new attempt at uni-

38. FAZ, August 16th, 1991, Süddeutsche Zeitung, August 16th, 1991, FAZ, December 20th, 1991.

39. Chapter 1, Appendix A1, d).

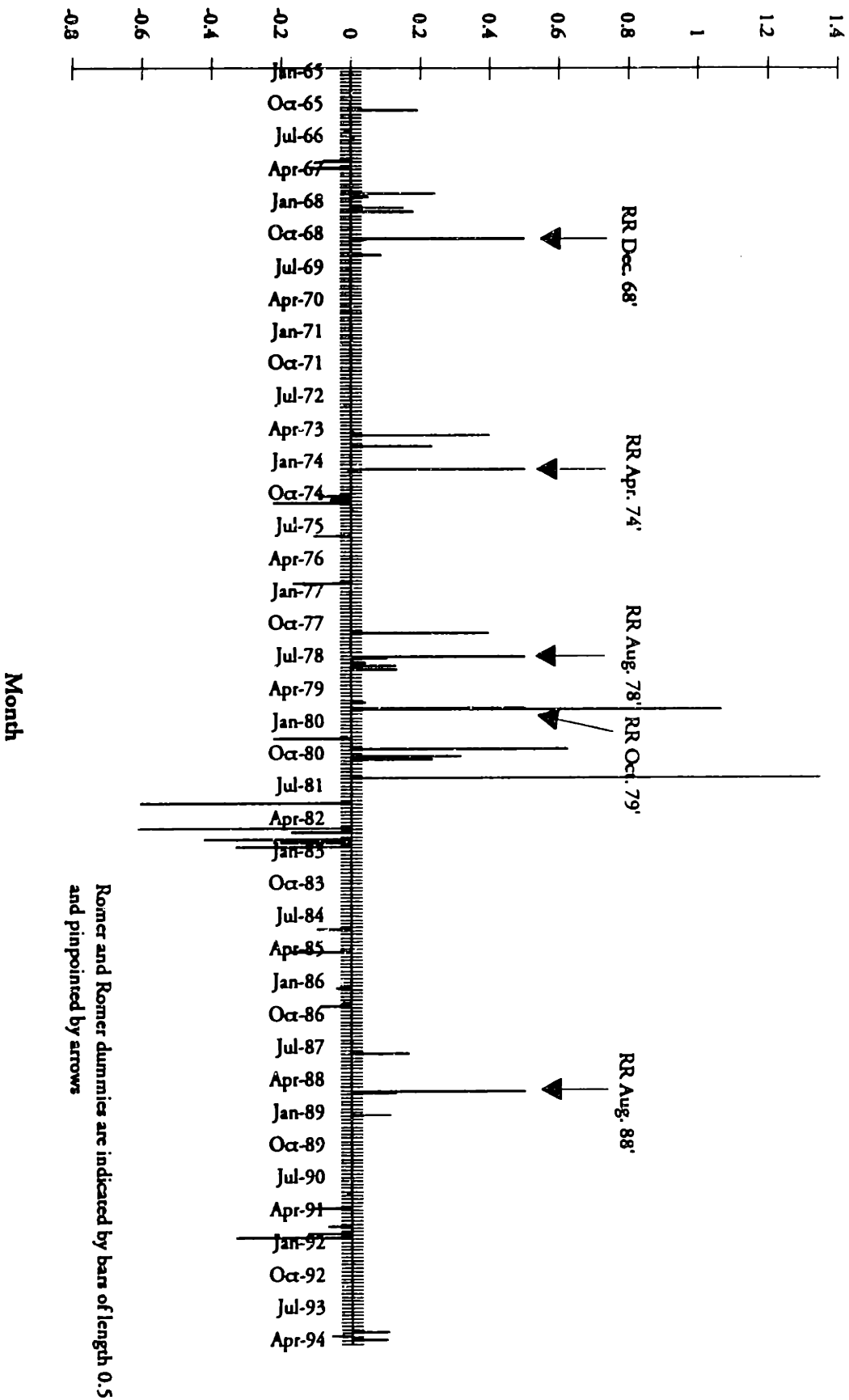
lateral relaxation until late 1991 when a Franc weakness and the infamous post-Maastricht Bundesbank tightening forced intervention rates up again. Finally, note a series of major expansionary shocks associated with the relaxation in policy stance from the Spring of 1993 onwards.⁴⁰

While the direction of major policy shocks thus generally corresponds to the direction of the policy actions that underlie them, a glance at the Table 4 in Appendix A1 confirms that, as in the case of the other countries, the unanticipated content of an action often bears little relationship to the size of the intervention rate movement that prompts it. In particular, there are some instances (for example, the June 1986 decrease in intervention rates) which by our measure were purely endogenous and thus would be incorrectly identified by a purely historical approach.

The correlation between intervention rate changes and changes in the three month rate was 0.728 for France over the whole sample.

40. *ibid.*

Figure 1: Index of Monetary Policy Shocks - United States



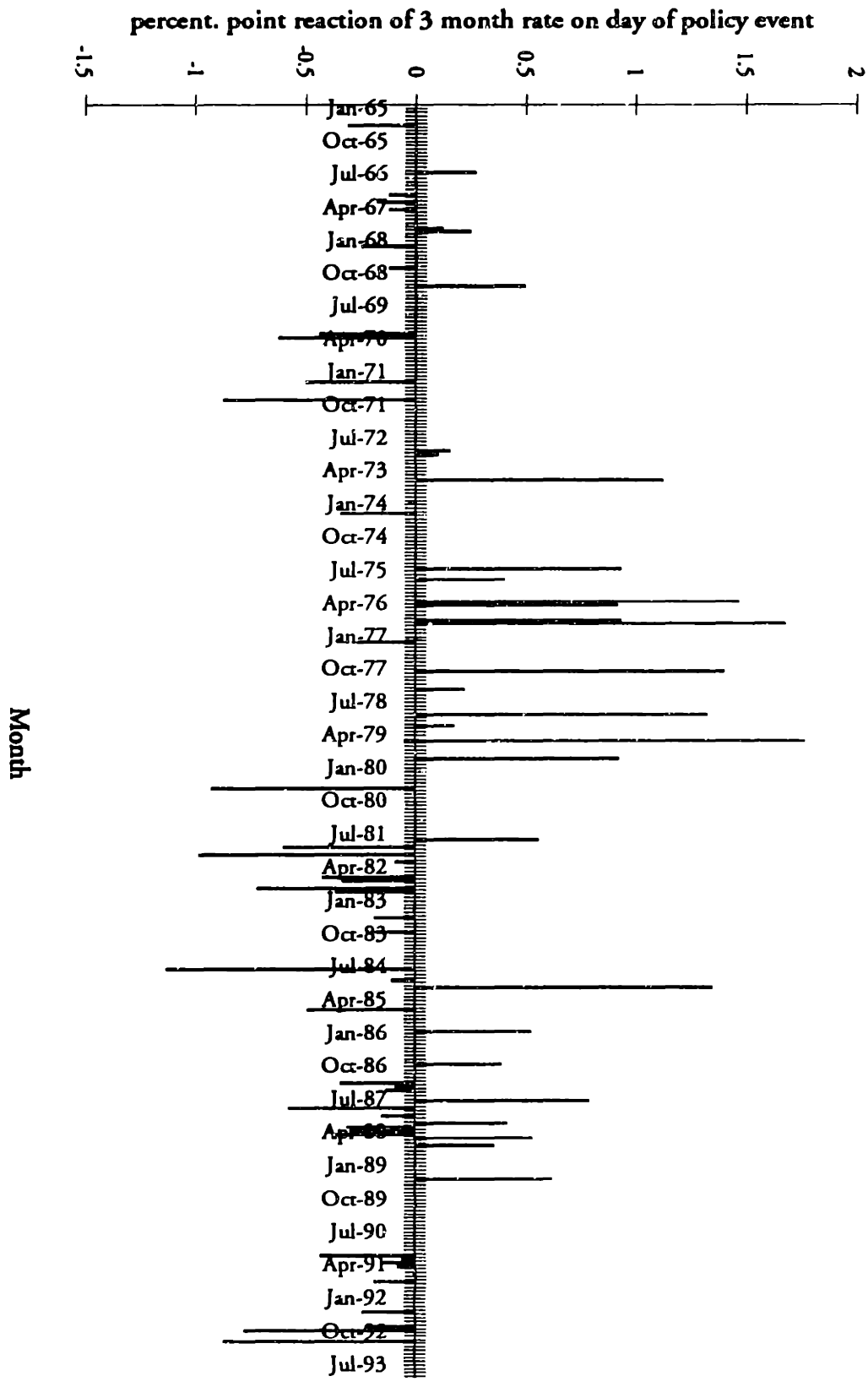


Figure 2: Index of Monetary Policy Shocks - United Kingdom

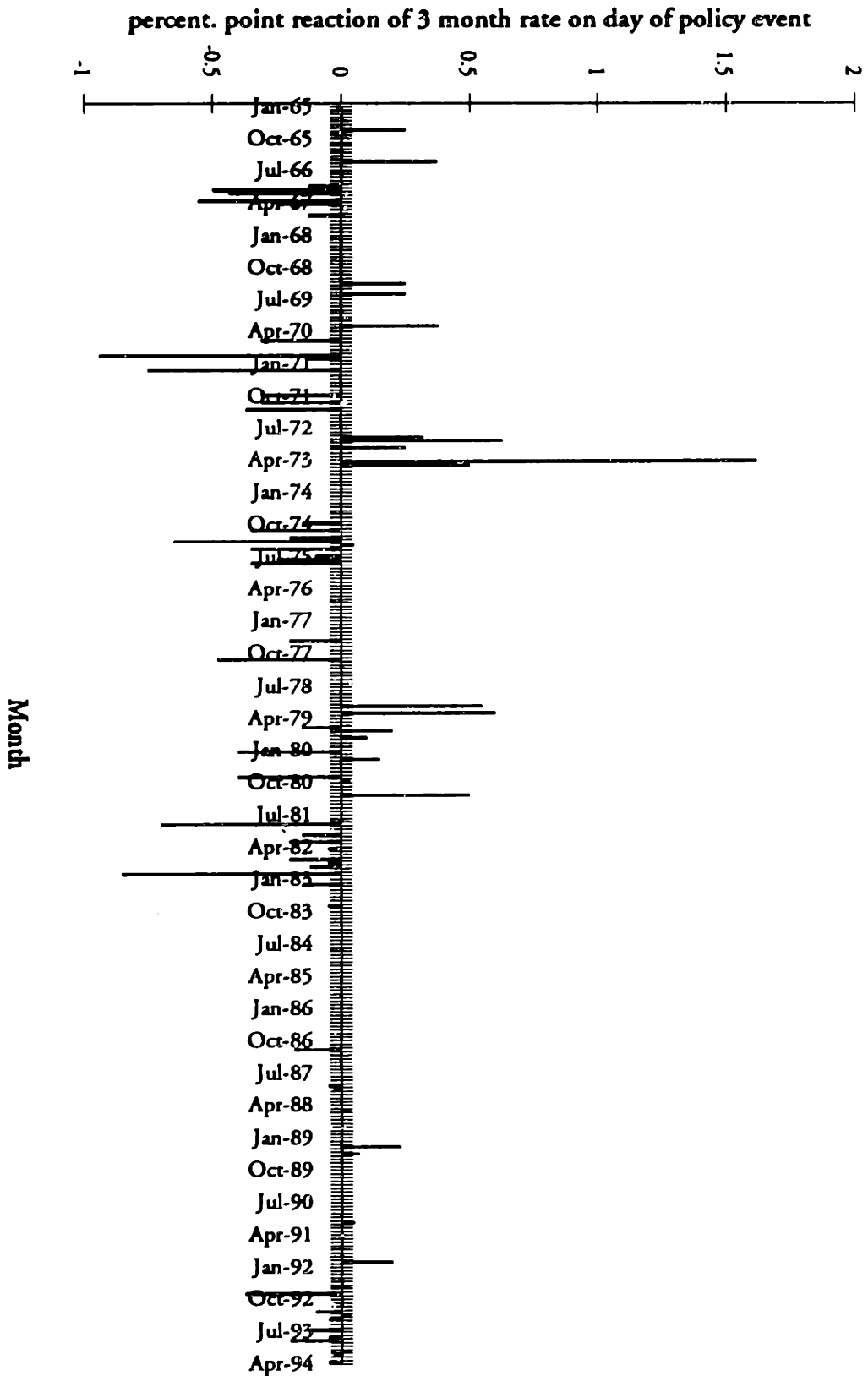


Figure 3: Index of Monetary Policy Shocks - Germany

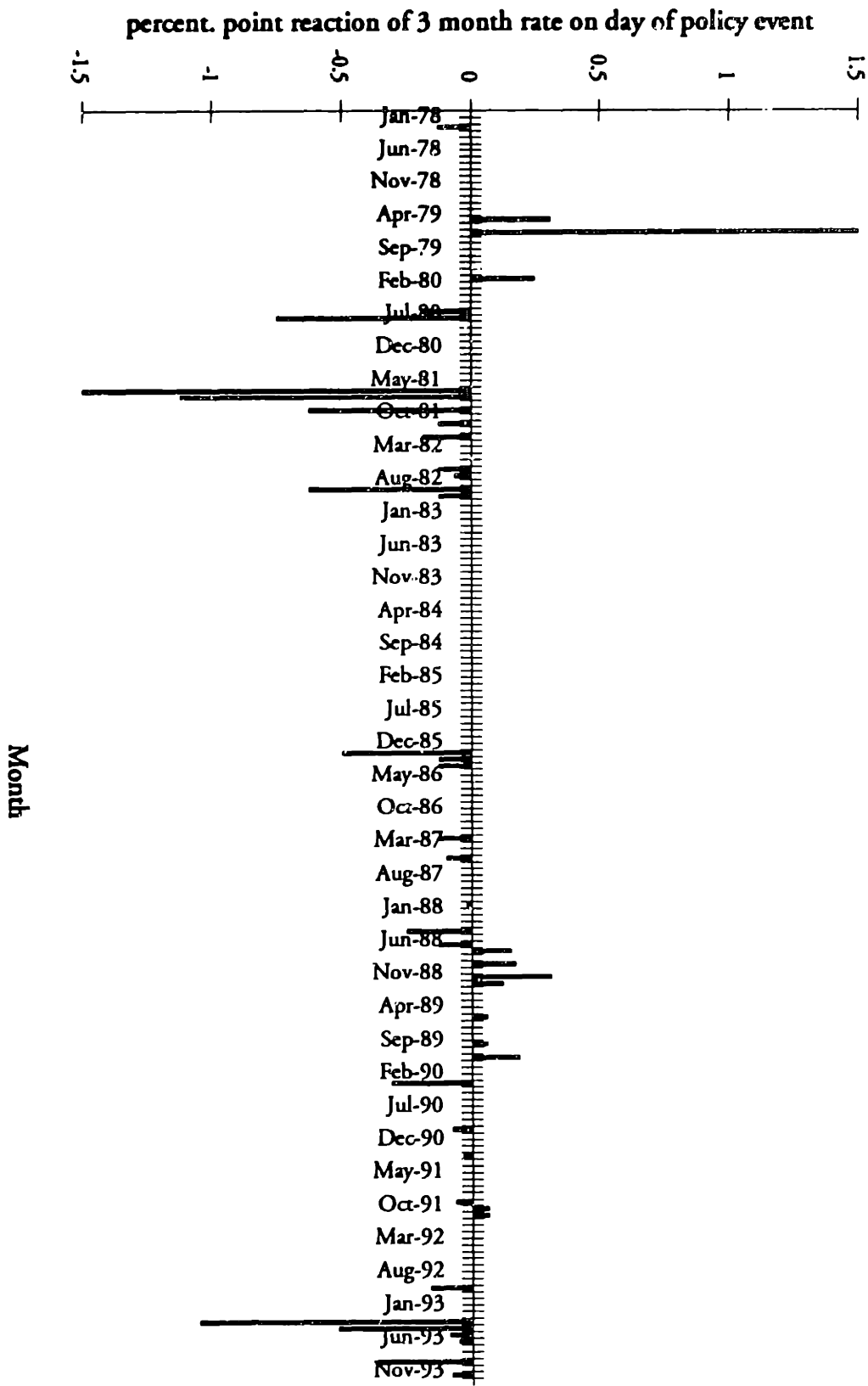


Figure 4: Index of Monetary Policy Shocks - France

2. Dynamic effects of monetary policy shocks

Our objective is to estimate (1) for four countries using the indices discussed above in the place of $m_t - E(m|Y_{t-1}, Y_{t-2}, \dots)$. We still need to decide, however, what variables should be included in Y_t . In order to make our results comparable with earlier findings, we adopt two benchmark specifications from the literature. The first is a small VAR employed by Gali (1992): $Y_t = (\Delta y, \Delta m, \Delta p, i)$, where y , m and p denote the logs of real GDP (or industrial production when using monthly data), M1 and the price index⁴¹ respectively and i denotes a short interest rate. The second is the six variable VAR employed by Sims (1992), an obvious choice since his is the only recent VAR-based study, to our knowledge, to compare the effects of monetary policy shocks for our group of countries. Sims has $Y_t = (y, m, p, i, xr, pc)$, where pc is a commodity price index and xr is an exchange rate against a basket of currencies (the SDR).⁴²

In the following we discuss the impulse responses generated from estimating these two specifications. We then present two extensions, the first of which studies exchange rate dynamics more carefully and takes up issues raised in a recent working paper by Eichenbaum and Evans (1993), whereas the second discusses the dynamic response of long interest rates.

(i) A four-variable VAR in $\Delta y, \Delta m, \Delta p, i$

Figures 5 and 6 show the responses to a policy-induced unanticipated rise in the three month rate by one percentage point, based on the estimation of (2) for $Y_t = (\Delta y, \Delta m, \Delta p, i)$ using quarterly and monthly data, respectively. In the cases of Britain, Germany and the U.S., the sample period is I:1965 to IV:1993, and i is a three-month interest rate, while for France data availability limited the sample to I:1978 to IV:1993 and a call rate needed to be used.⁴³ The standard error bands shown throughout the figures are based on the asymptotic variance-covariance matrix of the reduced form coefficients (see Appendix A2 for a detailed description of our procedure).

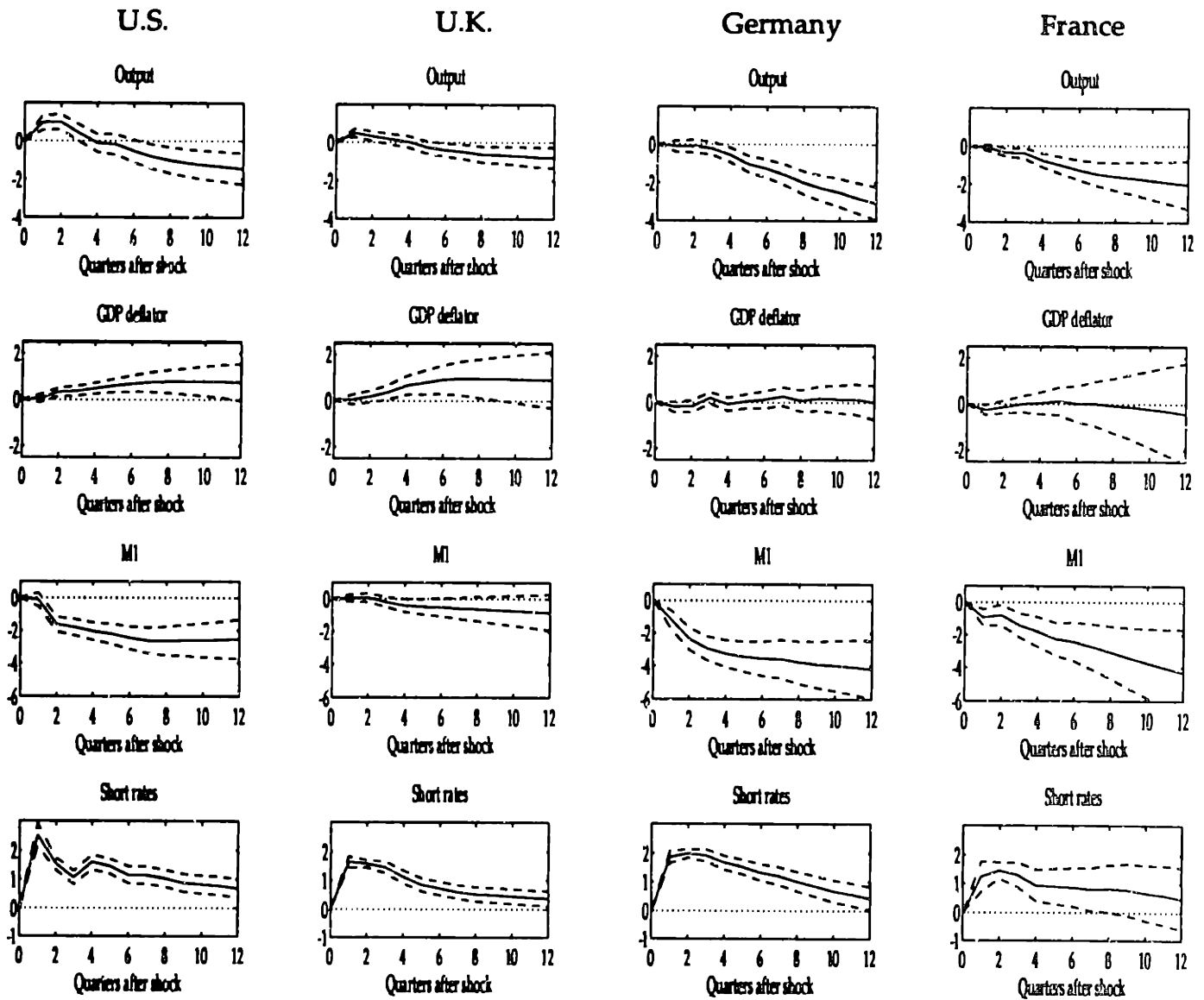
41. The GDP deflator for the case of quarterly data and the CPI minus shelter for monthly data (see appendix A3 for a description of the data used and its sources).

42. For reasons which are never made explicit, the traditional VAR literature (i.e. the literature relying on Wold causal orderings) tends to estimate the reduced form in levels, ignoring potential stationarity problems (for example, Christiano et al. (1994a); Christiano et al. (1994b); Sims (1992)). On the other hand, the structural VAR literature usually takes stationarity issues quite seriously, often setting out with a battery of unit root tests and typically estimating VAR's in first differences (e.g. Blanchard (1989); Gali (1992)). Since our purpose is to compare our results with those of other authors, we limit ourselves to existing specifications, picking one from each strand of the literature.

43. In the case of France, we also ran the VAR for an even shorter sample (1981 to 1993) for which a three month rate was available, and obtained very similar impulse response functions except for the CPI reaction, where the "price puzzle" was more strongly present in the shorter sample than in the larger sample (see text below).

The results can be summarized as follows. First, in most cases, output, interest rates and money show the conventional response, i.e. the response which accords with most economist's priors and previous results of the VAR literature. Following the shock, GDP tends to fall below its original level after two to four quarters. For two of our countries - the U.S. and the U.K. - we register an increase in GDP before it starts falling - a somewhat baffling fact which we cannot explain. Money falls immediately, and then in most cases levels off after about 4-6 quarters. Interest rates rise sharply upon impact, stay up for 2-4 quarters and then begin to return to

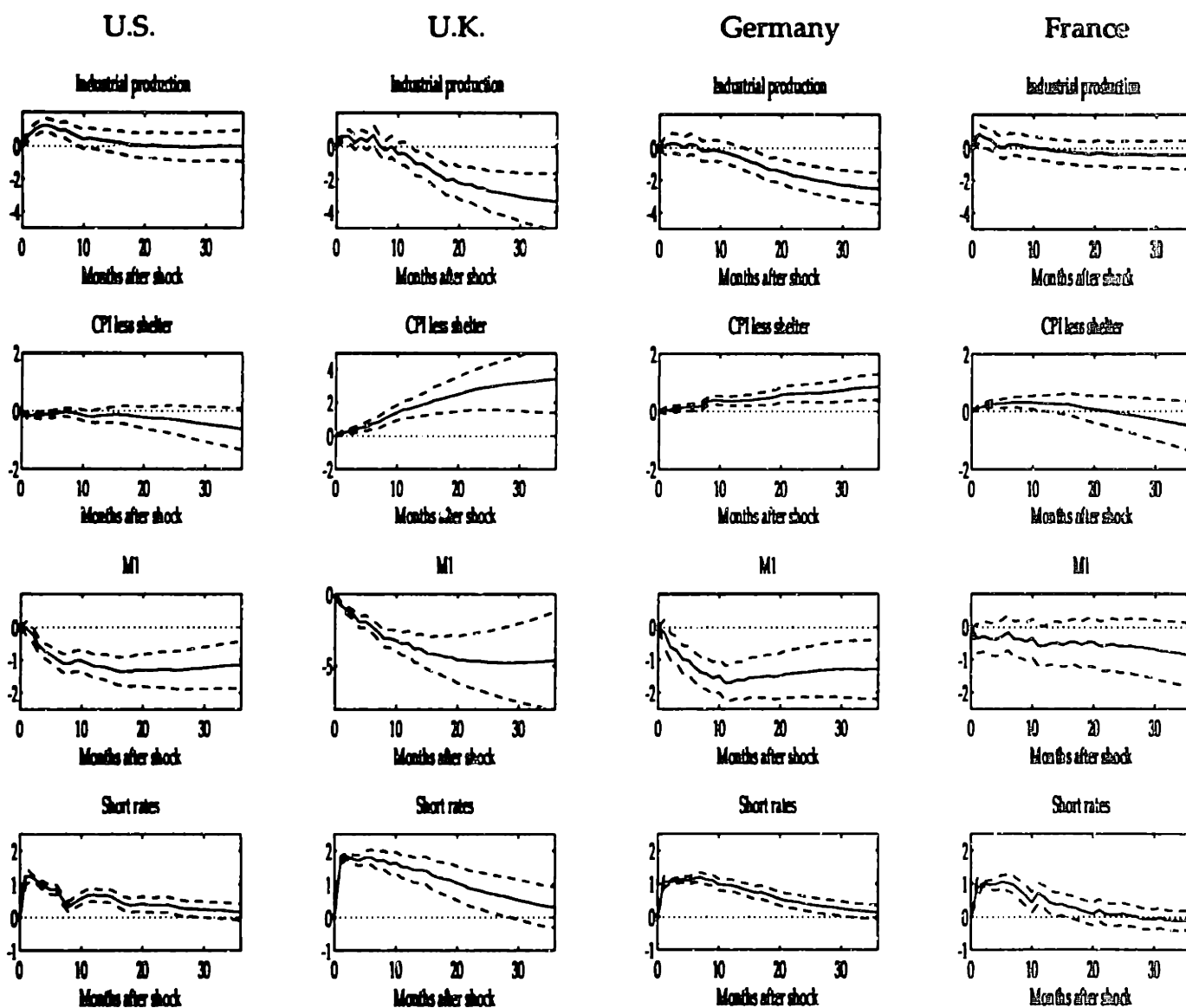
Figure 5: Effect of contractionary shock according to VAR (i) - quarterly data



their original level.⁴⁴ Standard errors are quite tight in most cases. For instance, for the case of output the upper standard error band drops below the zero line about 1.5 quarters (or 4-5

months) after the actual impulse response. The effects on industrial production are not quite as clear cut as those on GDP. Germany and the U.K show about the same response, but the U.S. and France do not (cf. Figure 6).

Figure 6: Effect of contractionary shock according to VAR (i) - monthly data



Second, the “price puzzle” noted by Sims (1992), Eichenbaum (1992) and Christiano et al. (1994b) - i.e. the price level rising rather than falling after a monetary contraction - is strongly present in four out of eight cases, the U.K. for both quarterly and monthly data, the U.S. for

44. For the case of the U.S. there is a large downward jump in the interest rate in the second quarter followed by a large reversal in the third quarter, a pattern which is also apparent in the monthly specification. We feel that this may simply be picking up the volatile swings in interest rates that were seen in 1980.

quarterly data and Germany for monthly data. Moreover, in no instance does the price level fall by more than one standard error.

Note that the first set of results conforms to the impulse responses shown by Gali (1992) for structural shocks to the money supply equation. Regarding the behavior of prices, Gali's impulse response to inflation (rather than to prices) involves no puzzle - inflation drops following a monetary contraction, overshoots slightly and settles down at a permanently lower level after about 12 quarters. However, this result seems to be a direct implication of his identifying restrictions, which impose long run neutrality of money, i.e. inflation must rise with money growth in the long run.⁴⁵ In our case, the puzzle remains whether the impulse response is expressed in terms of inflation or the price level.

(ii) A six-variable VAR in y, m, p, i, xr, pc

We now discuss the results from estimating (2) in a specification similar to that of Sims (1992). Since our VAR and our data are basically identical with Sims, we only differ in our identifying assumptions (Sims assumes a Wold causal chain with the policy variable i ordered first). This enables us to directly compare the impulse responses generated by our method to those of Sims for the four countries in our sample. In addition, it has been suggested that the inclusion of commodity prices in Y_t eliminates the "price puzzle" if pc is ordered before the monetary policy variable in the VAR (Christiano et al. (1994b)). In other words, the claim is that the "price puzzle" is an artifact of ignoring contemporaneous reactions of policy to pc . Our method of identifying monetary policy shocks should be immune to the omission of variables to which the monetary authorities are reacting, since our shocks should be uncorrelated with any variable that is observable by financial markets. We nevertheless include pc in the VAR to allow for comparability to Sims' impulse responses and to check on the robustness of our results.

Going from estimation in first differences, as in the previous section, to estimation in levels as such has no impact on the conclusions from section (i) above. For all countries except France the impulse responses are virtually identical to Figures 5 and 6, the only difference being that the standard errors are slightly smaller in some cases.⁴⁶ Thus, any major differences detected in this section must be due to the presence of pc and xr in the VAR.

Consider now the impulse responses shown in Figures 7 (quarterly data) and 8 (monthly data). Two major conclusions emerge. First, the qualitative results of our earlier VAR regarding output, industrial production, money and interest rates are unaffected. As above, the responses ac-

45. Gali (1992), p. 115.

46. Of course if we believe that the levels specifications may violate covariance stationarity we should trust our earlier, larger standard errors.

cord with standard priors except for the initial increase in GDP following a monetary contraction in the case of two countries (U.S. and U.K.) and in industrial production in all countries. These results are generally consistent with the impulse responses of Sims (1992).⁴⁷

Figure 7: Effect of contractionary shock according to VAR (ii) - quarterly data

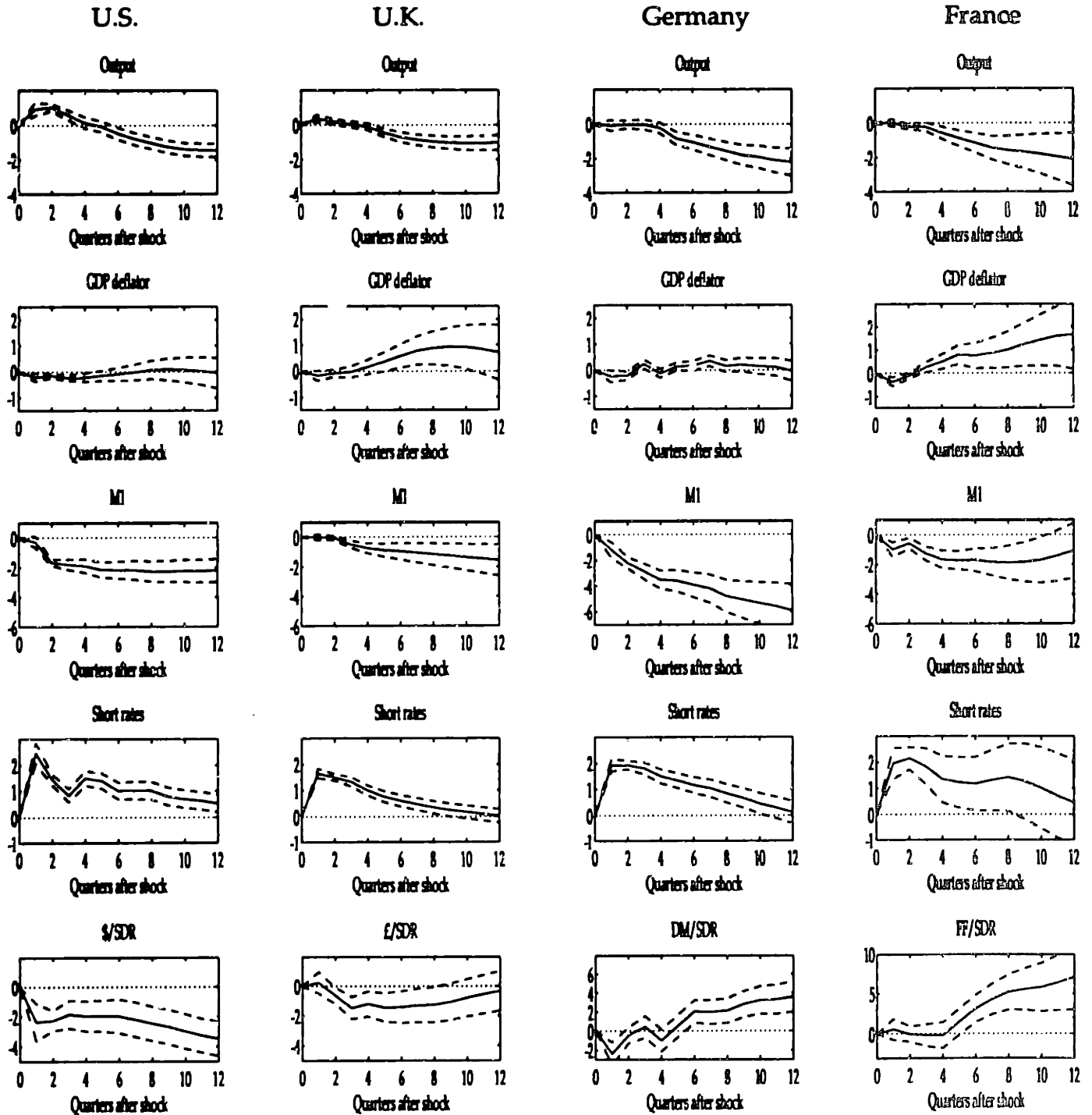
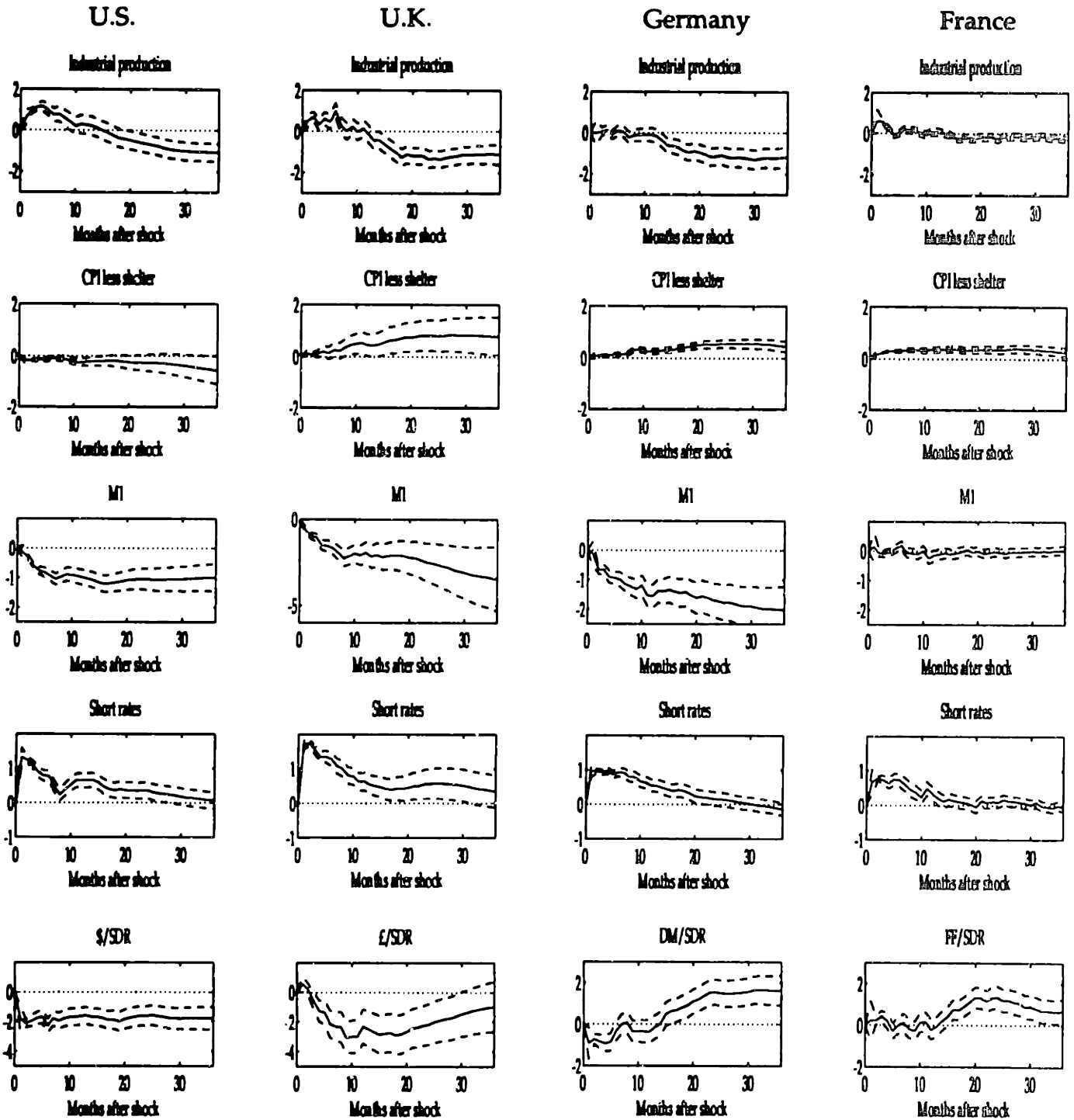


Figure 8: Effect of contractionary shock according to VAR (ii) - monthly data



47. The only difference is that Sims' impulse responses regarding industrial production display somewhat smaller initial increases than ours. Note however that the extent to which this difference is meaningful is unclear, since Sims does not show standard error bands.

Second, the “price puzzle”, which in Sims (1992) can be discerned for all countries, vanishes for the U.S., thus confirming the results of Christiano et al. (1994b). However, it continues to be present for all other countries. Only in the case of the U.S. is a contraction, according to our impulse response function, followed by an immediate reduction in the price level, which then stays away from the original level by at least one standard deviation for about 5 quarters. For the other countries the “puzzle” persists, especially when using the CPI-shelter and monthly data. When using the GDP deflator and quarterly data, we do observe a small decrease of the price level in the first quarter following the shock, but from the second quarter on the trend is upwards and the impulse responses exceed the original price level by more than one standard deviation after 3-5 quarters.

Figures 7 and 8 also display the responses of exchange rates to an unanticipated monetary contraction. U.S. exchange rate dynamics have received much attention recently following a study by Eichenbaum and Evans (1993), who find a puzzlingly slow appreciation, rather than a sharp reaction, of the dollar following a contractionary shock, and suggest that uncovered interest rate parity may be violated over long periods of time. In our case, the impulse responses for the U.K., Germany and France certainly do not conform to the expectation that a contractionary shock leads to a sharp and sudden appreciation of the currency, followed by a slow depreciation towards a new, appreciated steady state level. However, only the U.K. exchange rate shows a pattern similar to that noted by Eichenbaum and Evans. For France not much of a significant short-run response is discernible at all, while for Germany we do observe a significant immediate appreciation. Finally, both the franc and the deutschemark depreciate beyond their original levels after about one year, contradicting both the Dornbusch model and the Eichenbaum and Evans responses. Note that Sims (1992) found a similar response of the German and French exchange rates to interest rate innovations.

Finally, note that U.S. exchange rate behavior seems quite close to the standard paradigm: we see a sharp immediate appreciation and not much movement after that. This seems to be at odds with Eichenbaum and Evans’ findings. However, the VAR specification used in this section is not directly comparable to theirs, which is one of the reasons why we take up the issue separately below.

As in section (i), we redid all impulse responses discussed above based on regression model (3) rather than (2). Our results were very similar and are thus not reported. In addition, we also ran regression (2) after expressing commodity prices in the respective national currency and again, our impulse responses were very similar. In particular, the main result of this section - namely, that the “price puzzle” persisted for all countries except for the U.S. - was unaffected.

(iii) A closer look at exchange rate dynamics

The main difference between our specification in part (ii) and that used by Eichenbaum and Evans (1993) to study exchange rate dynamics is their use of various bilateral exchange rates and a corresponding interest rate differential rather than an exchange rate index in conjunction with the domestic interest rate level. Their specification makes sense, since any economic model incorporating capital mobility will imply that the interest rate differential is the appropriate predictor of bilateral exchange rate movements. For each country in our sample, we thus run three VARs, each with a different bilateral exchange rate vis à vis one of the other countries, and the corresponding interest rate differential. The other endogenous variables in each VAR are still y , m , p and pc . We restrict our sample period to the post-Bretton Woods era, i.e. from 1974 onwards.

Since the responses of y , m , p are similar to those reported in the previous section, we concentrate on the responses of bilateral exchange rates and interest rate differentials. The results are displayed in Figure 9 (a) for the U.S. and the U.K. and Figure 9 (b) for France and Germany.

Consider first the response of interest differentials. One can see that in almost all instances a monetary contraction in a country results in a large increase in the differential, which then disappears over time. Note that in most instances the change in the interest rate differential is close to zero within about twelve months, whereas in Figures 5 to 8 the point estimates for the impulse response of the own interest rate to a monetary shock are often still above zero even after three years. This suggests that monetary policy in one country is often transmitted overseas and thus a contraction that leaves one's own interest rates still higher after say twelve months may have no effect on the interest rate differential after twelve months.

The figure also shows that there are some exceptions to the expected pattern. In the case of the U.S. - German interest rate differential and the U.S. - French interest rate differential, the response is entirely counter to expectations - there is little initial response and within a few months there is a significant decline in U.S. relative to German and French rates following a U.S. contraction. We shall come back to this point when we discuss analogous impulse responses based on *relative* policy indices below.

Consider now the response of exchange rates to monetary shocks. Recall our main results from the previous section (Figure 8): for the U.S. the exchange rate appreciated sharply in the first month of a contraction and then remained at the same level thereafter, for the U.K. there was no initial jump in the exchange rate but then over time there was a gradual appreciation, while for France and Germany contractions were followed by significant *depreciations* after about fifteen months.

Figure 9 (a): Effect of Contractionary Shock on bilateral exchange rates and interest rate differential: U.S. and U.K.

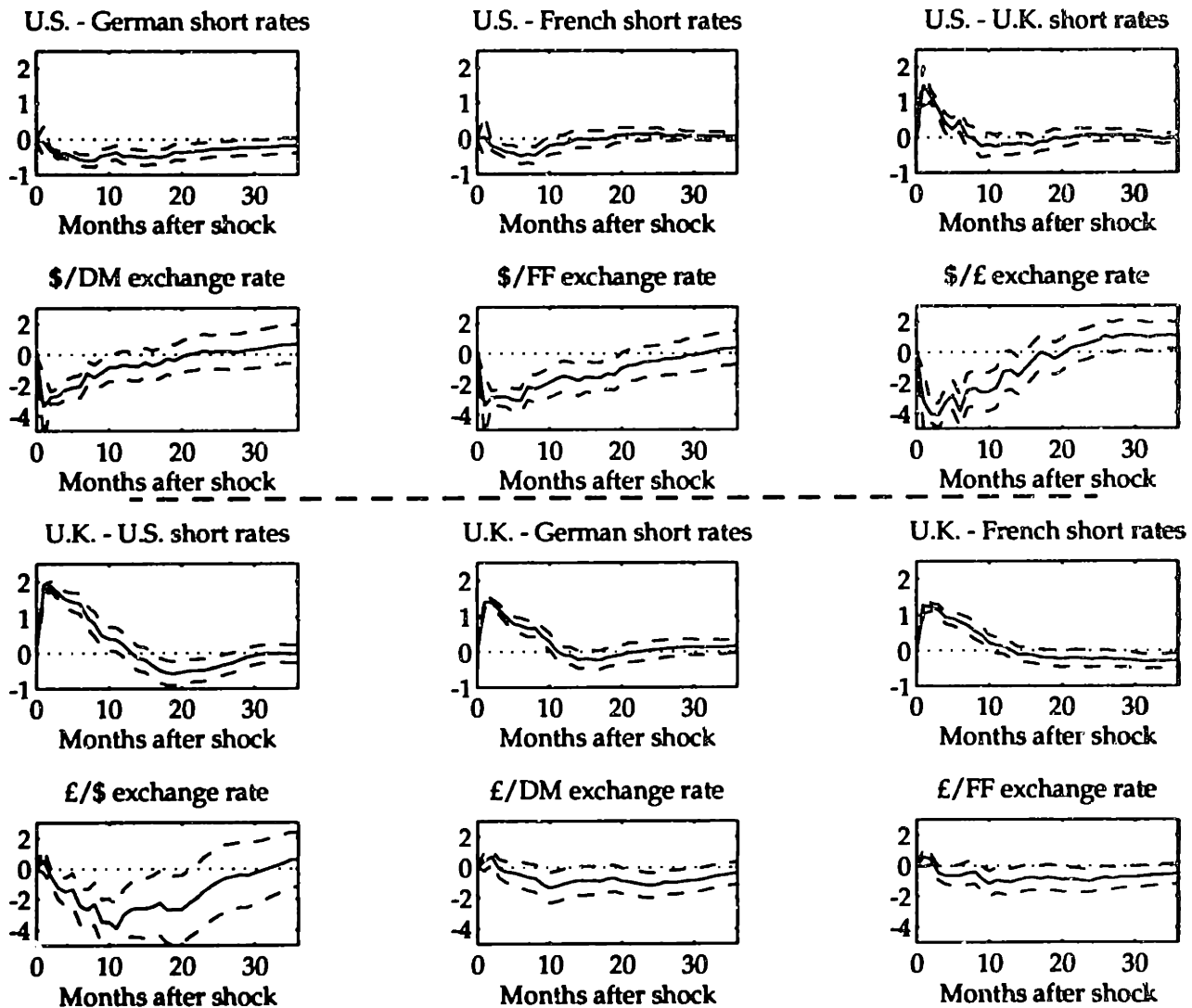
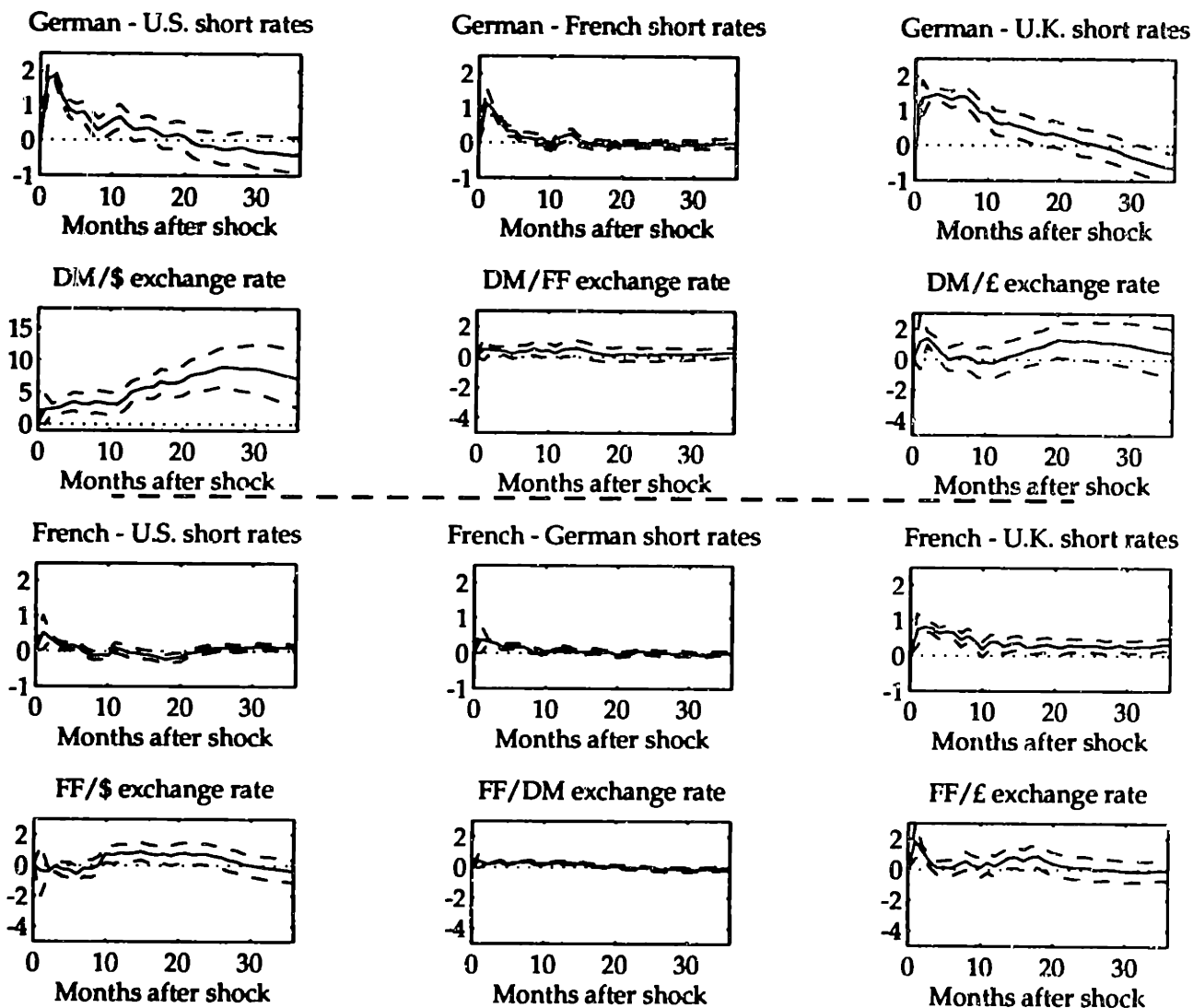


Figure 9 (b): Effect of Contractionary Shock on bilateral exchange rates and interest rate differential: Germany and France



The picture that emerges from Figure 9 is in most respects similar to that from Figure 8. The major qualitative difference concerns the response of the bilateral dollar exchange rates in response to U.S. monetary shocks. As before, the estimated immediate response of the dollar to a contraction is a significant appreciation. However, according to Figure 9 the dollar depreciates again in subsequent months and returns back to its old level, almost exactly as predicted by the Dornbusch model.⁴⁸

For the U.K. the earlier pattern also seems to be confirmed, providing tentative evidence for the behavior described by Eichenbaum and Evans. Thus, following a U.K. contraction there is little initial change in the sterling exchange rate. However, this is followed by a steady appre-

ciation over the subsequent twelve months, despite the fact that interest rate differentials had moved in favor of holders of sterling following the contraction. The evidence is particularly strong for the sterling-dollar exchange rate, while the £/DM and £/FF rates show a similar shape but of a somewhat smaller magnitude.

For the case of French and German monetary shocks the response of most bilateral exchange rates is generally small, with the impulse responses rarely diverging more than one standard deviation away from zero. This is most notably the case for the DM/FF rate. It certainly seems that membership of the ERM has eliminated most of the bilateral exchange rate fluctuations. The major exception is that of the DM/\$ exchange rate following a German contraction - not only does the picture suggest that there is a significant depreciation following such a change, the magnitude of the estimated response is also totally implausible.

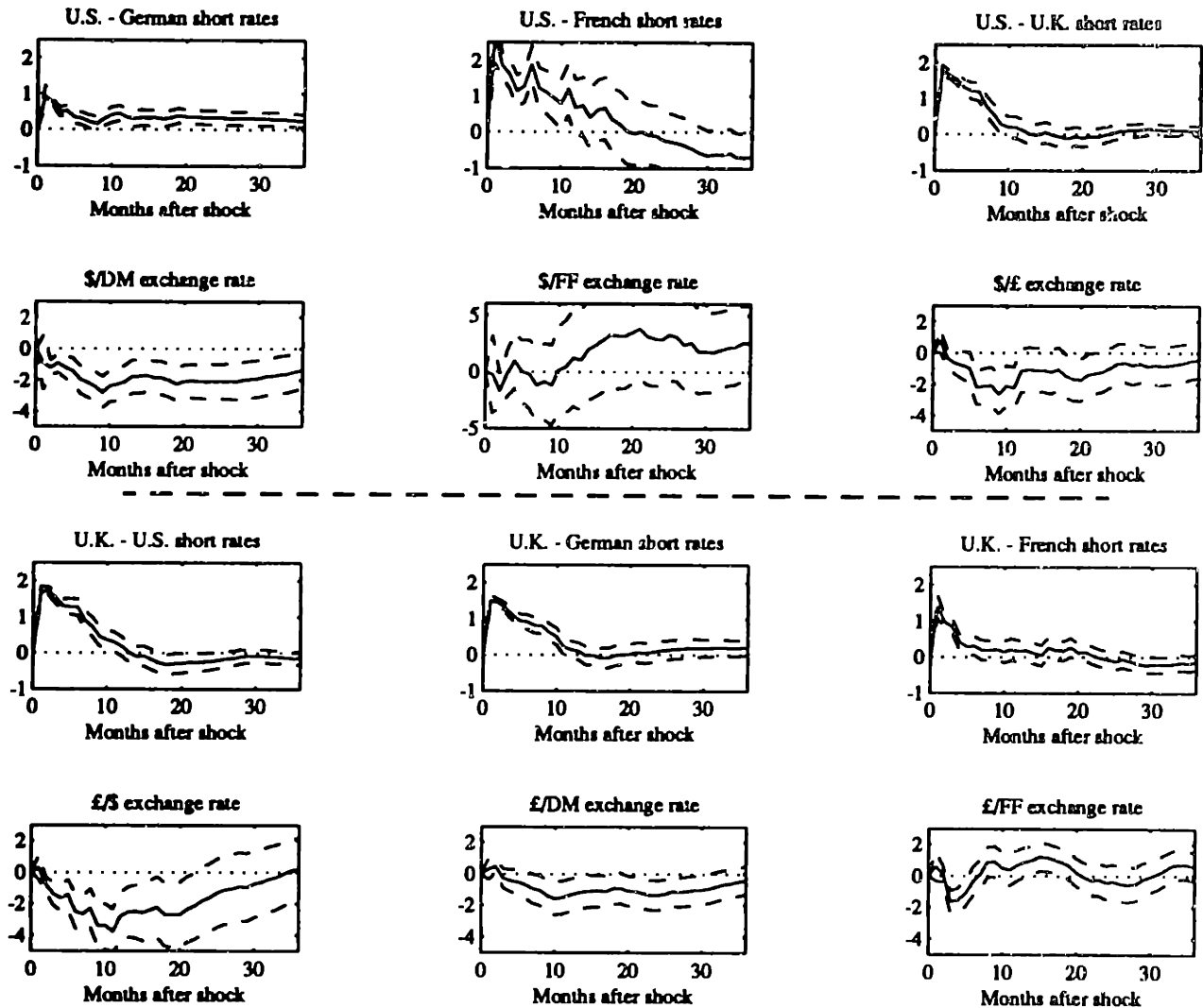
One explanation for the puzzling behavior of the U.S. - German and U.S. - French interest rate differentials we encountered above is that there may be confounding German or French actions in the same months that U.S. actions take place.⁴⁹ In order to remove this possible effect, and also to see how the exchange rate dynamics are affected, we constructed new policy indices based on the *difference* between the policy indices of the pair of countries under consideration. We then reran the Eichenbaum-Evans type VARs based on these relative policy for each country pair. The resulting impulse responses are shown in Figure 10 (a) and 10 (b).

As one can see from Figure 10 (a), using the relative policy index appears to resolve the earlier puzzle concerning the U.S. - German and U.S. - French interest rate differentials. As expected, a relative monetary contraction in the U.S. leads to higher relative short term interest rates in both cases, although the magnitude of the effect is smaller and the standard errors are larger than for the other pictures. In addition, Figure 10 (b) shows that the reaction of the DM/\$ exchange rate following a German contraction, which displayed a large depreciatory movement according to Figure 9 (b), is now somewhat less implausible. While there still appears to be a significant DM depreciation 15 months after a German contraction, the order of magnitude is at least more reasonable and the initial response is in the right direction.

48. The Dornbusch (1976) model predicts that in response to a permanent monetary contraction the exchange rate will appreciate initially and then depreciate slowly to its new long run higher (appreciated) level. If, however, the monetary contraction is only temporary the predicted response is similar to that shown. While the impulse response of U.S. M1 in Figure 8 appears to suggest that the monetary contraction that we are measuring is permanent, the response of M1 in the VAR's with interest rate differentials and bilateral exchange rates exhibits a tendency to return to its former level, suggesting we only have a temporary shock.

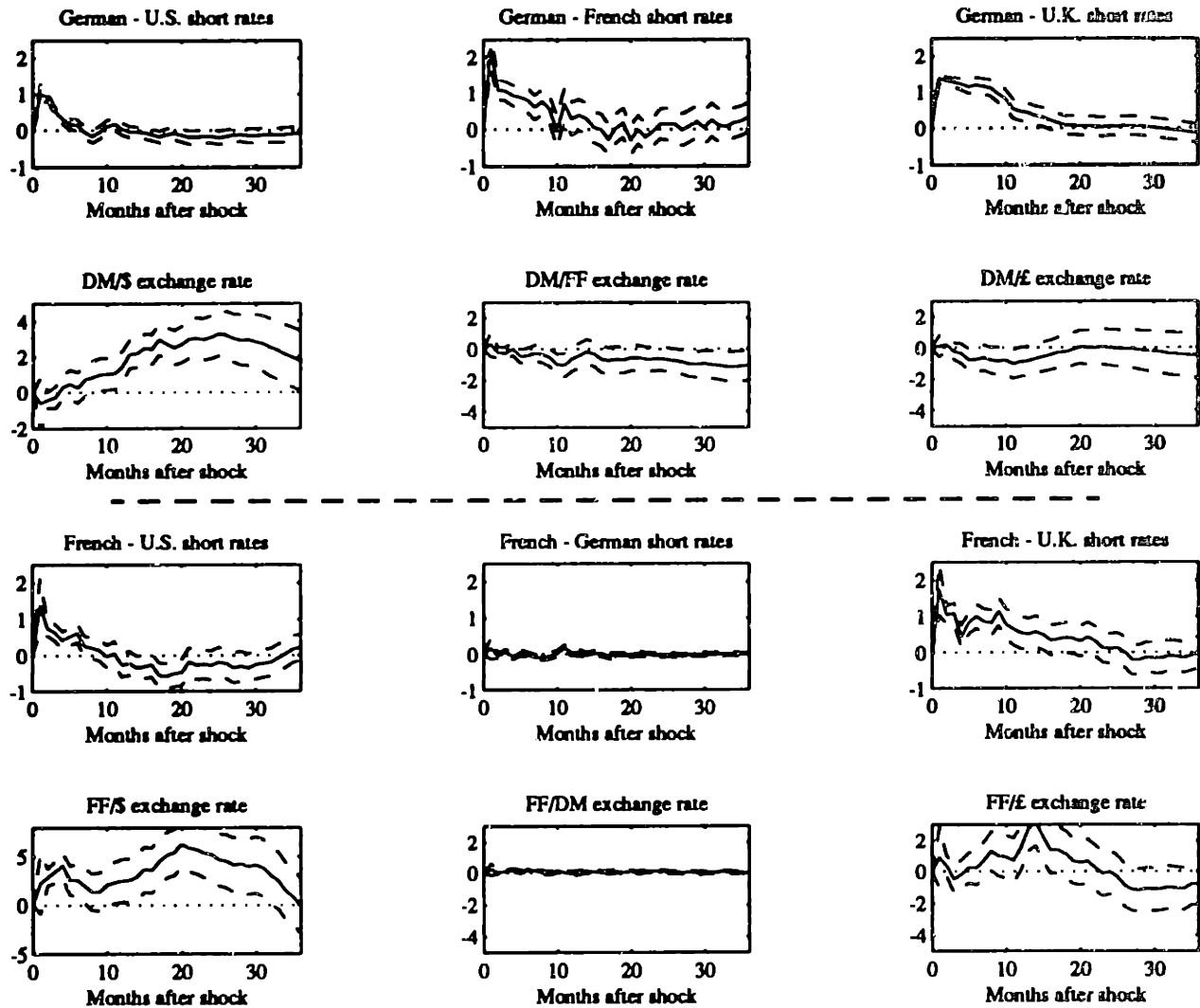
49. For the case of France the results may be confounded not by French monetary actions but by the events of May 1981. This month witnessed the greatest single unanticipated U.S. contractionary event and the election of the first Socialist President in the history of the Fifth Republic. In this month French short rates increased by about 6% even though there were no unanticipated French contractionary actions.

Figure 10 (a): Effect of Contractionary Shock on bilateral exchange rates and interest rate differential based on relative policy index: U.S. and U.K.



Finally, note that, according to Figure 10 (a), the response of the bilateral dollar exchange rates in response to a relative policy shock less closely resemble the predictions of the textbook Dornbusch model. Both the $\$/DM$ and the $\$/\text{£}$ exchange rates continue to depreciate for a number of months following a relative monetary contraction in the United States; in this sense our results for the U.S. are now closer to those of Eichenbaum and Evans (1993). On the other hand, the long run behavior of exchange rates is largely as before, with a return to the original levels. The standard errors in the estimated response of the $\$/FF$ rate are too great to enable one to draw any conclusions.

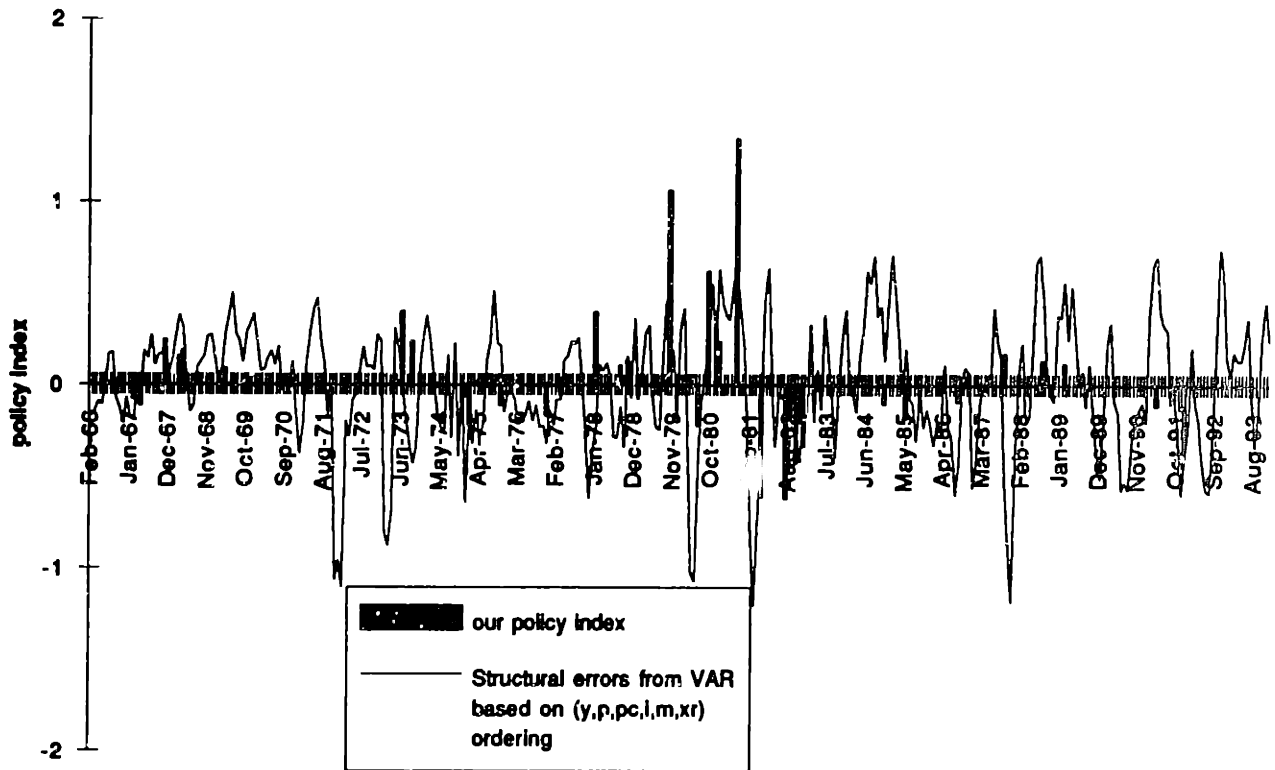
Figure 10 (b): Effect of Contractionary Shock on bilateral exchange rates and interest rate differential based on relative policy index: Germany and France



The last question we want to address in this section is whether any statement can be made regarding the relationship between the series of monetary policy shocks identified by Eichenbaum and Evans (1993) and ours. For instance, it would be interesting if there would be a systematic difference in the timing of our shocks compared to theirs.

Following Eichenbaum and Evans, we ran a six variable VAR with the ordering: industrial production, CPI, commodity prices, 3 month treasury bill rate, M1 and exchange rate. Innovations in the three month interest rate are taken to represent the Eichenbaum and Evans index

Figure 11: Comparison of Policy Series



of monetary policy shocks.⁵⁰ Figure 11 is a plot of their policy index against ours. Due to the erratic nature of the interest rate shocks recovered from the above VAR, we follow Christiano, Eichenbaum and Evans in plotting the three month moving average of the shocks rather than the shocks themselves.

As can be appreciated from the plot, no clear temporal relationship between the two indices is discernible to the naked eye. The contemporaneous correlation of the indices is 0.186 for the monthly shocks series and 0.378 for the quarterly shocks series.

In order to provide a statistical test of the temporal relationship between the two series, we decided to run Granger causality tests with lags ranging from six to twelve months. The results were somewhat sensitive to the number of lags used but can be summarized as follows: when one includes six to eleven lags, our policy index Granger causes the VAR-based index at the 5% level, while the VAR innovations do not Granger cause our policy index even at the 10% level.

50. This is not exactly Eichenbaum and Evans' policy index, since they used either the federal funds rate or the ratio of non-borrowed to total reserves as policy variable. However, we want to compare our policy index from the one implied by the same VAR we have used to generate our previous impulse responses if an ordering similar to that of Eichenbaum and Evans (i.e. policy variable ordered after output and prices) is used.

When one includes twelve lags neither index Granger causes the other at the 5% level, however both Granger cause each other at the 10% level. We conclude that while there is some indication that our index temporally precedes the VAR-based index, this evidence is not strong enough to provide a safe basis for an interpretation of the discrepancies between our results and those of Eichenbaum and Evans.

To conclude, using an Eichenbaum-Evans type VAR specification yields impulse responses of the interest rate differential between two countries as expected. A few puzzling exceptions observed in Figure 9 are resolved once we run our regressions based on a *relative* policy index. Regarding exchange rate dynamics, our results continue to contradict those of Eichenbaum and Evans for the U.S. when we study responses to the “raw” country-specific policy index, but appear substantially closer to theirs for impulse responses based on relative policy indices. We also find evidence suggesting that uncovered interest parity is violated for the case of the U.K. Finally, for German and French exchange rates there is either not much of a significant response or even a depreciation following a monetary contraction.

(iv) The dynamic response of long interest rates

In Germany and France, Central Banks were reluctant to lower short interest rates quickly during 1993, partly because they believed that monetary policy would not necessarily succeed in lowering *long-term* interest rates.⁵¹ In Chapter 1, we examined and compared the behavior of long rates on the days of policy events for the U.S., the U.K., France and Germany and concluded that there was a strongly significant immediate response of long rates to unanticipated policy actions in all countries. However, it is also interesting to ask what the dynamic response of long rates looks like over the months following the shock, and in particular, how persistent the effect of a shock on long rates is.

We addressed this question by adding long interest rates to our above VAR's in two ways. First, we extended the Galí-type specification by one more variable, the yield on the ten year government bond. Second, in the Sims-type specification we replaced the exchange rate index by the ten year government bond yield. We ran these VAR's both for monthly and quarterly data. In Figure 12, we limit ourselves to reproducing the impulse responses for long and short rates for both specifications and monthly data. The results for quarterly data were similar and the impulse responses corresponding to the other variables much the same as in sections (i) and (ii) above.

51. Chapter 1, Introduction.

Before discussing our results, recall that if arbitrage exists between long and short bonds, one would expect that the immediate effect on the long bond to be a discounted average of the current and future effects on the short bond. Assuming that the short rate returns after a while to its "normal" level, the initial response of the long bond should thus be smaller in magnitude and thereafter long rates should fall in order to generate a capital gain for long bond holders to compensate them for their lower yield.⁵² If after a period of time the impulse response of short rates is back to zero, then one would expect it also to be zero for long rates.

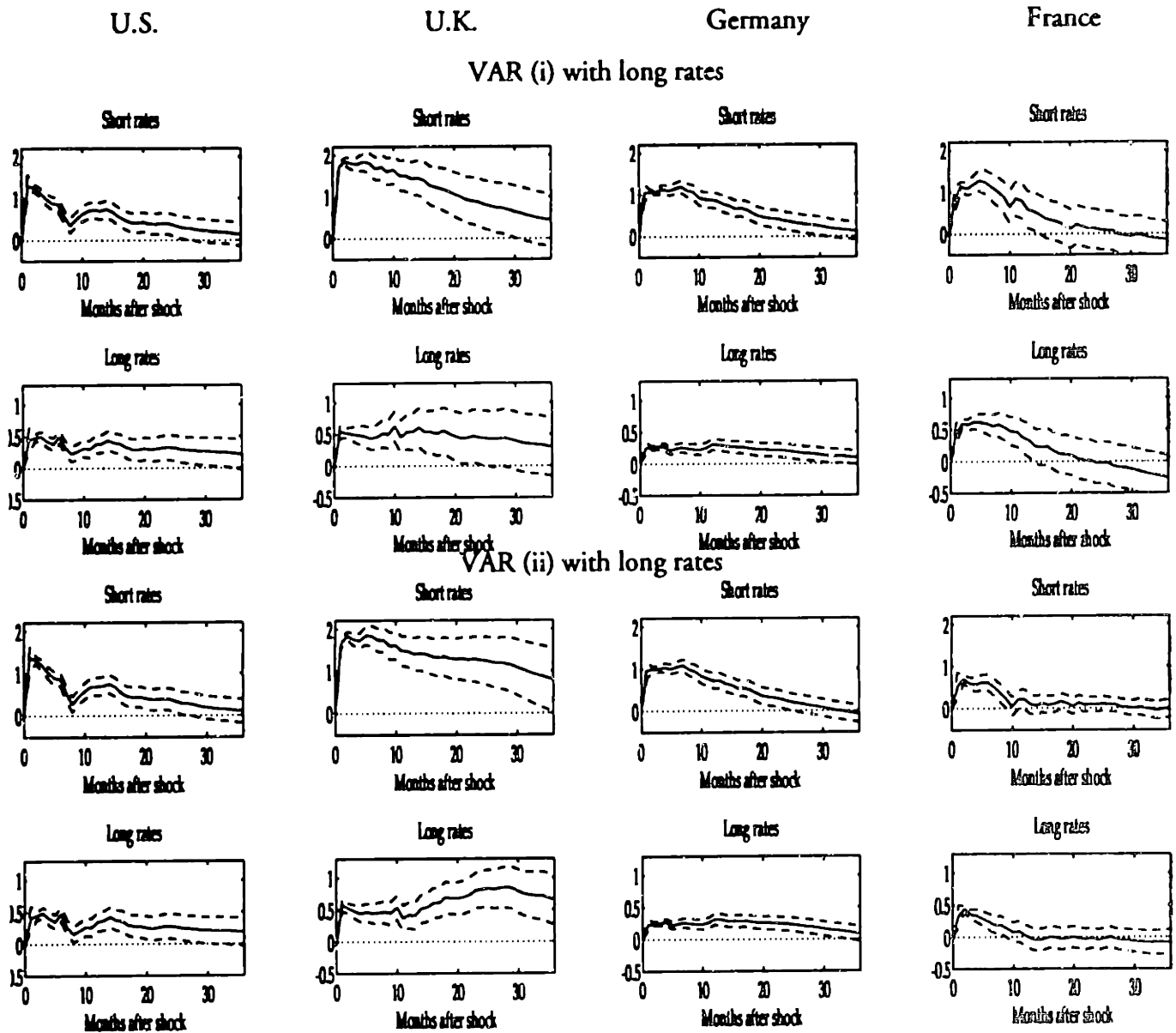
We now turn to the results shown in Figure 12. To begin with, note that in almost all cases the responses shown are virtually identical across the two specifications. They differ only slightly for the U.K. long rates and for both short and long rates for France. Nevertheless, the following qualitative conclusions apply throughout. First, as predicted by theory, long rates show a sharp and significant immediate increase to the monetary shock. For the U.S., the response of long rates within the first month to a one percentage point unanticipated rise in the three-month rate is about 0.4-0.5, for the U.K. it is about 0.55-0.6, for France, about 0.3-0.45, and for Germany about 0.25-0.3. If anything, the magnitude of these responses seems to be slightly greater than is justified by the duration of the shock to the short rate. For example, the German short rate impulse response shows that short rates are on average about 1% higher in the first year after a shock, 0.5% higher in the second year and 0.25% higher in the third year, suggesting a long rate response of about 0.2 rather than the 0.25-0.30 that we observe. Nevertheless, the difference in magnitudes between those predicted is small and the ordering of the countries is almost correct, with the U.K. showing the largest and longest lasting impact on the short rate, followed by the U.S. and then Germany and France.

Second, again as predicted by arbitrage, the dynamics show a slow return of long rates to their original levels following the initial spike (only the U.K. Sims-type specification does not). However, contrary to the predictions of theory, the return of long rates does not always appear to begin immediately and the effect of monetary shocks on long rates tends to be more persist-

52. In this discussion we talk as if the impulse response picture were pictures of the rates themselves. So long as short-long arbitrage holds for the endogenous parts of long and short rates that we do not show, then the implications for the impulse responses is exactly the same as for the rates themselves.

ent than that on short rates. Thus, for the U.S., the U.K. and Germany, three years after a contraction the point estimate of the long rate response is that rates are still only about half way

Figure 12: Effect of Contractionary Shock on Long Interest Rates - monthly data



back to where they would otherwise have been, while short rates at this time have almost returned to normal. We have no explanation for this phenomenon and merely point out that the standard errors after three years are quite large in all cases.

We conclude then, that there is a strong and persistent response of long rates to money shocks. The magnitude of the initial response and the subsequent behavior is broadly in line with that predicted by arbitrage, although some puzzling behavior is exhibited.

IV. CONCLUSION

The main contribution of this chapter is to propose an approach towards identification of monetary policy shocks that retains the appeal of the narrative method - constructing an index of shocks based on actual policy actions - while resolving the main flaws of the narrative approach. The key idea is to use the jump in the three month interest rate on the day of a policy announcement as a measure of the shock associated with a specific policy action. This measure, in turn, serves as the building block for a monthly or quarterly index of unanticipated policy. The validity of our method relies on a set of identifying assumption which were discussed extensively in Section II. We believe that these assumptions are weaker than those of any other method of estimating the effects of monetary policy.

We presented unanticipated policy indices for the United States, the United Kingdom, France and Germany constructed according to our method. The conclusion to emerge from these actual indices is that while large policy action in some direction typically do seem to involve an unanticipated component of the same sign, the magnitude of this component varies greatly across policy actions and bears little relationship to the magnitude of the action itself. Indeed, in several cases the unanticipated component was found to be zero or even negative. This illustrates the extent to which a purely narrative approach may be vulnerable to errors regarding the size and timing of a policy shock.

Finally, we studied the dynamic responses of output, interest rates, money, the price level and exchange rates to our measure of monetary shocks. The main conclusions are that regarding the first group of variables - output, interest rates and money - our results are in line with impulse responses based on Wold causal orderings: output falls below its original level after two to four quarters, money falls immediately, and interest rates rise sharply upon impact, stay up for 2-4 quarters and then begin to return to their original level, with long and short rate behavior roughly consistent. However, some disagreement exists between our results and the conclusions reached by the recent VAR-based literature on the dynamics of prices and exchange rates.

Take prices first. Christiano et al. (1994b) claim that the "price puzzle" noted by earlier authors (Eichenbaum and Evans (1993), Sims (1992)) disappears once one allows for endogenous responses of monetary policy to movements in commodity prices. We agree that this is the case for the United States, the country they study, but we also find that the "price puzzle" is still present for the other countries in our sample. While we have no explanation for this phenomenon, it seems safe to conclude that the "price puzzle" is not just an artifact of an incompletely specified VAR or a failure to address contemporaneous policy responses to prices, including commodity prices. Our method allows for endogenous policy responses to any type of infor-

mation which is also observable by financial markets, yet the "price puzzle" persists for three out of our four countries.

Second, consider exchange rate dynamics. Eichenbaum and Evans (1993), provide evidence for a slow reaction of U.S. exchange rates to monetary policy shocks, with uncovered interest parity apparently violated. We show that if our policy index is used, this puzzling phenomenon disappears for the United States when using a policy index based on policy actions of the United States only. Instead, we have a large immediate response of exchange rates with a subsequent slow return, much as would be predicted by the Dornbusch (1976) model. However, the pattern found by Eichenbaum and Evans (1993) reappears for impulse responses which are based on the *relative* policy index between the U.S. and Germany and the U.S. and the U.K. In addition, for the United Kingdom exchange rates respond in a way that is quite similar to that described by Eichenbaum and Evans, while for France and Germany our results are inconclusive. We conclude that more research is necessary in this area before any specific pattern can be accepted as a well established stylized fact.

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VI. APPENDIX

1. Policy Indices for four countries

Table 1: U.S. Policy Actions

Date	Action	jump in 3 m rate
12/6/65	DR increase from 4 to 4.5%	0.19
6/27/66	Increase in reserve requirements on time deposits in excess of \$ 5m from 4% to 5%	-0.02
8/17/66	Increase in reserve requirements on time deposits in excess of \$ 5m from 5% to 6%	0.01
2/28/67	Reduction in rr on savings deposits and other time deposits less than \$ 5m from 4% to 3%	-0.08
4/6/67	DR decrease from 4.5 to 4%	-0.11
11/18/67	DR increase from 4 to 4.5%	0.24
12/27/67	Increase in rr on demand deposits in excess of \$ 5m per bank by 0.5 percentage points	0.05
3/14/68	DR increase from 4.5 to 5%	0.15
4/18/68	DR increase from 5 to 5.5%	0.18
12/17/68	DR increase from 5.25 to 5.5%	0.04
4/3/69	DR increase from 5.5 to 6% and rr on demand deposits in excess of \$ 5m per bank up by 0.5 p.p.	0.09
8/17/70	Reduction in reserve requirements on time deposits in excess of \$ 5m from 6% to 5%, also now applied to issuance of commercial paper by banks affiliates	-0.03
5/16/73	Introduction of marginal rrs of 8% to new issues of CD's and commercial paper	0.01
6/8/73	DR increase from 6 to 6.5%	0.05
6/29/73	DR increase from 6.5 to 7% and increase in reserve requirements on all but the first \$ 2m of demand deposits by 0.5%.	0.35
9/7/73	Increase of marginal rr from 8% to 11% to new issues of CD's and commercial paper	0.25
4/24/74	DR increase from 7.5 to 8%	-0.01
11/13/74	Combination of measures amounting to release of reserves of \$ 750 m	-0.09
12/6/74	DR decrease from 8 to 7.75%	-0.06
1/3/75	DR decrease from 7.75 to 7.25%	-0.07
1/20/75	Combination package intended to release approx. \$ 1.1 bn of reserves into the banking system	-0.15
3/7/75	DR decrease from 6.75 to 6.25%	0.01
10/15/75	Reduction from 3% to 1% rrs on time deposits with an original maturity >4 years	-0.11
11/19/76	DR decrease from 5.5 to 5.25%	-0.17
1/6/78	DR increase from 6 to 6.5%	0.40
8/18/78	DR increase from 7.25 to 7.75%	0.10
9/22/78	DR increase from 7.75 to 8%	0.04
10/13/78	DR increase from 8 to 8.5%	0.13
11/1/78	DR increase from 8.5 to 9.5% and supplemental rr of 2% on time deposits above \$100,000	0.13
8/16/79	DR increase from 10 to 10.5%	0.04
10/6/79	DR increase from 11 to 12% and establishment of a rr of 8% on the amount by which a bank's total liabilities exceed the amount outstanding during the base period or \$ 100 m	1.06
6/12/80	DR decrease from 12 to 11%	-0.22
9/25/80	DR increase from 10 to 11%	0.62

Table 1: U.S. Policy Actions

Date	Action	jump in 3 m rate
11/14/80	DR increase from 11 to 12%	0.32
12/4/80	DR increase from 12 to 13%	0.23
5/4/81	DR increase from 13 to 14%	1.35
12/3/81	DR decrease from 13 to 12%	-0.61
7/19/82	DR decrease from 12 to 11.5%	-0.24
7/30/82	DR decrease from 11.5 to 11%	-0.37
8/13/82	DR decrease from 11 to 10.5%	-0.17
10/8/82	DR decrease from 10 to 9.5%	-0.42
11/19/82	DR decrease from 9.5 to 9%	-0.20
12/13/82	DR decrease from 9 to 8.5%	-0.33
11/21/84	DR decrease from 9 to 8.5%	-0.10
12/21/84	DR decrease from 8.5 to 8%	0.00
5/17/85	DR decrease from 8 to 7.5%	-0.18
3/6/86	DR decrease from 7.5 to 7%	-0.04
7/10/86	DR decrease from 6.5 to 6%	-0.03
8/20/86	DR decrease from 6 to 5.5%	-0.09
9/4/87	DR increase from 5.5 to 6%	0.17
8/9/88	DR increase from 6 to 6.5%	0.13
2/24/89	DR increase from 6.5 to 7%	0.11
12/18/90	DR decrease from 7 to 6.5%	-0.01
4/30/91	DR decrease from 6 to 5.5%	-0.11
9/13/91	DR decrease from 5.5 to 5%	-0.07
11/6/91	DR decrease from 5 to 4.5%	-0.12
12/20/91	DR decrease from 4.5 to 3.5%	-0.33
2/4/94	Fed Funds target raised from 3% to 3.25%	0.11
3/22/94	Fed Funds target raised from 3.25% to 3.5%	-0.06
4/18/94	Fed Funds target raised from 3.5% to 3.75%	0.10
5/17/94	DR increase from 3 to 3.5, Fed Funds target raised from 3.75% to 4.25%	0.00

Table 2: U.K. Policy Actions

Date	Action	jump in 3 m rate
6/3/65	Bank Rate decreased from 7.00 to 6%	-0.31
7/14/66	Bank Rate increased from 6 to 7%	0.28
1/26/67	Bank Rate decreased from 7 to 6.50%	-0.12
3/16/67	Bank Rate decreased from 6.50 to 6%	-0.18
5/4/67	Bank Rate decreased from 6 to 5.50%	-0.13
10/18/67	Bank Rate increased from 5.50 to 6%	0.13
11/9/67	Bank Rate increased from 6 to 6.50%	0.25
3/21/68	Bank Rate decreased from 8 to 7.50%	-0.25
9/19/68	Bank Rate decreased from 7.50 to 7%	-0.13
2/27/69	Bank Rate increased from 7 to 8%	0.50

Table 2: U.K. Policy Actions

Date	Action	jump in 3 m rate
3/5/70	Bank Rate decreased from 8 to 7.50%	-0.44
4/14/70	Bank Rate decreased from 7.50 to 7%	-0.63
4/1/71	Bank Rate decreased from 7 to 6%	-0.50
9/2/71	Bank Rate decreased from 6 to 5%	-0.88
11/30/72	Minimum Lending Rate increased from 7.50 to 7.75%	0.16
12/7/72	Minimum Lending Rate increased from 7.75 to 8%	0.02
12/21/72	MLR increased from 8 to 9% and Bank of England calls for 2% of special deposits	0.08
7/19/73	Minimum Lending Rate increased from 7.50 to 9%	0.50
7/27/73	Minimum Lending Rate increased from 9 to 11.50%	0.63
1/31/74	Minimum Lending Rate decreased from 12.75 to 12.50%	-0.03
4/5/74	Minimum Lending Rate decreased from 12.50 to 12.25%	-0.56
4/11/74	Minimum Lending Rate decreased from 12.25 to 12%	0.22
7/22/75	Minimum Lending Rate increased from 10 to 11%	0.94
10/3/75	Minimum Lending Rate increased from 11 to 12%	0.41
4/23/76	Minimum Lending Rate increased from 9 to 10.50%	1.47
5/21/76	Minimum Lending Rate increased from 10.50 to 11.50%	0.92
9/10/76	Minimum Lending Rate increased from 11.50 to 13%	0.94
10/7/76	Minimum Lending Rate increased from 13 to 15%	1.68
3/10/77	Minimum Lending Rate decreased from 12 to 11%	-0.27
11/24/77	Minimum Lending Rate increased from 5 to 7%	1.41
4/11/78	Minimum Lending Rate increased from 6.50 to 7.50%	0.22
11/9/78	Minimum Lending Rate increased from 10 to 12.50%	1.33
2/8/79	Minimum Lending Rate increased from 12.50 to 14%	0.18
6/12/79	Minimum Lending Rate increased from 12 to 14%	1.77
11/15/79	Minimum Lending Rate increased from 14 to 17%	0.93
7/3/80	Minimum Lending Rate decreased from 17 to 16%	-0.93
9/14/81	Base Rate increased from 12 to 14%	0.56
11/9/81	Base Rate decreased from 15.50 to 15%	-0.60
1/22/82	Base Rate decreased from 14.50 to 14%	-0.98
3/10/82	Base Rate decreased from 13.50 to 13%	-0.09
7/14/82	Base Rate decreased from 12.50 to 12%	-0.42
8/16/82	Base Rate decreased from 11.50 to 11%	-0.34
8/24/82	Base Rate decreased from 11 to 10.50%	0.00
10/5/82	Base Rate decreased from 10.50 to 10%	-0.05
10/12/82	Base Rate decreased from 10 to 9.50%	-0.67
11/1/82	Base Rate decreased from 9.50 to 9%	-0.36
4/14/83	Base Rate decreased from 10.50 to 10%	-0.01
6/13/83	Base Rate decreased from 10 to 9.50%	-0.19
10/3/83	Base Rate decreased from 9.50 to 9%	-0.19
8/8/84	Base Rate decreased from 12 to 11.50%	-0.15
8/10/84	Base Rate decreased from 11.50 to 11%	-0.92
8/17/84	Base Rate decreased from 11 to 10.50%	-0.06

Table 2: U.K. Policy Actions

Date	Action	jump in 3 m rate
11/5/84	Base Rate decreased from 10.50 to 10%	-0.11
1/14/85	Base Rate increased from 10.50 to 12%	1.35
7/11/85	Base Rate decreased from 12.50 to 12%	-0.21
7/26/85	Base Rate decreased from 12 to 11.50%	-0.28
1/8/86	Base Rate increased from 11.50 to 12.50%	0.53
10/14/86	Base Rate increased from 10 to 11%	0.40
3/9/87	Base Rate decreased from 11 to 10.50%	-0.21
3/18/87	Base Rate decreased from 10.50 to 10%	-0.14
4/28/87	Base Rate decreased from 10 to 9.50%	-0.09
5/8/87	Base Rate decreased from 9.50 to 9%	-0.14
8/6/87	Base Rate increased from 9 to 10%	0.79
10/23/87	Base Rate decreased from 10 to 9.50%	-0.58
11/4/87	Base Rate decreased from 9.50 to 9%	0.00
12/3/87	Base Rate decreased from 9 to 8.50%	-0.16
2/1/88	Base Rate increased from 8.50 to 9%	0.42
3/17/88	Base Rate decreased from 9 to 8.50%	-0.31
4/8/88	Base Rate decreased from 8.50 to 8%	-0.3
5/17/88	Base Rate decreased from 8 to 7.50%	-0.37
6/2/88	Base Rate increased from 7.50 to 8%	0.43
6/6/88	Base Rate increased from 8 to 8.50%	0.08
6/22/88	Base Rate increased from 8.50 to 9%	0.02
8/8/88	Base Rate increased from 10.50 to 11%	0.36
5/24/89	Base Rate increased from 13 to 14%	0.63
2/13/91	Base Rate decreased from 14 to 13.50%	-0.25
2/27/91	Base Rate decreased from 13.50 to 13%	-0.18
3/22/91	Base Rate decreased from 13 to 12.50%	-0.06
4/12/91	Base Rate decreased from 12.50 to 12%	-0.16
5/24/91	Base Rate decreased from 12 to 11.50%	-0.08
7/11/91	Base Rate decreased from 11.50 to 11%	-0.01
9/4/91	Base Rate decreased from 11 to 10.50%	-0.19
5/5/92	Base Rate decreased from 10.50 to 10%	-0.24
9/22/92	Base Rate decreased from 10 to 9%	-0.23
10/16/92	Base Rate decreased from 9 to 8%	-0.78
1/26/93	Base Rate decreased from 7 to 6%	-0.88

Table 3: German Policy Actions

Date	Action	jump in 3 m rate
1/21/65	DR from 3 to 3.5%, LR from 4 to 4.5%	0.00
8/12/65	DR from 3.5 to 4%, LR from 4.5 to 5%	0.25
5/26/66	DR from 4 to 5%	0.38
12/29/66	Intervention rate down by 1%	-0.13

Table 3: German Policy Actions

Date	Action	jump in 3 m rate
1/5/67	DR from 5 to 4.5%	-0.31
1/19/67	mrr + intervention rate reduced	-0.19
2/16/67	DR from 4.5 to 4%, rr down by 10%	-0.44
4/13/67	DR from 4 to 3.5%	-0.37
4/27/67	rr down	-0.19
5/11/67	DR from 3.5 to 3%	-0.25
6/29/67	rr down	0.00
8/10/67	LR from 4 to 3.5%, rr down retroactively (from Aug 1)	-0.13
3/20/69	LR from up, rq down with effect from July	0.25
4/17/69	DR from 3 to 4%	0.00
5/22/69	rr up with effect from June 1	0.00
6/19/69	DR from 4 to 5%	0.25
7/17/69	rr up with effect from August 1	0.00
9/11/69	DR from 5 to 6%	0.00
3/6/70	DR from 6 to 7.5%, LR from 9 to 9.5% & add. rr increase with effect April 1	0.38
7/15/70	DR from 7.5 to 7%, LR from 9.5 to 9%	-0.31
11/17/70	DR from 7 to 6.5%, LR from 9 to 8%	-0.94
12/2/70	DR from 6.5 to 6%, LR from 8 to 7.5%	-0.13
3/31/71	DR from 6 to 5%, LR from 7.5 to 6.5%, rq down by 10% with effect April 1	-0.75
10/13/71	DR from 5 to 4.5%, LR from 6.5 to 5.5%, rr down by 10% w effect Nov 1	-0.31
12/22/71	DR from 4.5 to 4%, LR from 5.5 to 5%, rr down by 10% with effect Jan 1	-0.31
2/24/72	DR from 4 to 3%, LR from 5 to 4%, rq down by 10% with effect from March	-0.37
10/6/72	DR from 3 to 3.5%, LR from to 5%	0.32
11/2/72	DR increased from 3.5 to 4%, LR increased from 5 to 6%	0.44
11/30/72	DR increased from 4 to 4.5%, LR increased from 6 to 6.5%	0.19
1/11/73	DR increased from 4.5 to 5%, LR increased from 6.5 to 7%	0.25
5/3/73	DR increased from 5 to 6%, LR increased from 7 to 8%	0.75
5/30/73	DR increased from 6 to 7%, LR increased from 8 to 9%	0.87
6/26/73	change in accounting rules for reserve requirements, amounts to a substantial increase	0.50
10/24/74	DR decreased from 7 to 6.5%, LR decreased from 9 to 8.5%	-0.15
12/19/74	DR decreased from 6.5 to 6%, LR decreased from 8.5 to 8%	-0.35
1/23/75	rediscount quotas increased	0.00
2/6/75	DR decreased from 6 to 5.5%, LR decreased from 8 to 7.5%	-0.20
3/6/75	DR decreased from 5.5 to 5%, LR decreased from 7.5 to 6.5%	-0.65
4/24/75	LR decreased from 6.5 to 6%	0.00
5/22/75	DR decreased from 5 to 4.5%, LR decreased from 6 to 5.5%	-0.35
7/3/75	rr down retroactively from July 1st	-0.10
7/17/75	rr on foreign liabilities down	0.00
8/14/75	DR decreased from 4.5 to 4%, LR decreased from 5.5 to 5%	-0.25
9/11/75	DR decreased from 4 to 3.5%, LR decreased from 5 to 4.5%; rq up	-0.35
7/14/77	LR decreased from 4.5 to 4%, interv. rates down	-0.20
12/15/77	DR decreased from 3.5 to 3%, and LR from 4 to 3.5%, but rr up on external liabilities.	-0.48

Table 3: German Policy Actions

Date	Action	jump in 3 m rate
1/18/79	LR increased from 3.5 to 4%, rr up	0.55
3/29/79	DR increased from 3 to 4%, LR increased from 4 to 5%, rq up	0.60
7/12/79	DR increased from 4 to 5%, LR increased from 5.5 to 6%	-0.15
8/23/79	decision to introduce quantitative limits on lombard credit facility ('lombard limits')	0.20
10/31/79	DR increased from 5 to 6%, LR increased from 6 to 7%, rq up	0.10
2/28/80	DR increased from 6 to 7%, LR increased from 7 to 8.5%, rq up, quantitative limits on lombard credit ('lombard limits') removed	-0.40
4/30/80	DR increased from 7 to 7.5%, LR increased from 8.5 to 9.5%, rr down	0.15
9/18/80	LR decreased from 9.5 to 9%	-0.40
10/16/80	rediscount quotas increased	0.03
2/19/81	BB suspends lombard credit, introduces "special lombard" at the rate of 12%	0.50
10/8/81	special lombard decreased from 12 to 11%	-0.70
12/3/81	special lombard decreased from 11 to 10.5%	0.00
1/21/82	special lombard decreased from 10.5 to 10%	-0.15
3/18/82	special lombard decreased from 10 to 9.5%	-0.20
5/6/82	special lombard decreased from 9.5 to 9% = LR level	-0.05
8/26/82	DR decreased from 7.5 to 7%, LR decreased from 9 to 8%	-0.20
9/23/82	rr down by 10%	-0.05
10/21/82	DR decreased from 7 to 6%, LR decreased from 8 to 7%	-0.12
12/2/82	DR decreased from 6 to 5%, LR decreased from 7 to 6%	-0.85
3/17/83	DR decreased from 5 to 4%, LR decreased from 6 to 5%, rq down for external reasons	-0.15
9/8/83	LR increased from 5 to 5.5%	-0.05
1/22/87	DR decreased from 3.5 to 3%, LR decreased from 5.5 to 5%, rq down, rr up	-0.18
11/5/87	LR decreased from 5 to 4.5%	-0.05
12/3/87	DR decreased from 3 to 2.5%	-0.03
6/30/88	DR increased from 2.5 to 3%	0.03
8/25/88	DR increased from 3 to 3.5%	0.00
12/15/88	LR increased from 5 to 5.5%	0.00
1/19/89	DR increased from 3.5 to 4%, LR increased from 5.5 to 6%	0.00
4/20/89	DR increased from 4 to 4.5%, LR increased from 6 to 6.5%	0.23
6/29/89	DR increased from 4.5 to 5%, LR increased from 6.5 to 7%	0.07
10/5/89	DR increased from 5 to 6%, LR increased from 7 to 8%	0.00
1/31/91	DR increased from 6 to 6.5%, LR increased from 8.5 to 9%	0.05
8/15/91	DR increased from 6.5 to 7.5%, LR increased from 9 to 9.25%	-0.07
12/19/91	DR increased from 7.5 to 8%, LR increased from 9.25 to 9.75%	0.20
7/16/92	DR increased from 8 to 8.75%	0.00
9/14/92	DR decreased from 8.75 to 8.25%, LR decreased from 9.75 to 9.5%	-0.37
2/4/93	open market sales, rr down, DR decreased from 8.25 to 8%, LR decreased from 9.5 to 9%	-0.10
3/18/93	DR decreased from 8 to 7.5%	0.03
4/22/93	DR decreased from 7.5 to 7.25%, LR decreased from 9 to 8.5%	-0.05
7/1/93	DR decreased from 7.25 to 6.75%, LR decreased from 8.5 to 8.25%	-0.12
7/29/93	LR decreased from 8.25 to 7.75%	0.00
9/9/93	DR decreased from 6.75 to 6.25%, LR decreased from 7.75 to 7.25%	-0.05

Table 3: German Policy Actions

Date	Action	jump in 3 m rate
10/21/93	DR decreased from 6.25 to 5.75%, LR decreased from 7.25 to 6.75%	-0.20
1/20/94	rr down (with effect from March 1)	0.03
2/17/94	DR decreased from 5.75 to 5.25%	-0.03
4/14/94	DR decreased from 5.25 to 5%, LR decreased from 6.75 to 6.5%	-0.05

Table 4: French Policy Actions

Date	Action	jump in 3 m rate
3/30/78	intervention rate decreased from 9 1/8 to 8 3/4%	-0.13
5/16/79	intervention rate increased from 6 3/4 to 7 1/8%	0.31
7/2/79	intervention rate increased from 8 3/8 to 8 5/8%	0.19
7/9/79	intervention rate increased from 8 5/8 to 8 7/8%	0.50
7/26/79	intervention rate increased from 9 1/2 to 10 1/4%	0.81
2/21/80	intervention rate increased from 12 to 12 3/8%	0.25
7/4/80	intervention rate decreased from 12 1/4 to 12%	-0.19
8/1/80	intervention rate decreased from 12 to 11 1/2%	-0.75
8/21/80	intervention rate decreased from 11 1/2 to 11 1/4%	0.00
7/3/81	intervention rate decreased from 22 to 19.75%	-1.00
7/21/81	intervention rate decreased from 18 1/4 to 17 3/4%	-0.50
8/5/81	intervention rate decreased from 17 3/4 to 17 1/8%	-1.13
10/9/81	intervention rate decreased from 18.5 to 17.75%	-1.25
10/14/81	intervention rate decreased from 17 3/4 to 16 7/8%	-0.75
10/21/81	intervention rate decreased from 16 7/8 to 16 1/2%	-0.75
10/26/81	intervention rate decreased from 16 1/2 to 16%	-0.38
12/18/81	intervention rate decreased from 15 3/8 to 15 1/8%	-0.13
2/10/82	intervention rate decreased from 14 3/4 to 14 1/4%	-0.19
7/2/82	intervention rate decreased from 15 1/4 to 15%	-0.13
8/6/82	intervention rate decreased from 14 5/8 to 14 1/2%	-0.06
10/25/82	intervention rate decreased from 13 3/4 to 13 1/2%	-0.69
10/27/82	intervention rate decreased from 13 1/2 to 13 1/4%	0.00
11/18/82	one month intervention rate decreased from 13 7/8 to 13 1/8%	-0.13
2/20/86	intervention rate decreased from 8.75 to 8.5%	-0.50
3/7/86	intervention rate decreased from 8.5 to 8.25%	-0.13
4/15/86	intervention rate decreased from 8.25 to 7.75%	-0.13
4/29/86	intervention rate decreased from 7.75 to 7.5%	0.00
6/17/86	intervention rate decreased from 7.25 to 7%	0.00
3/3/87	Balladur announcement of impending intervention rate decrease	-0.13
3/10/87	intervention rate decreased from 8 to 7.75%	0.00
6/29/87	intervention rate decreased from 7.75 to 7.5%	-0.09
1/25/88	intervention rate decreased from 7.5 to 7.25%	-0.02
5/25/88	intervention rate decreased from 7.25 to 7%	-0.25
7/8/88	intervention rate decreased from 7 to 6.75%	-0.13

Table 4: French Policy Actions

Date	Action	jump in 3 m rate
8/26/88	intervention rate increased from 6.75 to 7%	0.16
10/17/88	intervention rate increased from 7 to 7.25%	0.17
12/15/88	intervention rate increased from 7.25 to 7.75%	0.31
1/20/89	intervention rate increased from 7.75 to 8.25%	0.13
6/29/89	intervention rate increased from 8.25 to 8.75%	0.06
10/5/89	intervention rate increased from 8.75 to 9.5%	0.06
12/18/89	intervention rate increased from 9.5 to 10%	0.19
4/2/90	intervention rate decreased from 10 to 9.75%	-0.13
4/26/90	intervention rate decreased from 9.75 to 9.5%	-0.19
11/2/90	intervention rate decreased from 9.5 to 9.25%	-0.07
3/18/91	intervention rate decreased from 9.25 to 9%	-0.03
10/16/91	intervention rate decreased from 9 to 8.75%	-0.06
11/19/91	intervention rate increased from 8.75 to 9.25%	0.07
12/23/91	intervention rate increased from 9.25 to 9.6%	0.07
11/3/92	intervention rate decreased from 9.6 to 9.35%	-0.06
11/12/92	intervention rate decreased from 9.35 to 9.1%	-0.10
4/19/93	intervention rate decreased from 9.1 to 8.75%	-0.31
4/23/93	intervention rate decreased from 8.75 to 8.5%	-0.62
4/30/93	intervention rate decreased from 8.5 to 8.25%	-0.13
5/6/93	intervention rate decreased from 8.25 to 8%	-0.22
5/14/93	intervention rate decreased from 8 to 7.75%	-0.25
5/24/93	intervention rate decreased from 7.75 to 7.5%	-0.06
6/14/93	intervention rate decreased from 7.5 to 7.25%	0.00
6/21/93	intervention rate decreased from 7.25 to 7%	-0.08
7/2/93	intervention rate decreased from 7 to 6.75%	-0.05
10/22/93	intervention rate decreased from 6.75 to 6.45%	-0.37
12/3/93	intervention rate decreased from 6.45 to 6.2%	-0.08

2. Computation of standard error bands

The VAR's are estimated using OLS equation by equation. Thus, letting X be the matrix of RHS variables, lagged endogenous variables and any included exogenous variables and y be the matrix of LHS variables we have:

$$\beta = (X'X)^{-1} X'Y \quad (2)$$

$p \times k$ $p \times p$ $p \times T$ $T \times k$

where β is the matrix of estimated coefficients and the dimensions of all matrices are given below - k is the number of equations in the VAR (the number of endogenous variables), T is the

number of observations, and $p \equiv k \times l + 2$ is the number of right hand side variables, l being the number of lags of each endogenous variable and 2 being the policy index dummy and a constant).

The consistent estimate of the variance covariance matrix of the reduced form errors is given by:

$$\Omega_{k \times k} = \frac{(\epsilon' \epsilon)}{(T - p)} \quad (3)$$

where $\epsilon \equiv Y - X\beta$, is the matrix of reduced form residuals.

Therefore, the consistent estimate of the variance covariance matrix of the estimated coefficients is given by the $pk \times pk$ Kronecker product

$$\Sigma = \Omega \otimes (X'X)^{-1} \quad (4)$$

From the estimated coefficients it is straightforward to form the impulse response functions, which we denote $F(\beta)$, a $k \times m$ matrix, where m is the number of periods for which the impulse response is estimated. Applying the "Delta Method" (e.g. Hamilton, *Time Series Analysis*, Proposition 7.4, p. 186), we estimate the $km \times km$ Variance-Covariance matrix of $F(\beta)$ as

$$\text{Var}\{F(\beta)\} = F(\beta) \Sigma [F(\beta)]' \quad (5)$$

where $F(\beta)$ is the $km \times pk$ Jacobian matrix of derivatives of $F(\beta)$ with respect to β . The standard errors of our estimated impulse response are then given by the square root of the diagonal elements of this matrix.

3. Data Description

a) United States:

GDP - IFS tape, line 111 99b.r

GDP deflator - nominal GDP (IFS tape, line 111 99b.c) / real GDP (as above)

Seasonally adjusted M1 - IFS tape, line 111 34..b

End of month \$/SDR exchange rate - IFS tape, line 111 ..aa.

Industrial production - IFS tape, line 111 66..c

CPI less shelter - Citibase, series PUXHS

End of month short rate - 3 month treasury bill rate, from Federal Reserve Board

End of month long rate - 10 year treasury bond rate, from Federal Reserve Board

b) United Kingdom:

GDP - IFS tape, line 112 99b.r

GDP deflator - nominal GDP (IFS tape, line 112 99b.c) /real GDP (as above)

Seasonally adjusted M1 - from Bank of England. M1 until Jan 1988, then seasonally adjusted M2 spliced on for period thereafter.⁵³

End of month £/SDR exchange rate - IFS tape, line 112 ..aa.

Industrial production - IFS tape, line 112 66..c

CPI less shelter - Constructed from OECD series for UK CPI and UK CPI rent

End of month short rate - 3 month treasury bill rate, from Bank of England

End of month long rate - 10 year gilt yield, from Bank of England

c) Germany:

GNP - IFS tape, line 134 99a.r

GNP deflator - nominal GNP (IFS tape, line 134 99a.c) /real GNP (as above)

Seasonally adjusted M1 - from IFS tape, line 134 34..b

End of month DM/SDR exchange rate - IFS tape, line 134 ..aa.

Industrial production - IFS tape, line 134 66..c

CPI less shelter - Constructed from OECD series for German CPI and German CPI rent.

End of month short rate - 3 month treasury bill rate, from Deutsche Bundesbank

End of month long rate - 10 year bond yield, from Deutsche Bundesbank

d) France:

GDP - IFS tape, line 132 99b.r

GDP deflator - nominal GDP (IFS tape, line 132 99b.c) /real GNP (as above)

53. From about mid-1988 onwards the M1 series became increasingly misleading as banks began to pay interest on their demand deposits, which were then excluded from M1. Publication of M1 was discontinued in 1991 - in the final years the measure declined considerably, even as other monetary aggregates were growing rapidly.

Seasonally adjusted M1 - from IFS tape, line 132 34..c

End of month FF/SDR exchange rate - IFS tape, line 132 ..aa.

Industrial production - IFS tape, line 132 66..c

CPI less shelter - Constructed from OECD series for French CPI and French CPI rent.

End of month short rate - Full sample (1978-1993): call rate from Bulletin Mensuel de Statistique, INSEE (argent au jour le jour, marché monétaire).

End of month long rate - long bond yield, from Bulletin Mensuel de Statistique, INSEE,.

e) Common:

World commodity price index - IFS tape, line 001 76axd

Chapter 3

Monetary Policy, Real Interest Rates and Inflationary

Expectations: Evidence from the U.K.

I. INTRODUCTION

The ability of central banks to influence long term interest rates and the associated inflationary consequences of monetary policy actions has long been the subject of debate amongst macro-economists. In a Chapter 1, we showed that long nominal rates exhibit a significant increase (decrease) in response to monetary policy contractions (expansions). However, we could not separate this effect into a real interest rate response and an inflationary expectations effect.

In this chapter, I make use of the U.K. index linked bond market to decompose nominal interest rates into the sum of the real rate and inflationary expectations. Using all available index linked bonds provides one with a measure of real and nominal rates and inflationary expectations over the entire term structure. I then look at how these variables respond on the day of a monetary policy action. Assuming rational expectations and efficient bond markets, the entire response of all three variables to a particular policy shock should be reflected in real and nominal bond prices on the day of the shock. This method provides one with very precise estimates of the response of real and nominal rates and of inflationary expectations over very long time horizons.

I follow the approach of Chapter 1 for identifying monetary policy shocks. In Chapter 1, we defined policy actions as "actual policy actions (such as discount or intervention rate changes, changes in minimum reserve requirements etc.) undertaken with the intention of affecting economic conditions in a non-temporary fashion". They ensure that actions are uncorrelated with contemporaneous economic information by excluding actions that represented a within day policy response to another event or those actions which occurred on the same day that another major event took place that might also have influenced interest rates. They then use a market based measure of the magnitude of the policy shock, namely the change in the three month treasury bill rate on the day of the action. This is an appropriate measure of the unanticipated policy content of an action, since on any given day the change in the three month rate will be, to a first approximation, unanticipated.

There are two main results. First, as expected, both nominal and real rates show a significant increase following an unanticipated monetary contraction for horizons up to twenty and twenty-five years, respectively. The second major result is quite unexpected. I find that for horizons up to fifteen years the response of nominal rates exceeds that of real rates, implying that the inferred inflationary expectations *increase* in response to an unanticipated monetary contraction.

The chapter proceeds as follows. In section II.1 I describe the methodology for computing inflationary expectations from the U.K. index linked bonds. My method addresses the major issue not confronted by previous authors in this subject, namely the fact that inflationary expectations cannot be derived simply by comparing real and nominal bonds of a similar maturity, since the term structure is not flat. Instead, one must first construct a series of yields on pure discount bonds, both nominal and real, and then compare yields on these. In section II.2 I describe the derivation of the U.K. monetary policy index. The estimation results are described in section III, followed by a conclusion. The appendix contains a summary of the policy actions and the associated change in the three month interest rate.

II. METHODOLOGICAL ISSUES

1. Computing inflationary expectations

The nominal price of a nominal bond that pays semi-annual coupons is given by

$$PN_t = \frac{\text{coupon}}{(1+i_s)^{s-t}} + \frac{\text{coupon}}{(1+i_{s+0.5})^{s+0.5-t}} + \dots + \frac{\text{coupon}}{(1+i_m)^{m-t}} + \frac{\text{principal}}{(1+i_m)^{m-t}} \quad (1)$$

where s is the date of the first coupon payment, m is the date that the bond matures and i_s is the rate of interest on a nominal pure discount bond¹ maturing at date s .

Similarly, the real price of a real bond that pays semi-annual real coupons is given by

$$PR_t = \frac{\text{coupon}}{(1+r_s)^{s-t}} + \frac{\text{coupon}}{(1+r_{s+0.5})^{s+0.5-t}} + \dots + \frac{\text{coupon}}{(1+r_m)^{m-t}} + \frac{\text{principal}}{(1+r_m)^{m-t}} \quad (2)$$

1. A pure discount bond, also known as a zero coupon bond, is one which pays no interest during its lifetime. Its entire return is the capital gain as the price rises towards par at maturity. I refer to the interest rate on such a bond as the pure rate of discount.

where, again, s is the date of the first coupon payment, m is the date that the bond matures and r_s is the rate of interest on a real pure discount bond maturing at date s .

The expected inflation rate over the next m years is then given by the Fisher relation:

$$\pi_m^e = \frac{1 + i_m}{1 + r_m} - 1 \approx i_m - r_m \quad (3)$$

Thus to compute π_m^e one needs to know both i_m and r_m .² From (1) it is possible to solve for i_m if one knows the price, coupon, principal, maturity and dates of coupon payments of the bond and all the relevant pure rates of discount until six months before the bond matures i.e. $i_s, i_{s+0.5}, \dots, i_{m-0.5}$. While the first five elements are all readily obtainable one can only compute the previous pure rates of discount if all bonds have synchronized coupon payments and one has bonds maturing every six months. If these two conditions are satisfied one can then compute pure rates of discount for all maturities recursively. For example, the yield on a six month bond is the same as the pure rate of discount on that bond. For the twelve month bond one must discount the first coupon at the six month rate and one can then calculate the appropriate pure rate of discount on the final coupon and principal payments. One can then use these two rates for the eighteen month bond and so on.

In practice, however, the coupon payments of bonds are not synchronized and there may be instances in which two adjacent bonds mature more than six months apart. However, by assuming that the term structure of pure discount bonds is flat over short segments one can use a number of actual bonds to solve iteratively for pure discount rates. Thus, suppose one has n bonds that mature at m_1, m_2, \dots, m_n ; one can then make the following approximation

$$PN_t \approx \frac{\text{coupon}}{(1 + i_j)^{s-t}} + \frac{\text{coupon}}{(1 + i_j)^{s+0.5-t}} + \dots + \frac{\text{coupon}}{(1 + i_j)^{m-t}} + \frac{\text{principal}}{(1 + i_m)^{m-t}} \quad (4)$$

where $j = m_1$ for coupons paid before m_2 , $j = m_2$ for coupons paid after m_2 and before m_3 etc., So for the first bond maturing at m_1 , I assume that the pure rate of discount until m_1 is simply the yield to maturity on this bond. For the second bond, I use the discount rate from the first bond to discount all the coupons and then solve for the pure rate of discount applicable to the principal. For the third bond I use the discount rate from the first bond for coupons paid before the maturity of the second bond, the discount rate from the second bond for the remaining

2. When calculating expected inflation using UK index linked bonds Woodward (1990) compares the yield to maturity of index linked and nominal bonds. His method is only correct if both the real and the nominal term structures are perfectly flat, in which case $r_s = r_t$ and $i_s = i_t \forall s, t$.

coupons and then from the implied present value of the principal derive a pure rate of discount to m_3 . I follow this procedure iteratively until I have derived pure rates of discount for all of m_1, m_2, \dots, m_n . I used the same method to derive both nominal pure rates of discount and real pure rates of discount.

For the case of the real bonds the choice of m_1, m_2, \dots, m_n is simply given by the maturities of all of the indexed bonds in existence, which is never more than eleven at one time.³ For the case of nominal bonds there are usually more than 50 bonds in existence at any one time, however for the sake of computational ease I selected thirteen bonds with maturities about two years apart and similar coupons.⁴ A full description of all the bonds used is given in the appendix.

The result of this procedure was to give us real and nominal rates of discount to certain maturities for all the dates of monetary policy actions. If the maturities of nominal and real bonds coincide, then I can use (3) to determine inflationary expectations over that time horizon. However, in practice maturities rarely exactly coincide and, moreover, it is of little interest to compare how inflationary expectations up to, say, 1996 react to a monetary policy shock in, for example, 1985 relative to a shock in 1992. Instead, one is more interested in how inflationary expectations over, say, the next five years respond to monetary policy shocks. I, therefore, fitted a yield curve to all the derived nominal and real rates of discount and used the fitted values to give inflationary expectations over horizons from two to twenty-five years.

The specification I chose to fit both the nominal and the real yield curves was:

$$\log(1 + i_t) = c + \beta_1 t + \beta_2 \log(t) + \varepsilon_t \quad (5)$$

This specification was chosen because of its extreme parsimony and because it is relatively frequently used in the existing literature, for example in Woodward (1990). The presence of the $\log(t)$ term enables one to capture in a very simple way the typical non-linearity in the yield curve. In general, it has a much steeper slope (either positive or negative) at shorter maturities than at longer maturities.

3. Since the final action is in January 1993, I did not include the two bonds issued in September and October 1992, namely the 4.625% 1998 and the 4.375% 2004. In addition, since the longest dated nominal bond matures in 2017 I did not include the real bonds that mature after 2020.

4. I selected bonds with similar coupons because of one of the quirks of the British tax law, namely that while the income from bonds is taxable any capital gains is not, thus a low coupon bond that sells below par will receive part of its return in the form of untaxed capital gains and would therefore have a redemption yield below that of a similar maturity higher coupon bond. While I do not address this issue directly, selecting bonds with similar coupons minimizes the error in the calculated inflationary expectations. Moreover, this problem is further alleviated by the fact that I consider the change in yields over the course of a day. Thus, while the estimated pure discount rate on a bond may be measured with an error of a few basis points the change in this rate over the course of a day will be measured accurately, since the bond's coupon does not change from one day to the next.

2. Description of policy index

I now briefly describe the construction of the monetary policy shocks, for a more complete description I refer the reader to the appendix of Chapter 1. Using the Bank of England Quarterly Bulletin I first collected a complete set of all base rate changes for the period 1982-1994.⁵⁶ I then checked the reports concerning these actions in the relevant issue of the Financial Times in order to exclude:

- i) all actions which were simply a response to money demand shifts, i.e. actions which according to contemporaneous statements were undertaken merely to accommodate developments in the money markets;
- ii) actions which represented a within day response to another event, such as bad trade figures or an unexpectedly rapid growth in the money supply,
- iii) those actions which coincided with another major event that might also have influenced interest rates on that day.

Since my method for determining inflationary expectations relies on real and nominal bond prices, they will change only in response to unanticipated central bank actions. I took the change in the three month treasury bill rate as a measure of the unanticipated component of the central bank action.⁷ A complete summary of all the actions and the associated changes in the three month rate on that day are given in the appendix.

III. RESULTS

In the following, I now take up the central question of this chapter: how do inflationary expectations react to unexpected monetary policy shocks, as proxied by the reaction of the three month interest rate on the day of the announcement ?

I first present the results of the basic regression, the change in inflationary expectations for a given time horizon on the change in the three month interest rate on the day of a policy action. I then present scatter plots that look at individual points in the regression for three different horizons and discuss the outliers in greater depth. Because the inflationary consequences of an

5. In Chapter 1, we also considered changes in minimum reserve requirements, however, in the period since the first index linked bonds were issued (1981) changes in reserve requirements have not been an instrument of British monetary policy.

6. While the first index linked bonds were issued in 1981, until the March 1982 budget there were restrictions on who could hold these bonds and the market was consequently not very liquid. I have therefore restricted the sample to the period after March 1982.

7. While a three month treasury bill rate is sufficiently short term that the monetary authorities may be thought of as determining it, any changes on a day to day basis will be, to a first approximation, unanticipated.

tations increase rather than decrease for horizons up to twenty years.⁸ Moreover, this effect is highly significant even at horizons in excess of ten years.

Cloddish peculiar result be merely an artifact of the way the consumer price index is constructed in the United Kingdom?⁹ Since the housing cost of owner occupied dwellings is measured by mortgage interest payments and because of the large preponderance of variable rate rather than fixed rate mortgages, the immediate impact of a one percentage point increase in short rates is to raise the consumer price index by about 0.25%. However, the magnitude of the coefficients in the last row of Table 1 is such that this cannot be the full explanation. Moreover, this has a one-off effect of increasing the price level, whereas the response of inflationary expectations is such that the price level is predicted to continue increasing in response to the contraction until about the tenth year. Furthermore, other researchers who have uncovered the "price puzzle" have been careful to always consider the consumer price index excluding shelter to ensure that their results are not being driven by this effect. It is therefore clear that this result cannot simply be dismissed as being the consequence of using a poor measure of the price level.

Before discussing any further explanations for the result, we first look at scatter plots that summarize the response of inflationary expectations and real and nominal interest rates over various time horizons on each of the days of monetary policy actions. In this manner we can see whether the results are being driven solely by a few exceptional points or whether we have a highly consistent pattern.

Figures 1 to 3 show the change in inflationary expectations and real and nominal interest rates versus the change in the three month interest rate on the day of policy actions for five, ten and twenty year horizons. Figure 1 confirms the basic impression given by the regressions. For nominal rates there is a very tight relationship between the change in the short rate and the change in the five year rate, with few points very far from the regression line. In the case of real rates, there is also an obvious pattern; real rates certainly tend to move in the same direction as

8. Strictly speaking since the indexing of real bonds is treated as a capital gain and so is not subject to taxation, the following arbitrage relation should hold $(1 - \tau)r + \pi^e = (1 - \tau)i$, where τ is the tax rate, r is the real interest rate, i is the nominal interest rate and π^e are inflationary expectations. Thus, the change in inflationary expectations following a shock is given by $\Delta\pi^e = (1 - \tau)(\Delta i - \Delta r)$. However, using an appropriate estimate for τ would merely change the magnitude of the estimated coefficient on the change in inflationary expectations but would effect neither its sign nor its significance.

9. The United Kingdom index linked bonds are indexed to the consumer price index and so the inflationary expectations that we are measuring is expectations of the change in the CPI.

Figure 1

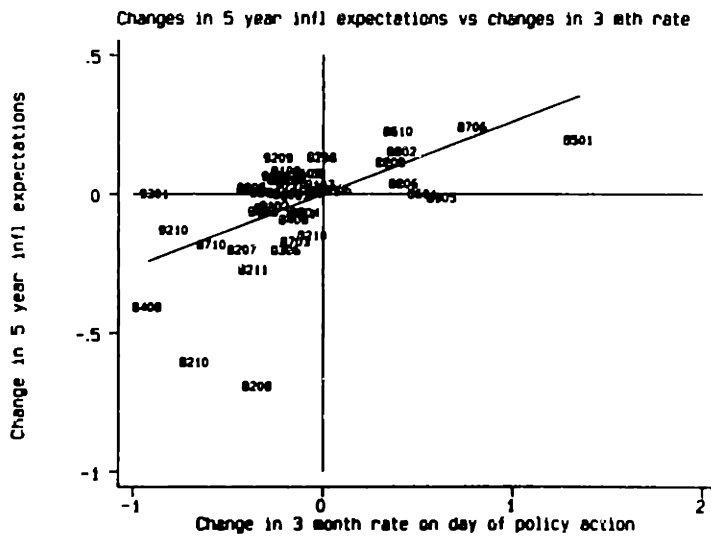
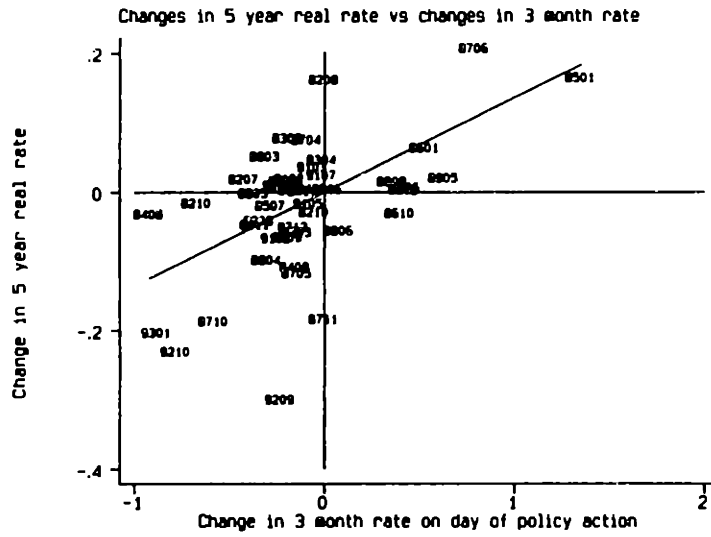
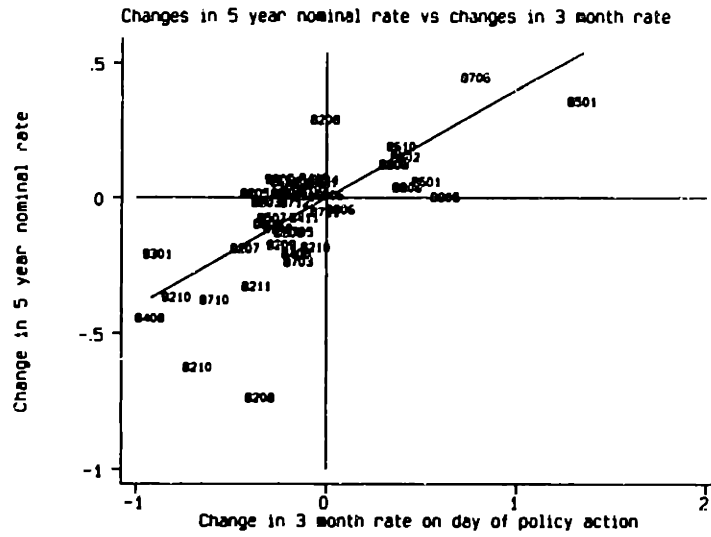


Figure 2

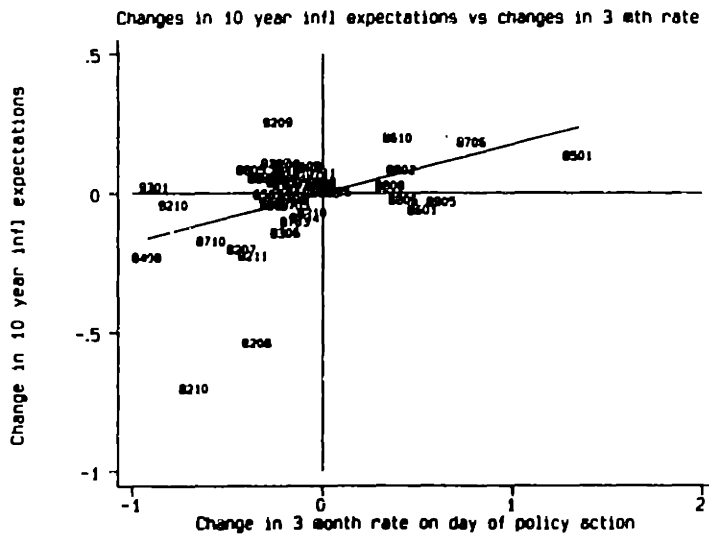
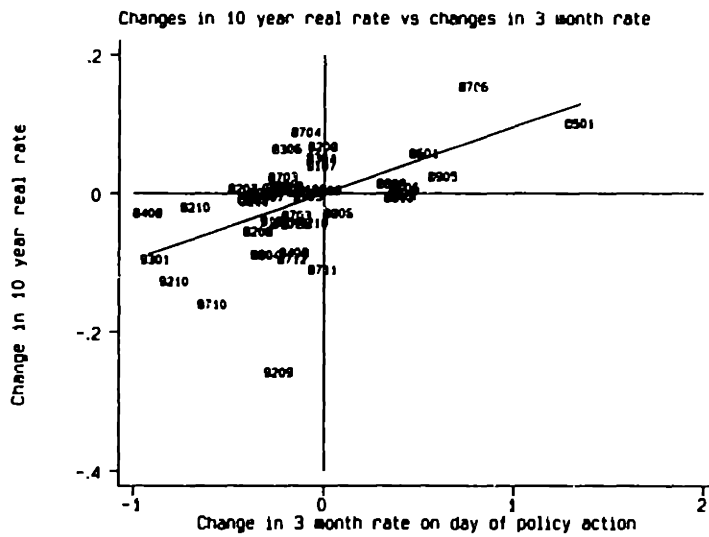
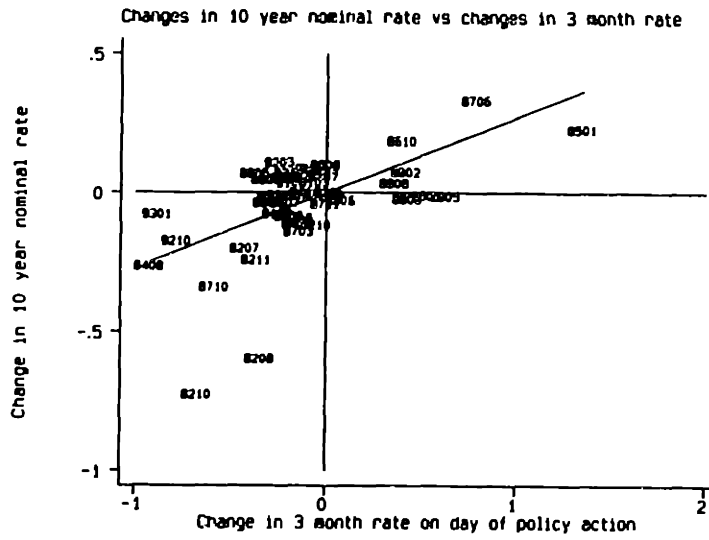
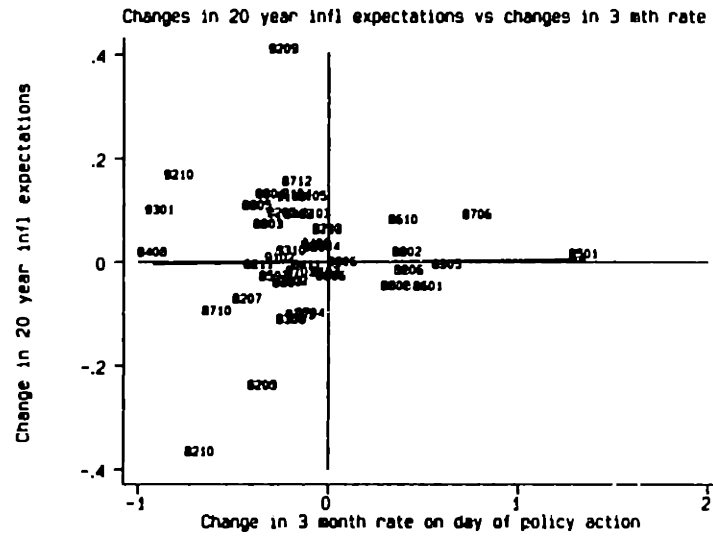
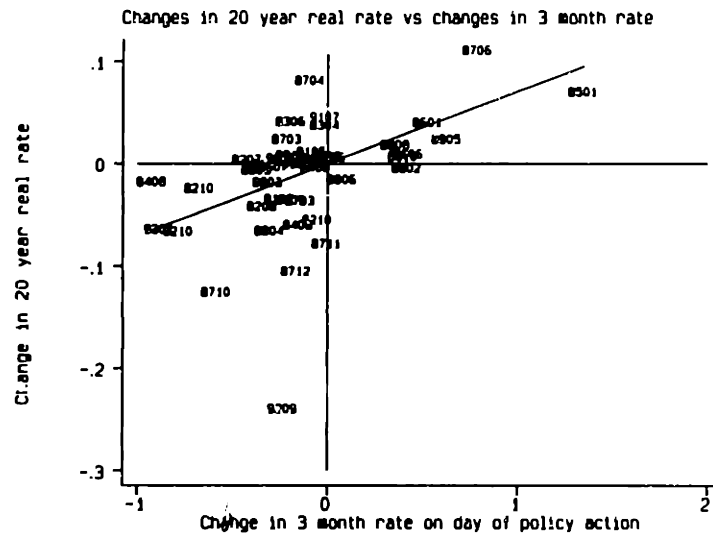
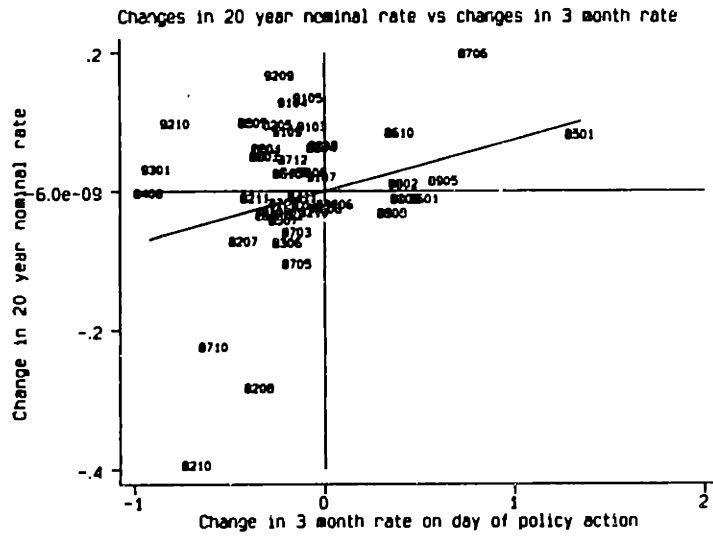


Figure 3



short nominal rates on days of monetary policy actions, however, the magnitude is on average much smaller and the fit is clearly less good. Finally, in the bottom panel of Figure 1, we see the implied response of inflationary expectations to these monetary policy shocks. The figure shows that on only fifteen of the 46 monetary policy action days were inflationary expectations revised in the conventional direction i.e. upwards when there was an unanticipated expansion and downwards when there was an unanticipated contraction. In all other cases, expectations reacted perversely.

Four of the most notable examples of “perverse” reactions correspond to July, August, October and November 1982 when unanticipated monetary expansions resulted in large downwards revisions of inflationary expectations. This was the time when monetary policy was beginning to be eased on both sides of the Atlantic following the very severe tightenings imposed by Mr. Volcker in the United States and Mrs. Thatcher in the United Kingdom. One explanation for the failure of real rates to respond to these policy shocks is that although restrictions on who could purchase index linked bonds had been lifted these bonds were still something of a novelty and the market was not as liquid as the nominal bond market. An alternative explanation is that the monetary authorities in the United Kingdom had superior information regarding the inflationary outlook and that, following a long period of monetary tightness designed to reduce inflation, market participants believed that the authorities would only reduce short interest rates when it was safe to do so. Thus, according to this story a reduction of short rates reveals to the market the superior information that the monetary authorities have and so causes inflationary expectations to be revised downwards.

Note that many of the fifteen occasions when the change in inflationary expectations moved conventionally i.e. in the opposite direction of the short rate, occurred during the time when the United Kingdom was a member of the European exchange rate mechanism. Britain’s participation in this arrangement was hailed as an opportunity to reduce British inflation to rates close to those of her European neighbors. However, it coincided with the worst recession in Britain since the Great Depression and pressure for higher rates emanating from Germany, the anchor of the system, caused by reunification. During its brief membership Britain cut rates from 15% to 10%, while German rates during this period increased moderately. While real long rates declined as short rates were cut, nominal rates barely moved implying that the cuts in rates resulted in increased inflationary expectations and presumably, signaled an absence of faith, subsequently justified, in Britain’s long term commitment to the system.

Figure 2 reveals that the change in inflationary expectations and real and nominal interest rates over a ten year horizon in response to monetary policy shocks is, to a large extent, similar to that over a five year horizon. Nominal and real rates both tend to move upwards in response

to a contraction and downwards in response to an expansion, with the typical magnitude of the response being greater for nominal rates, thus implying that inflationary expectations are revised upwards following a contraction. However, of the 46 points we now have 22 instances, rather than 15, when inflationary expectations over a ten year horizon moved in the opposite direction as the change in the short rate.

By the time one looks at a 20 year horizon, in Figure 3, the picture is very different. While there is still a reasonably tight relation between the change in 20 year real rates and the change in the three month rate, there is a barely significant relationship between 20 year nominal rates and the change in the three month rate. There are nearly as many instances when nominal rates fall (rise) following an unanticipated increase (decrease) in the three month rate as the reverse. The lower panel of Figure 3 shows the implied changes in inflationary expectations over a 20 year horizon following a monetary policy action. It reveals that there is no correlation at all between changes in inflationary expectations over this horizon and monetary policy shocks. Closer inspection of Figure 3 reveals another interesting phenomenon. Prior to December 1987, inflationary expectations move in the conventional direction - upwards following an unanticipated expansion and downwards following an unanticipated contraction - on only seven of the twenty five monetary policy action days. Since December 1987, however, this pattern has been almost completely reversed. Of the twenty one shocks since that date on only three occasions have inflationary expectations moved in the perverse direction.

There are a number of conclusions which may be drawn from our examination of the scatter plots. First, while there is a close positive relationship between changes in real rates and unanticipated changes in the three month rate for all horizons, the close fit that is apparent for nominal rates at short horizons is no longer in evidence at longer horizons. Consequently the implied changes in inflationary expectations following monetary policy shocks is perverse at short horizons, but for longer horizons there is no consistent pattern, confirming the results from Table 1. Second, some of the differences in response at different dates may be explained by reputation effects. Thus, if the monetary authorities have clearly demonstrated a determination to be tough on inflation, then an easing may not be viewed as inflationary but rather as a signal that the inflationary outlook was better than market participants had previously thought. Third, while there is no strong a priori reason for a structural break there appears to be a marked change in the response of inflationary expectations to monetary policy shocks in the second half of the sample relative to the first half. I now present further regressions that take up these issues in somewhat greater detail.

2. Regressions distinguishing between "policy phases"

Table 2

Horizon		2 years	5 years	10 years	20 years
Policy phase:		Coeff (S.E.)	Coeff (S.E.)	Coeff (S.E.)	Coeff (S.E.)
1981-82 expansion (N=6)	Real bonds:	.048 (.160)	.052 (.081)	.053 (.043)	.044 (.032)
	Nominal bonds:	.657 (.416)	1.032 (.270)	1.023 (.186)	.464 (.124)
	Infl expectations:	.609 (.327)	.979 (.222)	.970 (.158)	.420 (.112)
1983-85 expansion (N=9)	Real bonds:	.037 (.061)	.038 (.049)	.034 (.040)	.022 (.028)
	Nominal bonds:	.628 (.130)	.468 (.424)	.278 (.066)	.035 (.040)
	Infl expectations:	.591 (.118)	.477 (.085)	.244 (.064)	.012 (.055)
post-crash expansion (N=3)	Real bonds:	.336 (.316)	.334 (.223)	.311 (.150)	.255 (.128)
	Nominal bonds:	.597 (.137)	.641 (.116)	.577 (.105)	.354 (.121)
	Infl expectations:	.261 (.224)	.307 (.167)	.266 (.162)	.099 (.212)
1988-89 contraction (N=7).	Real bonds:	.128 (.067)	.110 (.054)	.083 (.038)	.066 (.026)
	Nominal bonds:	.479 (.110)	.287 (.102)	.163 (.086)	.090 (.056)
	Infl expectations:	.350 (.073)	.177 (.062)	.079 (.055)	.024 (.035)
ERM membership (N=8)	Real bonds:	.176 (.134)	.125 (.074)	.090 (.049)	.070 (.048)
	Nominal bonds:	.267 (.146)	.046 (.121)	-.114 (.127)	-.247 (.164)
	Infl expectations:	.091 (.139)	-.079 (.096)	-.204 (.109)	-.317 (.158)
post ERM expan- sion (N=3)	Real bonds:	.508 (.149)	.306 (.143)	.177 (.136)	.119 (.130)
	Nominal bonds:	.584 (.174)	.373 (.101)	.164 (.048)	-.092 (.089)
	Infl expectations:	.076 (.081)	.067 (.099)	-.013 (.146)	-.211 (.217)

Table 2 shows the results of running separate regressions for all of the clearly identifiable monetary policy phases. Note that while there were 46 monetary policy shocks in the full sample, some of these did not easily fit into a "policy phase" and so the six episodes described in the table above encompass only 36 of the policy shocks.

The most striking point to note from Table 2 is the considerable differences across phases in the response of both real and nominal rates to monetary policy shocks. Yet, the central finding that inflationary expectations react perversely to monetary policy shocks holds for all periods except for the most recent past where lack of sufficient observations inhibits any conclusion, and the phase of ERM membership, when inflationary expectations actually move in the conventional direction.

Consider first the behavior of real rates. In the first two phases there is little evidence of any response of real rates throughout the term structure. While the estimated coefficient is at all horizons positive, as expected, it is never significant at the 5% level. Moreover the maximum point estimate of the coefficient is just 5.3 basis points for the case of the ten year real rate in the 1981-82 expansion. By contrast, the four subsequent phases show a much greater response of real rates to policy shocks. Furthermore, whereas in the early phases the estimated response is relatively flat across all horizons, in the later phases there is a much greater impact on shorter term (2-5 years) real rates than on longer term real rates. Nevertheless, despite a much lower estimated coefficient the response at longer horizons is still, in general, significant.

For nominal rates the differences between phases are almost completely reversed. In the first two phases the estimated response of nominal bonds is high and very significant at all horizons (except 20 years for the 1983-85 expansion). Indeed, for the 1981-82 expansion the yield on 10 year nominal pure discount bonds is estimated to decline by over 100 basis points in response to an unanticipated policy induced one percentage point reduction in the three month interest rate. For the later phases the response of shorter nominal rates is of a similar magnitude, in all but one instance the estimated coefficient on the two year nominal rate is between 45 and 60 basis points. However, for longer maturity bonds the coefficient estimates decline quite sharply, so much so that for the last two phases the estimated coefficient on 20 year nominal bonds is even negative, although not significantly so.

Finally, looking at the implied impact on inflationary expectations we see that in the first two phases following an unanticipated monetary expansion there is in all cases, except again the 20 year horizon for 1983-85, a highly significant *reduction* in inflationary expectations. Indeed, for the 1981-82 period the reduction in inflationary expectations over a five to ten year horizon was almost one percent per annum following an unanticipated one percentage point reduction in the three month rate. For the third and fourth phases there is also a significant decrease (in-

crease) in inflationary expectations following an expansion (contraction) for horizons of two to five years, while for longer horizons the estimated coefficient is still positive, but is insignificant. For the phases encompassing ERM membership and after the response of inflationary expectations is never significantly positive and at horizons over 5 years for the ERM membership period and over 10 years for the post ERM membership period the estimated coefficient is actually negative i.e. its shows the "conventional" sign. Indeed, during the period of ERM membership a one percentage point reduction in the three month interest rate was associated with a 0.3% p.a. increase in inflationary expectations over the next twenty years.

I take the date of ERM membership as the candidate for a structural break in the response of inflationary expectations to monetary policy actions. A Chow test rejects the hypothesis of no structural break at the 5% significance level for horizons of two, five and ten years and at the 1% significance level for the twenty year horizon.

3. Regression with changes in inflation on the right hand side

While the differences in response across phases presented above may simply represent structural breaks, an alternative explanation is that the regression model is misspecified and that an omitted variable might help explain the differences in responses. The most plausible candidate for a missing variable is some measure of the anti-inflationary credibility of the monetary authorities. Thus, when the monetary authorities have significant credibility a reduction in interest rates is taken as a signal that inflationary pressures are lower than was previously perceived by the private sector and so inflationary expectations are reduced, while when the monetary authorities lack credibility any expansion is taken to herald a period of monetary laxity and so inflationary expectations increase. To test this hypothesis, I take recent changes in inflation as a proxy for the monetary authorities credibility and thus run the following regression:

$$\Delta \pi^e = c + (\beta_0 + \beta_1 (\pi - \pi_{-12})) \Delta 3m \quad (6)$$

where $\pi - \pi_{-12}$ represents the change in inflation over the last twelve months. If reputation effects are important one would expect a significant negative estimate for β_1 .

Table 3 - adding inflation changes to the right hand side

Horizon	2 years		5 years		10 years		20 years	
	Coeff	(S.E.)	Coeff	(S.E.)	Coeff	(S.E.)	Coeff	(S.E.)
β_0	.294	(.058)	.253	(.053)	.169	(.052)	.012	(.042)
β_1	-.007	(.033)	-.059	(.031)	-.071	(.030)	-.031	(.024)

Table 3 shows the results from including recent changes in inflation on the right hand side of the regression. The first point to note from Table 3 is that the inclusion of the inflation term on the right hand side barely makes any difference to the estimate of β_0 , it is never more than 2 basis points different from the estimates in Table 1. The second point of note is that in all cases the estimate of β_0 is negative, and for the cases of five and ten year horizons it is significantly so. Thus, Table 3 provide some tentative evidence that reputation effects play a role in how inflationary expectations react to monetary policy shocks.

IV. CONCLUSION

I have two main findings. First, the response of both real and nominal interest rates to monetary policy shocks, as proxied by the change in the three month interest rate on the day of a monetary policy action, is in the expected direction. Real rates increase at all horizons in response to a monetary contraction, while nominal rates increase for all horizons up to twenty years. The second major finding of the chapter is a rather startling one. Following an unanticipated monetary contraction (expansion), inflationary expectations show a significant *increase* (decrease) over horizons of up to fifteen years. The significant change in real interest rates in the expected direction (downwards for expansions and upwards for contractions) is accompanied by a change in nominal interest rates of an even greater magnitude in the same direction.

If one divides up the sample into smaller "policy phases", the result is still apparent for most phases. It is most extreme for the easing in 1982 that followed a long period of tight monetary conditions; during this time there were very large reductions in inflationary expectations at all horizons upon unanticipated interest rate reductions. The only instance in which the result is reversed i.e. inflationary expectations responded "conventionally" to policy is the time of Britain's membership in the exchange rate mechanism. During this time expansionary policy shocks were associated with increases in inflationary expectations for horizons beyond 5 years.

It is difficult to reconcile our main result with most standard economic models of efficient bond markets and inflation expectations formation. The only explanation that is consistent with efficient capital markets is that monetary authorities have far superior information about inflationary conditions than markets and reveal this information to bond markets through policy actions. Thus, when there is little inflationary pressure, the authorities cut rates revealing this information to bond market participants and causing them to revise downwards their inflationary expectations.

The problem with this line of argument is that it only seems to be a plausible explanation of “perverse” changes in inflationary expectations over a short horizon. While I feel that central banks may have superior information about the state of the economy in the very near future I find it unlikely that they might have superior information about conditions up to ten years in the future. Thus, it is difficult to accept the argument as an explanation for why medium term (five to fifteen years) inflationary expectations also move in a perverse direction. In addition, this explanation would imply that bond markets believe that the central bank’s contractionary actions will not be effective in reducing inflation even after several years. In summary, the line of argument emphasizing information revelation and efficient markets can only explain our results if a) the Bank of England has a great deal more information about the economy than the private sector, even far into the future and b) bond markets believe that the monetary authorities are essentially incapable of reducing inflation. Jointly, these seem to be very strong.

Although the above explanation seems implausible, all others are perhaps even more unpalatable as they suggest inefficiencies in bond markets. For example, a second possible explanation is that the index linked bond market was, in its early years, a relative novelty and so there were sometimes mistakes in pricing these assets following policy shocks. However, it seems very unlikely that in a market which even by 1986 accounted for about 10% of outstanding government debt and was open to all market participants arbitrage could have been violated. Another explanation that also requires peculiar behavior on the part of bond market participants relies on the notion that bond prices cannot jump too much on one day. Thus, consider a nominal ten year bond that yields 10% and a real ten year bond that yields 3%. If there is an expansionary monetary policy shock that results in a decline in the nominal rate of 20 basis points and an increase in inflationary expectations of say 0.1% p.a. over the next ten years, then the yield on the real bond should fall by 30 basis points. The implied price changes in the bonds are that the price of the nominal bond should increase by approximately 2%, while that of the real bond should increase by approximately 10%. If, for some reasons, market participants perceive that the real bond is a “safer” asset than the nominal bond it may not jump by as much as one would expect and then the change in inflationary expectations inferred from the different price changes might be “perverse”. While such a story has a modicum of intuitive appeal, it would be deeply disturbing to discover that this was the explanation for our peculiar result. I therefore conclude that there is, as yet, no convincing explanation for our puzzle.

V. REFERENCES

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VI. APPENDIX

1. Summary of monetary policy actions

Date	Action	jump in 3m rate
7/14/82	Base Rate decreased from 12.50 to 12%	-0.42
8/16/82	Base Rate decreased from 11.50 to 11%	-0.34
8/24/82	Base Rate decreased from 11 to 10.5%	0.00
10/5/82	Base Rate decreased from 10.5 to 10%	-0.05
10/12/82	Base Rate decreased from 10 to 9.5%	-0.67
11/1/82	Base Rate decreased from 9.5 to 9%	-0.36
4/14/83	Base Rate decreased from 10.5 to 10%	-0.01
6/13/83	Base Rate decreased from 10 to 9.5%	-0.19
10/3/83	Base Rate decreased from 9.5 to 9%	-0.19
8/8/84	Base Rate decreased from 12 to 11.5%	-0.15
8/10/84	Base Rate decreased from 11.5 to 11%	-0.92
8/17/84	Base Rate decreased from 11 to 10.5%	-0.06
11/5/84	Base Rate decreased from 10.5 to 10%	-0.11
1/14/85	Base Rate increased from 10.5 to 12%	1.35
7/11/85	Base Rate decreased from 12.5 to 12%	-0.21
7/26/85	Base Rate decreased from 12 to 11.5%	-0.28
1/8/86	Base Rate increased from 11.5 to 12.5%	0.53
10/14/86	Base Rate increased from 10 to 11%	0.40
3/9/87	Base Rate decreased from 11 to 10.5%	-0.21
3/18/87	Base Rate decreased from 10.5 to 10%	-0.14
4/28/87	Base Rate decreased from 10 to 9.5%	-0.09
5/8/87	Base Rate decreased from 9.5 to 9%	-0.14
8/6/87	Base Rate increased from 9 to 10%	0.79
10/23/87	Base Rate decreased from 10 to 9.5%	-0.58
11/4/87	Base Rate decreased from 9.5 to 9%	0.00
12/3/87	Base Rate decreased from 9 to 8.5%	-0.16
2/1/88	Base Rate increased from 8.5 to 9%	0.42

3/17/88	Base Rate decreased from 9 to 8.5%	-0.31
4/8/88	Base Rate decreased from 8.5 to 8%	-0.30
5/17/88	Base Rate decreased from 8 to 7.5%	-0.37
6/2/88	Base Rate increased from 7.5 to 8%	0.43
6/6/88	Base Rate increased from 8 to 8.5%	0.08
6/22/88	Base Rate increased from 8.5 to 9%	0.02
8/8/88	Base Rate increased from 10.5 to 11%	0.36
5/24/89	Base Rate increased from 13 to 14%	0.63
2/13/91	Base Rate decreased from 14 to 13.5%	-0.25
2/27/91	Base Rate decreased from 13.5 to 13%	-0.18
3/22/91	Base Rate decreased from 13 to 12.5%	-0.06
4/12/91	Base Rate decreased from 12.5 to 12%	-0.16
5/24/91	Base Rate decreased from 12 to 11.5%	-0.08
7/11/91	Base Rate decreased from 11.5 to 11%	-0.01
9/4/91	Base Rate decreased from 11 to 10.5%	-0.19
5/5/92	Base Rate decreased from 10.5 to 10%	-0.24
9/22/92	Base Rate decreased from 10 to 9%	-0.23
10/16/92	Base Rate decreased from 9 to 8%	-0.78
1/26/93	Base Rate decreased from 7 to 6%	-0.88

2. Description of bonds used

Real bonds:

2% 1988, 2% 1990, 2% 1992, 2% 1994, 2% 1996, 2.5% 2001, 2.5% 2003, 2% 2006, 2.5% 2009, 2.5% 2011, 2.5% 2013, 2.5% 2016.

Nominal bonds:

Up to March 1987: 12% 1984, 12.25% 1985, 12% 1986, 11.5% 1989, 12.5% 1990, 12.25% 1992, 12.5% 1994, 13.25% 1996, 12% 1998, 13% 2000, 12% 2002, 12.5% 2005, 11.75% 2007.

After March 1987: 9.75% 1988, 10% 1989, 10% 1990, 10% 1992, 10% 1994, 10% 1996, 9.75% 1998, 10% 2001, 10% 2003, 9.5% 2005, 8.5% 2007, 8% 2009, 7.75% 2015.