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The Real Effects of Monetary Policy in the European Union: What Are the Differences?

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The main finding of this paper is that the European Union (EU) countries fall into two broad groups according to the effects of monetary policy adjustments on economic activity. Estimates based on a vector autoregression model indicate that the full effects of a contractionary monetary shock on output in one group of EU countries (Austria, Belgium, Finland, Germany, the Netherlands, and the United Kingdom) take roughly twice as long to occur, but are almost twice as deep as in the other group (Denmark, France, Italy, Portugal, Spain, and Sweden). The paper discusses the implications of these results for the effective conduct of monetary policy in the euro area. [JEL E5, E52, E58]

The advent of European Economic and Monetary Union (EMU) scheduled for the beginning of 1999 has sparked off a debate about the best way of conducting monetary policy in the euro area. One dimension of this discussion concerns the preferred framework for conducting monetary policy—that is, about whether the European Central Bank (ECB) ought to tar-

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get inflation, monetary aggregates, or the exchange rate. A second is about differences in the effects of changes in monetary policy on activity in different EU countries, related to differences in the transmission mechanism.

Opinions have tended to be divided on the question of the preferred monetary policy framework for the euro area, although recently, there appears to be a consensus emerging in favor of informal inflation targeting, accompanied by monitoring of monetary aggregates and other indicators.[1] In any event, policy discussions have in general tended to focus less on questions relating to the real effects of monetary policy in the EU than on the issue of the appropriate framework for conducting monetary policy in the euro area. This may be partly due to the fact that many of the issues pertaining to identification of the monetary transmission mechanism tend to be econometric rather than economic. Nevertheless, a proper understanding of possible differences in the effects of changes in monetary policy on activity among the EU countries is crucial for an appreciation of the difficulties that may arise from the implementation of a unified monetary policy throughout the euro area. And this issue is the main focus of the paper.

Recent empirical studies of the effects of monetary policy on activity have focused mainly on a subset of EU countries. Gerlach and Smets (1995), using a vector autoregression (VAR) approach with long-run identifying restrictions, found that the effects of a change in the monetary stance on output were somewhat larger in Germany than in France or Italy, while the United Kingdom fell somewhere in between. However, the differences in the transmission of monetary policy documented in the Gerlach-Smets study were not found to be very large. Barran, Coudert, and Mojon (1996) estimate a VAR using the recursive Choleski identifying assumptions to document the differences in the transmission of monetary policy for a group of EU countries. They find that the effect of a contractionary monetary shock on output is relatively long lasting in Germany, with output (relative to baseline) bottoming out about 10 quarters after the shock, somewhat less long lasting in the United Kingdom with output bottoming out after about 8 quarters, whilst in France output reaches the trough about 6 quarters after the shock.[2] A recent Bank of England study by Britton and Whitley (1997), which simulates a variant of the Mundell-Flemming model to analyze the transmission mechanism, found that the response of output to an interest rate shock was smaller in the United Kingdom than in Germany or France,

[1] See, for instance, the discussions in Monticelli and Papi (1996), Masson and Turtelboom (1997), Ramaswamy (1997), Begg (1997), and EMI (1997).

[2] In this context, a recent study using higher frequency data by Levy and Halikias (1997) indicates that the response of output to changes in the short-term interest rate in France is relatively muted.

but that the differences in the transmission of monetary policy among these countries were not very large. Dornbusch, Favero, and Giavazzi (1998) estimate the impact of a coordinated monetary policy move on activity in a group of EU countries, controlling for intra-European exchange rates. They find that the "impact-effects" of a change in monetary policy are similar in Germany, France, and the United Kingdom, but smaller than in Sweden and Italy. The full effects of the coordinated monetary policy move are, however, lower in the United Kingdom than in Germany and France, a result that is broadly consistent with that of Britton and Whitley (1997).

An interesting finding that emerges from these studies, which use different estimation strategies, is that there are differences in the effects of monetary policy on activity among the large EU countries. However, these differences do not correspond closely to popular perceptions about how output may be expected to respond to changes in monetary policy. In particular, some of these studies indicate that the response of output to monetary policy actions is not more sensitive in the United Kingdom than it is in some "core" EU countries.[3]

This paper analyzes the nature of the differences in the effects of monetary policy on activity in the EU by examining a larger set of EU countries than previous studies.[4] Moreover, unlike previous empirical studies, which have each relied on one particular model specification for estimating the dynamics of the transmission of monetary policy, this paper examines the robustness of the estimates of the response of output to monetary shocks in the different EU countries with respect to alternative specifications of the VAR approach. The main finding is that, based on estimates using the VAR approach, the EU countries fall into two broad groups as far as the transmission of monetary policy is concerned. In one group (Austria, Belgium, Finland, Germany, the Netherlands, and the United Kingdom) output (relative to baseline) typically bottoms out about 11 to 12 quarters following a contractionary monetary shock, with the decline in output being in the range of 0.7 to 0.9 percent from the baseline.[5] In the other group (Denmark,

[3]A good example of popular perceptions about the transmission mechanism in the EU countries is CEPR (1997), which argues that the impact of an interest rate shock on output would be disproportionately large in the United Kingdom because a relatively high proportion of private sector debt is at variable interest rates, partly reflecting the predominance of variable-rate mortgages for house purchase.

[4]The empirical analysis in this paper covers all EU countries except Greece, Luxembourg, and Ireland. These three countries were excluded because of the absence of a sufficiently long quarterly time series of national income accounts.

[5]The monetary shock is of the same dimension for all the countries—a one standard deviation shock to the orthogonalized error term of the interest rate equation in the VAR. It corresponds approximately to a 1 percentage point shock to the interest rate for most EU countries in the sample period under consideration. See the Appendix

France, Italy, Portugal, Spain, and Sweden), output typically bottoms out about 5 to 6 quarters after a contractionary monetary shock, with the decline in output being in the range of 0.4 to 0.6 percent from baseline. It is interesting to note in this context that while these two groups of EU countries bear a relatively close resemblance to the "core" and the "periphery," respectively, that are distinguished in the literature on asymmetric shocks, there are some important differences. The response of activity to monetary shocks in Finland and the United Kingdom corresponds more closely to that of the "EU core," whereas the real effects of monetary policy in France appear to correspond more closely to that of the "EU periphery."[6] It is, of course, important to note that these results are derived on the basis of past relationships between monetary shocks and activity in the EU countries. EMU will constitute a regime shift that could well lead to shifts in behavioral relationships.

I. The Transmission Mechanism: Conceptual Issues

Why does a change in the nominal interest rate affect the level of activity in the economy? An increase in the nominal interest rate is transformed in the short run into an increase in the real interest rate, given that prices are sticky over the near-term horizon.[7] But why does an increase in the real short-term interest rate have relatively strong effects on long-lived assets such as residential and nonresidential investments? The answer to this question leads to the core of the debate on the monetary transmission mechanism. Opinions tend to be divided on the importance of the channels through which an interest rate shock affects activity, although there is a widespread consensus that monetary shocks have real effects in the short run.

There are a number of different channels through which a tightening of monetary policy tends to depress activity. The direct effects of a monetary shock operate through the interest rate channel—the increase in the cost of

for details on how the monetary shock is measured. The focus of this paper is on the response of output to monetary shocks, and not also on the response of prices to monetary shocks. This is done to keep the scope of cross-country comparisons of the transmission mechanism more focused, and also because we do not want to enter in this paper into a detailed discussion of the so-called "price puzzle" for the entire set of EU countries. The price puzzle is the tendency for prices to rise immediately following a contractionary monetary shock; see Leeper, Sims, and Zha (1996) for a more detailed discussion of issues pertaining to the price puzzle.

[6]See Bayoumi and Eichengreen (1996) for an overview of the discussion on asymmetric shocks in the EU.

[7]For discussions regarding the emerging consensus on the real effects of monetary shocks, see Bernanke and Gertler (1995); Taylor (1995); and Solow (1997).

capital leads to declines in the interest-sensitive components of aggregate demand. The exchange rate channel of the transmission mechanism becomes more important in small open economies—a monetary tightening causes the nominal exchange rate to appreciate, which, given nominal rigidities, translates into a short-run appreciation of the real exchange rate, which tends to compress net exports. Some have emphasized the asset price channel as the crucial ingredient in explaining the short-run real effects of monetary policy.[8] An increase in short-term interest rates leads to falls in the prices of a wide range of assets, which in turn reduces consumption expenditure through wealth effects, and investment expenditure through Tobin's q-effects. The credit channel of the monetary transmission mechanism has been emphasized by economists who are skeptical of the strength of the cost-of-capital and wealth effects on aggregate demand.[9] Thus, in the "credit-view," the contractionary impulses of monetary policy are transmitted to a large extent through declines in bank lending.

Given the ongoing debate about the relative importance of the different channels of the monetary transmission mechanism, the choice of any one particular structural model over another for empirical estimation may tend quickly to get mired in controversy. Consequently, recent empirical investigations of the transmission of monetary policy have tended to be based largely on reduced-form VARs. A VAR essentially consists of a set of equations in which each variable in the system is determined by its own lagged values and the lags of all the other variables in the system. The VAR approach, despite its black-box nature, is particularly useful when the main objective of the empirical exercise is to derive an estimate of the statistical relationship between a set of variables—as in this case, between monetary shocks and output—without necessarily wanting to unravel, or to establish the relative importance of, the various channels of the transmission mechanism. The VAR approach also provides an appropriate framework for making cross-country comparisons—the same reduced-form equations can be used in all countries for estimating the response of output to monetary shocks. In addition, the VAR approach allows, as it were, the data to speak, when there are no clear priors about the shape of the impulse responses for the different countries.

To draw valid empirical inferences about the response of output to changes in monetary policy, we need an appropriate way of identifying the monetary shocks inherent in the data. As noted in the introduction, there are two dimensions to the conduct of monetary policy. One is that central banks

[8]See Meltzer (1995) for a good overview of the monetarist position.
[9]See Bernanke and Gertler for a discussion of the "credit-view" (1995).

adjust the instruments of monetary policy—usually one or more key short-term interest rates—in response to changes in variables related to their objectives—the reaction function. The other is that actions taken by the central bank to adjust the instruments of monetary policy affect the real economy. Since our interest in this paper is on this latter issue, it requires an empirical strategy for identifying the policy-induced component of changes in output. A starting point for doing this is to focus on short-term interest rates rather than on money or reserves for identifying monetary policy innovations. Most central banks smooth overnight or other short-term interest rates, changing them only when they deliberately intend to change the stance of monetary policy. Consequently, changes in money or commercial banks' reserves typically reflect demand shocks rather than policy induced shocks.[10] The estimation strategy adopted in this paper for quantifying the impact of a policy-induced change in short-term interest rates on output is discussed in the Appendix. Given proper identifying restrictions, the fact that the monetary authorities in different countries may have different reaction functions should not in principle affect estimated cross-country differences in the effects of monetary policy in the EU.

II. Empirical Estimations

This paper follows the general convention in the empirical literature on the transmission of monetary policy by estimating a VAR with three variables for all EU countries: the level of output, the level of prices, and a short-term interest rate.[11] The data span the period from 1972:1 to 1995:4. As can be seen from Table A1, both the Dickey-Fuller and the Phillips-Perron tests indicate that both the level of output and the level of prices are nonstationary in all the EU countries used in the sample. Why then is the VAR specified in levels rather than in the first differences of the variables, given that time series normally ought to be stationary for making valid statistical inferences? The answer to this question involves an assessment of the trade-off between the loss of efficiency (when the VAR is estimated unrestricted in levels) and the loss of information (when the VAR is estimated in first differences), and is discussed in the Appendix. The reasons for preferring the unrestricted version of the VAR to that of imposing cointegration restrictions, and the robustness of the results to alternative specifications of the VAR are also examined in the Appendix. However, in addition to the statistical criteria, there is an economic argument for estimating

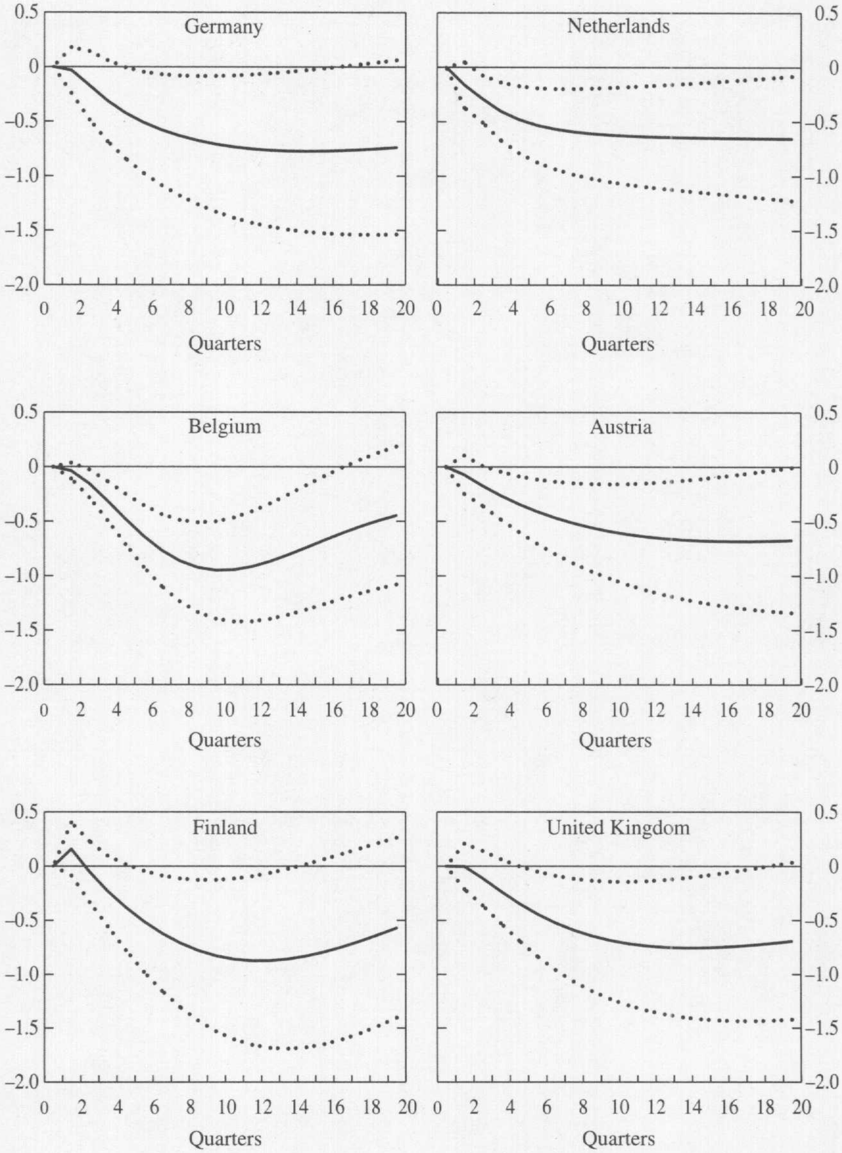
[10]For a more detailed discussion of these issues see Bernanke and Blinder (1992), Christiano, Eichenbaum, and Evans (1994), and Bernanke and Mihov (1996).
[11]See the Appendix for a description of the data sets used in this study.

the VAR in levels rather than in first differences. The impulse response of the first difference of output to an interest rate shock tends to have the implication that monetary shocks have a permanent impact on the level of output. In contrast, in the case of the impulse response of the level of output to an interest rate shock, history determines whether the effects of monetary shocks are long lasting or not. This is the reason why much of the literature on this topic estimates the VAR in levels.

The VAR is estimated with two lags based on both the Akaike and Schwartz criteria (Table A2). Experimenting with longer lag lengths (both 4 and 6 lags) did not change the results of the estimations very much. Figures 1 and 2 trace the response of output in the various EU countries to a standardized monetary shock. The EU countries fall into two broad groups as far as the response of output to monetary shocks is concerned. In one group (Austria, Belgium, Finland, Germany, the Netherlands, and the United Kingdom), output typically bottoms out (relative to baseline) about 11 to 12 quarters after a contractionary monetary shock. There are some small differences within this group in the magnitude of the decline in output from baseline. In Austria, Germany, the Netherlands, and the United Kingdom, the decline in output following a monetary shock is about 0.7 to 0.8 percent from baseline. The decline in output following an interest rate shock is, however, deeper in Belgium and Finland (about 0.9 percent from baseline), but the impact of the monetary shock tends to dissipate after about 12 quarters in these two countries. In the other group of countries (Denmark, France, Italy, Portugal, Spain, and Sweden), output typically bottoms out about 5 to 6 quarters after a contractionary monetary shock. Again, there are some differences within this latter group in the magnitude of the decline in output from baseline. In Denmark, France, and Spain, the decline in output following a monetary shock is about 0.3 to 0.4 percent from baseline, while it is about 0.5 to 0.6 percent from baseline in Italy, Portugal, and Sweden. The impact of the monetary shock on output tends to dissipate after bottoming out in most countries of this latter broad group. These results are relatively stable when estimations are carried out with the inclusion of the nominal exchange rate in the VAR, except most notably in the case of Sweden, where there was a dampening of the response of output to the interest rate shock (see Appendix for details).[12] Imposing cointegration restrictions on the VAR does not in general change the shape of the impulse responses derived from the unrestricted VAR for the EU countries, but it alters the deviation of output from baseline for some EU countries

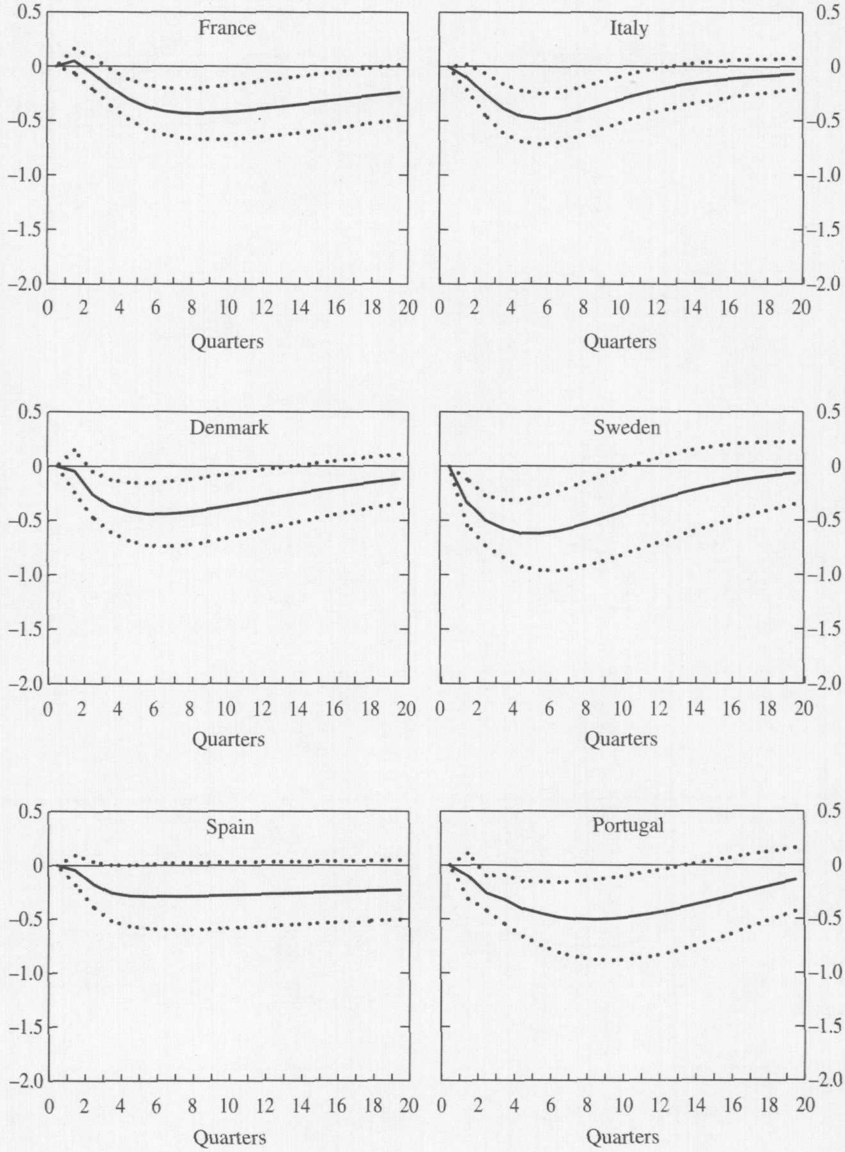
[12]The impulse response function estimated with the three-variable VAR for Sweden is broadly consistent with the results obtained by Thomas (1997), using a simulation model of the IS/LM variety for Sweden.

Figure 1. *Impulse Response of Output to an Interest Rate Shock*[1]
(In percent deviation from baseline)



[1]Dotted lines denote two standard error bands.

Figure 2. *Impulse Response of Output to an Interest Rate Shock*[1]
(In percent deviation from baseline)



[1]Dotted lines denote two standard error bands.

(see Appendix for details). Using a shorter sample period for the estimations (1981:1 to 1995:4) also did not change the results markedly.

What accounts for this particular pattern of impulse responses of activity to monetary shocks in the EU countries? Cross-country differences in financial structures—such as the importance of fixed versus flexible mortgages, bond financing versus bank financing, and the extent of indebtedness of households and firms—should presumably provide explanations for the observed differences in the transmission of monetary policy. However, while differences in financial structures among the EU countries provide potential explanations for the differences in the transmission of monetary policy in some cases, they do not do so in other cases. For instance, there is no convincing explanation for why the impulse response of activity to monetary shocks is similar in the United Kingdom and Germany despite the significant differences in their financial structures. The explanation may possibly have something to do with the effects of a complex, but not clearly understood, interaction between financial structures and labor market flexibility. These puzzles should provide a rich agenda for future research on this topic.

III. Conclusion

There are two basic preconditions that determine the ability to conduct monetary policy smoothly in the euro area. One is a framework that can provide stable feedback rules for the monetary authority to react in a timely way to prospective changes in activity and inflation. The other is the need for the real effects of monetary policy to be relatively uniform across the different EU countries. The latter issue has been the focus of this paper, with the main finding being that the EU countries fall into two broad groups. Based on the results from the methodological approach used in this paper, the full effects of a contractionary monetary shock on activity take roughly twice as long to occur but the resulting decline in output is almost twice as deep in one group of EU countries (Austria, Belgium, Finland, Germany, the Netherlands, and the United Kingdom) as in the other group (Denmark, France, Italy, Portugal, Spain, and Sweden). It is interesting to note in this context that the distinction between the two groups of EU countries in relation to the effects of monetary policy does not overlap fully with the traditional distinction made between the "core" and the "periphery" of the EU.

Thus, based on past experience, there appear to be marked differences in the real effects of monetary policy among the EU countries. However, the important question is to what extent these differences are likely to carry through once the euro comes into circulation. The answer to this question can only, of course, be speculative. On the basis of the results in this paper about the extent of the differences in the effects of monetary policy on activity among the EU countries, the conjecture is that the task of conducting monetary policy at the EU-wide level is likely to be a challenging one in the initial years of the monetary union. However, the creation of a single financial market, and the operation of the common monetary policy, is likely to be a regime change that will narrow over time the differences in the transmission of monetary policy among the EU countries. It is perhaps very likely that the harmonization of the transmission of monetary policy will take place more rapidly than the harmonization of the "real side" of the EU countries.

APPENDIX

Specification and Identification Strategies

The Appendix discusses in greater detail two sets of conceptual issues relating to the estimation strategy that were noted in the main text. The first is the appropriate specification of the VARs; the second is the method used for identifying monetary shocks. The main issue regarding specification is whether the model should be estimated in levels, pure differences, or as a vector error correction model. This section discusses the criteria for choosing among them. It turns out that in the case of the EU countries, for the sample period under consideration, the impulse responses of output to an interest rate shock do not in general change significantly when alternative specifications are used. The issue of identification is related to the empirical strategy of obtaining a measure of the purely policy-induced change in interest rates.

Specification

In deciding on which particular specification of the VAR to use, it is necessary to confront the trade-off between (statistical) efficiency and the potential loss of information that takes place when economic time series are differenced. A VAR specified in differences, when the time series are nonstationary, will generate estimates that are efficient, but will ignore potential important long-run relationships.

More generally, there are three different ways of specifying a VAR when the time series under consideration are nonstationary. The VAR can be specified in pure differences; it can be specified in levels without imposing any restrictions; or it can be specified as a vector error correction model to allow for the existence of cointegration. In general, the vector error correction specification can generate efficient estimates without losing information about the long-run relationships among the variables.

If cointegration exists, and the true cointegrating relationship is both known and can be given an economic interpretation, the VAR should be estimated using the vector error correction model with the reduced rank estimation suggested by Johansen (1995). However, if the true cointegrating relationships are unknown, and furthermore, when the relationships are not the main focus of the analysis, then imposing cointegration may not be the appropriate estimation strategy. Imposing inappropriate cointegration relationships can lead to biased estimates and hence bias the impulse-responses derived from the reduced form VARs. In cases where there is no a priori economic theory that can suggest either the number of long-run relationships or how they should be interpreted (as is the case with the set of variables under consideration in this paper), it is reasonable not to impose the restriction of cointegration on the VAR model.[13]

Consequently, an unrestricted VAR in levels has been chosen as the preferred specification in this paper. It is, nevertheless, still interesting to test how robust the results are to alternative specifications of the VAR. In order to do this, cointegration is imposed as follows. We first test for the number of cointegrating relationships in the VAR, and then impose these cointegrating vectors on the VAR. The cointegrating vectors are derived assuming a linear trend in the data and furthermore an intercept but no trend in the cointegrating vector. The impulse responses generated from this vector error correction model (i.e., by imposing cointegration on the basic VAR) are reported in Figures A1 and A2. It can be seen that imposing cointegration on the VAR does not in general change the shape of the impulse responses derived from the unrestricted VAR for the EU countries, but it alters the deviation of output from baseline for some EU countries. Figures A3 and A4 show the impulse responses generated by including the nominal exchange rate in the unrestricted VAR.[14]

Identification

The VAR model that is estimated is of the reduced form

$$X_t = A_1 X_{t-1} + \dots + A_p X_{t-p} + u_t , \tag{A1}$$

where X_t is a vector of variables at time t and with the variance covariance matrix $E[u_t u_t']=\Omega$ of the innovations, u_t.

This reduced form can be represented in terms of its structural version

$$X_t = B_0 X_t + B_1 X_{t-1} + \dots + B_p X_{t-p} + \varepsilon_t , \tag{A2}$$

where ε_t is called the primitive shocks, which we are trying to identify through the estimates of the reduced form in equation (A1).

Rewriting the reduced form in terms of the structural form and defining $A(0) = [I-B_0]^{-1}$, we get $A_i = A(0)B_i$ for $i=1, \dots ,n$. This in turn leads us to the relationship between the innovations and the primitive shocks

$$u_t = A(0)\varepsilon_t . \tag{A3}$$

[13] A number of empirical studies of the transmission mechanism have tended to follow the route of estimating VARs that are unrestricted in levels. See, for instance, Bernanke and Blinder (1992), Christiano, Eichenbaum, and Evans (1994) and Leeper, Sims, and Zha (1996). In this context, Faust and Leeper (1997) argue that imposing long-run restrictions does not necessarily provide a reliable basis for drawing structural inferences.

[14] The nominal exchange rate used is the bilateral deutsche mark exchange rate for all countries. In the case of Germany, the bilateral dollar exchange rate is used.

Figure A1. *Impulse Response of Output to an Interest Rate Shock*[1]
(In percent deviation from baseline)

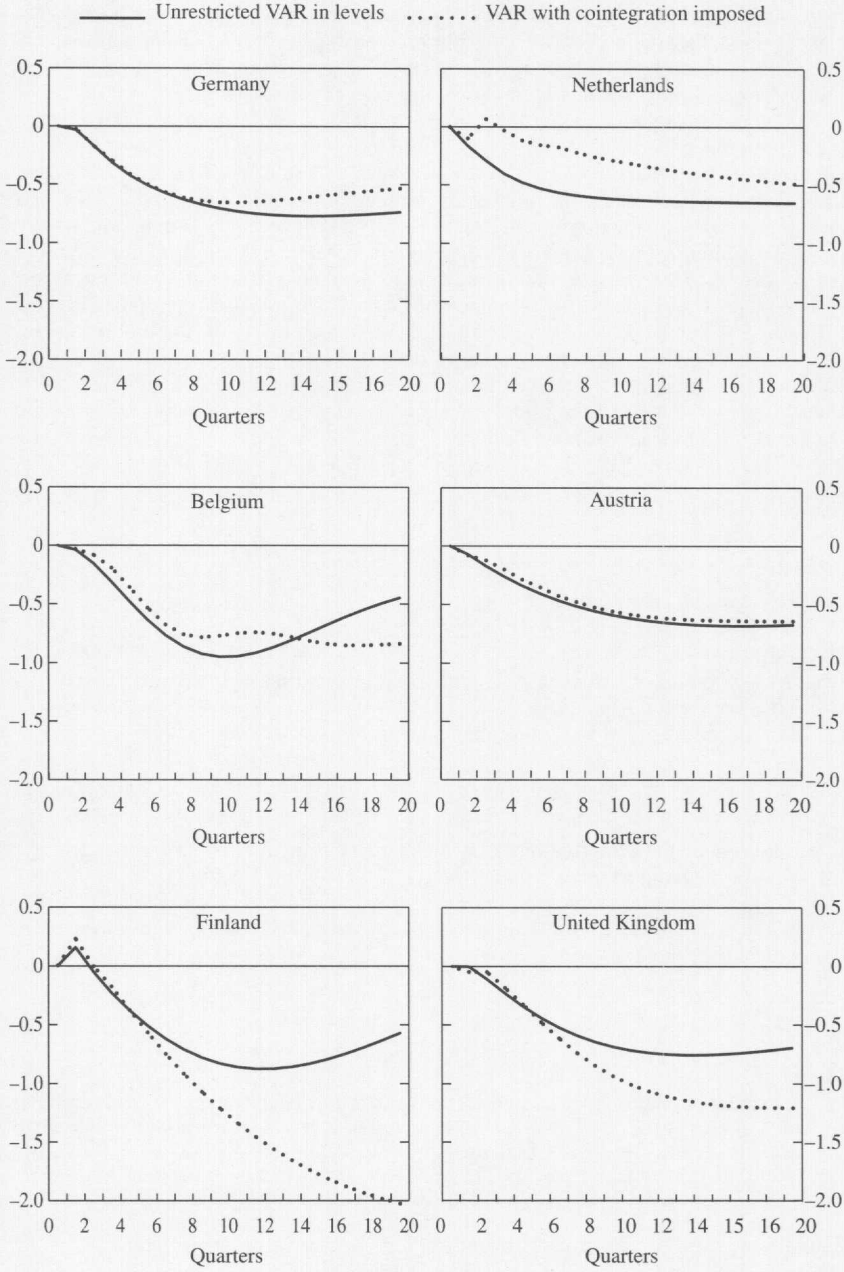


Figure A2. *Impulse Response of Output to an Interest Rate Shock*[1]
(In percent deviation from baseline)

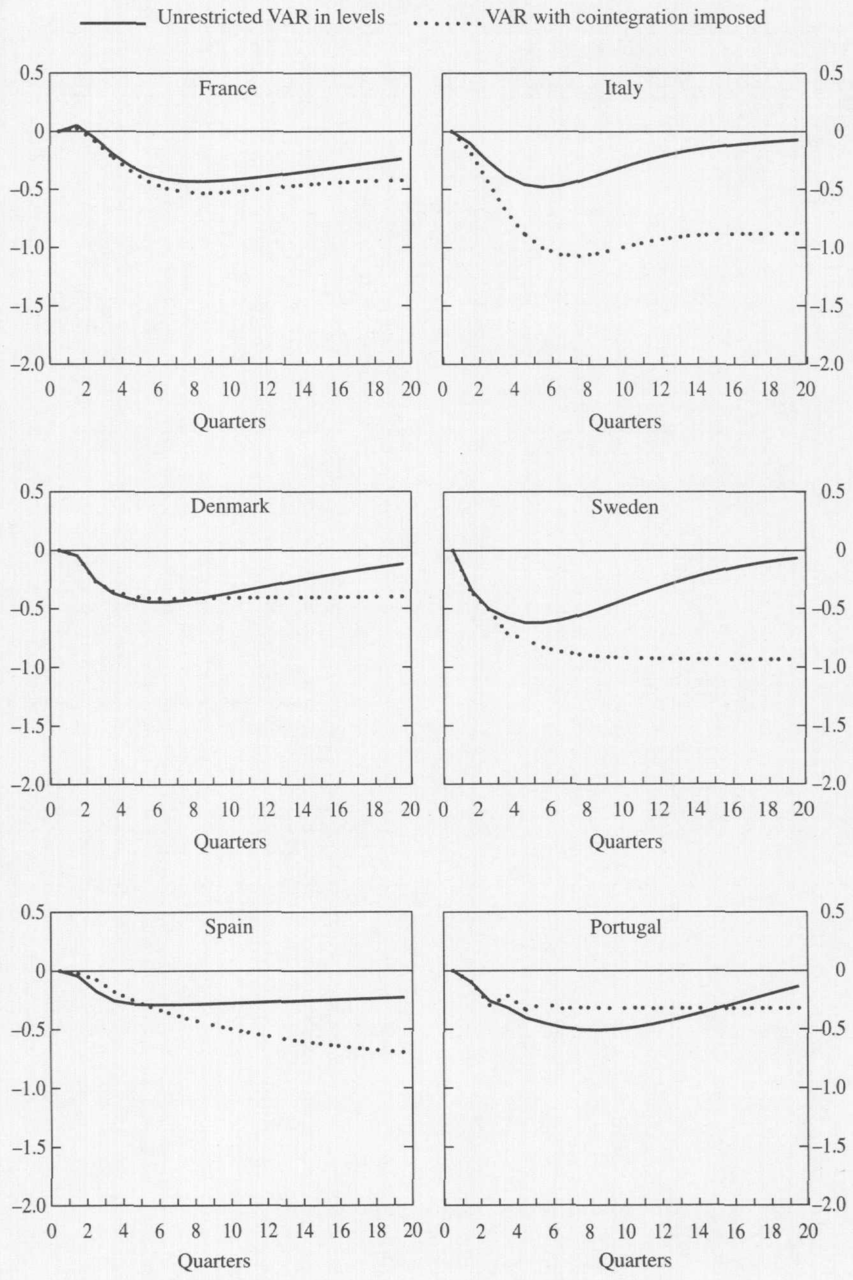
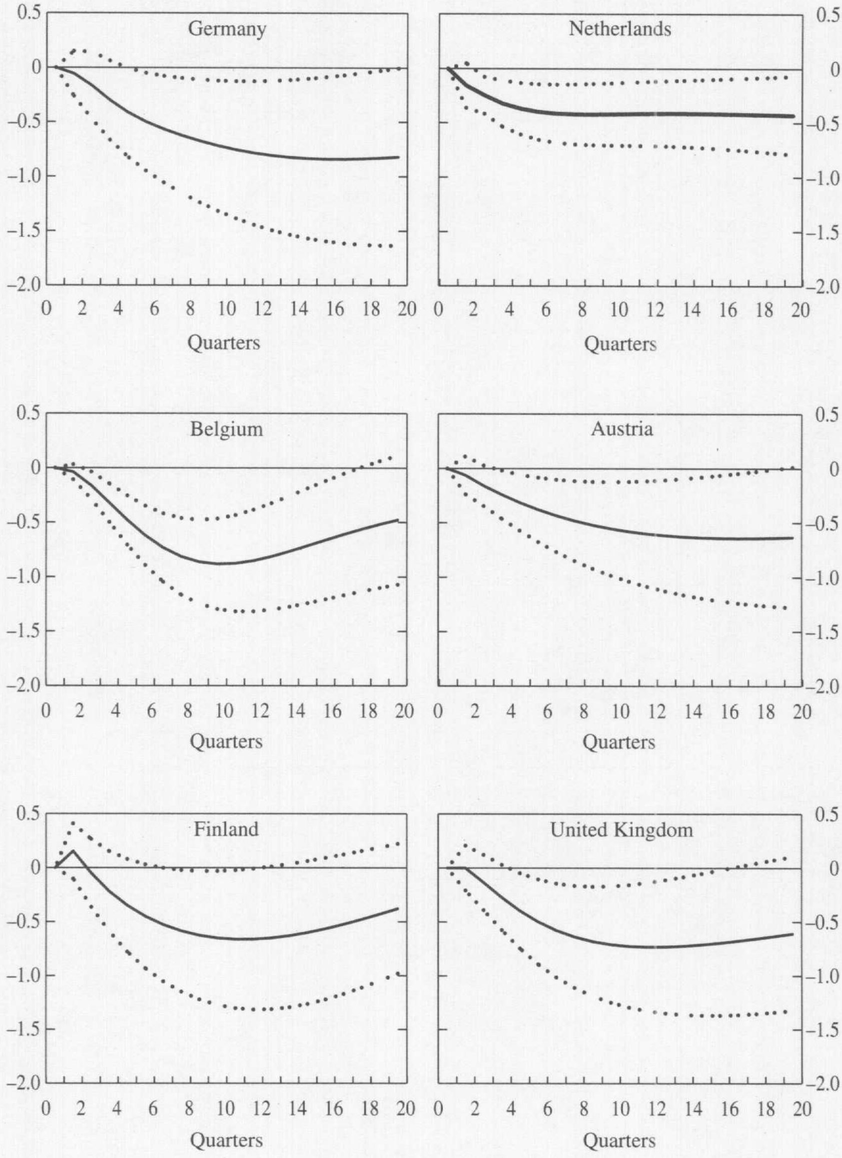
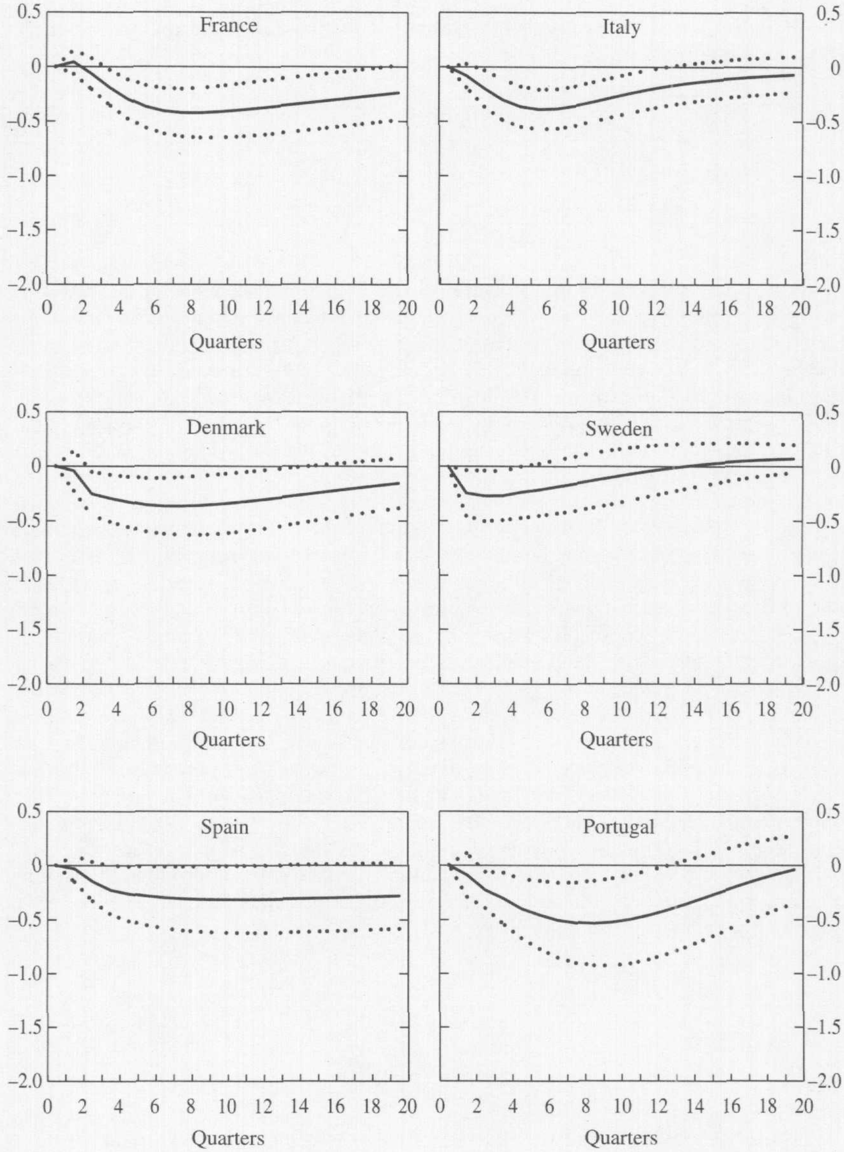


Figure A3. *Impulse Response of Output to an Interest Rate Shock (Exchange Rate Included)*[1]
(In percent deviation from baseline)



[1]Dotted lines denote two standard error bands.

Figure A4. *Impulse Response of Output to an Interest Rate Shock (Exchange Rate Included)*[1]
(In percent deviation from baseline)



[1]Dotted lines denote two standard error bands.

Hence,

$$E[u_t\, u_t']=\Omega=A(0)A(0)'. \tag{A4}$$

The impulse-response functions to the structural shocks can be obtained through the MA-representation

$$X_t=[I\text{-}B(L)]^{-1}\,\varepsilon_t=\gamma(L)\varepsilon_t\,. \tag{A5}$$

From equations (A2) and (A3) we can calculate $\gamma(L)$ as

$$\gamma(L)=[I\text{-}A(L)]^{-1}A(0)\,. \tag{A6}$$

We now have to identify the structural shocks, which is done by determining the n^2 elements of $A(0)$. As the variance-covariance matrix is known from the estimation of equation (A2), we have to solve equation (A4) for $A(0)$, and then calculate ε_t from equation (A3). However, equation (A4) provides only $n(n+1)/2$ nonlinear restrictions on the n^2 elements of $A(0)$. Hence $n(n-1)/2$ additional restrictions are needed for identification.

There are different identification approaches that can be used: (1) the traditional Choleski decomposition, where it is assumed that $A(0)$ is lower triangular, and a recursive decomposition of the Ω matrix is used; (2) restrictions of the form that some variables cannot contemporaneously affect each other (through restrictions on B_0)—which we call the Bernanke-Blinder restrictions; (3) long-run a priori theoretical restrictions on $B(1)$ or $A(1)$; and (4) some combination of these three identification schemes, for example by restricting elements of the covariance matrix to be of a certain value using what are called "informal restrictions on the reasonableness of the impulse responses."[15]

In using the VAR approach we are primarily interested in the response of output to a shock to the interest rate. To do this we assume that a shock to the interest rate has no contemporaneous effect on output. This assumption can be implemented through either the recursive Choleski decomposition or the Bernanke-Blinder restrictions. Put more technically, both the recursive Choleski decomposition and the Bernanke-Blinder restrictions identify monetary policy by taking the residuals from the reduced form of the interest rate equation and regressing them on the residuals from the output and the price equations.[16] Since we are only interested in the effects of monetary policy on output, these two identification schemes yield the same impulse-response functions. The only difference between these two identification procedures is that the Choleski decomposition, unlike the Bernanke-Blinder restrictions, assumes in addition that prices have no contemporaneous effect on income.

[15] See Leeper, Sims, and Zha (1996) for a more detailed discussion.

[16] Actually two identification schemes are suggested in Bernanke and Blinder (1992). We however only focus on the scheme where there is no contemporaneous effect of monetary policy on output. Their other identification scheme suggests that the policy variable does not respond contemporaneously to changes in the nonpolicy variables.

Data Sources

Data are obtained from the IMF's *International Financial Statistics* (IFS) and from the Analytical Database of the OECD. Output and prices are in logs and are seasonally adjusted.

The series on real GDP is defined in national currency and is obtained from the OECD database (the series called *GDPV*). The series on the consumer price index is obtained from the IFS (no. 64 for each national series). The nominal interest rate is the money market rate, and is obtained from the IFS (series no. 60b).

For all countries quarterly data are used covering the period 1972:01–1995:04, except for Finland, where we only had data covering 1978:01–1995:04, and Portugal, for which data cover 1981:01–1994:04.

Table A1. *Unit Root Analysis*
(The number of lagged differences included in the Dickey-Fuller test is 2 and for the Phillips-Perron test the Bartlett Kernel is 3)

		With trend	
Country	Variable	Dickey-Fuller	Phillips-Perron
Austria	*Y*	–2.98	–3.02
	P	–2.47	–2.73
	i	–2.96	–2.54
Belgium	*Y*	–2.49	–2.92
	P	–1.78	–1.02
	i	–3.06	–2.71
Denmark	*Y*	–2.41	–2.81
	P	–0.33	0.35
	i	–3.05	–3.55
Finland	*Y*	–1.24	–1.28
	P	–1.30	–0.20
	i	–1.81	–2.89
France	*Y*	–2.77	–2.24
	P	–0.82	0.82
	i	–3.35	–2.63
Germany	*Y*	–1.78	–1.55
	P	–2.20	–2.47
	i	–3.22	–2.47
Italy	*Y*	–2.98	–2.07
	P	–0.81	0.00
	i	–3.03	–2.60
Netherlands	*Y*	–1.93	–2.30
	P	–2.86	–2.65
	i	–3.58	–3.54
Portugal	*Y*	–2.69	–2.53
	P	–0.64	1.71
	i	–2.28	–2.80
Spain	*Y*	–2.17	–2.09
	P	–0.30	0.60
	i	–3.43	–4.90
Sweden	*Y*	–1.98	–2.41
	P	0.36	0.95
	i	–3.23	–5.27
United Kingdom	*Y*	–2.08	–2.04
	P	–1.67	–0.78
	i	–2.10	–1.90

Notes: *Y* denotes real GDP; *P* denotes the consumer price index; and *i* denotes the money market interest rate. Critical values (1, 5, and 10 percent) taken from MacKinnon (1991); Dickey-Fuller and Phillips-Perron without trend –3.50, –2.89, – 2.58); Dickey-Fuller and Phillips-Perron with trend (–4.06, –3.46, –3.15).

Table A2. *Choice of Lag Length*
(Carried out for basic model with output, consumer prices, and short interest rate)

VAR lag length	Akaike	Schwartz	Log-likelihood
Austria			
1	−19.93	−19.61	697.00
2	−20.09	−19.53	706.30
3	−20.10	−19.28	708.26
4	−20.12	−19.05	710.88
5	−20.00	−18.67	706.99
6	−20.07	−18.49	712.13
7	−20.09	−18.24	714.65
8	−20.23	−18.12	722.68
Belgium			
1	−20.26	−19.94	712.66
2	−21.34	−20.77	764.86
3	−21.94	−21.12	793.61
4	−21.84	−20.77	789.88
5	−21.78	−20.46	788.28
6	−22.51	−20.92	821.64
7	−23.04	−21.20	846.03
8	−23.10	−20.99	848.87
Denmark			
1	−17.06	−16.74	560.57
2	−17.14	−16.59	567.26
3	−16.99	−16.17	563.62
4	−17.02	−15.95	568.27
5	−16.83	−15.51	562.93
6	−16.69	−15.10	559.85
7	−16.61	−14.76	559.66
8	−16.58	−14.47	562.14
Finland			
1	−17.92	−17.54	452.59
2	−18.49	−17.81	475.15
3	−18.34	−17.37	472.51
4	−18.40	−17.12	477.06
5	−18.48	−16.90	482.29
6	−18.28	−16.39	478.39
7	−18.25	−16.04	480.00
8	−18.15	−15.62	479.39
France			
1	−20.54	−20.21	725.59
2	−21.08	−20.51	752.76
3	−20.97	−20.16	748.86
4	−20.82	−19.75	743.00
5	−20.88	−19.55	747.07
6	−20.85	−19.26	746.92
7	−21.02	−19.17	755.93
8	−21.03	−18.92	757.78
Germany			
1	−17.06	−16.74	560.57
2	−17.14	−16.58	567.26
3	−16.99	−16.17	563.62
4	−17.02	−15.95	568.27
5	−16.83	−15.51	562.93
6	−16.69	−15.10	559.85
7	−16.61	−14.76	559.66
8	−16.58	−14.47	562.14

Table A2. *(concluded)*

VAR lag length	Akaike	Schwartz	Log-likelihood
Italy			
1	−19.21	−18.89	662.57
2	−19.79	−19.22	691.83
3	−19.67	−18.85	688.31
4	−19.58	−18.51	686.20
5	−19.51	−18.19	685.05
6	−19.49	−17.91	686.04
7	−19.68	−17.83	696.29
8	−19.63	−17.51	695.95
Netherlands			
1	−17.99	−17.67	604.81
2	−18.15	−17.58	614.99
3	−18.25	−17.43	622.17
4	−18.15	−17.08	620.07
5	−18.21	−16.88	625.52
6	−18.19	−16.60	627.25
7	−18.11	−16.27	626.75
8	−18.05	−15.94	626.66
Portugal			
1	−16.14	−15.71	304.31
2	−16.27	−15.50	311.46
3	−15.98	−14.86	307.27
4	−16.03	−14.56	312.34
5	−15.87	−14.05	312.05
6	−15.69	−13.51	311.40
7	−15.69	−13.14	315.34
8	−16.33	−13.40	334.50
Spain			
1	−16.37	−16.00	430.11
2	−16.33	−15.69	432.00
3	−16.31	−15.38	434.92
4	−16.30	−15.09	438.23
5	−16.40	−14.90	445.42
6	−16.67	−14.87	458.54
7	−16.77	−14.67	465.69
8	−17.25	−14.84	485.79
Sweden			
1	−16.12	−15.80	516.07
2	−16.28	−15.72	527.21
3	−16.13	−15.32	523.84
4	−16.12	−15.05	526.80
5	−16.08	−14.75	528.61
6	−16.01	−14.43	529.36
7	−15.85	−14.01	526.08
8	−15.71	−13.60	523.84
United Kingdom			
1	−17.49	−17.17	581.05
2	−17.84	−17.27	600.47
3	−17.77	−16.95	599.97
4	−17.70	−16.63	599.41
5	−17.84	−16.51	608.69
6	−17.80	−16.22	610.03
7	−17.86	−16.02	615.86
8	−17.83	−15.72	616.90

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