

IMF WORKING PAPER

© 1995 International Monetary Fund

This is a Working Paper and the author(s) would welcome any comments on the present text. Citations should refer to a Working Paper of the International Monetary Fund, mentioning the author(s), and the date of issuance. The views expressed are those of the author(s) and do not necessarily represent those of the Fund.

WP/95/40

INTERNATIONAL MONETARY FUND

European I Department

**Recession and Recovery in the United Kingdom in the 1990s:
A Vector Autoregression Approach**

Prepared by Luis Catão and Ramana Ramaswamy ^{1/}

Authorized for distribution by Martin Fetherston

April 1995

Abstract

This paper uses a vector autoregression (VAR) approach to identify the causes of the 1990-92 recession in the UK. The VAR approach is shown to be particularly pertinent for quantifying the relative magnitude of the different demand shocks, and in decomposing them into monetary and expectational factors. The main finding is that the recent recession was precipitated primarily by shocks to consumption, and that monetary factors explain just part of this contraction. The VAR model also offers interesting insights about the long duration of the recession and the nature of the recovery that is currently underway.

JEL: E32, C32

^{1/} We are grateful to Michael Deppler, Martin Fetherston, Alex Hoffmaister, Eswar Prasad, Angel Ubide-Querol, and especially, John Green and Brian Henry for their comments on earlier versions of this paper. We are also grateful to the participants in the European I seminar for their comments. Fritz Pierre-Louis assisted ably with the data processing.

Table of Contents

Summary	iii
1. Introduction	1
2. Methodology	4
3. Results of first stage VAR	7
4. Results of enlarged VAR	10
5. Focusing on consumption dynamics	13
6. Observations on the recovery	14
7. Conclusions	14
 Appendix	
Orthogonalization Procedure for Impulse-response Analysis using Structural Restrictions	15
 Tables	
1. First Stage VAR Shocks (Cumulated from 1990:1)	8
2. First Stage VAR Shocks (Cumulated from 1979:3)	9
3. Enlarged VAR Shocks (Cumulated from 1990:1)	11
A1. Unit Root Tests	16
 Charts	
1. Gross Domestic Product	2a
2. Policy Stance	2b
3. Net Exports: Contribution to GDP Growth	2c
4. Aggregate Demand Indicators	2d
5. Impulse Response to a 1 Percent Negative Shock	14a
 References	17

Summary

The U.K. economy experienced one of its worst postwar recessions in 1990-92, when output declined by a cumulative 3 1/2 percent. This paper uses a vector autoregression (VAR) model to identify the shocks that were instrumental in causing the recession. The VAR approach is particularly useful when there are no strong priors about what caused the recession; it allows competing hypotheses of the recession to be distinguished without imposing many restrictions on the data.

The main finding of this paper is that the recent recession in the United Kingdom was precipitated primarily by shocks to consumption. This stands in marked contrast to the experience in 1979-81, when investment shocks were the main cause of the recession. The VAR analysis indicates that consumption shocks have a long lasting effect on GDP and, hence, offers a potential explanation for the long duration of the recession as well. The nature of the recovery taking place in the United Kingdom is shown to be basically consistent with the results of the model.

The VAR approach also allows a decomposition of the impact of monetary policy and expectational shocks on activity. The results of the paper indicate that the recent recession can be explained only in part by the prior monetary tightening and the subsequent collapse of the housing market. Expectational shocks are shown to have been equally important in bringing about the recession.

1. Introduction

After a sustained expansion of output which began in the second half of 1981, the U.K. economy experienced a decline in real GDP starting in the second quarter of 1990, which continued into the first quarter of 1992. The cumulative fall in output over the two years amounted to more than 3 1/2 percent, in contrast to the 1979-81 recession, when output declined by about 4 1/2 percent over a period of 6 quarters (Chart 1). This paper seeks to identify the shocks which were instrumental in causing the recession in 1990, and to analyze how these shocks impinged on the persistence of the recession as well as on the nature of the subsequent recovery.

The obvious contenders that could qualify as possible proximate causes of the recession in 1990 are: (1) changes in the stance of fiscal policy; (2) shocks arising from the external sector; (3) the stance of monetary policy preceding the recession; and (4) shocks to individual demand components. This paper starts by providing an intuitive discussion of the various possible factors that could have induced the recession, and then proceeds to offer a more rigorous analysis of the proximate causes using a vector autoregression (VAR) approach.

A cursory examination of the data fails to provide support for the hypothesis that fiscal and external shocks were instrumental in precipitating the recession. As can be seen from Chart 2, the fiscal impulse measure for the United Kingdom was expansionary when the economy went into recession, and except for a brief contractionary interlude in mid-1991, remained strongly positive well into 1993. ^{1/} This stands out in marked contrast to the 1979-81 recession, when the fiscal impulse was strongly contractionary. The external sector's contribution to output growth was also positive when the economy went into recession. However, as Chart 3 shows, the external sector's contribution to growth started to decline as the recession got underway, and this may have possibly contributed to prolonging the recession. This again stands in contrast with the experience in 1979-81, when the external sector's contribution to growth was negative at the start of the recession.

As regards the role of monetary policy, the policy stance was tightened sharply beginning in mid-1988. Base rates were increased from a low of 7 1/2 percent in May 1988 to 13 percent by the end of that year and further to a high of 15 percent by the fourth quarter of 1989. Real interest rates were relatively high in this period and, in fact, averaged over 7 percent in the second half of 1989. Base rates continued to remain at high levels until January 1991, when they were 14 percent, before tapering off through a series of reductions to 10 1/2 percent by the last quarter of 1991. An index of monetary conditions (a weighted average of the interest rate and exchange rate), which provides a broader measure of the monetary stance, indicates that monetary policy was even more restrictive around 8 quarters

^{1/} The fiscal impulse measure, defined as the change in the structural balance, provides one particular indicator of the impact of fiscal policy on activity. A positive value for the fiscal impulse indicates an expansionary fiscal stance, and a negative value a contractionary one. See Heller, Haas and Mansur (1986) for a discussion of the fiscal impulse measure.

preceding the recession than would appear from just looking at the nominal interest rates (Chart 2). That is, the data on interest rates and monetary conditions suggest a plausible role for the monetary transmission mechanism in bringing about the recession in 1990.

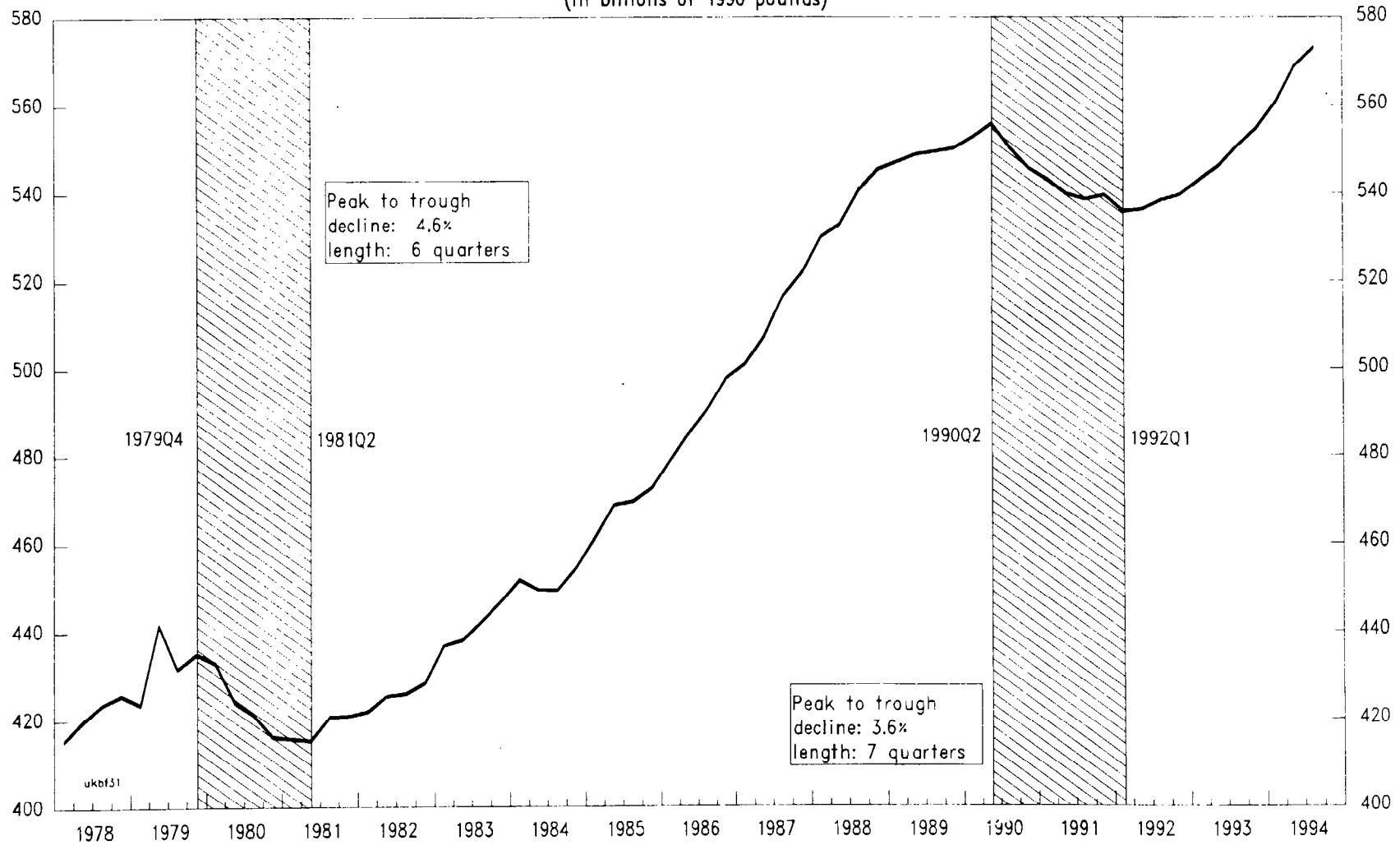
There is, however, much controversy over the precise channels through which monetary policy impinges on activity and on the magnitude of the monetary impact on the distinct expenditure components. 1/ In the case of consumption, this is not only on account of the potentially offsetting income and substitution effects, but is also related to the changing nature of the interaction between interest rates and wealth-effects following the financial liberalization in the 1980s. Quantifying the monetary impact is also made difficult by the potential feed-back effects such as the substitution between durable and non-durable consumption in response to changes in monetary policy. 2/ The impact of interest rates on fixed investment is also subject to controversy. While the direct effect of higher interest rates would in general be to lower investment (through the cost of capital), the substitution of labor for capital in response to the higher rates may act to dampen the immediate contractionary effect.

Chart 4 shows a steep increase in the personal savings ratio and a sharp decline in the ratio of gross fixed investment to GDP from 1989 onwards. These changes are not inconsistent with the impact of the prior monetary tightening. However, as discussed above, it is difficult to come up with an a priori judgement about how much of the contraction in consumption and investment was due to the prior monetary tightening. There is, in fact, also a conceptual issue of the need to separate the causal mechanisms of shocks to both consumption and investment. One component of the increase in the personal savings ratio and decline in the investment ratio that took place in the United Kingdom in this period is possibly the lagged response to monetary tightening and, in this sense, is indeed a manifestation of the earlier monetary shock. However, the rising savings ratio could also reflect changes in consumption behavior that are neither strictly a response to monetary policy nor even related to endogenous income

1/ Detailed discussions about the monetary transmission mechanism can be found in Miles and Wilcox (1991), Bernake and Blinder (1992), and Mankiw (1994). See Muellbauer (1994) for a detailed review of the literature on consumer behavior. Muellbauer's review indicates that while the real interest rate effect on consumption is negative for the UK, it is much smaller than that for the United States. Further, these estimates are not stable when the estimation period is changed. While one would not in general expect consumption to respond perversely to interest rate changes, the Japanese case seems to be an exception to the rule.

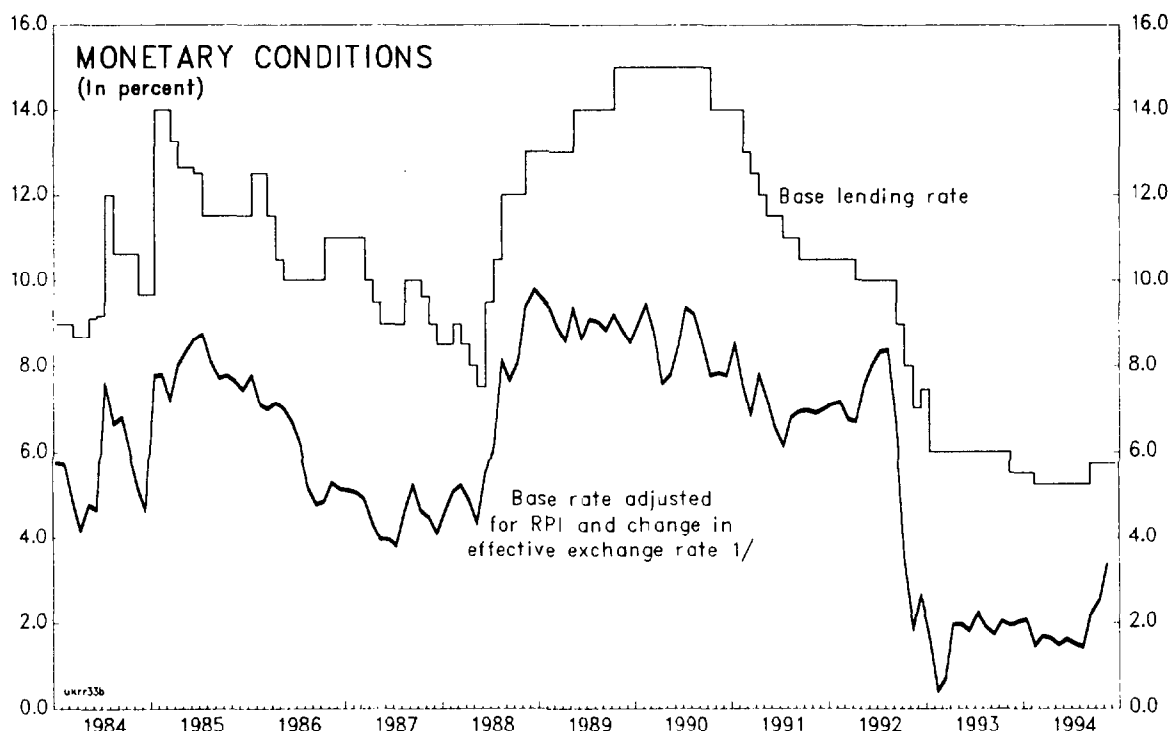
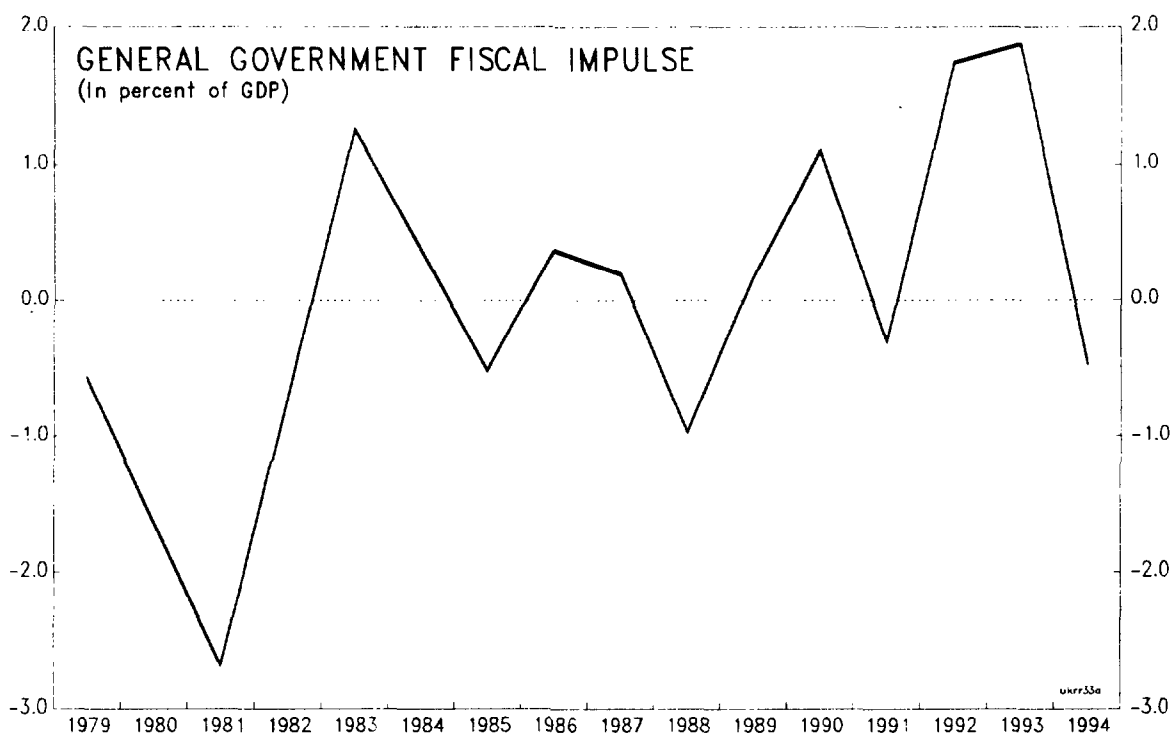
2/ For instance, while consumption of durables may be cut back in response to higher interest rates, part of the additional savings can be used to increase the purchase of non-durables. Mankiw (1985) provides evidence of a relatively high degree of substitution between durables and non-durables using U.S. data.

CHART 1
UNITED KINGDOM
GROSS DOMESTIC PRODUCT
(In billions of 1990 pounds)



Source: CSO, Economic Trends.

- 2b -
CHART 2
UNITED KINGDOM
POLICY STANCE

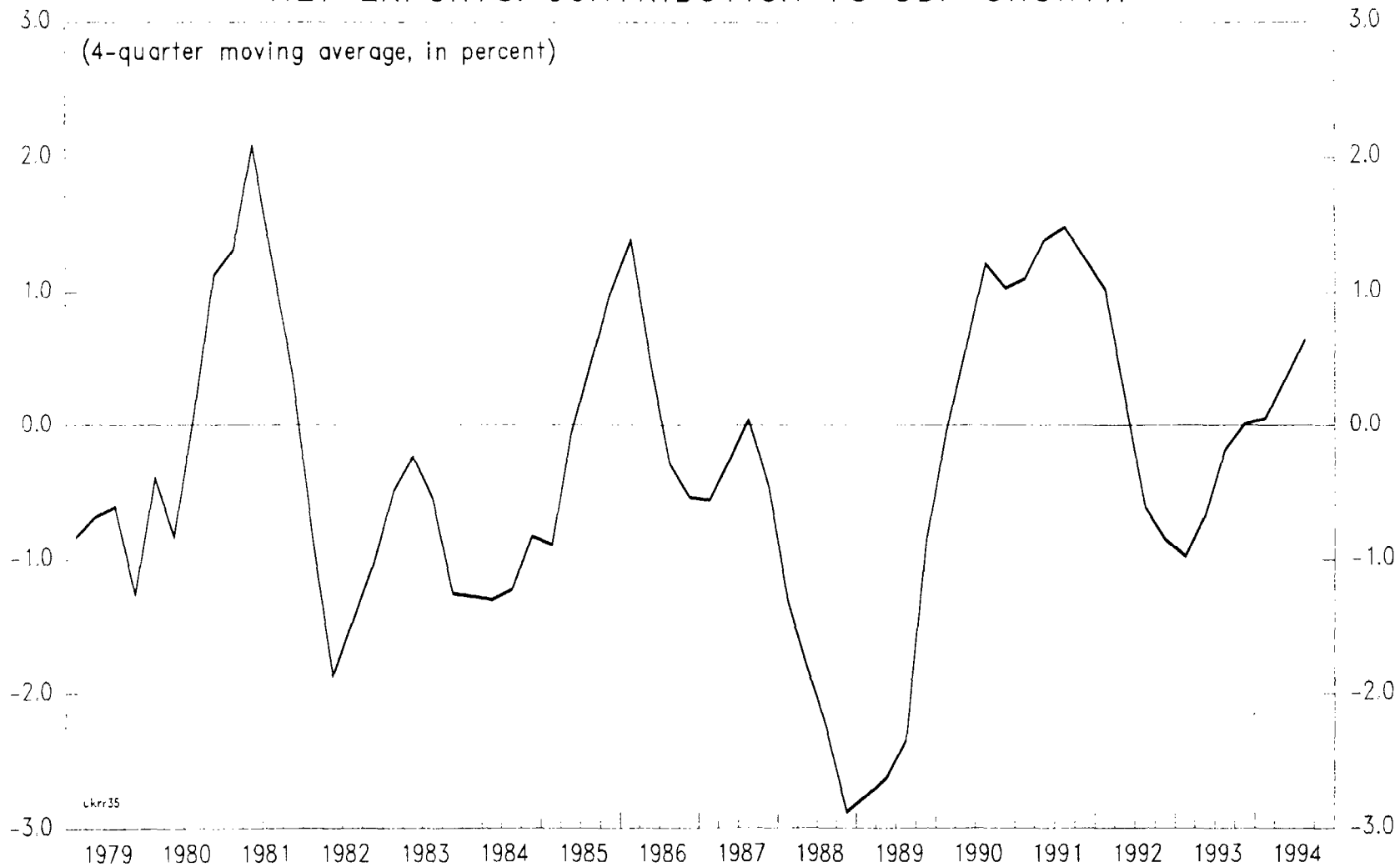


Sources: Central Statistical Office; and staff calculations.

1/ This measure aims at capturing the net impact on aggregate demand of changes in the level of domestic interest rates and the exchange rate. Accordingly, base rates are adjusted for change in the real exchange rate index from its level at end 1987 and change in RPI excluding mortgage interest, using the UK Treasury's estimate of a 4 to 1 ratio for the equivalence of the demand effect between an increase in interest rates and the change in the exchange rate.

CHART 3
UNITED KINGDOM

NET EXPORTS: CONTRIBUTION TO GDP GROWTH



Source: Central Statistical Office.

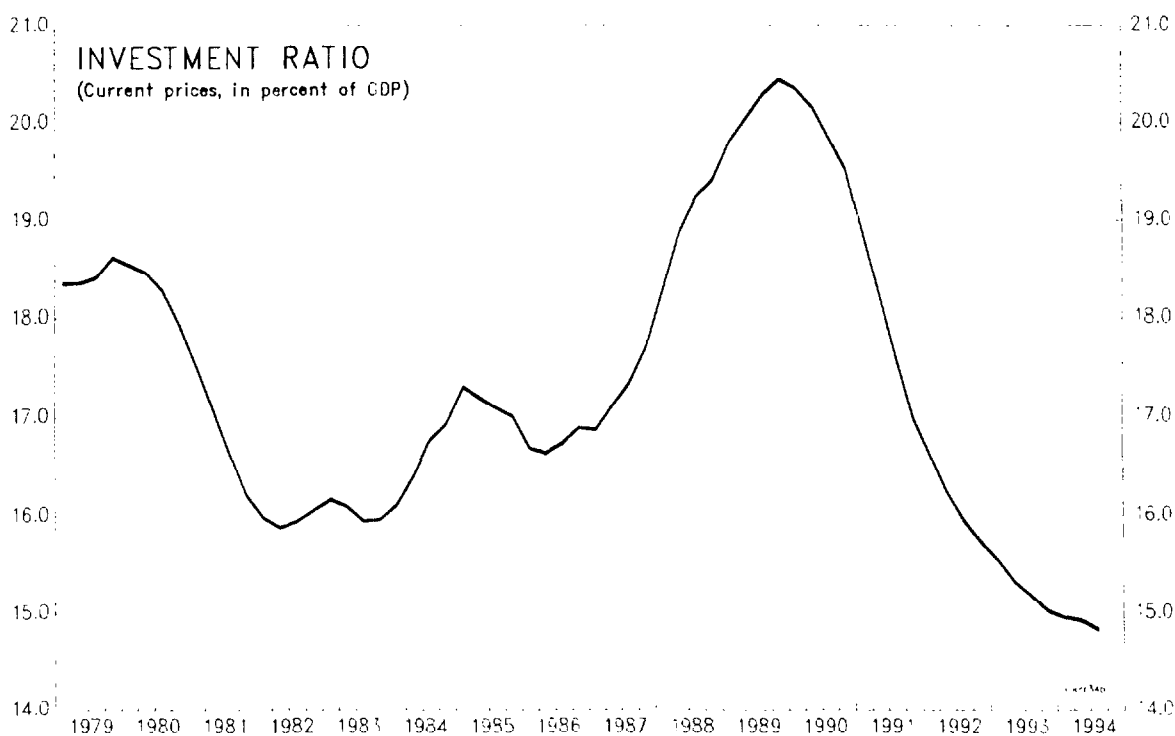
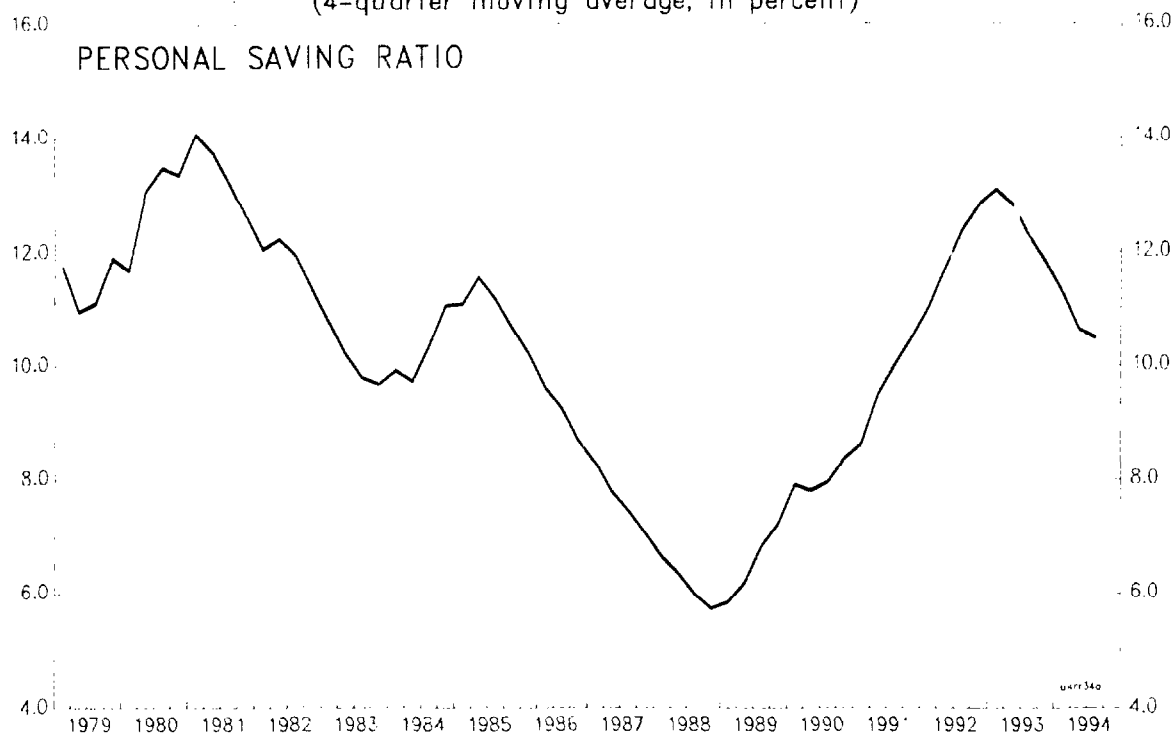
- 2d -

CHART 4

UNITED KINGDOM

AGGREGATE DEMAND INDICATORS

(4-quarter moving average, in percent)



Source: CSO, Economic Trends.

dynamics or asset price movements. Such a contraction of consumption could simply be the manifestation of the pessimism that people have about the future, or reflect their anxiety about the particular course of political and social developments. While this pessimism may either be justifiable or not on "rational" grounds, it can nevertheless manifest itself in practice as a "true" demand shock--defined here as one that cannot be easily explained by obvious economic factors. Such a "true" demand shock can very well play an important role in precipitating the recession and prolonging its duration. 1/

This paper aims to provide a deeper understanding of the economic cycle by providing a conceptual and empirical separation of the monetary and "true" shocks that were instrumental in bringing about the recession and in influencing the nature of the current recovery. We use a vector autoregression (VAR) approach for empirically identifying the types of shocks that the United Kingdom was subject to during this period. 2/ Specifically, the VAR estimation is sequenced in three stages. The first stage identifies shocks to the demand components at the time of the recession that are based strictly on an analysis of the income dynamics. That is, this part of the exercise attempts to capture changes in each demand component that cannot be fully explained by the past behavior of the expenditure variables. The second stage VAR expands the expenditure based system to include interest rates, the real exchange rate, and wealth effects. This allows us to identify changes in the demand components that are not explained by past income dynamics, but which can nevertheless be accounted for by the stance of monetary policy and asset price movements. The residuals of the second system capture the role of factors other than past income dynamics and prior monetary tightening--"true shocks"--in

1/ In an analysis of the U.S. recession of 1990-91, Blanchard (1993) identifies a consumption shock associated with the anxieties caused by Iraq's invasion of Kuwait in August 1990 as one possible contender for the proximate cause of the recession. See also in this context Hall (1993). In the case of the United Kingdom, there was added uncertainty relating to domestic political developments and membership of the European Union in this period. We return to this theme later on in this paper.

2/ Other recent studies that have used the VAR approach for identifying macroeconomic shocks include Blanchard (1993) and Cochrane (1994)--both for the United States. However, neither of these studies specifically attempts to use the VAR methodology for separating monetary and expectational shocks in an expenditure based system. The justification for using the VAR methodology is explained later in the paper.

precipitating and sustaining the recession. ^{1/} The third stage is concerned with dynamic simulations. An impulse-response analysis is carried out to test how the expenditure variables evolve over time in response to shocks.

The principal conclusions of this paper are: (i) Shocks to consumption played a crucial role in precipitating the recession. The large contraction in consumption can be accounted for, roughly speaking, by an equal mixture of both monetary and "true" shocks. (ii) Shocks to residential investment are largely accounted for by the episode of prior monetary tightening and asset price changes. (iii) There were no large shocks to non-residential investment. This is in marked context to the 1979-81 recession when investment shocks were an important proximate cause of that recession. (iv) The relatively long duration of the 1990-92 recession is explained by the impact of large consumption shocks--impulse-response functions show that consumption shocks have a long lasting impact on GDP.

2. Methodology

A vector autoregression (VAR) essentially consists of a system of equations in which each variable in the system is determined by its own lagged values and the lags on all other variables in the system. The VAR approach was first introduced by Sims ^{2/} as one possible way of avoiding the identification problems inherent in structural macroeconomic modelling. It is particularly useful when there are no strong priors about a number of competing explanations of a particular phenomenon. The VAR approach itself does not exclude any particular hypothesis, but allows us to distinguish between competing hypotheses on the basis of the information content of the time series. This is particularly pertinent for analyzing the UK case--especially when we start with no strong priors about what caused the recession.

As the first step, we estimate a vector autoregression (VAR) model for the United Kingdom which focuses only on the national accounts expenditure variables. The eight variable VAR is composed of private consumption of non-durables [Cnd], private consumption of durables [Cd], non-residential fixed investment [If], residential fixed investment [Ir], inventories [Inv],

^{1/} "True" consumption shocks, in turn, can be broken up into two components. First, a contraction of consumption may reflect the downward revision of expectations of future income (lower permanent income). Second, the consumption shock could also reflect the expectation of a greater variability of future income (precautionary motive). In order to keep the focus of the paper at the broad macro level, we do not get into the estimation issues relating to the further breakdown of the "true" consumption shock into its components.

^{2/} See Sims (1980). A critical appraisal of the VAR methodology in relation to other econometric methodologies can be found in Pagan (1987).

exports [X], imports [M], and government consumption [G], all measured in constant 1990 prices. The eight variables VAR of order P (i.e., with P lagged variables) can be represented as:

$$\Delta Y_t = K + \sum_{i=1}^{i=P} \theta_i \Delta Y_{t-i} + \gamma d_t + U_t \quad (1)$$

where:

$$Y_t = \begin{bmatrix} Cd_t \\ Cnd_t \\ X_t \\ M_t \\ G_t \\ If_t \\ Ir_t \\ invr_t \end{bmatrix}, K = \begin{bmatrix} K_1 \\ K_2 \\ \dots \\ K_8 \end{bmatrix}, \theta_i = \begin{bmatrix} \theta_{11,i} & \theta_{12,i} & \dots & \theta_{18,i} \\ \theta_{21,i} & \theta_{22,i} & \dots & \theta_{28,i} \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ \theta_{81,i} & \theta_{82,i} & \dots & \theta_{88,i} \end{bmatrix}, U_t = \begin{bmatrix} U_{1t} \\ U_{2t} \\ \dots \\ U_{8t} \end{bmatrix} \text{ with } \gamma = \begin{bmatrix} \gamma_1 \\ \gamma_2 \\ \dots \\ \gamma_8 \end{bmatrix}$$

where $d_t = 0$ for $t \leq 1973:4$ and $d_t = 1$ for $t \geq 1974:1$
and $U_{it} \sim N(0, \sigma_{i1}^2)$

The model follows the standard VAR approach, where each variable in the system is determined by its own lagged values and lags on all other variables in the system. All variables, with the exception of inventory accumulation, are estimated in first difference logs since the levels are non-stationary. ^{1/} Inventories are entered into the model as a ratio of GDP (Invr) and a post-1973 dummy is included to allow for the long-term shift in the system's mean growth rate following the first oil shock. GDP is entered into the model as an auxiliary equation, given that the components of the VAR add up to GDP. The initial VAR model was first tested for the appropriate lag length using a likelihood ratio test and three lags were selected as being optimal for the system.

The primary aim of estimating a first stage VAR on the national accounts expenditure variables is to estimate the residuals for the demand components. Each of these residuals provides an indication of changes in the behavior pattern of the variables that are not explained by the previous history of the system. For instance, a large residual for consumption durables could indicate changes in consumption patterns that are not explained by the past history of changes in the consumption of durables or in the other demand components.

^{1/} See Table A1 for unit root tests.

As is well-known, VAR residuals are generally correlated across equations, reflecting their joint dependence on common underlying shocks as well as the direct contemporaneous dependence of the variables on each other. For instance, part of the consumption residual could just be a reflection of contemporaneous shocks to exports or investment. In order to obtain a true measure of the shocks to the demand components, it is necessary to purge from the residuals of each component of the VAR, the shocks which are derived from the other components. In order to orthogonalize the shocks, we make two identifying assumptions. First, it is assumed that within each quarter, the residuals of the equations are related to each other only through income. For example, it is assumed that consumption residuals depend on investment residuals only through their common dependence on income. While this assumption is somewhat restrictive, it is not unduly so, since the feedback effects among these variables tend to take longer than one quarter. The second identifying assumption is that government consumption and exports are contemporaneously exogenous, and hence can be used as instruments for GDP (block exogeneity tests do not reject the hypothesis that both government consumption and exports "Granger-cause" the rest of the macroeconomic system). 1/

We can now purge the component of consumption residuals which reflects shocks originating in GDP by regressing the residuals of the consumption equation on the residuals of the auxiliary GDP equation. However, this cannot be accomplished directly due to the simultaneity bias problem-- consumption residuals and GDP residuals are likely to be dependent on each other. Hence, we use government consumption and export residuals from the VAR to instrument the GDP residuals out. The error term from this equation provides a measure of the "true" consumption shock. 2/

-
- 1/ The estimated χ^2 statistic for the joint exclusion of X and G is $\chi^2_{36} = 71.92$, and this is significant at the 1 percent level.
 2/ That is, in the case of durable consumption (cd), for instance, the "time" orthogonalized consumption shock corresponds to the residual ϵ_{cd} of the following regression:

$$\begin{aligned} \gamma_{cd} &= \hat{\gamma}_{gdp} + \epsilon_{cd} \\ \epsilon_{cd} &\sim N(0, \sigma^2_{cd}) \end{aligned} \quad (2)$$

γ_{cd} and γ_{gdp} are the original (non-orthogonalized) VAR residuals obtained from the estimation of (1). $\hat{\gamma}_{gdp}$ is an instrumental variable for γ_{gdp} which stands for the fitted values of the following regression.

$$\begin{aligned} \gamma_{gdp} &= \beta_1 \gamma_g + \beta_2 \gamma_x + \epsilon_o \\ \epsilon_o &\sim N(0, \sigma_o^2) \end{aligned} \quad (3)$$

Where γ_g and γ_x are the residuals for government consumption and exports obtained from the estimation of the VAR system.

3. Results of first stage VAR

The results of the first-stage or expenditure based VAR, estimated over the period 1960:1 to 1994:3 are reported in Table 1. The shocks are derived from the procedure outlined in the above footnote--that is, the orthogonalized residuals of each equation are normalized by the standard deviation. Each observation in the table represents the cumulative sum of shocks from the given benchmark, and individual residuals are distributed with mean 0 and unit standard deviation. The pattern of shocks during the recent recession is then compared with the shocks during the 1979-81 recession.

The results of the first stage VAR reported in Table 1 show the cumulative build up of negative shocks to all components from 1990 onwards. In particular, there are large negative shocks to GDP between 1990:2 and 1992:2--a reflection of the large negative shocks to both durable and non-durable consumption in this period. 1/ While there are negative shocks to both residential and non-residential investment during the same period, the magnitude of these shocks is relatively smaller than that of the consumption shocks. 2/ Shocks to the external sector are negligible at the beginning of the recession; however, they get more negative as the recession gets underway, and this is one possible explanation for the prolonged nature of the recession. By 1993:4 there are positive shocks to all the expenditure components as reflected by the decline in the cumulative shocks, and this is indeed consistent with the strengthening of the recovery during this period.

It is interesting, in this context, to contrast the nature of the shocks in the 1990-92 recession with that of the previous recession in 1979-81 (reported in Table 2). During 1990-92, shocks to consumption have been much larger than shocks to non-residential investment. The experience in 1979-81 was the opposite; shocks to non-residential investment predominated over consumption shocks. Also, unlike the recent recession, shocks to the external sector was one of the proximate causes of the 1979-81 recession. Another striking contrast between the two recessions is in the behavior of residential investment. There were large positive shocks to residential investment between 1979:4 and 1980:2. While a large positive shock to residential investment during the beginning of a recession is puzzling, this is accounted for by the impact of the credit liberalization in the domestic mortgage market during this period. 3/ However, the positive shocks to residential investment dampened soon after as the impact of the deep

1/ GDP shocks are derived as the weighted average of shocks to the expenditure components.

2/ The magnitude of the shocks to residential investment is somewhat understated by the estimation period, since residential investment started declining from 1989:2.

3/ The pent-up demand for housing due to the earlier period of credit controls led to an explosion of demand for housing with the financial liberalization. See Muellbauer (1994) for details.

Table 1. First-stage VAR Shocks (Cumulated from 1990:1)

	GDP	Consumption of durables	Consumption of non- durables	Non- residential investment	Residential investment	Trade balance	Government consumption	Inventories
1990:2	-0.02	-1.05	-0.55	0.33	-1.64	0.58	1.12	-0.07
1990:4	-2.81	-3.45	-1.83	-1.29	-1.74	-0.03	2.57	-2.29
1991:2	-4.58	-6.11	-4.60	-2.04	-4.44	-0.35	3.07	-1.31
1991:4	-5.55	-6.46	-4.31	-2.24	-3.71	-1.60	2.98	-1.22
1992:2	-7.46	-7.31	-4.70	-1.63	-3.61	-3.55	3.48	-1.40
1992:4	-8.28	-6.61	-4.00	-2.53	-2.35	-4.11	1.66	-2.14
1993:2	-8.72	-5.94	-4.77	-3.40	-1.67	-4.63	1.56	-1.77
1993:4	-7.09	-4.60	-3.94	-2.49	-1.27	-3.73	1.48	-1.89
1994:2	-5.43	-3.82	-4.96	-2.33	-1.48	-1.99	1.57	-1.58

Table 2. First Stage VAR Shocks (Cumulated from 1979:3)

	GDP	Consumption of durables	Consumption of non- durables	Non residential investment	Residential investment	Trade balance	Government consumption	Inventories
1979:4	-2.58	-1.84	-1.81	-0.44	2.69	-2.56	1.37	-1.13
1980:2	-2.40	-2.96	-1.15	-5.35	6.88	-2.15	2.07	-1.13
1980:4	-3.76	-3.75	-1.87	-5.19	6.10	-2.22	0.56	-2.18
1981:2	-5.49	-3.29	-1.80	-7.68	6.65	-2.33	-1.55	-3.93
1981:4	-7.50	-4.29	-3.22	-6.50	5.41	-5.48	-1.34	-2.43
1982:2	-7.73	-4.83	-3.84	-5.43	6.29	-6.72	-1.71	-1.17
1982:4	-7.83	-2.26	-2.58	-3.45	8.17	-6.18	-1.98	-5.77

recession offset the initial stimulus provided by the immediate aftermath of the credit liberalization. Another notable difference is that the 1990-92 recession, unlike the previous one, was marked by positive shocks to government consumption. This reinforces our earlier hypothesis that the stance of fiscal policy was not a contributory factor in the recent recession.

4. Results of enlarged VAR

As explained previously, the next step is to examine how much of the "shocks" in the first stage VAR can be explained by movements in variables such as interest rates and asset prices. Accordingly, the second stage VAR enlarges the first system by incorporating changes in the real interest rate (defined as the nominal base rate minus four quarter changes in CPI), the real exchange rate, and the ratio of household wealth to GDP. Granger-causality tests indicate that changes in real interest rates, the real exchange rate, and the household wealth-GDP ratio are block exogenous to the system, and hence, are entered accordingly. 1/ In order to take account of the structural changes induced by financial liberalization in the 1980s, the coefficient on the interest rate is allowed to shift proportionately to the cyclically adjusted ratio of consumer credit to GDP. 2/ The enlarged VAR now consists of the national accounts expenditure components and the three new predetermined variables--the real interest rate, the real exchange rate and the wealth-GDP ratio.

The enlarged VAR is estimated to see if "shocks" to the demand components in the first system continue to persist in the enlarged system. If, for instance, shocks to consumption durables in the first system come down substantially in the second stage VAR, we are in a position to infer that changes in consumption behavior that could not be explained by the income dynamics, can in fact be explained by changes in the monetary stance and wealth effects. If, on the other hand, shocks continue to persist in the enlarged system, these in effect can be identified as "true shocks"--that is, changes in consumption pattern for which there is no obvious economic explanation. The results from estimating the second stage VAR are presented in Table 3.

The results from the second stage VAR show that shocks to both consumption of durables and residential investment come down significantly once changes in real interest rates, the real exchange rate and wealth-effects are taken into account. Shocks to consumption of non-durables in the first system come down sharply in the beginning of the recession, but remain relatively high as the recession evolves. Shocks to non-residential

1/ The estimated χ^2 statistic for the joint exclusion of these variables is $\chi^2 = 120.19$, which is significant at the 5 percent level.

2/ ⁸⁸ We also allow for a longer lag structure for the interest rate variable by using 5 instead of 3 lags. This is to take account of the long lags through which monetary policy operates.

Table 3. Enlarged VAR Shocks (Cumulated from 1990:1)

	GDP	Consumption of durables	Consumption of non- durables	Non- residential investment	Residential investment	Trade balance	Government consumption	Inventories
1990:2	0.98	-0.42	0.56	0.64	-0.19	0.75	1.25	-0.41
1990:4	-1.35	-2.14	-0.48	-0.86	-0.92	0.22	2.24	-1.70
1991:2	-1.80	-4.02	-3.37	-0.69	-2.94	0.19	1.87	0.53
1991:4	-2.72	-4.46	-3.24	-1.15	-0.81	-0.90	1.47	0.56
1992:2	-3.96	-4.67	-2.25	-0.34	0.01	-2.58	2.04	0.02
1992:4	-3.75	-2.94	-0.79	-0.89	1.49	-2.62	-0.04	-0.54
1993:2	-4.70	-1.19	0.19	-1.64	3.44	-4.49	-0.32	-0.48
1993:4	-3.56	0.42	0.82	-1.71	4.90	-4.41	-0.41	0.02
1994:2	-1.40	1.59	0.37	-1.94	4.21	-2.55	-1.07	0.78

investment come down only to a limited extent in the enlarged system. These results do have an intuitive explanation. One would indeed expect both consumption of durables and residential investment to be relatively more sensitive to changes in interest rates and wealth. The results of the VAR bears this out--it shows that an important component of the shocks in the expenditure-based system can, in fact, be identified as responses to changes in the monetary stance and wealth effects. 1/

How do these results relate to the findings of recent studies on consumer behavior in the United Kingdom? An influential view (Murphy and Muellbauer (1990) and Miles (1992)) attributes the boom-bust cycle primarily to the effects of changes in monetary policy on consumption, operating through the house prices channel in the environment of financial liberalization. Our results, however, provide support for the hypothesis that the recession in 1990 was precipitated by a combination of both monetary and "true" shocks. In terms of the assumptions of the model, the monetary stance and wealth effects appear to have contributed just over a half to the contraction of activity during the recession.

The importance of expectational shocks in precipitating the recent recession gets empirical support from recent studies using micro data. Acemogulu and Scott (1994) use the information content of consumer confidence indicators to track changes in consumption in the United Kingdom. They find that consumer confidence is a leading indicator of consumption growth, and the decline in consumption in 1990 is predicted by the sharp fall in the Gallup Consumer Confidence Index--which is consistent with the hypothesis of "true" shocks. 2/ Attanasio and Weber (1994) use panel data to document the sources of the consumption boom during 1985-88. They find that it is difficult to explain the consumption boom in the United Kingdom primarily in terms of the effects of financial liberalization and the housing boom, since the biggest increases in consumption during this period came from younger consumers who did not own any property. While this

1/ In order to reinforce our earlier hypothesis that fiscal policy did not play a significant role in the recent recession, we tested the VAR system by adding a cyclically adjusted measure of the fiscal balance (controlling for government consumption, which is already in the system). This additional variable does not make any perceptible change to the pattern of shocks in the enlarged system, and provides further support for the hypothesis that fiscal policy was not instrumental in causing the recession of 1990-92.

2/ This result is also consistent with the findings for the United States. Carroll, Fuhrer and Wilcox (1994) show that the University of Michigan's Index of Consumer Sentiment predicts changes in consumption spending for the United States. This index fell sharply in the three months following Iraq's invasion of Kuwait, indicating that a consumption shock was a proximate cause of the 1990 downturn in the United States. The implicit conclusion from these findings is that the stochastic implications of the permanent income-rational expectations hypothesis do not strictly hold.

finding relates to the period of overheating rather than the recession, they do provide support to the hypothesis that expectational changes can cause large swings in consumption.

5. Focusing on consumption dynamics

While the VAR analysis presented above serves the important role of identifying shocks to which the economy was subject, it tells us little about the path taken by the different variables following a shock. There are no strong reasons, for instance, to expect that the impact of a unit shock to investment on GDP, will be the same as that of a unit shock to consumption. The severity of a recession, and the strength of the recovery can vary, depending on how the system reacts to negative shocks to the different variables. It is, nevertheless, possible to simulate these effects by using the estimates of the VAR parameters. This is precisely what the impulse-response function does. The correspondence of the actual behavior of the economy to the simulated impulse-response also provides an additional test of the robustness of the VAR results.

Since both monetary and "true" consumption shocks have been identified as the main driving forces behind the recent business cycle, we undertake an impulse-response analysis in a VAR on consumption, GDP, the real interest rate, the real exchange rate, and real wealth. Working with such a reduced-scale VAR in this context has clear advantages. Its dynamics are not only easier to describe, but such a VAR allows the long-run co-integrating relationship between consumption, income, and wealth to be incorporated into the analysis. 1/

The results of the impulse-response functions are shown in Chart 5. 2/ It shows that a 1 percent negative shock to GDP has only a mildly negative impact on consumption, and this in fact dies out after about 5 quarters. In contrast, a 1 percent negative shock to consumption has a strongly negative impact on GDP and this effect lasts for over 16 quarters, dying out very slowly. The main message emerging from the impulse-response functions is that shocks to consumption have a stronger and more lasting

1/ Unlike the case of identifying shocks, incorporating co-integrating relationships becomes important for estimating the impulse response functions as it ensures the long-run consistency of the dynamic response of the distinct variables in the system. Consequently, we set up the VAR in the logs of the first differences as before, but now including an error correction term defined as the cointegration vector between the levels of consumption, GDP, wealth and real interest and exchange rates. The vector which binds these variables together in the long-run is estimated according to the standard Johansen procedure. See Johansen (1988) and Johansen and Juselius (1990).

2/ A description of the orthogonalization procedure underlying these impulse-response estimates is provided in Appendix 1.

impact on the economy than shocks to the other components of GDP, and this provides one explanation for the long duration of the recession.

6. Observations on the recovery

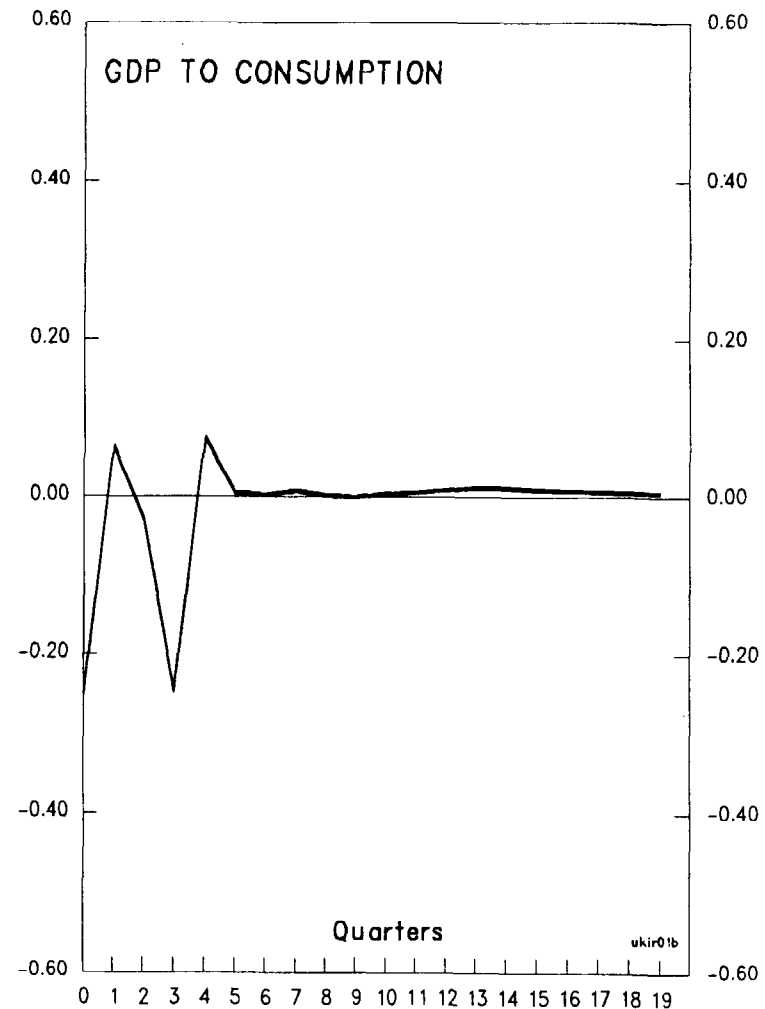
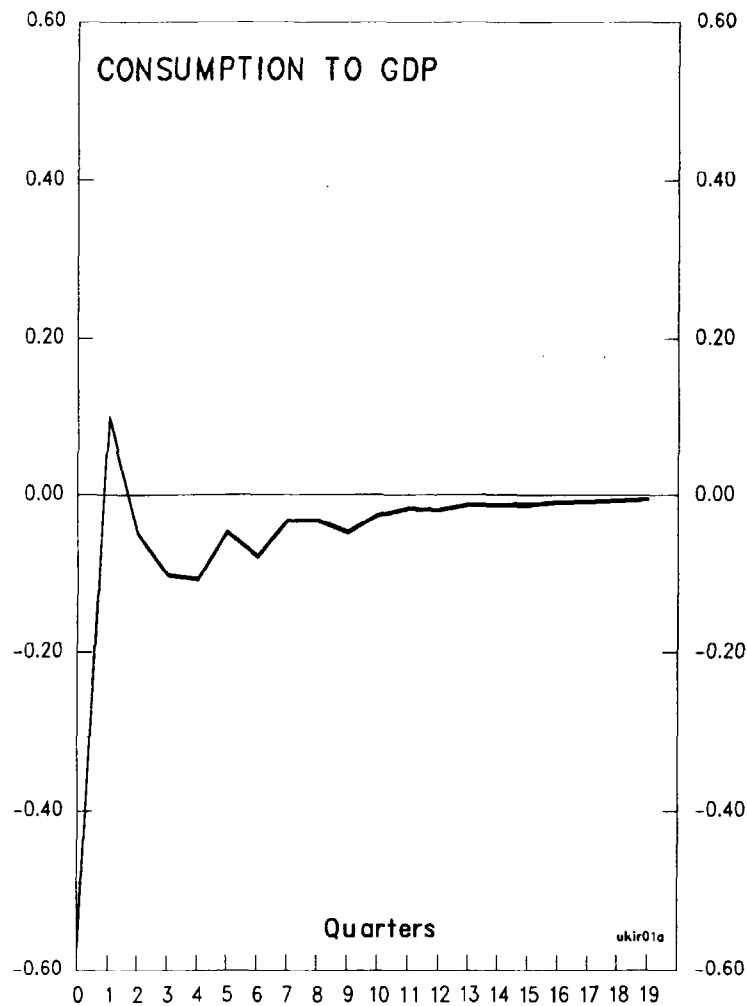
What lessons can be drawn from this exercise about the recovery taking place currently in the United Kingdom? Given the fact that movements in consumption prior to and during the recession were driven by monetary tightening as well as "true" shocks, one would expect consumption to drive the recovery in the initial stages, once these negative shocks dissipate away. This is exactly what has happened in the current recovery. The recovery was initially fueled by a sharp increase in durable consumption from the fourth quarter of 1992, followed by a pick up in non-durable consumption in 1993:2. The significant contribution from exports to the recovery came later in 1993, and especially in 1994, reflecting the lagged effects of the real exchange rate depreciation and the recovery in external demand.

The situation regarding residential investment is complex. One would expect some recovery in residential investment given that the VAR residuals indicate its high degree of sensitivity to interest rates and wealth. The data indicate a sharp pick up in residential investment from the second quarter of 1993. In fact the large positive shocks to residential investment in the enlarged system from 1993:2, indicate that its recovery has been more robust than what the monetary easing and flat house prices would indicate. The situation regarding non-residential investment is somewhat easier to explain. Non-residential investment during the recession was not affected significantly either by monetary shocks or "true" shocks, but responded largely to income dynamics. Consequently, one would expect non-residential investment to recover substantially only in the later stages of the cycle. The most recent data seem to bear this out.

7. Conclusions

The VAR analysis has identified the role of both monetary and non-monetary or "true" shocks as causes of the 1990-92 recession. In particular, consumption shocks are shown to have played an important role as the proximate cause of the recession. The results indicate that consumption shocks were caused by a mixture of both monetary and "true" shocks. Unlike the 1979-81 recession, shocks to non-residential investment did not play an important role in the 1990-92 recession. Estimates of impulse response functions indicate that consumption shocks have a long lasting impact on the economy, and provide a potential explanation for the long duration of the recession. The implicit policy conclusion emerging from this paper is that monetary policy does matter. However, the analysis suggests that it is difficult for monetary policy to fine-tune the economy when it is subject to large "true" shocks.

CHART 5
UNITED KINGDOM
IMPULSE RESPONSE TO A 1 PERCENT NEGATIVE SHOCK
(In percent)



Source: Staff estimates.

Orthogonalization Procedure for Impulse-response
Analysis using Structural Restrictions

A standard practice in VAR estimation is to orthogonalize the residuals for impulse-response analysis using the so-called "Choleski factorization." The main problem with this procedure is that it is usually based on very restrictive assumptions about the contemporary correlations between shocks to the different variables in the system. In particular, the pattern of cross-equation residual correlations yielded by the Choleski method is crucially dependent on the ordering of the variables.

Consider, for example, a VAR on consumption, GDP and wealth, set up in this very order. The Choleski factorization will map the original VAR residuals u_i onto orthogonal v_i shocks in the form of a lower triangular matrix:

$$\begin{aligned} u_c &= \gamma_{11}v_c \\ u_{gdp} &= \gamma_{21}u_c + \gamma_{22}v_{gdp} \\ u_w &= \gamma_{31}u_c + \gamma_{32}u_{gdp} + \gamma_{33}v_w \end{aligned} \quad (A1)$$

where $E(v_i v_j) = 0$, for $i \neq j$

It is clear from (A1) that shocks to consumption (v_c) can affect GDP (through u_c) but shocks to GDP will have no contemporary impact on consumption. Likewise, consumption will also be unaffected by shocks to wealth. This is clearly unacceptable, particularly in light of the findings of Sections 2 and 3. Moreover, no other ordering of the variables is likely to provide a satisfactory solution, as consumption, GDP, and wealth are bound to be contemporaneously interdependent.

To avoid these shortcomings of the Choleski method, we use instead three identifying restrictions to map u onto v . First we use the export and government consumption residuals to create an instrument to shocks to GDP (γ_{gdp} --see footnote 2 on page 6). Secondly, we assume that shocks to the real interest rate are exogenous, and so use the residuals of the real interest rate VAR equation together with γ_{gdp} to create an instrument for shocks to wealth. Thirdly, we assume that shocks to consumption do not have, within the quarter, a contemporary effect on household wealth. Using these instruments, we can then map the original VAR residual u 's onto the orthogonal shock v 's by OLS, obtaining the following results:

$$\begin{aligned} u_c &= 0.25 v_{gdp} + 0.12 v_{hw} + v_c \\ u_{gdp} &= 0.56 v_c + 0.08 v_{hw} + v_{gdp} \\ u_{hw} &= 0.50 v_{gdp} + 0.54 v_{ir} + v_{hw} \end{aligned} \quad (A2)$$

where the subscripts c , gdp , hw , and ir , stand for total real private consumption, real gdp, real household wealth and real interest rate respectively. On the basis of these estimated structural restrictions on the residuals, we shocked v_c and v_{gdp} to obtain the orthogonalized responses plotted in Chart 5.

Table A1. Unit Root Tests 1/

<u>Variable</u>	<u>ADF</u>	<u>PP</u>	<u>L</u>
GDP	-2.21	-2.13	2
Durable Consumption	-2.87	-2.93	2
Non-durable Consumption	-2.08	-1.39	2
Exports	-1.91	-3.44	1
Imports	-2.77	-1.95	4
Government Consumption	-1.87	-2.49	1
Non-residential Investment	-2.38	-1.85	5
Residential Investment	-2.73	-3.10	3
Inventory Ratio	-5.13*	-5.81*	1
Real Interest Rate	-3.13	-2.39	1
Real Exchange Rate	-2.31	-2.30	4
Real Household Wealth	-2.77	-1.92	3

1/ ADF stands for Augmented Dickey-Fuller test, computed with a drift and time trend. PP stands for the Phillips-Perron test, also computed with a drift and a time trend. L is the number of lags for the ADF test, selected according to the H-Q criterion. The critical value for the t-statistic in both tests is 3.451 at the 5 percent significance level. * Indicates that the unit root hypothesis is rejected at the 5 percent significance level.

References

- Acemoglu, D. and A. Scott, A., "Consumer Confidence and Rational Expectations: Are Agents' Beliefs Consistent with the Theory?," *Economic Journal*, Vol 104, No. 422, January 1994.
- Attanasio, O.P. and G. Weber, "The UK Consumption Boom of the Late 1980s: Aggregate Implications of Microeconomic Evidence," *Economic Journal*, November 1994.
- Bernake, B.S. and A.S. Blinder, "The Federal Funds Rate and the Channels of Monetary Transmission," *American Economic Review*, Vol. 82, No. 4, September 1992.
- Blanchard, O., What Caused the Last Recession? Consumption and the Recession of 1990-91, *American Economic Association Papers and Proceedings*, May 1993.
- Carrol, C.D., J.C. Fuhrer, and D.W. Wilcox, "Does Consumer Sentiment Forecast Household Spending? If so, Why?" *American Economic Review*, Vol 84, No. 5, December 1994.
- Cochrane, J.H., "Shocks," NBER Working Paper, No. 4698, April 1994.
- Hall, R., "Macro Theory and the Recession of 1990-91", *American Economic Association Papers and Proceedings*, May 1993.
- Heller, P.S., R.D. Haas, and A.S. Mansur, *A Review of the Fiscal Impulse Measure*, Occasional Paper No. 44, IMF, May 1986.
- Johansen, S., "Statistical Analysis of Cointegration Vectors," *Journal of Economic Dynamics and Control*, pp. 231-54, 1988.
- Johansen, S. and K.V. Juselius, "Maximum Likelihood Estimation and Inference on Cointegration - with Application to the Demand for Money," *Oxford Bulletin of Economics and Statistics*, pp. 169-210, 1990.
- Mankiw, G., "Consumer Durables and the Real Interest Rate," *The Review of Economics and Statistics*, August 1985.
- Mankiw, G., *Monetary Policy*, The University of Chicago Press, 1994.
- Miles, D., "Consumption, Financial Liberalization and Income Shocks: What Can We Learn from the U.K.?" Discussion Paper in Financial Economics, Birkbeck College, July 1994.
- Miles, D. and J. Wilcox, "The Money Transmission Mechanism," in Christopher Green and David T. Llewellyn, *Surveys in Monetary Economics* (Oxford: Basil Blackwell, 1991).

Muellbauer, J., "The Assessment: Consumer Expenditure," *Oxford Review of Economic Policy*, Vol. 10, No. 2, Summer 1994.

Muellbauer, J. and A. Murphy, "Is the UK Balance of Payments Sustainable?" *Economic Policy*, Vol. 11, 1990.

Pagan, A., "Three Econometric Methodologies: A Critical Appraisal," *Journal of Economic Surveys*, Vol. 1, No. 1, 1987.

Sims, C.A., "Macroeconomics and Reality," *Econometrica* 48, 1980.