Comparing the monetary transmission mechanism in France, Germany and the United Kingdom: some issues and results

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In this article,[1] *Erik Britton and John Whitley analyse the importance of commonly cited structural differences between the economies of the United Kingdom, France and Germany for the response of output and prices to changes in monetary policy. They review previous studies and report results from a complementary empirical approach, summarising the evidence as inconclusive. They argue that some of the differences between the three economies are not really structural and that even where they are, this does not automatically imply that one economy will be more sensitive than another to a change in monetary policy.*

Introduction

The prospect of a single European monetary policy raises the key question of whether this would affect all Member States equally. The answer will depend crucially on how each economy adapts to a single currency, which will not be known in advance. But we can start by evaluating how far a similar change in monetary policy (in particular, a change in interest rates) has had different effects on prices and output in these countries in the past.

It is normally assumed that, in the long run, changes in the stock of money will be fully reflected in changes in the price level, with little or no effect on real output. But wages and prices are not perfectly flexible in the short to medium term. So changes in monetary policy may have consequences for real output over this period. This nominal stickiness may partly be caused by incomplete adjustment of economic agents' expectations of inflation, and partly by the costs of acquiring information on the appropriate price to charge and of changing prices accordingly. Some economists argue that these real effects are largely the result of 'structural' features, ie those institutional arrangements and underlying determinants of individual behaviour that are insensitive to changes in fiscal and monetary policy. These dictate the relative importance of different channels of the monetary transmission mechanism.[2] That suggests that structural differences between countries may lead to differences in the effects of a change in monetary policy. Indeed, structural differences between the UK economy and other (especially European) economies have been cited as *prima facie* evidence that the effects of changes in monetary policy in the United Kingdom are different from those experienced elsewhere. However, one of the problems in this debate is the lack of consensus as to what is meant by structural.

This article has two main parts. The first section looks at some of the commonly cited differences between the three economies. It considers whether the differences are in some sense fundamental, and whether they have important implications for the transmission of monetary policy onto output and inflation. The second section reviews a selection of empirical studies of the monetary transmission mechanism in the United Kingdom, France and Germany, and sets out our own results, which are based on a complementary approach. It evaluates the different empirical approaches to assessing how important structural differences are for the impact on output and prices of changes in interest rates.

Structural differences between the United Kingdom, France and Germany

The differences often cited as structural cover the main channels of the transmission mechanism: from changes in policy interest rates to changes in market interest rates, to changes in demand for goods and money and the exchange rate, and so through to output and prices. We note, however, that some of the differences outlined may not in fact be structural, and also that structural differences may not map straightforwardly onto changes in output and prices.

The response of market interest rates to policy rates

How fast and far the central bank's policy rates translate into market interest rates and bank loan rates can vary significantly between countries. This may reflect differing competitive pressures between the banking sectors. But banks and other market lenders may respond differently to a change in policy rates. The response depends partly on how long the change is expected to be sustained, and partly on the costs of taking action in response. So this response may be different for different policy changes.

(1) Useful comments on earlier drafts have been received from Shamik Dhar, Ray Barrell, Keith Cuthbertson, Paul Fisher, Simon Wren-Lewis and representatives of the central banks of France, Germany and Italy. David Tinsley contributed to estimation of the models. We are particularly indebted to Charles Bean for comments.

(2) There is broad agreement about the channels of the monetary transmission mechanism themselves (see the recent symposium in the *Journal of Economic Perspectives*, Fall 1995).

According to estimates by the Bank for International Settlements (BIS), changes in policy rates are most rapidly and fully reflected in changes in market interest rates in the United Kingdom, less so in Germany, and more slowly and incompletely in France. A simple statistical analysis of the past relationships between different interest rates gives a similar result. But estimates of this sort often fail to identify genuine structural differences, because they take an average of temporary and persistent interest rate changes. So a country that has experienced more temporary changes to policy rates will probably—on most empirical estimates—appear to have a smaller pass-through from policy to market interest rates.

In the United Kingdom, France and Germany, monetary policy is set with reference to different targets (for inflation, the exchange rate and monetary growth), but in each case policy is implemented primarily through policy rates at the short end of the yield curve. This might lead us to expect that activity will respond more sensitively to a change in policy rates in a country where there is a higher proportion of lending and borrowing at short rates. But this is not necessarily the case. Nominal interest rates (risk premia aside) are equal to the sum of real interest rates and expected inflation. So the change in expected inflation resulting from any shock will determine the effect of that shock on the yield curve at all maturities. A shock that affects short rates may also affect long rates. The extent of this depends on two factors. First, the nature of the shock: a demand shock and a change in the target of monetary policy will affect the yield curve in different ways. Second, the expected response of the monetary authority: in some cases, the authority will be expected to accommodate some of the inflationary effects of any demand shock, or to be prepared to miss a target for monetary growth (or any other nominal target), which would lead to expectations of higher inflation.

Moreover, the extent to which the monetary regime is expected to accommodate inflationary shocks (the extent to which it is less than fully credible) may also be reflected in the proportion of borrowing that takes place at long rates. A monetary regime that is not expected to accommodate inflationary shocks is likely to incur a lower inflation risk premium and so encourage borrowing at long-term rates. As countries move to a single European monetary policy and economic agents anticipate that the authorities will respond in a more uniform way to inflationary shocks, we might expect some convergence of behaviour in both the extent of borrowing at long rates and the response of the yield curve to changes in policy rates.

Demand for goods and money

(a) Household and corporate indebtedness

How changes in policy rates affect activity depends partly on how policy rates translate into interest rates more generally (as above) and also partly on how interest rates influence the decisions of households and firms on spending and investment. Changes in nominal interest rates can influence real behaviour by affecting short-term real interest rates, which may change the rate at which households and firms substitute future for current spending. These consumption decisions will also be affected by the current level of indebtedness, which may be partly determined by structural features. Since households and firms tend to have interest-bearing assets as well as liabilities, the net level of debt, rather than the gross level, will be a more useful measure of their indebtedness. As Table A shows, the level of net indebtedness is not very different between the three countries. The ranking in the corporate sector is as we would expect given the propensity of UK firms to finance their investment internally.

Table A
Net debt position (interest-bearing assets minus liabilities) in 1990

Measured as a percentage of GDP

	Household	Corporate
United Kingdom	-5	-23
France	-4	-38
Germany	1	-41

Source: OECD *Financial Accounts of OECD Countries*, UK *Financial Statistics*.

The size of any policy effect in each economy depends on who the creditors and borrowers are; on their relative marginal propensities to consume; and on the extent of liquidity constraints. A high level of gross indebtedness may indicate the absence of liquidity constraints and, for a given level of net indebtedness, will be associated with weaker rather than stronger real interest rate effects on expenditure.(1) The gross levels of household and corporate indebtedness are significantly higher in the United Kingdom than in Germany or France, consistent with the view that the process of financial liberalisation in the United Kingdom has significantly reduced the level of liquidity constraints.

(b) Home ownership

The finance of house purchase in different countries is often singled out as a prime reason for differences in how real demand responds to changes in interest rates. In particular, more owner occupation and greater use of variable-rate finance are often cited as reasons why real demand in the United Kingdom may be more sensitive than in its European neighbours (see Tables B and C). But if there are no credit constraints, consumer spending will depend on current and prospective income and debt servicing costs. These are not

Table B
Homeowners as a percentage of total households in 1994

United Kingdom	France	Germany
66	54	40

Source: Council of Mortgage Lenders *European Mortgage Review*.

(1) Some of the literature (summarised in Mayer, 1994) suggests that liquidity constraints are a more important determinant of investment in the United Kingdom than elsewhere. One reason put forward for this has been the relatively large number of small firms in the United Kingdom. But in fact data on the distribution of employment by enterprise size show no marked difference between the United Kingdom, France and Germany.

Table C
Variable-rate mortgages as percentage of total mortgages in 1993

United Kingdom	France	Germany
90	10	<10

Source: National central banks.

affected at the aggregate level by homeownership patterns or by the extent of fixed versus variable-rate mortgages.

Fixed rates will generally be higher than variable rates on average, since they incorporate an inflationary risk premium. A person holding a fixed-rate mortgage can be expected to have taken account of this inflationary risk in calculating his current and prospective income and real debt servicing costs. The variable-rate mortgage holder does not pay this premium and so has to be prepared to bear the costs of any inflationary shocks. Although permanent income will be unchanged in both cases in response to a nominal shock, agents may nevertheless substitute between current and future consumption. This will not depend on whether they are borrowing at fixed or variable rates. But if agents who are borrowing at variable rates are also constrained in their ability to borrow, they may be forced to change their consumption more sharply, especially if debt is front-loaded (so that the schedule of debt repayments declines in real terms over the lifetime of the mortgage). Although the United Kingdom has a higher proportion of variable-rate mortgages, there may be fewer liquidity constraints, as noted above. The change in consumption may also vary in response to changes other than a nominal shock, such as a shift in the policy regime.

The shares of variable-rate and fixed-rate mortgage lending shown in Table C may respond to changes in either supply or demand. Demand is partly determined by attitudes to risk, which may be sensitive to monetary policy arrangements if these affect the general level of risk; they may also change over time. For example, when mortgages with competitive rates fixed for up to ten years were made available in the United Kingdom in 1994, up to 63% of new mortgages were on these terms. Supply will depend on the portfolio structure of lending and borrowing by financial institutions, which may also be sensitive to the policy regime.

(c) Finance for companies

The same factors apply to companies, and whether their financing is variable or fixed rate will make no difference to the investment decisions they make in response to a shock, unless they have liquidity constraints. As Table D shows,

Table D
Variable-rate lending as percentage of total lending to firms, 1993

United Kingdom	France (a)	Germany
<50	67	<50

Source: BIS (from national central banks).

(a) More recent figures suggest that in France this proportion may since have fallen.

the pattern of variable-rate finance for companies is not the same as that for mortgage finance in the United Kingdom, France and Germany.

The exchange rate

Another key part of the transmission mechanism is how the level of output responds to a movement in the real exchange rate in response to a change in policy rates. In an open economy, nominal wage and price stickiness may mean that a change in policy interest rates has short-term real effects. This is because the nominal exchange rate is not sticky and can adjust more rapidly than other prices in response to a shock, causing a change in the real exchange rate in the short term. A change in the real exchange rate can affect inflation and output by changing the supply and demand for exports and imports. Other factors such as supply-side shifts may also cause the real exchange rate to shift. So it is not easy to trace the relationships between the real exchange rate, activity and prices.

Whatever the shock and its effect, we might expect a more open economy to be more exposed to external shocks and to respond differently to changes in monetary policy. In fact the United Kingdom, France and Germany have a similar degree of openness in trade, as shown in Table E.

Table E
Average of imports and exports as a percentage of GDP in 1995

United Kingdom	France	Germany
29	25	27

Source: OECD: *National Accounts.*

Nominal stickiness

Domestic demand will also be affected in the short run by a change in real interest rates, whether the economy is open or closed. The adjustment to a new steady-state inflation rate is then determined in either case by the extent of nominal stickiness, which in turn depends on how quickly agents learn about monetary policy as well as on institutional contract arrangements. So a common monetary policy regime—as in monetary union—might cause the degree of nominal stickiness in different economies to converge to some extent. A reduction in nominal stickiness would reduce the real costs of adjustment to any shock.

The behaviour of agents in the labour market is a key factor determining the extent of nominal stickiness. So the degree of nominal stickiness may change as labour market reforms are introduced; for example reducing the bargaining power of the unions, and increasing the flexibility of contract arrangements. Of the three countries, the process of labour market reform is most advanced and started earliest in the United Kingdom. This is grounds for concluding that the degree of nominal stickiness may have fallen in the United Kingdom relative to the other two countries in recent years. Measures produced by Layard, Nickell and Jackman (1991) show almost the same degree of nominal stickiness between

the United Kingdom, France and Germany, but these are based on historical averages and may not accurately reflect the current situation, if relevant changes—such as labour market reforms—have had an impact on recent economic behaviour.

Nominal stickiness, combined with the other features discussed above, can be summarised by the cumulative cost in terms of higher unemployment (or lower output) of achieving one percentage point lower inflation (the sacrifice ratio). Ball (1993) shows that although the sacrifice ratio is related to the degree of nominal stickiness, the two do not correspond exactly. This confirms that nominal stickiness is important in explaining the real output consequences of a change in monetary policy, but it is not the only influence. Neither of these papers suggests that the sacrifice ratio has been higher in the United Kingdom in the past than elsewhere.

Different approaches to identifying the effects of structural differences

As discussed above, the relationship between the structural differences and the effects of changes in monetary policy on output and prices in the different economies is rarely straightforward. So we need to look at empirical approaches to quantify structural differences and their effects.

Three contrasting approaches have been commonly used to compare monetary transmission mechanisms. The first is based on the comparative properties of large, one-country macroeconometric models (MEM1s). These are systems of equations representing relationships between economic aggregates, with varying degrees of economic theory imposed. They are typically designed for forecasting and simulation in a single-country context, and are seldom strictly comparable across countries.

The second approach uses multi-country macroeconometric models (MEM2s). These have typically been designed to generate forecasts and simulations for individual countries that are consistent with the implied forecasts for the world (or the group of countries) as a whole. Because they are systems involving many individual country models, multi-country models are generally larger than one-country models.

The third approach is based on 'structural vector auto-regressions' (SVARs). Vector auto-regressions (VARs) are essentially models that describe a purely statistical relationship between variables, designed to produce forecasts and simulation results. SVARs impose long-run restrictions on model responses to make the auto-regressions more amenable to an economic interpretation. It is in this sense that they are called structural. Whereas MEMs focus on the relationships between economic aggregates, SVARs focus on shocks and allow shocks to, for example, supply or demand to be identified.

Each approach uses a similar method to identify cross-country differences. Having decided which type of model to use, the next step is to simulate a change in monetary policy within that model, and to observe the responses of variables such as output and prices. But there are problems at every step, both in choosing which model to use and in deciding what assumptions to make when simulating changes in monetary policy.

A problem common to all three approaches is the extent to which they can identify differences which are not the result of changes in fiscal and monetary policy, particularly when the estimated parameters embody implicit assumptions about expectations.

Different studies tend to rank countries differently on the impact of changes in monetary policy on output and prices either because they use different models, or because of differences in simulation design. First, the literature shows that very different results can be obtained for the same country by using different models of that country.(1) Many of the differences between macroeconometric model results have been traced to superficially 'unimportant' equations in the individual models.(2) The differences that arise from these equations are often at least as large as differences identified across countries using the same or similar models.

Further issues relating to the choice of model are:

- When different models give different results, it can be very difficult to test whether these are statistically significant or to judge their economic importance.
- Large macroeconometric models are often criticised for their lack of transparency. In a very large model it may be difficult to explain what features are responsible for the overall response of key variables to a shock.
- Decisions about the specification of the model are not systematic: choices depend on individual modeller preference (maybe related to topical issues) rather than on any standardised procedure. Differences in individual preferences can introduce country-specific effects selectively, and this can dominate any genuine cross-country differences.

These considerations are crucial in assessing the differences between the transmission mechanism in different countries. For the observer there is often no way of distinguishing between conflicting results. Also, simulation results may vary according to the assumptions made, even for the same model of the same economy. Key assumptions relate to the following issues:

- What sort of change in monetary policy is being simulated? What is the maintained monetary strategy (or nominal target)? Targeting the money stock and

(1) See Church *et al* (1993).
(2) See Turner *et al* (1989).

targeting the exchange rate may give differing dynamic responses. In particular, it is not sufficient to model a change in monetary policy by a change in interest rates because this does not describe a monetary policy strategy and leads to an indeterminate price level. To close the system one usually needs to assume that some nominal target is pursued after the initial shock.

- If the shock is to interest rates, what should its scale, direction and duration be?

- Is the shock assumed to be common across countries, or is it restricted to one country? For example, depending on how the exchange rate is modelled, there may be no implied exchange rate response for a common interest rate shock. The exchange rate is often held fixed for forecasts, and sometimes for simulations.

- Changes in real activity or the exchange rate may depend on whether the change represents an announced (and anticipated) change in policy, or whether it is an unannounced (and unanticipated) change. The assumptions about how expectations are formed and how they respond to any change can be crucial to the ultimate response of output and prices.

Outlined above are two important sources of difference between the results obtained in different studies: the choice of model and the design of the simulation. A third is genuine differences between the economies being studied. For the observer, it is often very difficult to assess whether or not genuine differences exist. Since different studies have resolved these problems in different ways, comparison of the results is extremely difficult. Offered below is a representative summary, drawing out the extent to which similar modelling approaches generate similar results, together with results from recent Bank research using a different, small model approach.

Large macroeconometric models: national models (MEM1s)

An example of this approach is a study by the BIS using G10 central banks' own national models (Smets, 1995). The MEM1 approach is very detailed and can capture some structural features of different countries by either disaggregation or inclusion of country-specific factors. Our discussion above, however, indicates how difficult it is in practice to map structural differences onto predictable econometric relationships. In principle the MEMs approach can also allow for expectations to be explicitly linked to the policy regime, and so it partly addresses the criticism that the relationships between economic variables embody an implicit assumption about expectations. But this criticism still has force when thinking about the future: when trying to forecast using a MEM, for example. MEM1s can also be used in like-for-like simulations by trying to make common assumptions about monetary policy across countries.

The BIS study suggests that output responds more to changes in nominal short interest rates in the United Kingdom than in most other countries, including France and Germany. The response in price level is also considerably larger in the United Kingdom, although the implied trade-off between output and prices is less so. But the simulations are not strictly comparable. The French and German models maintain the restriction of operating with a narrow-band exchange rate mechanism (ERM) and their exchange rates are held fixed against other European countries in the simulations. But this is valid only if all ERM countries simultaneously change interest rates and trade effects are also allowed for, requiring a multi-country approach.

Large structural models: multi-country models (MEM2s)

Multi-country models typically apply the same modelling strategy to each country, and so reduce the scope for differences from this source. Three examples of the MEM2 approach are: (1) a study by the National Institute of Economic and Social Research (NIESR) using its NIGEM multi-country model (NIESR, 1995); (2) a study by Richardson (1987), using the OECD Interlink model; and (3) results from the US Federal Reserve multi-country model (MCM), reported in the BIS study using national country models. The NIESR study finds the same relative ranking as the BIS (MEM1) study above in the responses of both output and prices to a change in monetary policy. However, that ranking is not replicated in the OECD study, which finds that the United Kingdom has only an average response. This is explained by the fact that the OECD model tends to adopt similar parameter values as well as structure across countries.(1) The results from the US-based MCM also show much smaller cross-country differences than the national country models.

Structural VAR models (SVARs)

This approach has the advantage that it involves small tractable systems, designed to have simulation properties that are firmly rooted and identifiable in the historical behaviour of the variables being modelled. Criticisms of the relevance of the SVAR approach to the issue of the monetary transmission mechanism point to the lack of detail and to the fact that structural differences cannot be traced to or from estimated parameters of the system. Since in some studies the shocks in the different countries are determined relative to the past volatility of interest rates and in others are a one percentage point shock, it is difficult to ensure that simulations are comparable across studies or across countries.

Examples of the SVAR approach are: (1) a study by the BIS for the G7 countries (Gerlach and Smets, 1995); and (2) a recent study by the IMF (IMF, 1996). Neither the BIS nor

(1) See Whitley, 1992.

the IMF study finds the United Kingdom to be an outlier in respect of the output or price level response.

Small stylised models (SSMs)

A fourth method, designed to complement the other three, is based on the use of a small structural model with an underlying theoretical framework that is well-understood and relevant to the issue at hand.(1) Such an approach has been the subject of some recent research at the Bank of England. The basic model comprises four equations for four key variables: aggregate demand; aggregate supply; the money stock; and the exchange rate. When demand exceeds the equilibrium rate of output, inflation is higher than economic agents expected when the nominal contracts were set. Positive price surprises make it profitable for firms to increase output temporarily (the familiar Phillips curve). Aggregate demand for goods is related to the real interest rate and the real exchange rate. The demand for money is a function of nominal demand and the nominal interest rate, and an uncovered interest rate parity condition determines the relation of the exchange rate to the interest rate, following any initial jump in the exchange rate. The key feature of this model is that the prices of domestic goods adjust slowly to any change in demand. Hence monetary policy has real effects in the short run through changes in real interest rates and real exchange rates. But the form of the aggregate supply equation (Phillips curve again) ensures that money is neutral (has no effect on real variables) in the long run.

The small model approach captures many of the key features of the monetary transmission mechanism (recently discussed by Taylor, 1995). In particular it assumes that agents form their expectations in a rational (model-consistent) way.(2) The advantages of the approach are that: (1) the framework is identical across countries; (2) it involves quantification of key economic relationships which contain parameters that can be related to structural characteristics; and (3) the model can be estimated so that the cross-country differences in the key economic relationships can be tested for statistical significance. The main criticism is that it is too highly aggregated to capture cross-country differences, in other words that by keeping the number of variables so small, it risks glossing over many of the most important cross-country differences. But by being highly aggregated, it concentrates on differences that are important at the aggregate level. The estimation will probably miss some of the dynamics picked up by a VAR, and the form of the model will inevitably involve much simplification of the true process, reducing a large number of parameters to a handful in the model. But behavioural differences can be related directly to stylised structural features (even if not by a one-to-one mapping).

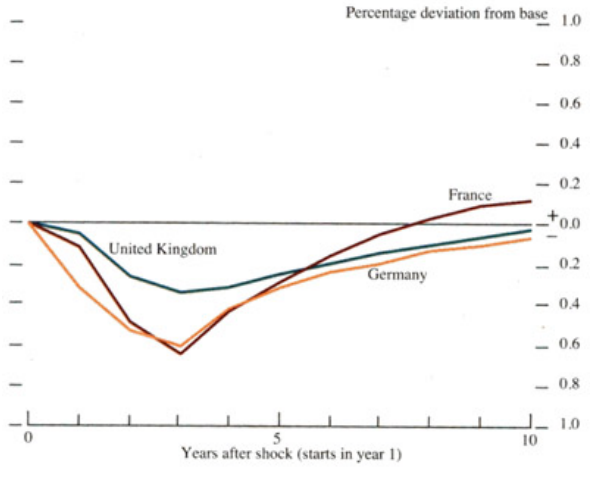
One major problem that it shares with the other three approaches is that any estimated parameter may reflect both underlying economic behaviour and the policy regime (and hence expectations), so the parameters may change for a 'new' policy regime, such as EMU. The results from the small model approach can be interpreted as showing what might happen in the absence of any structural change or shifts in the way that expectations evolve.

We illustrate the results of using this approach in two parts. First, since the estimated models are small and stylised, it is feasible to compare the estimated economic relationships across countries. Second, it is also possible to simulate comparable changes in interest rates within the estimated models, as in the other three approaches.

Estimates of the key parameters of the models for the three economies suggest that the sensitivity of output to the real interest rate is lower in the United Kingdom than elsewhere, but the sensitivity of inflation to output (deviations from trend) is higher.(3) But the cross-country differences between these relationships are not generally large enough to be statistically significant (see below). Parameter estimates are also fairly stable over the period of estimation, which suggests the absence of major regime shifts.

We can use the estimated models to simulate the response of output and inflation to a change in monetary policy designed to reduce the price level. For each country model this involves holding official nominal short interest rates one percentage point higher than base for a period of two years, before letting them evolve according to a common monetary policy rule, under which they respond to deviations in output from its trend level and in prices from their target level. The overall output response is, if anything, smaller in the United Kingdom than in either France or Germany, although the response of prices is very similar (see Charts 1 and 2).

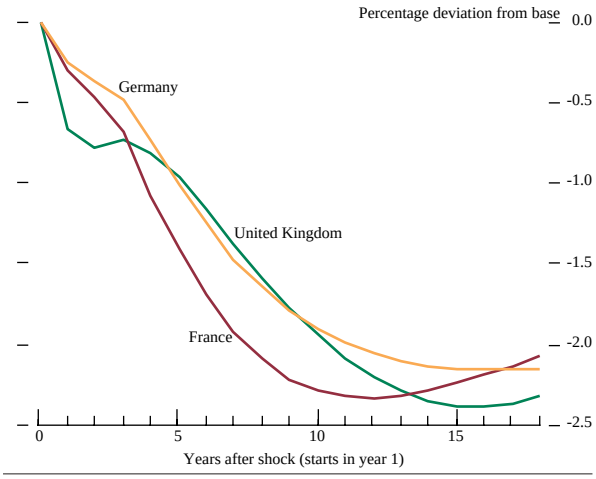
Chart 1
Output response



The economic significance of the estimates can be summarised by weighing up the temporary output cost of

(1) We use the exchange rate overshooting model of Dornbusch, which is an extension of the Mundell-Fleming framework.
(2) Although the informational requirements of rational expectations are quite extreme this model gives a consistent framework to assess cross-country differences, and in the spirit of Currie (1985) it does not rely on expectational errors.
(3) See Appendix for detailed description of the model and estimated results.

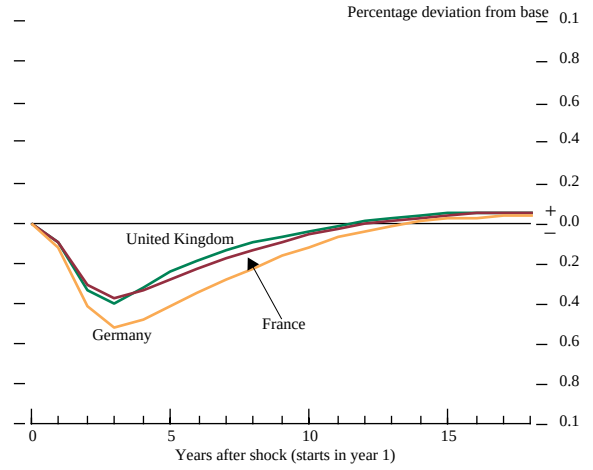
Chart 2
Price level response



the monetary policy change against the reduction in the price level. One way to do this is to calculate a loss function for each country, which sums the squared deviations of output from trend and the squared deviations of the price level from its target, attaching relative weights to these total output and price level 'losses'. The simulation results show that the United Kingdom does not suffer the greatest loss. This holds for any choice of relative weights on output and prices, as long as the same loss function is applied to each country.

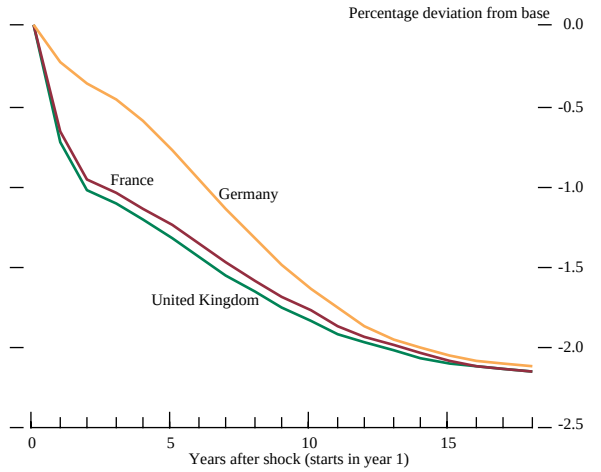
The statistical uncertainty attached to the parameter estimates is quite large, though no larger than in the other approaches described above. Parameter uncertainty maps directly on to the simulated responses of output and prices, and so we cannot be confident that the responses shown in Charts 1 and 2 are significantly different in statistical terms. Moreover, the data do not yield an unique ranking by country of the size of these responses. To illustrate this point, we estimate the model for all three countries jointly, allowing for differences in parameter estimates where justified by the data. This joint model produces much smaller variations between the responses of each country, and the rankings by size of response are also different (see

Chart 3
Output response from joint model



Charts 3 and 4). But though the data do not allow us to identify significant differences in how output and prices respond to an interest rate shock in the three economies, we cannot rule out the possibility that there may be such

Chart 4
Price level response from joint model



differences. Econometric tests of these alternative hypotheses have low power and are unlikely to resolve the issue.

Conclusions

This article has identified some differences between the United Kingdom, France and Germany which are likely to affect the transmission mechanism of monetary policy. Some of these may be structural, others not. So the effects of policy changes are unlikely to be identical in the three countries. More specifically, it has been suggested that a change in interest rates will have a greater short-term output cost in the United Kingdom than in continental Europe.

Many studies have used a quantitative framework to evaluate the importance of these structural differences. But they are inconclusive on whether there is a general distinction between continental Europe and the United Kingdom in the transmission of monetary policy onto output and inflation. Some studies disagree about the ranking of the sensitivity of different countries to a change in interest rates, and others find no major difference in response.

This article discusses a further econometric approach which identifies the key economic relationships and yields estimates of these in three European economies. The results suggest that there are no marked differences between the three economies in the response of output or inflation to a common change in policy interest rates. But these empirical estimates are insufficiently robust to draw a firm conclusion.

The inconclusiveness of the econometric approach leads us to place greater emphasis on economic analysis of the role

of distinguishing features of the three economies, some of which may be structural. But unless we know how these features interact with each other, our information may not be enough to predict macroeconomic responses to a change in monetary policy. And some of the commonly cited differences between the three economies may themselves change in response to monetary policy changes such that they should not be considered structural at all.

We have shown in this article that many of the main links in the monetary policy transmission mechanism may be sensitive to the anti-inflationary credentials of the policy regime. Where these change, as under EMU, responses estimated for past data will be invalid. So even if there have been differences in how countries have responded to a monetary policy shock in the past, we cannot be confident that these differences will persist under a different regime.

Appendix

The theoretical framework which forms the basis of the new research reported in this article is a small structural model of the economy. The model laid out below is the exchange rate overshooting model of Dornbusch *et al* and is well-known in the macroeconomics literature.

1	$m = p + \delta i + \xi y$	(Money demand)
2	$r \equiv i - \Delta p^e$	(Fisher identity)
3	$y = \alpha r + \beta(e + p - p^w)$	(IS curve)
4	$e = e_{(+1)} + (i - i^w)$	(Uncovered interest parity)
5	$\Delta p = \Delta p^e + \gamma(y - y^*)$	(Phillips curve)

m	=	money stock	r	=	real interest rate
p	=	domestic price level	p^w	=	world price level
e	=	nominal exchange rate	i^w	=	world interest rate
i	=	domestic interest rate	y^*	=	equilibrium level of output
y	=	aggregate demand	Δp^e	=	expected inflation

For estimation we separate out aggregate demand into domestic demand and net trade (see detailed model below). Table 1 below gives our estimates of the key long-run parameters in this model, as they relate to the template laid out above. These are calculated from dynamic versions of the model estimated on annual data for 1964–94. Details of the model are shown in Table 2.

Table 1
Estimated long-run parameter values (annual data 1964–94)

	United Kingdom	France	Germany
α (real interest rate effect on demand)	-0.9	-1.4	-1.2
β (real exchange rate effect on demand)	-0.1	-0.3	-0.1
δ (nominal interest rate effect on money demand)	-3.3	-5.5	-2.3
γ (output gap parameter in Phillips curve)	0.5	0.2	0.3
ξ (income elasticity of money demand)	1.0	1.0	1.0

The **elasticity of output with respect to the real interest rate** (α) is larger in France and Germany than in the United Kingdom. This suggests that any structural differences do not make the United Kingdom more sensitive to interest rate changes through the impact upon aggregate demand. The speed of response of demand to a change in real interest rates is also found to be slower in the United Kingdom than elsewhere.

As estimated the **elasticity of exports with respect to the real exchange rate** (β) is small in all three countries. It is most negative in France, with similar estimates for Germany and the United Kingdom. However, dynamic adjustment in the United Kingdom appears more rapid than in the other two economies. There is little *a priori* reason to suppose that this key parameter should be very different across the different economies, and this is confirmed by the estimates.

The data suggest that the parameter δ: **the elasticity of demand for real money balances with respect to the short nominal interest rate**, is greater in France than in the United Kingdom or Germany. The parameter ξ: **the elasticity of demand for real money balances with respect to output and prices** has been imposed to equal one in all three models. This restriction is accepted by the data, and allows us to think of the equations as modelling velocity rather than real money demand. It is assumed that in the long run, the demand for real money balances should be proportional to output; in log form it should equal output plus a constant and a time trend, where the latter picks up to what extent velocity is trended over time. Deviations from this relationship provide the measure of disequilibrium in the demand for money equation.

The parameter estimates of the Phillips curve suggest that γ: **the trade-off between output deviations from trend and the rate of inflation** is larger in the United Kingdom than elsewhere. Thus for a given output gap, prices adjust more quickly in the United Kingdom than in France or Germany, suggesting that there may be less nominal inertia in the United Kingdom. Thus UK prices respond more flexibly (than German prices) to a deviation in rates of growth in output. The results for this parameter suggest that the United Kingdom may not have to sacrifice more cumulative output or employment (in the short run) than Germany or France in order to bring down the rate of inflation. This result is borne out by other pieces of empirical research. Estimates of the coefficient on lagged prices in the Phillips curve gives us a measure of price stickiness, and these also suggest a faster pass-through of a demand shock to inflation in the United Kingdom than in either France or Germany.

Significance of these differences

Although there are some differences in the parameters, it is not clear that they are greater than differences that we would expect when looking at different samples from the same economy. Using joint estimation (pooled regression) finds only the demand elasticity with respect to the real exchange rate and the interest rate elasticity for the demand for money to be statistically different across the three economies. There are also some differences in adjustment parameters and an important difference is found in the relation between import prices and domestic inflation. Here import prices operate less directly on domestic prices for Germany than

either France or the United Kingdom. This could reflect averaging of different shocks and differing degrees of credibility of the monetary authorities in the past.

We therefore cannot be confident that, in general, the parameters are really different. But the different point estimates suggest that the United Kingdom is less sensitive to real interest and real exchange rate changes on demand, and more flexible in its price response, than either France or Germany.

The form of the estimated models is set out below. They are estimated in error correction and detrended form. The models are expressed as log-linear relationships.

The country models (logs)

Domestic demand (net of government spending)

$$\Delta dd = \alpha_0 + \alpha_1 dd_{-1} + \alpha_2 t + \alpha_3 r_{-1} + \alpha_4 \left(p_0 - p^w\right)_{-1} + \alpha_5 \Delta\left(p_0 - p^w\right) + \alpha_6 \Delta r + \alpha_7 \Delta TAX$$

Exports

$$\Delta x = \beta_0 + \beta_1 x_{-1} + \beta_2 \Delta y^w + \beta_3 y^w{}_{-1} + \beta_4 \left(p_x + e + p^w\right)_{-1} + \beta_5 \left(p_x - p\right)_{-1} + \beta_6 \Delta\left(p_x + e - p^w\right) + \beta_7 \Delta\left(p_x - p\right)$$

Imports

$$\Delta z = u_0 + u_1\ z_{-1} + u_2 dd_{-1} + u_3 \Delta dd + u_4 \left(p - p_z\right)_{-1} + u_5 \left(p_z + e - p^w\right)_{-1} + u_6 \Delta\left(p - p_z\right) + u_7 \Delta\left(p_z + e - p^w\right)$$

Phillips curve

$$\Delta p = \gamma_0 + \gamma_2 \Delta\left(y - y^*\right) + \gamma_1 \left(y - y^*\right)_{-1} + \gamma_3 \Delta p_{-1} + u_1 \Delta p_z$$

Money demand

$$\Delta m = \Delta p + \xi_0 + \xi_1 \left(m - p - y\right)_{-1} + \xi_2 t + \xi_3 \Delta i + \xi_4 i_{-1} + \xi_5 \Delta\left(i_L - i\right) + \xi_6 \left(i_L - i\right)_{-1}$$

dd	=	private domestic demand	p_x	=	export prices
x	=	exports	e	=	nominal exchange rate
z	=	imports	p_z	=	import prices
t	=	time trend	m	=	narrow money stock
r	=	real interest rate	p	=	domestic price
p_0	=	price of oil	i_L	=	long nominal interest rate
p^w	=	world prices	i	=	short nominal interest rate
TAX	=	aggregate tax rate	y	=	aggregate output
y^w	=	world income	y^*	=	trend output
			t_i	=	detrending factor

Table 2
Estimated country coefficients

	United Kingdom		France		Germany	
Domestic demand $\Delta(dd\text{-}\tau_1 t)$						
constant	-0.002	(0.3)	0.051	(4.1)	0.004	(0.2)
$(dd\text{-}\tau_1 t)(-1)$	-0.217	(1.7)	-0.346	(2.4)	-0.434	(2.7)
$\Delta(i_L\text{-}i)(-1)$	-0.114	(0.7)				
$\Delta r(-1)$						
$r(-1)$			0.492	(3.6)	-0.505	(2.0)
$r(-2)$	-0.205	(1.5)				
$(p_o\text{-}p^w)(-1)$					-0.008	(0.7)
$\Delta(p_o\text{-}p^w)$	-0.049	(2.8)	-0.012	(1.3)		
Δ(TAX)			-1.585	(1.6)		
Δ(TAX)(-1)					-2.501	(2.1)
dummy 1998	0.116	(4.1)				
Exports $\Delta(x\text{-}\tau_2 t)$						
constant	0.924	(3.0)	1.117	(1.9)	0.645	(1.6)
$(x\text{-}\tau_2 t)(-1)$	-0.719	(3.9)	-0.270	(2.1)	-0.439	(1.8)
$(y^w\text{-}\tau_3 t)(-1)$	0.812	(1.8)	0.540	(2.1)	0.960	(1.8)
$\Delta(y^w\text{-}\tau_3 t)$	0.441	(1.3)	1.149	(4.1)	1.573	(2.0)
$\Delta(p_x\text{+e-}p^w)$	-0.094				-0.471	(1.7)
$(p_x\text{+e-}p^w)$			-0.242	(2.0)		
$(p_x\text{+e-}p^w)(-1)$	-0.212	(3.8)			-0.140	(1.6)
$p_x\text{-}p$	0.196	(3.0)	0.231	(2.3)		
Imports $\Delta(z\text{-}\tau_4 t)$						
					(z-δt)	
constant	-0.264	(2.1)	-0.009	(0.4)	0	(0)
$(z\text{-}\tau_4 t)(-1)$	-0.890	(4.1)	-0.345	(2.1)		
$\Delta(dd\text{-}\tau_1 t)$	1.297	(7.6)	2.130	(10.4)		
$(dd\text{-}\tau_1 t)$					0.883	(5.5)
$(dd\text{-}\tau_1 t)(-1)$	1.187	(3.7)	0.451	(1.1)		
$(p\text{-}p_z)(-1)$	0.056		0.164	(3.4)		
$\Delta(p_z\text{+e-p}^w)$	0.072	(1.0)				
$(p_z\text{+e-}p^w)$			0.006	(1.0)		
Money demand $\Delta(m\text{-}p)$						
constant	-3.316	(4.6)	-2.668	(4.0)	0.481	(6.3)
$(m\text{-}p\text{-}y)(-1)$	-0.501	(4.7)	-0.580	(4.4)	-0.777	(6.4)
t	-0.018	(4.1)	-0.013	(6.0)	0.010	(5.4)
Δy					0.432	(2.3)
$(i_L\text{-}i)(-1)$			-3.397	(3.6)	-0.013	(2.7)
Δi	-0.308	(1.8)	-1.025	(2.0)	-0.013	(2.8)
$i(-1)$	-1.640	(10.1)	-3.168	(5.5)	-1.807	(4.2)
dummy 1978			0.056	(1.6)		
dummy 1990					0.092	(7.2)
Phillips curve Δp						
constant	0.023	(2.0)	0.004	(0.9)	0.014	(4.9)
$\Delta p(-1)$	0.500	(3.3)	0.769	(12.6)	0.483	(5.8)
Δp_z	0.226	(2.8)	0.142	(6.1)	0.084	(4.9)
$\Delta(y\text{-}\tau_5 t)(-1)$	0.424	(1.4)	0.594	(3.4)	0.242	(3.8)
$(y\text{-}\tau_5 t)(-2)$	0.540	(2.7)	0.180	(1.3)	0.329	(4.0)

Note: *t* statistics in brackets.

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