THE INDUSTRY RESPONSE TO MACROECONOMIC SHOCKS IN THE UK, GERMANY AND FRANCE AND THE CONVERGENCE DEBATE

Keith Cuthbertson*, Simon Hayes** and Stuart Hyde**

Abstract

In this paper, we investigate the response of stock returns at an industry level to macroeconomic shocks for the UK, Germany and France. The betas between the stock returns and the macroeconomic factors provide a metric for the markets view of the homogeneity of industry response to the various macroeconomic shocks. We find that the market seems to focus on the interest rate and the exchange rate as key sources of important shocks and that shocks to real output growth have little or no direct effect on most industry returns in all three countries

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* Management School, Imperial College, London.
** Department of Economics, University of Newcastle upon Tyne.
Corresponding Author: S.Hyde, Department of Economics, University of Newcastle upon Tyne, Newcastle upon Tyne, NE1 7RU. Tel: 44 (0) 191 222 6551. Fax: 44 (0) 191 222 6548. Email: s.j.hyde@ncl.ac.uk. S. Hyde would like to acknowledge financial assistance from the ESRC. The authors are grateful to an anonymous referee, participants at the 1997 MMF Conference, Durham and the 1998 IEA Conference, Limavady for their useful comments. Part of this work work was completed under the auspices of the LARE, Université Montesquieu Bordeaux and financed by the Commissariat Général du Plan, Paris.

1 : Introduction

There has been much debate on the appropriate convergence criteria required for a successful move to EMU and whether countries are likely to achieve convergence, in the light of the Maastricht January 1st 1999 deadline for the 'first wave'. The Maastricht criteria have been subject to much criticism as measures of convergence. They are 'macro criteria' and hence pay no regard to industrial structure in different countries. Indeed, some have argued that the Maastricht convergence criteria can only be met *after* the adoption of a common currency.

A key point is that it is the homogeneity of industry response across countries, to macroeconomic shocks, that will determine the degree of factor mobility or fiscal federalism required to maintain a successful common currency area. In addition, the Maastricht convergence criteria and the Treaty itself are not clear on the interaction between exchange rate and interest rate policy under EMU. The EMI and the Commission in Brussels have utilised large scale models to try and ascertain the macroeconomic implications of asymmetric shocks to EU aggregate country outputs, but little has been done at the industry level.

In this paper we address two key questions, for industries in the UK, France and Germany. Namely, how do macroeconomic shocks impinge on different industries in different countries, and how might the exchange rate - interest rate policy nexus of the European Central Bank influence these industries. We do not use large scale macro-models or structural VARs in our analysis. The somewhat novel aspect to the paper is that we use the change in stock prices across industries in different countries, as a measure of the economy’s response to macroeconomic shocks.

In our analysis we use the rational valuation formula (RVF) for stock prices (ie. price equals the discounted present value of future dividends and discount rates) as our theoretical starting point. The basic idea here is that stock returns quickly reflect the transmission mechanism and the impact of policy changes, across industries in different countries. If there is a fairly homogeneous industrial structure in two countries (ie. convergence), then macro-shocks should impinge on the returns in the same industries in two (or more) countries, in the same manner.

For example, a change in the exchange rate will have an economic impact on the capital goods industry. Investors, who are forward looking, will assess the impact of exchange rates on sales, costs, fixed investment etc. and equilibrium stock returns on capital goods will adjust to reflect these factors. If the capital goods sectors in the two countries are homogeneous, then we would expect the same 'response' in the two countries. The metric we employ here (drawing on the APT) is the industry's beta with respect to a particular factor (e.g. exchange rate). It is also the case in our framework, that we can apportion the response to say an exchange rate shock between revisions to expectations about (i) future dividends (cyclical effect), (ii) future interest rates (monetary policy effect) and (iii) future discount factors (i.e. risk premium). The real interest rate is likely to be a better indicator of monetary policy than the monetary aggregates which are distorted by varying degrees of financial innovation in the three countries. A pre-requisite for this approach to yield insights is that our model of (industrial) stock returns is reasonable. To facilitate this we use a (linear) factor model which includes macroeconomic variables such as output, the exchange rate and interest rates together with financial variables known to help predict industry returns (e.g. dividend-price ratio).

The rest of this paper is organised as follows: In Section 2 we outline how a multifactor model can be used to link macroeconomic shocks to changes in stock returns across industrial sectors, sections 3, 4 and 5 then provide the econometric framework which has been adopted. Section 6 discusses the findings of this study and finally section 7 draws together some conclusions from this approach with suggestions for further work in this area.

2 : Sources of Systematic Risk and the Transmission Mechanism

In this section we demonstrate how a linear factor model and the (linearised) RVF can be used to provide estimates of how interest rates, the exchange rate and output influence stock returns in different industries. With a homogenous industrial structure across different countries we would expect these effects to be of a similar magnitude for similar industry groupings across different countries. The analysis assumes that market participants are able to assess the impact of these variables on the future course of dividends and discount rates in particular industries and that this information is then reflected in equilibrium returns.

According to the Linear Factor Model (Burmeister and McElroy 1988)[1], the unexpected excess return on any asset depends on a set of factor innovations and their factor loadings (betas), plus an idiosyncratic innovation. The factor betas measure the extent to which investors adjust their required risk premium on an asset in response to news about non-diversifiable (systematic) risk. Since the theory gives no indication of the likely identity of the factors, the latter have been determined empirically, and previous researchers have used variables such as real output growth, the real exchange rate, interest rates and the dividend-price ratio (see, for example, Clare and Thomas 1994, Chen 1991, Chen, Roll and Ross 1986).

Using a log-linear version of the rational valuation formula[2] (RVF), Campbell and Mei (1993) demonstrate that factor innovations can impact upon required excess returns in three ways: by affecting expectations of future dividend payments; by affecting expectations about future real interest rates; and by affecting future risk premia. In the APT literature, the focus has been on testing which factors are priced, rather the channels through which the factors impact upon an asset's systematic risk. We take a number of macroeconomic and financial factors and attempt to determine how each factor impinges on expectations of future dividends, future real interest rates and future excess returns. We are then able to ascertain how an asset's factor betas are determined by covariances between fundamentals and macroeconomic risks.

We are concerned with how shocks (including macro-shocks) impinge on equilibrium returns. Excess returns on a set of stock portfolios in each of the three countries are assumed to depend linearly on a set of state variables. The latter are modelled as a VAR process. We are then able to decompose the excess stock returns and the state variables into expected and unexpected components. The unexpected portions of the state variables are taken to be factor innovations, and the factor betas are estimated as scaled covariances between the unexpected excess asset returns and these factor innovations.

[1]The Arbitrage Pricing Theory (Ross 1976) is a special case of the Linear Factor Model.
[2]The rational valuation formula states that the price of a stock is equal to the expected discounted present value of future dividends accruing to the stock holder.

3 : A Theoretical Framework

We adopt the log linear representation of the present value model formulated by Campbell and Shiller (1988a,b). This approximates the one-period log real holding return as;

$$h_{i,t+1} \approx k + r_i p_{i,t+1} + (1 - r_i) d_{i,t+1} - p_{i,t} \qquad (1)$$

where $h_{i,t}$ is the expected return on portfolio *i* in period t, $p_{i,t}$ is the price of portfolio *i* at the end of period t and $d_{i,t}$ is the dividend paid on portfolio *i* during period t, ρ_i is $1/(1 + \exp(d_i))$ where d_i is the mean dividend price ratio of portfolio *i* and *k* is a constant equal to $-\log(r_i) - (1 - r_i)\log(\frac{1}{r_i} - 1)$. Imposing the terminal condition that $\lim_{j \to \infty} E_t r^j p_{i,t+j} = 0$[3], equation (1) can be solved forward to give;

$$p_{i,t} = \frac{k}{1-r} + (1 - r) E_t \sum_{j=0}^{\infty} r^j d_{i,t+j+1} - E_t \sum_{j=0}^{\infty} r^j h_{i,t+j+1} \qquad (2)$$

This equation enables the effect of a change in expected stock returns on the stock price to be calculated. However, equation (2) is not an economic model but has been derived from an approximation to an identity and imposing a terminal condition. From this approximation, Campbell (1991) shows that it is possible to obtain a decomposition of the unexpected stock return;

$$\begin{aligned} \tilde{h}_{i,t+1} &\equiv h_{i,t+1} - E_t h_{i,t+1} \\ &= (E_{t+1} - E_t)\left\{ \sum_{j=0}^{\infty} r^j \Delta d_{i,t+j+1} - \sum_{j=1}^{\infty} r^j h_{i,t+j+1} \right\} \qquad (3) \end{aligned}$$

by substituting $p_{i,t}$ and $p_{i,t+1}$ out of equation (1). This formulation is written in terms of real log stock returns, however, for the purposes of this investigation we deal with excess

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[3] This implies that there are "no rational bubbles" that would cause explosive behaviour of the stock price. See Cuthbertson et al. (1997) for further details of the derivation of (1).

stock returns over a short term interest rate. Therefore we define the excess *real* return, $e_{i,t+1} \equiv h_{i,t+1} - r_{i,t+1}$, where $h_{i,t+1}$ is the expected return and r_{t+1} is the *real* interest rate, such that the innovation in the excess real return is given by;

$$\begin{aligned} \tilde{e}_{i,t+1} &= (E_{t+1} - E_t)\left\{ \sum_{j=0}^{\infty} r^j \Delta d_{i,t+j+1} - \sum_{j=0}^{\infty} r^j r_{t+j+1} - \sum_{j=1}^{\infty} r^j e_{i,t+j+1} \right\} \\ &= \tilde{e}_{di,t+1} - \tilde{e}_{ri,t+1} - \tilde{e}_{ei,t+1} \end{aligned} \qquad (4)$$

This states that the unexpected excess return on portfolio *i*, $\tilde{e}_{i,t+1}$, is equal to the news about future dividends on portfolio *i*, $\tilde{e}_{di,t+1}$, minus the news about future real interest rates, $\tilde{e}_{r,t+1}$, and the news about future excess returns, $\tilde{e}_{ei,t+1}$.

4 : A Beta Decomposition

The beta decomposition is defined by using the unconditional variances and covariances of the innovations in returns and factors. The beta with respect to the *k*th factor (eg. output) is defined as;

$$b_{i,k} = \frac{\text{cov}(\tilde{e}_i, \tilde{e}_k)}{\text{var}(\tilde{e}_k)} \qquad (5)$$

which is simply the covariance between the unexpected excess return on portfolio *i*, $\tilde{e}_i$, and the unexpected excess return on factor *k*, $\tilde{e}_k$, divided by the variance of the unexpected excess return on the *k*th factor. $b_{i,k}$ can then be decomposed into;

$$b_{i,k} = \frac{\text{cov}(\tilde{e}_{di}, \tilde{e}_k)}{\text{var}(\tilde{e}_k)} - \frac{\text{cov}(\tilde{e}_{ri}, \tilde{e}_k)}{\text{var}(\tilde{e}_k)} - \frac{\text{cov}(\tilde{e}_{ei}, \tilde{e}_k)}{\text{var}(\tilde{e}_k)} \qquad (6a)$$

$$= b_{di,k} - b_{ri,k} - b_{ei,k} \qquad (6b)$$

Where $b_{di,k}$ is the beta between the innovation in the *k*th factor (eg. output) and news about asset *i*'s future cash flows, $b_{ri,k}$ is the beta between the innovation in output and news about future real interest rates and $b_{ei,k}$ is the beta between the innovation in output and news about asset *i*'s future excess returns. This forms the basic framework for considering the effects of different factors on asset returns.

Thus from equations (6a,b), it can be seen that for any given factor, $b_{i,k}$ will tend to be larger, the greater the covariance between factor innovations and revisions to expected future cash flows, $b_{di,k}$, and smaller, the greater the covariance between factor innovations and revisions in either expectations of future real interest rates, $b_{ri,k}$, and expectations of portfolio *i* excess returns, $b_{ei,k}$. For example, suppose a stock has a large positive dividend beta then an unexpected fall in output growth, which implies a large downward revision in expected dividends will lead to a fall in the current stock price. Thus, investors will demand a large current excess return to compensate for this "dividend" risk. However, if negative innovations to output growth also lead to downward revisions in expectations of future real interest rates and future excess returns (i.e. $b_{ri,k}$ and $b_{ei,k}$ are positive in (6b)), then this will attenuate the "dividend effect" on stock returns. Returns will therefore be less susceptible to shocks to output growth, and the required overall risk premium to compensate for this macro-shock will be smaller. Thus, the overall effect of any factor on the required return of any portfolio depends upon the relative magnitudes of the three beta components.

5 : The VAR Framework

In order to estimate the beta decomposition, it is necessary to construct empirical proxies for news about future cash flows, excess returns and real interest rates. The excess return on each portfolio, $\mathbf{e}_i$, under consideration is assumed to be a linear function of the chosen state variables, $\mathbf{x}_t$, which are known to all participants in the market, and which provide a summary of the state of the economy, at the end of period *t*:

$$\mathbf{e}_{i,t+1} = \mathbf{a}_i \mathbf{x}_t + \tilde{\mathbf{e}}_{i,t+1} \qquad (7)$$

In addition, the vector of state variables is assumed to follow a first order VAR process:

$$\mathbf{x}_{t+1} = \Pi \mathbf{x}_t + \tilde{\mathbf{x}}_{t+1} \qquad (8)$$

where $\tilde{\mathbf{x}}_{t+1}$ is the innovation in the vector of state variables. Hence the expectation in the current period of any future values of the state variables is,

$$E_t \mathbf{x}_{t+j+1} = \Pi^j \mathbf{x}_{t+1}$$

and the revision in long horizon expectations of $\mathbf{x}_t$ made between the current period and the next is,

$$(E_{t+1} - E_t)\mathbf{x}_{t+j+1} = \Pi^j \tilde{\mathbf{x}}_{t+1} \qquad (9)$$

Using the definitions of the news variables in equations (4) and revision of expectations in the vector of state variables in equation (9), it is possible to derive the "news components" of the portfolio returns:

$$\tilde{e}_{di} = \tilde{\mathbf{e}}_{i,t+1} + (i_r' + r\mathbf{a}_i')(\mathbf{I} - r\Pi)^{-1}\tilde{\mathbf{x}}_{t+1} \qquad (10a)$$
$$\tilde{e}_{ei} = r\mathbf{a}_i'(\mathbf{I} - r\Pi)^{-1}\tilde{\mathbf{x}}_{t+1} \qquad (10b)$$
$$\tilde{e}_r = i_r'(\mathbf{I} - r\Pi)^{-1}\tilde{\mathbf{x}}_{t+1} \qquad (10c)$$

where $\tilde{\mathbf{e}}_i$ is the *i*th row of the vector $\tilde{\mathbf{e}}$ and $\mathbf{a}_i$ is the *i*th row of the coefficient matrix **A**. i_r is a selection vector which "picks out" the real interest rate from the VAR, (i.e. $i_r'\mathbf{x}_{t+1} \equiv r_{t+1}$). The factor innovations are the residuals from the k individual VAR equations, i.e.;

$$\tilde{\mathbf{e}}_k = \tilde{\mathbf{x}}_{k,t+1} \qquad (10d)$$

where $\tilde{\mathbf{x}}_{k,t+1}$ is the kth row of the innovation vector $\tilde{\mathbf{x}}_{t+1}$. Having estimated equations (7), (8) and (9), and obtained the variables in equations (10a) - (10d), it is straightforward to calculated the relevant variances and covariances, and hence the betas in equation (6).

6 : Data and Empirical Results

For the UK, Germany and France our data comprise end-of-month observations from January 1970 to January 1993 of returns on industry-based portfolios. The industry classifications are not always available across all three countries and they may not exactly match in terms of their component industries. However, the classifications are broad enough to warrant a meaningful comparison.

Initially we studied five state variables: the market dividend yield, the real 1-month TB rate, the inflation rate, the industrial production growth rate and the percentage change in the real Effective Exchange Rate[4]. However, we find statistically significant coefficients for a VAR including only three of the state variables; the real interest rate, the industrial production growth rate and the exchange rate. We therefore report our key results using a three state variable VAR[5]. We also report some variants on this basic VAR system. All variables in the VAR are defined as deviations from their mean and results are reported initially using a VAR lag length of one[6].

The linearisation constant, ρ_i, is estimated as defined in section 2. Since the range of estimated ρ_i's across the portfolios is not very large, and our results are not sensitive to variations of ρ within this range, we set ρ equal to 0.9958 for all UK portfolios, corresponding to a mean market dividend-price ratio of 4.95% and similarly, 0.9977 for German portfolios and 0.9966 for French portfolios. From equation (10c), it is clear that the use of the same value of ρ_i for all portfolios restricts the impact of each factor innovation on revisions to expectations of future real interest rates ($b_{ri,k}$) to be the same across all portfolios.

[4]All monthly rates are expressed as percent per annum, except for the dividend-price ratio which is in basis points per annum.
[5]All other results available from the authors on request.
[6]Both the Schwartz (BIC) and Akaike (AIC) selection criteria are minimized for a lag length of one for all three countries.

6.1 : Sample Statistics

Tables 1A, 1B and 1C show, to the right of the diagonal, the correlation coefficient between factors while the correlations between factor *innovations* are shown to the left of the diagonal (for the UK, German and French state variables respectively). There is a large negative correlation between the real interest rate and the rate of inflation and their factor innovations for all three countries. For all three countries, industrial production growth and its innovations and the real exchange rate and its innovations are not highly correlated with any other variables or innovations in variables. This suggests that apart from the interest rate - inflation variables, the factor innovations are nearly orthogonal.

It is worth noting at the outset that in common with other studies (e.g. Campbell and Mei 1993) the 'R-squareds' from the industry (monthly) return regressions are relatively low, in the range 3% to 6%. Of course, this implies that most of the observed movements in returns is due to news (i.e. as reflected in the error term in the returns equations). However, this does not invalidate the analysis in this paper which, broadly speaking, seeks to correlate the residuals in the returns equation (i.e. 'news' about returns) with news about macroeconomic factors (i.e. the error term in the regression for the *k*th factor). A low R^2 in the returns regression does not preclude the possibility of a statistically significant correlation between the residuals from these two separate equations.

6.2 : Real Interest Rate Betas

Turning now to the direct real interest rate effects, the first column of numbers in Table 2A[7] shows that for the UK, the real interest rate betas are negative: a positive shock to the level of the current real interest rate is associated with a downward revision in required stock returns, for all industries. Interpreting the real interest rate effect as a change in monetary policy we note that the capital goods, engineering, metals, building, and aerospace are strongly affected. A high level of capital investment, external borrowing and debt would be consistent with this affect working via Tobin's Q and gearing. Forward looking behaviour by market participants is reflected in the fact that a current positive surprise to interest rates leads to higher real interest rates in the future - this is a manifestation of the long memory or persistence in real rates, since $b_{r,r}$ = 1.86 for the UK. Overall, the results show that the real interest rate transmission mechanism impinges disproportionately on the construction and manufacturing sector (capital goods, aerospace, metals, packaging and paper) relative to the service sector and banks and insurance sectors.

In the main, the real interest rate betas for German industries are similar to those for the UK industries. Engineering, Metals and Chemicals have large negative interest rate betas in Germany similar to those found for the UK. In France, Metals and Chemicals also have large negative betas. Hence, the interest rate response of what we could loosely classify as capital goods\manufacturing\chemicals are similar across the three countries. This implies that under a European Central Bank, which controlled interest rates (in a common currency), the response of these sectors would be similar and hence asymmetry problems would not arise.

For all three countries, an unexpected increase in the real interest rate is associated with a significant increase in expected future real interest rates (final row, table 2A). It seems, therefore, that changes in monetary policy are viewed as "persistent" in all three countries, hence the change to a common currency would not necessarily have a differential impact, if policy where set by a European Central Bank.

6.3 : Industrial Production Growth Betas

In general the point estimates of the effect of innovations in the growth rate of industrial production are relatively small for all three countries. Indeed, only two of the industrial production growth betas are significantly different from zero (table 3A). They are the German Building Materials portfolio and the French Property portfolio. Such results lead us to conclude that the shocks to industrial production do not contain any incremental information relevant to

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[7] In Tables 2A - 4B all figures given in parentheses are standard errors and all significant beta estimates are embolded.

the pricing of shares. This suggests that shocks to monthly industrial production are capable of being diversified away and hence are not priced.

6.4 : Real Exchange Rate Betas

Shocks to the real Sterling exchange rate provide a portmanteau measure of unexpected changes in the international competitiveness of British firms, and might therefore be expected to have some influence on investors' required returns. From Table 4A it appears that, on the whole, an unexpected appreciation of Sterling coincides with a rise in current expected returns. This effect is particularly important in the export-intensive Capital Goods sector and sub-sectors (eg. electricals and engineering), where the betas are generally significantly positive. The major source of this effect appears to come through adjustments in expectations about future real interest rates. We estimate the real interest rate beta to be -0.1724 (s.e.=0.0549), so that an unexpected appreciation of Sterling coincides with a fall in expected future real interest rates. Since for much of our data period the Bank of England has actively used interest rates to influence the exchange rate, this is a highly plausible result. These results highlight the importance for the transmission mechanism of the interaction between interest rates and exchange rates, particularly for the manufacturing sector.

In general terms, for French and German portfolios there seems to be a weak negative relationship between unexpected changes in the real exchange rate and required returns, but only the German Chemicals sector has a significantly negative beta. This suggests, in contrast to the UK results, that an unexpected appreciation of either the Deutschemark or the Franc results in a fall in current expected returns. In part this appears to be because of the near zero real interest rate betas. Faced with an appreciation of the Deutschemark, market participants do not associate this with a future fall in the real interest rates and with the Franc shadowing the Deutschemark, the appreciation is interpreted as having a deflationary impact on future profits and hence industry returns.

6.5 : Variants

Tables 2B, 3B and 4B show the decomposition of the real interest rate, industrial production growth and the real exchange rate respectively. The decompositions appear in columns 2, 3 and 4 for the UK, columns 5, 6 and 7 for Germany and the final columns for France.

The decomposition of the real interest rate (table 2B) shows that the main source of influence upon the real interest rate beta is news about future excess returns. For both the UK and Germany the excess return betas are significantly positive, while for France they are significantly negative. Furthermore, Campbell and Mei (1993) find that an unexpected increase in the ex post real interest rate is associated with a significant increase in expected future cash flows. While this is largely the case for the UK and German sector portfolios, it is clearly not for France. In fact, for the majority of the portfolios under consideration, the estimates suggest that an unexpected increase in the real interest rate corresponds to a fall in expected future dividends.

The decomposition of the industrial production growth beta (table 3B) reinforces the similarities between the UK and Germany and the difference of France. Again, we find that the future excess returns beta contains the significant information with the betas being significantly negative for the UK and Germany but positive for the French portfolios.

Decomposing the real exchange rate betas we find that whilst most of the UK dividend betas are insignificant, the future excess return betas are all significantly negative (columns 3,4 table 4B), Thus, the direct effect of an unexpected appreciation of Sterling on future dividends is fairly minimal compared with the reduction in future real interest rates, and so stock prices increase. For most of the German portfolios, the cash flow and excess returns betas are mainly negative as for the UK.

6.6 : Sensitivity Results

When inflation is added to the VAR, we find that the UK inflation betas are significant while French and German returns are insensitive to the inflation factor. In fact, none of the inflation betas are statistically significant for either country. This suggests that it is real interest rates that are important and that nominal rates and inflation have no differential impact on stock prices. This is due to the fact that most of the variability in real interest rates is due to movements in nominal rates through the operation of monetary policy.

Our results appear to be robust to changes in the VAR lag length. For p=2 or 3 the signs and statistical significance of the beta estimates largely unchanged, and the point estimates are all very close to those obtained from a VAR(1) model. For instance, the real interest rate beta for the Metals sector is -2.4254 (s.e. 1.1272) for Germany and -6.4683 (s.e. 2.4809) for France when the state variable VAR is increased to two lags.

7 : Conclusions

We use a linearised RVF to apportion unexpected changes in asset returns into news about fundamentals, namely future dividends, real interest rates and future returns. Macroeconomic factors which might influence expected asset returns can do so only if they contain news about these three fundamentals. The analytical framework therefore combines the time-series VAR method for estimating "news" components with the cross-section approach more familiar in the APT framework.

The basic metric used is the asset's beta with a risk factor, $\beta_{i,k}$. Any $\beta_{i,k}$ can be decomposed into betas between the three fundamentals and the chosen factor. We examine the channels through which macroeconomic factors influence fundamentals, and hence asset prices. Here, in contrast to studies that look at multivariate determinants of returns without imposing the consistency requirement of the RVF, we find that simple "causal" relationships cannot be made. This is because the chosen factor can have offsetting effects on the fundamentals.

Surprisingly, we find that shocks to real output growth have little or no direct effect on most industry returns in all three countries. The market instead appears to focus on the interest rate and exchange rate as key sources of important macro-shocks. These two shocks have their most potent effects on the manufacturing and allied sectors. Higher real interest rates have a direct negative effect on stock prices which is then reinforced by expectations of higher future excess returns; (ie. persistence). The latter effects swamp any effect via expected changes in future cash flows (dividends). In the UK, a higher real exchange rate has its major impact via lower expected future real interest rates, and so leads to higher current stock prices. The recent rapid rise in the UK stock market may therefore be attributable to the favourable interest rate-exchange rate nexus of leaving the ERM. However, for France and Germany the exchange rate betas are often negative for the manufacturing industries. This is because Germany is perceived as not lowering future interest rates after an appreciation and as French monetary policy is closely tied to German policy, this results in similar negative effects in French industries.

Such findings pose interesting questions with respect to convergence and the prospect of EMU. Under such a union, the three countries would be subject to the same interest rate policy. We find that the capital goods, metals chemicals, engineering and electrical industries (i.e. broadly the manufacturing sector) react in the same way in all three countries to shocks to the real interest rate. Hence a common monetary policy would not have differential impacts on these sectors.

Reactions to exchange rate shocks differ between the three countries. This is mainly due to the different future interest rate response engendered by the exchange rate shock. Germany does not appear to ease monetary policy after an appreciation of the Deutschemark, France follows suit which then leads to a deflationary impact on the economy and hence on stock returns.

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Table 1A: Correlations of Factors and Factor Innovations : UK[(1)]

	r	ipg	infl	Δs
r		0.0030	-0.9430	-0.3380
ipg	-0.0370		-0.0230	-0.0880
infl	-0.9950	0.0410		0.3710
Δs	-0.4440	-0.0290	0.4210	

Table 1B: Correlations of Factors and Factor Innovations : Germany[(1)]

	r	ipg	infl	Δs
r		0.0149	-0.8823	0.0690
ipg	0.0218		-0.0688	-0.1105
infl	-0.9937	-0.0185		-0.0911
Δs	0.0771	-0.0852	-0.0812	

Table 1C: Correlations of Factors and Factor Innovations : France[(1)]

	r	ipg	infl	Δs
r		-0.590	-0.8376	0.0545
ipg	-0.0972		-0.0001	0.0212
infl	-0.9823	0.1091		-0.1193
Δs	-0.0101	0.0125	-0.0207	

Notes:

(1) The upper right portion of the table presents the contemporaneous correlations between the four factor **variables** while the lower left portion gives the contemporaneous correlations between the factor **innovations**. The four state variables are, reading the columns left to right, the real interest rate, industrial production growth, the rate of inflation and the change in the effective exchange rate.

Table 2A: Real Interest Rate Beta

	UK $b_{i,r}$	Germany $b_{i,r}$	France $b_{i,r}$
Building Materials	**-2.4487** **(0.9691)**	0.2084 (1.3225)	-1.8744 (1.5880)
Electricals	-1.4236 (0.7642)	-1.2872 (1.0993)	-2.4661 (1.8655)
Engineering (General)	**-2.1494** **(0.8151)**	**-2.1367** **(1.0434)**	-0.7332 (2.4324)
Metals & Metal Forming	**-2.4500** **(0.8640)**	**-2.4137** **(1.1205)**	**-4.8903** **(2.3704)**
Capital Goods	**-2.2109** **(0.8214)**		
Food Manufacturing	-1.6969 (0.9078)	0.6512 (1.0215)	-2.5043 (1.5331)
Packing, Paper & Print	**-2.3567** **(0.9102)**	-0.9861 (1.3333)	3.2704 (2.3520)
Textiles	**-1.8366** **(0.8888)**	0.9744 (1.2949)	-0.9611 (2.1307)
Chemicals	-1.5335 (0.8158)	**-2.4457** **(1.0509)**	**-2.7305** **(1.3540)**
Aerospace	**-2.5515** **(0.8157)**		-0.9606 (2.8838)
Food Retailing	**-1.8005** **(0.7804)**		0.1122 (1.4567)
Hotels & Leisure	**-2.2999** **(1.0294)**		-1.7113 (1.6099)
Property	**-2.0465** **(1.0077)**		1.1216 (1.9653)
Financial Services	-1.2417 (0.8921)		-1.2694 (2.1499)
Banks	-0.7155 (0.9307)	-0.4115 (1.0269)	
Real Interest Rate $b_{r,r}$	**1.8103** **(0.0188)**	**1.4487** **(0.0016)**	**2.4396** **(0.0165)**

Note : All figures in parentheses are standard errors.
Significant estimates are embolded.

Table 3A: Industrial Production Growth Beta

	UK $\beta_{i,ipg}$	Germany $\beta_{i,ipg}$	France $\beta_{i,ipg}$
Building Materials	-0.0860 (0.2636)	**-0.4420 (0.2228)**	0.3469 (0.4483)
Electricals	-0.2159 (0.2167)	0.0052 (0.1828)	0.4165 (0.4652)
Engineering (General)	0.1005 (0.2333)	0.0672 (0.1851)	-0.3159 (0.5250)
Metals & Metal Forming	0.1850 (0.2415)	0.0222 (0.1957)	1.1264 (0.6636)
Capital Goods	-0.0306 (0.2278)		
Food Manufacturing	0.0463 (0.2186)	0.0811 (0.1606)	0.3059 (0.4193)
Packing, Paper & Print	-0.000 (0.2487)	0.1256 (0.1893)	0.6336 (0.5065)
Textiles	0.0791 (0.2330)	-0.3005 (0.2516)	0.5144 (0.4883)
Chemicals	-0.1205 (0.2082)	0.0583 (0.1767)	0.0560 (0.3418)
Aerospace	0.1986 (0.2306)		-0.7160 (0.6011)
Food Retailing	-0.1805 (0.2744)		0.1162 (0.3565)
Hotels & Leisure	-0.1721 (0.2934)		0.2955 (0.3825)
Property	-0.2392 (0.3218)		**1.2197 (0.5675)**
Financial Services	-0.1530 (0.2528)		0.6812 (0.4769)
Banks	-0.1408 (0.2992)	0.0098 (0.1831)	
Real Interest Rate $\beta_{r,ipg}$	-0.0090 (0.0553)	-0.0058 (0.0168)	**-0.0820 (0.0324)**

Note : All figures in parentheses are standard errors.
Significant estimates are embolded.

Table 4A: Real Exchange Rate Beta

	UK $b_{i,\Delta s}$	Germany $b_{i,\Delta s}$	France $b_{i,\Delta s}$
Building Materials	**0.6171** **(0.2620)**	0.0230 (0.4273)	-0.3137 (0.7401)
Electricals	**0.5624** **(0.2225)**	-0.164 (0.3950)	-0.0258 (0.7343)
Engineering (General)	**0.4583** **(0.2265)**	-0.6277 (0.3803)	-1.0562 (0.6003)
Metals & Metal Forming	0.4720 (0.2722)	-0.5868 (0.4091)	0.2704 (0.7466)
Capital Goods	**0.5414** **(0.2212)**		
Food Manufacturing	0.0952 (0.2105)	0.2042 (0.3936)	0.0256 (0.6243)
Packing, Paper & Print	0.3033 (0.2424)	-0.2777 (0.4356)	0.3677 (0.8827)
Textiles	0.1923 (0.2550)	0.1456 (0.4188)	-0.0946 (0.6994)
Chemicals	0.1122 (0.2209)	**-0.7234** **(0.3300)**	-0.1447 (0.4245)
Aerospace	**0.5053** **(0.2310)**		-1.2619 (0.6824)
Food Retailing	**0.4908** **(0.2240)**		0.1679 (0.4429)
Hotels & Leisure	0.3890 (0.2476)		-0.3876 (0.6180)
Property	**0.6519** **(0.2773)**		-0.8484 (0.9877)
Financial Services	0.2388 (0.2342)		0.9394 (0.7918)
Banks	0.0893 (0.2469)	-0.1443 (0.3439)	
Real Interest Rate $b_{r,\Delta s}$	**-0.1724** **(0.0549)**	0.0358 (0.0252)	-0.0449 (0.0504)

Note : All figures in parentheses are standard errors.
Significant estimates are embolded.

Table 2B: Decomposition of Real Interest Rate Beta

	UK $b_{i,r}$	UK $b_{di,r}$	UK $b_{ei,r}$	Germany $b_{i,r}$	Germany $b_{di,r}$	Germany $b_{ei,r}$	France $b_{i,r}$	France $b_{di,r}$	France $b_{ei,r}$
Building Materials	**-2.4487** **(0.9691)**	0.0313 (0.9704)	**0.6698** **(0.0300)**	0.2084 (1.3225)	**3.4386** **(1.3483)**	**1.7815** **(0.1286)**	-1.8744 (1.5880)	-2.4395 (1.6084)	**-3.0047** **(0.2319)**
Electricals	-1.4236 (0.7642)	0.4442 (0.7649)	**0.0575** **(0.0266)**	-1.2872 (1.0993)	1.4194 (1.1079)	**1.2578** **(0.0849)**	-2.4661 (1.8655)	-1.3581 (1.8862)	**-1.3315** **(0.2964)**
Engineering (General)	**-2.1494** **(0.8151)**	0.0634 (0.8325)	**0.4025** **(0.0647)**	**-2.1367** **(1.0434)**	-1.3040 (1.1227)	**-0.6161** **(0.2734)**	-0.7332 (2.4324)	**-12.2095** **(2.5172)**	**-13.9159** **(0.3762)**
Metals & Metal Forming	**-2.4500** **(0.8640)**	0.2212 (0.8707)	**0.8610** **(0.0445)**	**-2.4137** **(1.1205)**	-1.9871 (1.1844)	**-1.0222** **(0.2734)**	**-4.8903** **(2.3704)**	-3.3448 (2.3924)	**-0.8941** **(0.1686)**
Capital Goods	**-2.2109** **(0.8214)**	0.1095 (0.8234)	**0.5101** **(0.0326)**						
Food Manufacturing	-1.6969 (0.9078)	0.4683 (0.9078)	**0.3549** **(0.0539)**	0.6512 (1.0215)	**5.8972** **(1.0499)**	**3.7973** **(0.2304)**	-2.5043 (1.5331)	**-3.7204** **(1.5407)**	**-3.6557** **(0.2104)**
Packing, Paper & Print	**-2.3567** **(0.9102)**	0.6900 (0.9068)	**1.2364** **(0.0266)**	-0.9861 (1.3333)	-0.1556 (1.3601)	**-0.6183** **(0.2119)**	3.2704 (2.3520)	0.2307 (2.3869)	**-5.4792** **(0.1510)**
Textiles	**-1.8366** **(0.8888)**	0.2403 (0.8987)	**0.2666** **(0.0511)**	0.9744 (1.2949)	**3.4648** **(1.2933)**	**1.0416** **(0.0455)**	-0.9611 (2.1307)	0.2729 (2.1069)	**-1.2055** **(0.2796)**
Chemicals	-1.5335 (0.8158)	-0.2865 (0.8449)	**-0.5632** **(0.1094)**	**-2.4457** **(1.0509)**	1.0544 (1.0663)	**2.0513** **(0.0976)**	**-2.7305** **(1.3540)**	**-5.2314** **(1.3564)**	**-4.9404** **(0.0631)**
Aerospace	**-2.5515** **(0.8157)**	-0.4161 (0.8256)	**0.3251** **(0.0444)**				-0.9606 (2.8838)	**-14.4391** **(3.0142)**	**-15.9180** **(0.5209)**
Food Retailing	**-1.8005** **(0.7804)**	0.8964 (0.7801)	**0.8866** **(0.0562)**				0.1122 (1.4567)	-1.0789 (1.5351)	**-3.6306** **(0.2760)**
Hotels & Leisure	**-2.2999** **(1.0294)**	-0.0080 (1.0466)	**0.4816** **(0.0777)**				-1.7113 (1.6099)	-2.4100 (1.6105)	**-3.1382** **(0.0378)**
Property	**-2.0465** **(1.0077)**	0.7576 (1.0061)	0.9939 (0.0167)				1.1216 (1.9653)	2.6058 (1.9582)	-0.9554 (0.0763)
Financial Services	-1.2417 (0.8921)	1.5073 (0.8917)	**0.9388** **(0.0354)**				-1.2694 (2.1499)	-0.4996 (2.2008)	**-1.6697** **(0.2061)**
Banks	-0.7155 (0.9307)	1.08281 (0.9326)	**0.7333** **(0.0482)**	-0.4115 (1.0269)	**4.0305** **(1.0274)**	**2.9932** **(0.0067)**			

Note : All figures in parentheses are standard errors. Significant estimates are embolded.

Table 3B: Decomposition of Industrial Production Growth Beta

	UK $\beta_{i,ipg}$	UK $\beta_{di,ipg}$	UK $\beta_{ei,ipg}$	Germany $\beta_{i,ipg}$	Germany $\beta_{di,ipg}$	Germany $\beta_{ei,ipg}$	France $\beta_{i,ipg}$	France $\beta_{di,ipg}$	France $\beta_{ei,ipg}$
Building Materials	-0.0860 (0.2636)	-0.1544 (0.2633)	**-0.0594** **(0.0213)**	**-0.4420** **(0.2228)**	**-0.5379** **(0.2297)**	**-0.0902** **(0.0309)**	0.3469 (0.4483)	0.2904 (0.4482)	0.0256 (0.0748)
Electricals	-0.2159 (0.2167)	-0.2872 (0.2192)	**-0.0623** **(0.0074)**	0.0052 (0.1828)	-0.0655 (0.1862)	**-0.0649** **(0.0210)**	0.4165 (0.4652)	0.1214 (0.4726)	**-0.2131** **(0.0736)**
Engineering (General)	0.1005 (0.2333)	0.0920 (0.2361)	0.0005 (0.0226)	0.0672 (0.1851)	0.0494 (0.1943)	-0.0120 (0.0463)	-0.3159 (0.5250)	0.1956 (0.5585)	**0.5935** **(0.1688)**
Metals & Metal Forming	0.1850 (0.2415)	0.1024 (0.2425)	**-0.0737** **(0.0282)**	0.0222 (0.1957)	-0..0948 (0.2034)	**-0.1113** **(0.0466)**	1.1264 (0.6636)	1.1188 (0.6698)	0.0744 (0.0421)
Capital Goods	-0.0306 (0.2278)	-0.1069 (0.2280)	**-0.0673** **(0.0173)**						
Food Manufacturing	0.0463 (0.2186)	-0.2096 (0.2140)	**-0.2470** **(0.0124)**	0.0811 (0.1606)	0.0224 (0.1789)	-0.0529 (0.0615)	0.3059 (0.4193)	0.2533 (0.4254)	0.0284 (0.0775)
Packing, Paper & Print	-0.000 (0.2487)	0.1192 (0.2338)	**0.1282** **(0.0374)**	0.1256 (0.1893)	0.0392 (0.1933)	**-0.0806** **(0.0359)**	0.6336 (0.5065)	**1.1005** **(0.5078)**	**0.5489** **(0.0716)**
Textiles	0.0791 (0.2330)	0.0245 (0.2287)	**-0.0456** **(0.0169)**	-0.3005 (0.2516)	-0.4000 (0.2528)	**-0.0937** **(0.0121)**	0.5144 (0.4883)	-0.0101 (0.4806)	**-0.4425** **(0.0638)**
Chemicals	-0.1205 (0.2082)	-0.2504 (0.2118)	**-0.1209** **(0.0381)**	0.0583 (0.1767)	-0.0038 (0.1729)	-0.0564 (0.0300)	0.0560 (0.3418)	0.1240 (0.3503)	**0.1500** **(0.0694)**
Aerospace	0.1986 (0.2306)	0.2070 (0.2297)	0.0174 (0.0162)				-0.7160 (0.6011)	-0.1527 (0.6465)	**0.6453** **(0.1970)**
Food Retailing	-0.1805 (0.2744)	-0.4583 (0.2803)	**-0.2688** **(0.0268)**				0.1162 (0.3565)	0.1705 (0.3723)	0.1363 (0.0884)
Hotels & Leisure	-0.1721 (0.2934)	-0.3106 (0.2894)	**-0.1296** **(0.0260)**				0.2955 (0.3825)	0.3097 (0.3840)	0.0962 (0.0438)
Property	-0.2392 (0.3218)	-0.3335 (0.3179)	**-0.0853** **(0.0298)**				**1.2197** **(0.5675)**	1.0641 (0.5633)	**-0.0736** **(0.0239)**
Financial Services	-0.1530 (0.2528)	-0.3405 (0.2570)	-0.1785 (0.0281)				0.6812 (0.4769)	0.6315 (0.4840)	0.0323 (0.0570)
Banks	-0.1408 (0.2992)	-0.3875 (0.3021)	**-0.2378** **(0.0220)**	0.0098 (0.1831)	-0.0071 (0.1936)	-0.0112 (0.0348)			

Note : All figures in parentheses are standard errors. Significant estimates are embolded.

Table 4B: Decomposition of Real Exchange Rate Beta

	UK $b_{i,\Delta s}$	UK $b_{di,\Delta s}$	UK $b_{ei,\Delta s}$	Germany $b_{i,\Delta s}$	Germany $b_{di,\Delta s}$	Germany $b_{ei,\Delta s}$	France $b_{i,\Delta s}$	France $b_{di,\Delta s}$	France $b_{ei,\Delta s}$
Building Materials	**0.6171** **(0.2620)**	0.2130 (0.2734)	**-0.2318** **(0.0140)**	0.0230 (0.4273)	-0.5750 (0.4294)	**-0.6338** **(0.0381)**	-0.3137 (0.7401)	0.5808 (0.7396)	**0.9394** **(0.0608)**
Electricals	**0.5624** **(0.2225)**	0.2689 (0.2350)	**-0.1211** **(0.0045)**	-0.164 (0.3950)	-0.5531 (0.3928)	**-0.4125** **(0.0268)**	-0.0258 (0.7343)	1.1082 (0.7119)	**1.1789** **(0.0355)**
Engineering (General)	**0.4583** **(0.2265)**	-0.0880 (0.2394)	**-0.3740** **(0.0014)**	-0.6277 (0.3803)	**-2.1028** **(0.3779)**	**-1.5109** **(0.0093)**	-1.0562 (0.6003)	**-2.6292** **(0.6267)**	**-1.5282** **(0.2917)**
Metals & Metal Forming	0.4720 (0.2722)	-0..0299 (0.2892)	**-0.3296** **(0.0168)**	-0.5868 (0.4091)	**-2.0499** **(0.4051)**	**-1.4989** **(0.0216)**	0.2704 (0.7466)	0.9023 (0.7387)	**0.6768** **(0.0199)**
Capital Goods	**0.5414** **(0.2212)**	0.1507 (0.2336)	**-0.2183** **(0.0095)**						
Food Manufacturing	0.0952 (0.2105)	-0.2385 (0.2252)	**-0.1613** **(0.0139)**	0.2042 (0.3936)	**-0.9328** **(0.4019)**	**-1.1728** **(0.0741)**	0.0256 (0.6243)	0.8310 (0.6285)	**0.8503** **(0.0738)**
Packing, Paper & Print	0.3033 (0.2424)	-0.0528 (0.2625)	**-0.1837** **(0.0356)**	-0.2777 (0.4356)	**-1.4020** **(0.4336)**	**-1.1601** **(0.0152)**	0.3677 (0.8827)	0.4873 (0.9061)	0.1644 (0.1288)
Textiles	0.1923 (0.2550)	-0.2626 (0.2639)	**-0.2826** **(0.0037)**	0.1456 (0.4188)	0.3165 (0.4245)	**0.1352** **(0.0214)**	-0.0946 (0.6994)	0.8465 (0.6756)	**0.9860** **(0.0531)**
Chemicals	0.1122 (0.2209)	**-0.4926** **(0.2228)**	**-0.4324** **(0.0372)**	**-0.7234** **(0.3300)**	**-1.1615** **(0.3190)**	**-0.4739** **(0.0401)**	-0.1447 (0.4245)	0.0457 (0.4446)	**0.2353** **(0.1017)**
Aerospace	**0.5053** **(0.2310)**	0.0697 (0.2416)	**-0.2632** **(0.0007)**				-1.2619 (0.6824)	**-3.4421** **(0.7021)**	**-2.1354** **(0.3326)**
Food Retailing	**0.4908** **(0.2240)**	0.0923 (0.2316)	**-0.2262** **(0.0252)**				0.1679 (0.4429)	**1.2318** **(0.4503)**	**1.1088** **(0.0754)**
Hotels & Leisure	0.3890 (0.2476)	-0.2074 (0.2571)	**-0.4214** **(0.0075)**				-0.3876 (0.6180)	-0.2932 (0.6242)	**0.1393** **(0.0646)**
Property	**0.6519** **(0.2773)**	0.3085 (0.2854)	**-0.1711** **(0.0274)**				-0.8484 (0.9877)	-0.6035 (0.9748)	**0.2898** **(0.0204)**
Financial Services	0.2388 (0.2342)	-0.1125 (0.2475)	**-0.1790** **(0.0264)**				0.9394 (0.7918)	**1.7305** **(0.7848)**	**0.8360** **(0.0341)**
Banks	0.0893 (0.2469)	-0.2549 (0.2636)	**-0.1719** **(0.0218)**	-0.1443 (0.3439)	-0.0744 (0.3491)	0.0342 (0.0523)			

Note : All figures in parentheses are standard errors. Significant estimates are embolded.