EQUITY PRICES AND THE REAL ECONOMY – A VECTOR-ERROR-CORRECTION APPROACH

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Abstract We assess the impact of equity prices on the level of output in the Europe Union economies and the US using Vector Error Correction (VECM) time series techniques. The distinction between impacts in bank based and equity market based economies is shown to be important, with equity prices having a greater impact on output in market-based economies. Share prices are shown to be largely autonomous in variance decompositions, whilst equity price do have a strong impact on output in the UK and US in their variance decompositions. An analysis of impulse responses suggests that large market based economies have more effective fiscal and monetary policy instruments.

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1 Introduction

In this paper we address the impact of equity prices on the level of output in the Europe Union economies and the US using Vector Error Correction (VECM) time series techniques. This approach is intentionally 'unstructural' in that we do not identify or estimate the relationships in the economy that theory might lead us to expect. However the data generation process producing the time series we investigate should produce interpretable results in terms of both economic theory and our knowledge of the structure of the economies we study. The impact of changes in equity prices on the level of output could come through a number of routes, and their strength in various economies will depend on the nature of institutions. If consumption depends on the level of financial wealth then a change in the level of equity prices may impact on the consumption decision and hence on the level of output. If investment decisions depend upon sources of finance and in particular on the cost of equity sourced finance, then a change in equity prices may influence the level of investment and hence the level of output in the economy. In this paper we first discuss the evidence on the impact of equity prices on consumption, drawing on Barrell and Davis (2004), and we also discuss the role of equity prices in the investment decision, drawing of Byrne and Davis (2005). In particular we make the common distinction between impacts in bank based and equity market based economies, and we would expect the effects of a change in equity prices to be larger in the market-based economies. We then discuss the merits of VECM techniques and set out a standard testing procedure before we turn to the estimation of the models we then analyse. We conclude with policy discussion.

2 The role of equity prices in the economy

Equity markets trade in the assets of companies, both domestic and foreign, that are largely held in private hands. Owning or issuing an equity instrument involves taking on a bundle of risks and a set of income streams with an associated uncertain capital value. The holder of the equity stake accepts risks, and the value of their wealth is uncertain. Changes in the bundle of risks or set of income streams change the vale of the asset and hence influence the behaviour of individuals. These impacts are often caught through the analysis of wealth effects in consumption or Tobin's Q effects in investment. In the longer term the connection between equity prices and output depends upon the sources of technical progress. As Davis and Madsen (2005) show increases in capital productivity can raise output the profit share and hence equity prices and output, but over the longer run technical progress cannot be consistently capital augmenting. Hence we would expect to see equity prices having a bounded association with real output.

2.1 Consumption.

For the individual consumer their equity holdings carry forward information on some of their future income flows, and hence it is not surprising that they 'add' explanation to simple forward looking Euler equation models as advocated by Hall (1978) for instance. The strongest case for

including financial wealth as a determinant of consumption is based on the Life-Cycle Hypothesis of Ando and Modigliani (1963) as derived in Deaton (1992). In this model, planned consumption (C_t^*) is a function of total wealth. Total wealth is the sum of human wealth (H_t) and net financial wealth (FW_{t-1}) Planned consumption can accordingly be expressed as a function of H_t and FW_{t-1} *t-1*

$$C_t^* = m(H_t + FW_{t-1}) \qquad (1)$$

where *m* is the Marginal Propensity to Consume (MPC) out of total resources on average across the population. Meanwhile, unobservable human wealth can be proxied by some function k of current labour income (i.e. $H_t = kY_t$).

The weights on financial and human wealth could plausibly vary, given their varying liquidity and the possibility of liquidity constraints on households in general. When there are no credit constraints, as in a liberalised financial system, ability to consume out of illiquid financial wealth is enhanced. In particular we might expect to see a relatively larger role for recent changes in income in systems with more liquidity-constrained consumers, and a larger role for wealth when there are no liquidity constraints.

Empirically, there is a significant literature that has departed from the confines of the strict life cycle hypothesis investigating the impact of wealth on consumption, albeit mainly focusing on financial wealth and personal disposable income. A recent example is Davis and Palumbo's (2001) study of the US consumption function, which attempted to determine whether changes in wealth affect the growth rate of consumer spending. They examined quarterly aggregate US data from 1960 to 2000 and modelled long-run relationships to investigate whether (logged) consumption, income and wealth share a common trend. They found that there is a statistically significant long run wealth effect on consumer spending. Ludvigsen and Steindel (1999) also examined wealth effects in a loglinear long-run consumption relationship and found a statistically significant wealth and income effect. They also showed that these variables share a common trend, using quarterly US data.

Outside the US, Barrell, Byrne and Dury (2003a) found evidence of an effect of wealth and income on consumption in the European economies, and tested in a panel context for differences between European countries. They found that it is possible to show that France, Germany, the Netherlands and Austria have similar consumption behaviour with significant financial wealth effects. Byrne and Davis (2003a) analysed the impact of disaggregated financial wealth on consumption for G-7 countries, and found that, contrary to earlier empirical work, illiquid financial wealth, (equities, bonds, life insurance and pension assets less mortgage debt) scaled by personal disposable income (PDI), tends to be a more significant long-run determinant of consumption than liquid financial wealth (deposits and money market instruments less other

debt) across the G-7. They suggested that this pattern reflects a shift from liquidity constrained to life cycle behaviour following financial liberalisation, and also a more disaggregated pattern of wealth holding. Results were robust in SUR analysis, tested in a nested manner, using varying definitions of liquid assets and using non-property income instead of personal disposable income.

Barrell and Davis (2004a) look at the standard model of consumption discussed above and encompass it and the Euler equation approach by including real interest rates. They find in a panel context that real interest rates do affect consumption in the G5 economies, but only after 1990 in the case of the UK and France. However, income and wealth effects are also significant, and hence we cannot presume that consumers only look forward. They find a clear role for both the level and the change in financial wealth. However, they also find that wealth effects differ between countries, with no impact from changes in equity-based wealth in Germany but a relatively strong effect in the UK and the US. These differences reflect the relative importance of both direct and indirect holding of equities in household portfolios. To an extent the existence of equity value effects on consumption behaviour rest on the existence of imperfect markets, and differences between countries again rest on the relative importance of liquidity constraints on consumption behaviour. Barrell and Davis (2004b) test for changing liquidity constraints directly and find a significant role for them in the US, the UK, Germany France and Sweden in the countries considered in this paper.

2.2 Investment

The cost of equity finance has a strong impact on investment where firms have reasonably good access to the capital market, and in particular there is evidence that the value of the equity of a company relative to the price of capital goods has an impact on the investment decision. This ratio, Tobin's q is a sufficient statistic for explaining investment if returns to scale are constant for both production and adjustment costs and if there is perfect competition. The source of finance matters when there are informational asymmetries between internal and external finance provision. The providers of outside finance have less information than insiders, and hence require an equity risk premium. If the equity risk premium falls then the equity price rises and more finance is provided by equity markets.

Evidence for the US suggests that the stock market bubble of the late 1990s influenced corporate investment, raising it significantly (Gilchrist, Himmelberg and Huberman, 2004). More generally there is a significant body of evidence for the US that stock prices affect the level of investment and hence have an impact on the level and rate of change in GDP, although other factors such as the existence of external finance constraints, appear to explain behaviour as well (Hubbard 1998). There is also evidence for the UK that the Q approach to the determination of investment is fruitful, as is discussed in Blundell et al (1992).

The shortcomings of the assumption of perfect capital markets when analysing investment decisions are clear (Schiantarelli 1996). Firms face financial constraints that are dependent on their characteristics and the perceptions of financial market analysts and providers of bank based finance for investment. Financial constraints have a significant impact on investment amongst firms in the US, and they also impact on the differences that we might see between countries. Some firms have relatively strong links with banks, and this reduces the informational asymmetries between providers and users of fund. The strength of links with banks should reduce the importance of financial constraints and equity prices on investment. Bank finance has been particularly important in Italy and Japan and to a lesser extent in France and Germany; although in the latter much investment has been financed from internally generated funds.

We would in general expect more market-based economies to have more impacts from equity prices and from financial constraints, and this does appear to be the case. For instance Bond et al (2003) construct a set of company panel data for Belgium, France, Germany and the UK over the period 1978 to 1989 and find that financial constraints and the associated variations in market based equity risk premia were perhaps more important in the latter country. The more bank-based countries have a smaller role for equity prices as we might expect, although Byrne and Davis (2003b) argue that France is an intermediate case of bank and market finance. Meanwhile, Byrne and Davis (2005) show that volatility as well as levels of share prices can affect investment.

2.3 Structural and VAR models of the impact of equity prices

The differences in structure that we discuss above impact on the reactions of economies to equity market shocks, and influence the differences between countries that we observe in the Monetary Transmission Mechanism. The traditional money based view of this mechanism is that interest rates affect consumption and investment in perfect capital markets, and induce substitutions over time. Imperfect capital markets and the existence of liquidity constraints are at the core of the credit view of the transmission mechanism, and these can be picked up by investigating the role of equity prices in the overall economy. Allen, Chui and Maddeloni (2004) discuss the impacts of financial systems in Europe, the US and in Asia on the transmission mechanism, stressing the role of bank versus market based systems as well as the importance of equity markets. However, they do not discuss the differences that we observe amongst the members of the Euro Area.

The impacts of equity prices on GDP can be evaluated either with VAR based models or with more structural approaches. Pesaran et al (2004) build a compact error correction based global model of 25 countries in which they focus on domestic equity price effects on GDP, showing that they are both significant and vary across countries. Pesaran et al (2005) build on this model to evaluate credit risk using this large dynamic global macroeconomic VAR model attached to descriptions of portfolios. They apply generalised impulse response function for equity price shocks, calculating the correlations between past shocks and applying sets of shocks to all equity

prices. They do not disentangle all the routes through which equity prices affect the economy, but they do show that effects on bank portfolios can be large and asymmetric from relatively mild equity price shocks. Barrell and Davis (2005) use a structural model to evaluate the impacts of changes in equity prices on the economy. Equity holdings affect consumption behaviour in their model, and they include holdings of foreign equities. This allows them to model direct interdependence between economies, both through interdependent portfolios and by applying single country shocks with the associated correlated shocks to other countries.

3 Estimation of Cointegrating Relationships

As a counterpart to work with the Institute macromodel NiGEM reported in Barrell and Davis (2005) cited above, we seek to extend the work of Pesaran and others and further assess links of equity prices to the real economy by estimating Vector Error Correction Mechanisms (VECMs) for 13 EU countries and the US. These have the advantage of a reduced form approach, not imposing restrictions on the data, while also allowing both short and long run (cointegrating) effects to be discerned. In each case we estimate a 4 variable VAR system, and we look for factors that would cause output to cycle around its equilibrium value. As we are investigating real output we would like to use other real variables unless there is a strong case for not doing so. We presume that we should look for policy variables and for an exogenous shock variable such as equity prices. Hence besides real equity prices (LREQP) we utilise real GDP (LY), the government surplus to GDP ratio (GBR) as an indicator of the stance of fiscal policy, and 3-month real short rate (RR) as an indicator of the stance of monetary policy. In order to be sure that we may find a cointegrating vector, we use the data period 1971-2003, covering the era since the end of Bretton Woods.

As at least two of our variables, (LY and LREQP) are integrated of order one we should work in error correction form to avoid spurious regressions. We may write this as

$$\Delta y = \Sigma_i \beta_i \Delta y(-i) + \gamma y(-1) + \varepsilon \qquad (2)$$

Where β_i is a matrix of dynamic response coefficients, γ is the matrix of coefficients on the long run levels terms and y is the vector of the four explanatory variables in each country. We first have to determine the length of lags we need to include in the VAR, and once we have done this we can test the matrix γ to investigate the number of cointegrating vectors. Following Johansen (1995), which summarises and extends his approach, we then estimate these, and place them in the VAR. In general we find that there is one cointegrating vector. We have to normalise on one variable in order to aid interpretation this vector and then analyse long and short responses

Table 1 Lag structure tests (optimal length of lag in VAR)

VAR	UK	France	Germany	Netherlands	Spain	Italy	US
AIC	8	6	2	3	6	3	3
SC	1	2	2	2	2	2	1
HQ	2	2	2	2	2	2	2
VAR	Belgium	Denmark	Finland	Ireland	Austria	Portugal	Sweden
AIC	3	2	3	7	6	5	3
SC	2	2	2	2	2	2	2
HQ	2	2	2	4	2	2	2

We accept a lag length of 2 for all countries in the VAR, based on consideration of the three standard tests (AIC, Schwarz and Hannan-Quinn), as shown in Table 1, although in the case of Ireland there may be an argument for a longer lag length.

Table 2 Estimation results – cointegrating vector 1971:1-2003:4

Normalised on log real equity prices	UK	France	Germany	Nether-lands	Spain	Italy	US
LREQP(-1)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LY(-1)	-1.8	-3.5	-2.1	-1.9	-3.9	-4.0	-1.5
	(5.8)	(2.1)	(10.1)	(5.7)	(6.9)	(2.5)	(6.3)
GBR(-1)	-0.04	0.8	-0.31	-0.06	0.09	-0.08	-0.13
	(1.5)	(3.6)	(8.6)	(1.2)	(1.3)	(0.9)	(2.5)
RR(-1)	0.01	0.6	0.11	0.04	0.02	-0.12	0.02
	(0.5)	(5.7)	(3.6)	(1.4)	(0.5)	(1.4)	(0.7)
C	22.3	19.3	11.9	21.7	19.8	22.3	13.7
Cointegration specification	2	3	3	2	2	2	2
Period	1971-2003	1971-2003	1971-2003	1971-2003	1977-2003	1971-2003	1971-2003
Normalised on log real equity prices	Belgium	Denmark	Finland	Ireland	Austria	Portugal	Sweden
LREQP(-1)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LY(-1)	7.5	-4.7	-3.5	-8.5	-2.4	-2.7	-3.0
	(4.8)	(4.4)	(5.8)	(6.4)	(5.0)	(6.0)	(4.1)
GBR(-1)	-0.6	-0.05	-0.12	-0.07	0.03	0.12	-0.04
	(6.2)	(0.8)	(2.9)	(3.8)	(0.4)	(2.8)	(1.4)
RR(-1)	-0.6	-0.14	0.11	-0.16	0.06	0.14	-0.13
	(5.3)	(2.1)	(3.2)	(5.8)	(1.1)	(4.0)	(3.1)
C	-30.2	60.2	35.0	67.3	26.7	8.0	40.7
TREND				0.1			
				(6.0)			
Cointegration specification	3	2	2	4	2	3	2
Period	1971-2003	1976-2003	1971-2003	1971-2003	1971-2003	1988-2003	1971-2003

* Key to cointegration specifications: specification 2 is intercept in CE and no intercept in VAR, specification 3 is intercept in CE and VAR, and specification 4 is intercept and trend in CE and intercept in VAR.

Cointegration is accepted by the Trace and Maximum-Eigenvalue tests for all countries except Greece, albeit with a trend in the cointegrating equation (CE) in the case of Ireland. There is a common positive relation of LY (i.e. a negative sign in the normalised equations) to LREQP except for Belgium, as shown in Table 2. Generally, a one percent rise in GDP is associated with a 2-4% rise in real equity prices. Monetary policy is negatively related to output and to equity prices in 9 of 14 countries, but often the coefficient is insignificant. Fiscal policy is positively related to output in 10 of 14 countries, i.e. an improved fiscal position is associated with higher GDP, implying either "expansionary fiscal tightening" or simple operation of the automatic stabilisers. We tested the robustness of our results on a shorter time period, starting in 1986q1. Results are reported in the Appendix. In general the results were less satisfactory over this period, and 6 of the 14 coefficients on income attracted the wrong sign. We would conclude that using the longer time period helps us

There are clear differences between countries and we may summarise the information in table 2 by treating it as a quasi panel, and grouping together response coefficients. Using the simple formulae for coefficients and t values shown here it is possible to estimate the size and significance of Panel cointegrating coefficients and t values. The formula for β_{panel} is as follows:

$$\beta_{panel} = \frac{\sum_{i=1}^{n} \beta_i}{n} \qquad (3)$$

β_{panel} is the panel coefficient, β_i the coefficient for individual countries, and n the number of countries concerned. T-values for the panel co-integration were calculated by following the formula, where $t_{\beta,panel}$ is the panel t-values, and t_{β_i} the t-value for individual countries.

$$t_{\beta,panel} = \frac{\sum_{i=1}^{n} t_{\beta_i}}{\sqrt{n}} \qquad (4)$$

Table 3 Panel Johansen coefficients

	LY	GBR	RR
All 14	-2.525	-0.045	-0.004
	(-17.7)	(-5.0)	(0.7)
Large	-2.580	0.048	0.124
	(-12.0)	(3.1)	(3.8)
Small	-2.567	-0.078	-0.073
	(-13.2)	(-3.9)	(-2.0)
Bank	-1.586	0.007	0.030
	(-10.5)	(2.8)	(3.0)
Market	-3.557	-0.073	-0.036
	(-14.6)	(-4.2)	(-2.1)

With the proviso that the procedure is vulnerable to outliers, the results are shown in Table 3 at this stage as measures of association, although we might expect that increases in GDP would be positively associated with equity prices, real interest rates would negatively related to GDP, whilst changes in budget surpluses might be either positively or negatively associated with output. The unweighted average for all 14 countries is a long run rise of 2.5% in share prices for a 1% rise in output. Similar results for the output-equity price link are found for the larger (UK, Germany, France, Italy, US) and smaller (the rest) countries. On the other hand, in the market oriented countries (the UK, US, Ireland, the Netherlands and the Nordic countries) there is a considerably larger effect than in the bank dominated ones. The fiscal position is associated positively to share prices and negatively to GDP on average, in the smaller economies and in market oriented countries. The large positive coefficient on France outweighs the negative coefficients in all other large countries, and hence a positive (Ricardian) association to GDP is apparent in the larger countries and the bank-dominated countries. However, if we were to trim this outlier, the result would change to be consistent with the overall conclusion that an improvement in the fiscal position appears to be associated with higher GDP. Correspondingly, a negative effect of monetary policy on GDP and equity prices is found in the large and bank dominated countries only. This may reflect the fact that the real interest rate is an exogenous not a policy variable in small open economies, and if we were to weight the economies by size then the overall negative effect of real interest rates on output and equity prices would be clear.

4 Investigating the Causal Structure

The normalised cointegrating vector can enter each element of the VAR, and in the Johansen procedure we can investigate long run causality in this way. The matrix γ can be decomposed as $\gamma = \lambda * \alpha$ where α is the matrix of coefficients on the cointegrating vectors (in this case there is one row vector) and λ is the matrix of loading coefficients that associate cointegrating vectors with elements in the VAR – this is also a column vector in this case. The significance of the loading factors (or in this case error correction coefficient) tells us about the causality structure in the long run. The cointegrating equation is significant in the corresponding VAR for the log of real GDP (LY) in all countries except Germany, France and Belgium (implying long run causality from share prices and policy to output), as shown in Table 4. There is no case where the cointegrating vector has a significant long term effect on share prices, implying they are autonomous, as could be anticipated for a forward looking variable. There are some cases of long run effects on fiscal and monetary policy.

Table 4 Significance of CE in VAR (long run causality)

VAR	UK	France	Germany	Netherlands	Spain	Italy	US
DLREQP							
DLY	*			*	*	*	*
DGBR		*	*			*	
DRR		*		*			*
VAR	Belgium	Denmark	Finland	Ireland	Austria	Portugal	Sweden
DLREQP							
DLY		*	*	*	*	*	*
DGBR	*		*				
DRR	*			*			

We can evaluate short run causality relations by looking at the structure of the β matrices, testing to see if lagged changes in one variable impact on the others. If they do not impact in this way they do not short term Granger cause the other variable.

Table 5 Significance of lags in VAR (Short run causality)

VAR	Variable	UK	France	Germany	Netherlands	Spain	Italy	US
DLREQP	LDV	*	*	*			*	*
	DLY			*		*		
	DGBR							
	DRR							*
DLY	LDV		*		*	*	*	*
	DLREQP		*	*			*	*
	DGBR			*			*	
	DRR							*
DGBR	LDV	*	*	*	*	*	*	
	DLREQP							*
	DLY		*				*	
	DRR				*			
DRR	LDV			*	*	*	*	*
	DLREQP	*	*		*			*
	DLY				*			*
	DGBR	*	*					
VAR		Belgium	Denmark	Finland	Ireland	Austria	Portugal	Sweden
DLREQP	LDV	*	*		*	*	*	*
	DLY			*				
	DGBR			*				*
	DRR							
DLY	LDV	*	*	*	*	*	*	*
	DLREQP			*				
	DGBR						*	
	DRR	*					*	*
DGBR	LDV	*	*	*	*	*	*	*
	DLREQP		*					
	DLY			*		*		
	DRR	*	*					
DRR	LDV	*	*		*		*	
	DLREQP			*		*		*
	DLY							*
	DGBR					*		

As we can see from table 5 equity prices are mostly autonomous in the short run, again as befits forward looking variables. In four countries changes in output or fiscal policy are significant in the short run, and in one, the US, changes in real interest rates impact on changes in real equity prices. In 11 countries past changes in equity prices significantly impact on current equity price changes. In 12 countries lagged changes in real output impact on current changes in real output, and in 7 countries changes in other indicators are significantly associated with changes in output. Changes in other indicators are significant in 8 of the fiscal change VARs and all display significant effects from lagged fiscal policy changes. Lagged changes in real interest rates are only present in 9 interest rate change VARs and in these five cases other changes in indicators are significant, suggesting a more complex pattern of causality. Output and policy indicators are more commonly endogenous. Rises in equity prices help to predict short run growth in 5 countries (France, Germany, Italy, the US and Finland), monetary policy impulses help predict short term growth in 4 countries (including the US) and fiscal policy impulses help predict short run growth in 3 countries. Equity prices help predict fiscal developments in 2 countries and monetary policy in 7 countries.

5 Shocking the VECMs

While estimation results give some information, the main outputs of interest from a VECM are variance decompositions and impulse response. As a first step we use the decomposition of the variances of forecasts to evaluate the structure of the economies we are studying.

Table 6 Variance decomposition of LREQP and LY after 20 quarters (percent)

Decomp **of.**.by	UK	France	Germany	Netherlands	Spain	Italy	US
LREQP	100	96	94	72	92	95	93
LY	0	3	1	1	6	2	5
GBR	0	0	5	26	0	2	1
RR	0	1	0	0	2	0	1
LY	23	87	87	76	34	49	22
LREQP	72	12	4	22	59	32	51
GBR	4	2	6	1	7	1	26
RR	1	0	2	0	0	18	0
Decomp **of.**.by	Belgium	Denmark	Finland	Ireland	Austria	Portugal	Sweden
LREQP	97	97	93	97	98	95	89
LY	1	2	6	0	0	3	6
GBR	1	1	0	0	1	0	4
RR	1	0	0	2	1	2	2
LY	98	23	77	33	35	32	28
LREQP	2	48	13	21	58	49	28
GBR	0	1	6	0	0	14	2
RR	0	27	3	46	7	4	42

In order to undertake the necessary Cholesky decomposition we must make a decision on ordering of variables in the VARs. We consider it appropriate to have equity prices first, as they

anticipate the behaviour of other variables, followed by GDP reflecting technology and other shocks, after which comes fiscal policy (which to some degree responds automatically to GDP) and finally monetary policy, which takes into account information on the behaviour of all other variables, but affects output (as does fiscal policy) with a lag. We attempted to reverse the ordering for the UK as a robustness check and the results are virtually identical.

As shown in Table 6, we may note in particular the "autonomy" of share prices in variance decompositions, compared with a marked (albeit variable) impact of share price variance on real GDP. In the variance decomposition for equity prices the extremes are the UK and the Netherlands, with the forecast variance for UK share prices being explained solely by the past history of equity prices themselves. This suggests that the UK equity market, which is large relative to the size of the economy, is completely autonomous. Most economies in our sample have virtually autonomous equity markets, with only Sweden and the Netherlands having less than 90 per cent of the forecast variance accounted for by the past history of equity prices.

The variance decompositions for output are much more varied, with past history for output contributing between 22 and 98 per cent, with equity prices contributing between 2 and 72 per cent. The largest role for equity prices in the decomposition of output variance is in the UK, followed Spain, Austria and the US, all of whom have a share above 50 per cent. The large shares for the UK and the US do fit with our priors and there is clearly a strong case to be made for there being a difference between these large equity based economies and the others. However, the strong role for equity prices in Austria and Spain does not necessarily fit with our priors about the differences between market and bank based economies.

Table 7 Summary of average variance decomposition

Decomp **of..**by	All	Large	Small	Bank dominated	Market oriented
LREQP	93	96	92	95	91
LY	3	2	3	2	3
GBR	3	2	4	1	5
RR	1	0	1	1	1
LY	50	54	48	60	42
LREQP	34	34	33	31	39
GBR	5	8	3	4	7
RR	11	4	14	4	12

There are clear differences in the factors affecting the variance of output between countries, and we can see if groupings help us understand the differences. To summarise the decompositions, we again class the large (UK, US, Germany, France and Italy) countries and the others as small; the UK, US, Ireland, the Netherlands and the Nordic countries are seen as market oriented and the others as bank dominated The results are reported in table 7, but differences between country groupings are not as large as we might expect. We note that a narrower definition of market

orientation including only the US, UK and Ireland could also be used, which would have 97 per cent of the variance of equity price forecasts explained by past equity price developments, and 48 per cent of the forecast variance for output would be explained by past developments in equity prices. These numbers bring out more clearly the expected differences between bank based and market based economies. The impact of equity prices on output variance is in line with the importance of the stock market in most cases, and it is larger in the market oriented countries than bank dominated ones, albeit comparable between small and large open economies.

6 Impulse responses

We can evaluate the set of VARs using standard impulse responses, which allow the effects of an individual shock to build up over time both through the lagged value of the dependent variable in the equation and through current and lagged effects from the impact of the shock and the changes in the first variable on other variables. We would expect equity price effects to be positive and build up slowly over time before reaching a permanent level, whilst real interest rate effects might be considered to be generally negative if we are to see this as an indicator of the monetary stance. However, there may be differences both between countries and over the time horizon. In the short run real interest rates may be determined by central bank policy, but in the longer term they should, at a world level be determined by the balance of saving and investment. In the shorter term a rise in real rates should reduce output, and hence the impact effect in the first few years should be negative. In the longer term this may not be the case. There may also be difference over time between countries, as small open economies may 'take' the world real interest rate in the long run, whilst savings and investment balances in large economies such as the US may determine it.

We see a positive impact of real share prices on GDP in all impulse responses, albeit to an extent that differs more than we might expect. It tends to be less in Germany and France than in the US and UK, despite the significant differences in equity holdings between the first two countries, as is discussed in Davis (2003) for instance. The lowest impacts from equity prices on output are in the founder members of the European Union along with Ireland and Finland. This may suggest that the integration of these economies and the operation of a common monetary policy in the ERM (except in the case of Finland) has changed the interactions between equity markets and the macro economy.

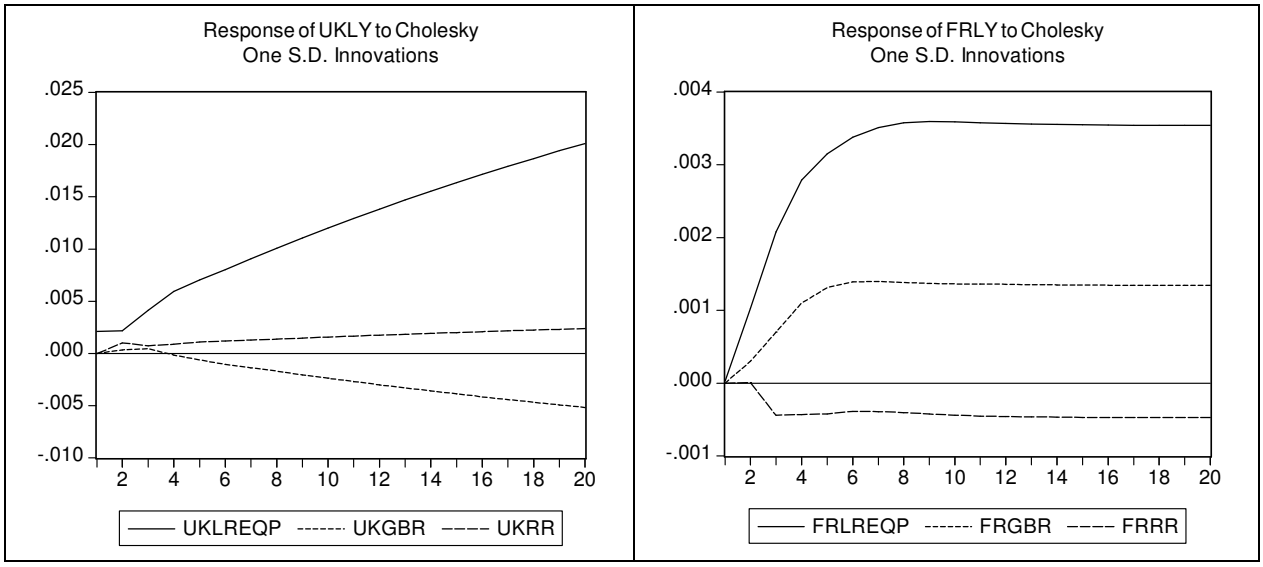
Fiscal and monetary effects on output are generally sizeable and monetary impulses are of the expected sign. The main exceptions are the UK, Austria and – after 1 year – Portugal. For the latter economies changes in real interest rates may reflect activity in a close neighbour (Germany and Spain respectively) and hence the covariation of output and interest rates may reflect supply side influences rather than the impacts of monetary policy. For the UK we may see a similar pattern with real interest rates following those in the US relatively closely as compared to the

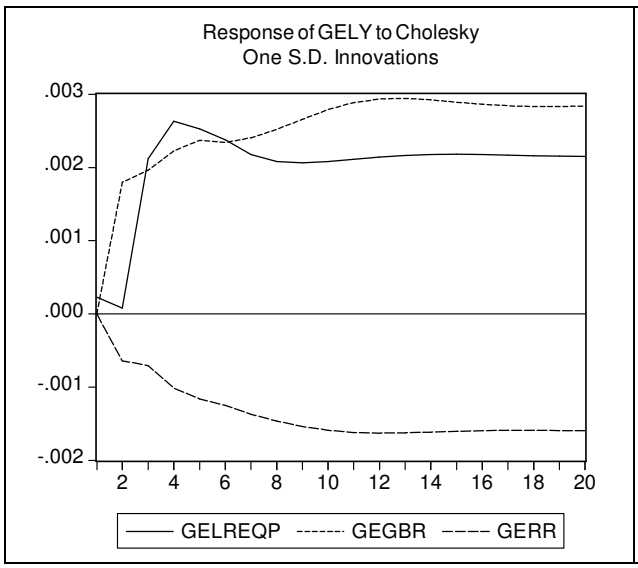
remaining countries which were members of the ERM during much of our data period. The impact of real interest rates in the US is small as compared to other countries suggesting that the saving investment balance in that country determines real rates and hence that increases in output that are sometimes associated with increases in investment will also sometimes be associated with higher real rates. Real interest rate sensitivities are higher in Germany and Italy than in France, much in line with the results from structural models summarised in Wallis (2004).

Fiscal policy responses may not reflect short term innovations in fiscal policy but rather longer run impacts on the capacity to produce or the shorter term response of the deficit to changes in the level of activity. Hence our plotted impulses commonly give "expansionary fiscal contraction" or automatic stabiliser style results over the long term, with a small and a rising positive association between improvements in the fiscal balance and output in the short term reflecting the fact that as borrowing becomes less negative we see higher levels of output. The exceptions to this are the US and UK, together with Austria and Belgium (after a short period of expansionary contraction). These results suggest that in the longer term fiscal policy crowds our real activity.

Figure 1 Impulse response of LY

Country definitions UK, FR: France, GE : Germany, NL : Netherlands, SP : Spain, IT : Italy, US, BG : Belgium, DK : Denmark, Fn : Finland, IR : Ireland, OE : Austria, PT : Portugal, SD : Sweden, Variable definitions LREQP log real equity price, GBR ; Government deficit as a percent of GDP, RR : short term real interest rate.

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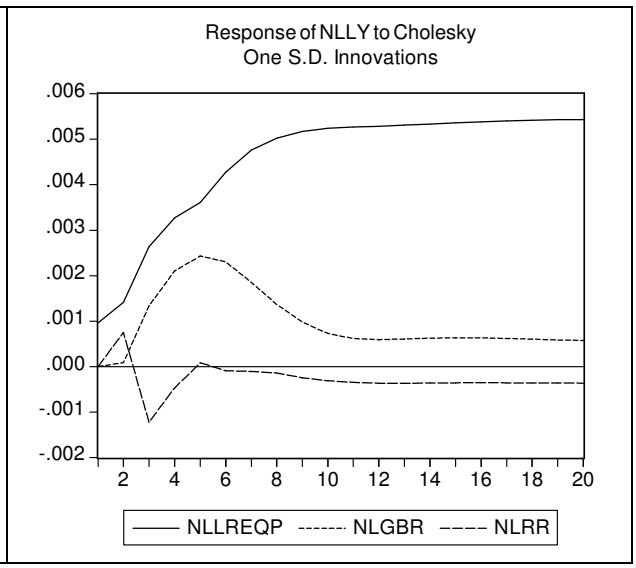
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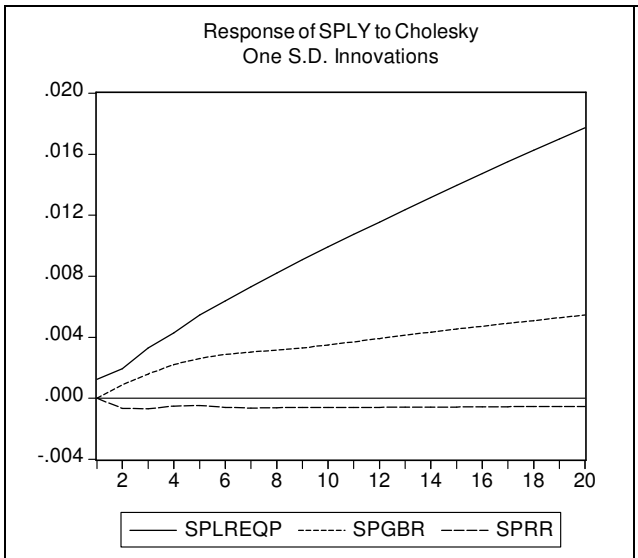
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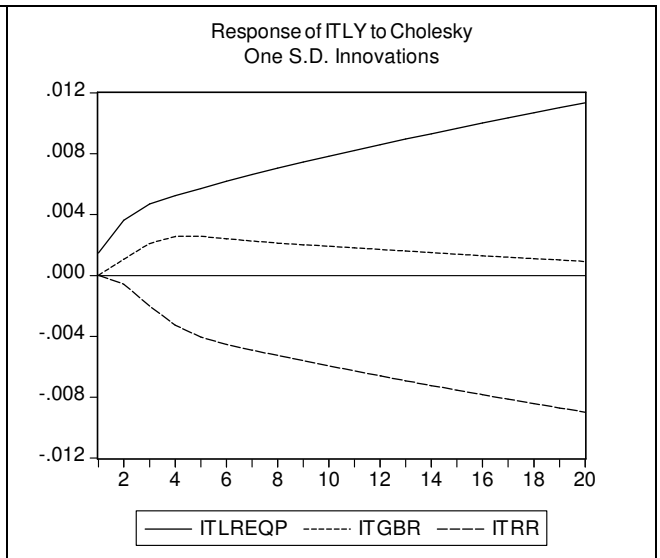
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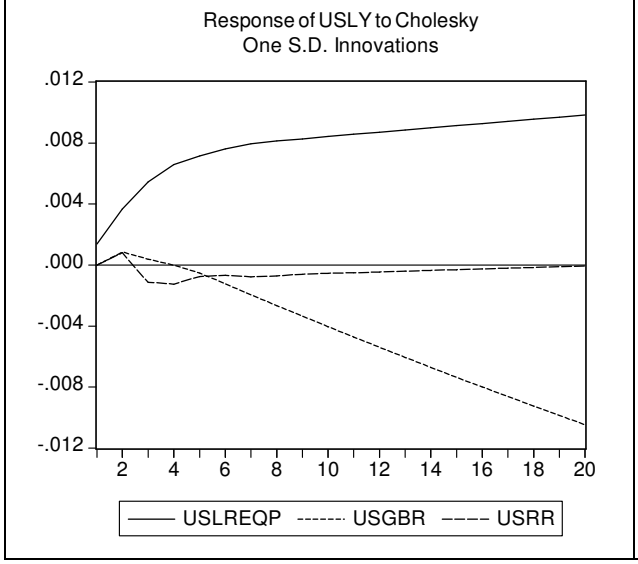
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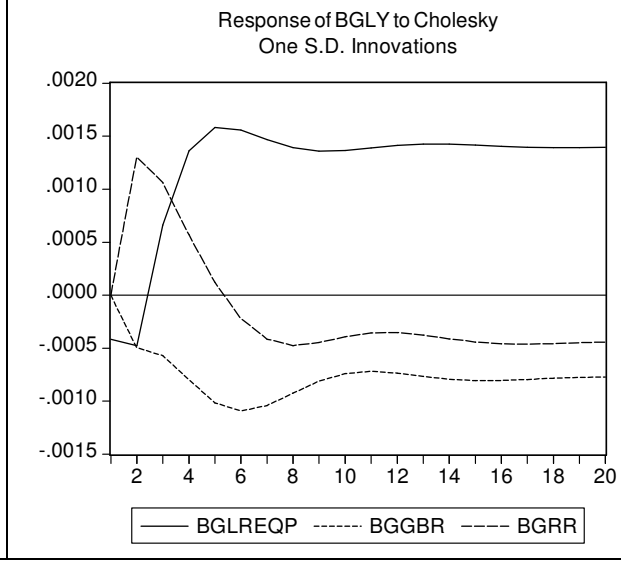
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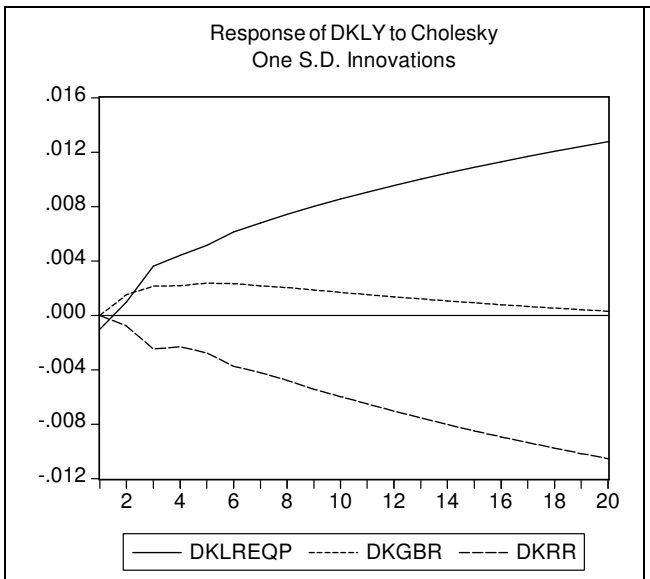
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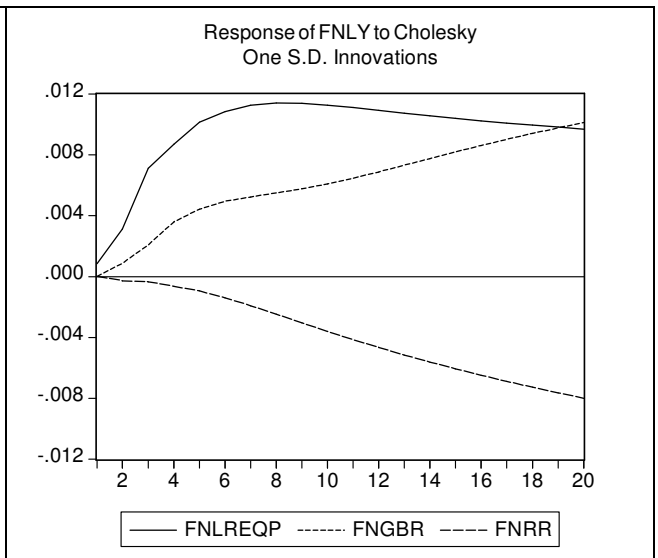
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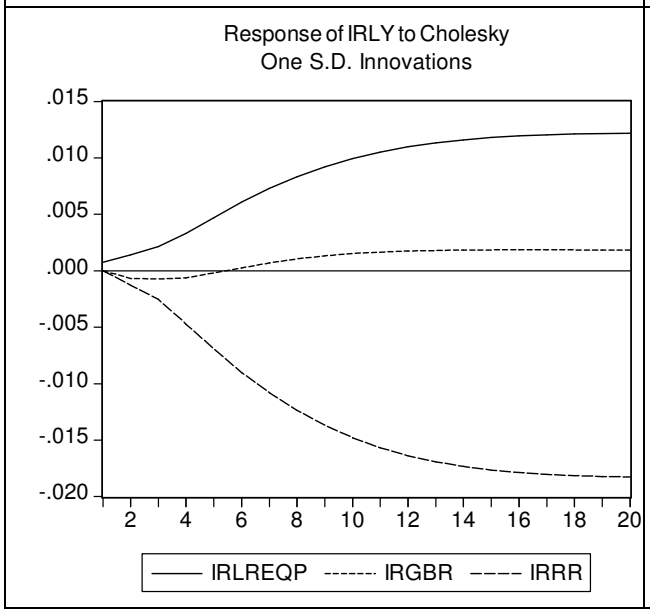
FNLREQP FNGBR FNRR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-.015
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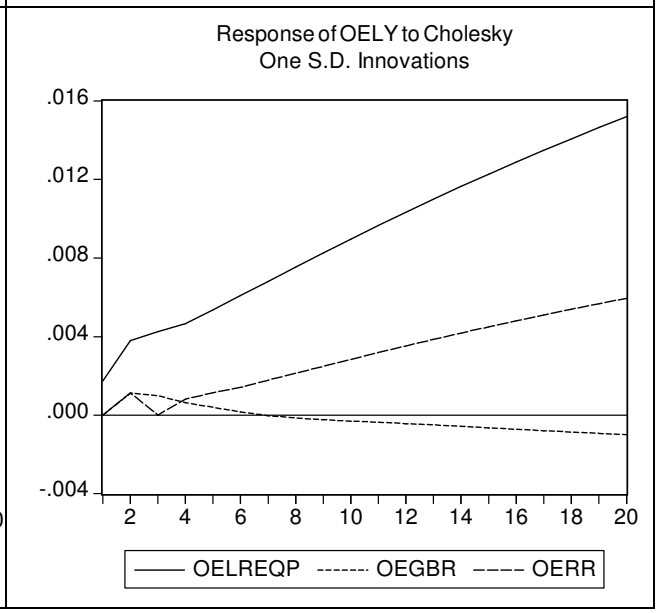
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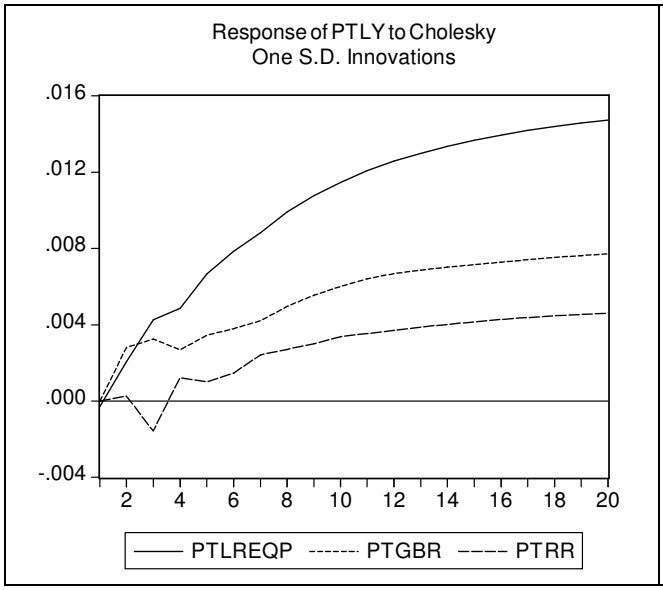
OELREQP OEGBR OERR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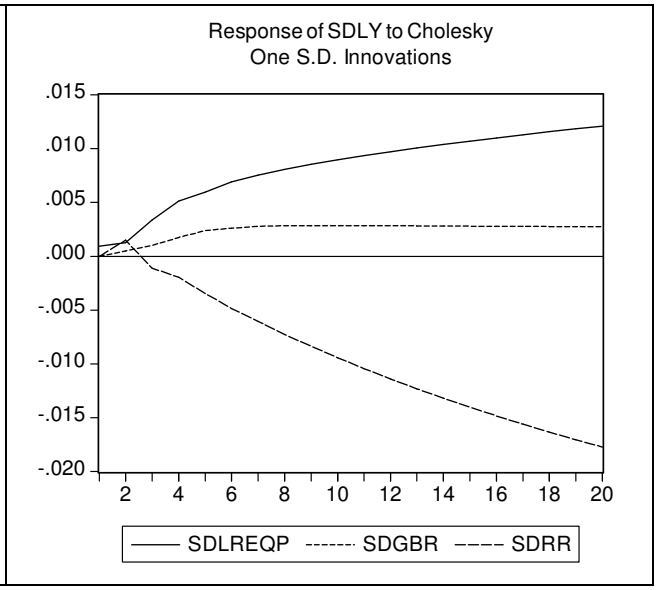
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SDLREQP SDGBR SDRR

7 Assessing the role of US equity prices

In Barrell and Davis (2005) we argue that changes in US equity prices impact directly on the European economies through direct holdings of US equities in European portfolios, and we also show that we should expect these effects to be larger in the UK than in other countries in Europe. As a variant, we included real US share prices in the VECM for the larger EU countries. We reran the tests for selected EU countries with the log of real US share prices coming first in the Choleski ordering. As can be seen from the variance decomposition, there is a major impact of including the US on share price variance – indicating a considerable influence of the US on EU markets - but no change to the overall autonomy of share prices. US equity prices seem to be relatively important in the very open equity markets of the UK and the Netherlands. As regards the determination of domestic output, there is now a large contribution by US share prices, with it being more important in the decomposition than domestic equity prices in all economies except for the UK and Germany. The overall impact of share prices is comparable to the basic results, except for Sweden where the effect is markedly smaller.

The impulse responses associated with these VARs are not reported here. In these responses, the effect of US share prices on domestic GDP is generally parallel to that of domestic share prices when only those are included. However, there are clear differences between countries, and these may reflect the strength of co-movements in equity prices that are discussed in Davis (2003). The overall impact of equity prices is larger in Italy, France, the Netherlands and Spain, comparable in the UK and Sweden and smaller in Germany.

Table 8 Selected variance decompositions of LREQP and LY after 20 quarters including US share prices (percent)

Decomp **of.**.by	UK	France	Germany	Netherlands	Spain	Italy	Sweden
LREQP	31	60	57	29	54	54	31
USLREQP	68	37	39	48	36	43	40
LY	0	1	0	1	5	1	7
GBR	1	0	3	22	0	1	5
RR	0	1	0	0	4	0	16
LY	25	82	61	76	30	68	86
USLREQP	25	13	1	18	45	14	7
LREQP	44	3	8	3	21	9	6
GBR	1	2	12	2	4	5	0
RR	5	0	19	0	0	5	0

8 Conclusions

We have estimated Vector Error Correction Mechanisms (VECMs) for 13 EU countries and the US using data on real GDP, real equity prices, the real interest rate and the government surplus as a percent of GDP. Our results suggest that equity prices play a major independent role in the

determination of output in both the European Union and in the US, even in the presence of proxies for monetary and fiscal policy. This effect is consistent across both small and large countries, as well as in bank dominated and market oriented countries. We find a noticeably larger association between equity prices and GDP in market based economies. The real interest rate appears to be negatively associated with equity prices and output in most countries we study, and especially in the market based economies, as we would expect. Fiscal policy is positively associated with output with a reduction in borrowing being associated with higher output, again more noticeably in market-based economies. However, we cannot draw conclusions solely on the basis of the structure of the cointegrating vector alone and we have also looked at causality, variance decomposition and impulse responses.

The directions of causality in our data set are relatively clear, and there is no long run causality from output to equity prices, suggesting that technical progress over this period has not raised the share of capital in any consistent way. Indeed share prices appear to be largely autonomous both in the short and long run. In general we can say that equity prices consistently cause real output, except perhaps in Belgium. They are present in the long run in all countries except Germany, France and Belgium, whilst they cause real income in the short run in France, Germany, Italy, the US and Finland. However, the relative importance of equity prices may differ, with market-based economies more likely to see some causal relationship from equity prices to output. The uni-directionality of the causality might suggest that our VAR is picking up demand side channels from equity prices to output.

Share prices are also shown to be largely autonomous in a variance decomposition, with over 90 per cent of the forecast variance of equity prices being explained by the past variance of equity prices. The forecast variance of equity prices does affect the forecast variance of output and the impact of equity prices on output variance is in line with the importance of the stock market in most cases. It is marginally larger in the market oriented (40 per cent of variance) countries than bank dominated ones (30 per cent of variance), albeit comparable between small and large open economies. However, equity price do have a strong impact on output in the two largest market based economies, the UK and the US, in their variance decompositions. Real interest rates also make a noticeably larger contribution in market based than bank based economies.

An analysis of impulse responses suggests that equity price effects are positive and build up slowly over time. The impact of changes in equity prices on the level of output could come through changes in consumption or investment, and their strength in various economies will depend on the nature of institutions. The distinction between impacts in bank based and equity market based economies is shown to be important, with equity prices having more impacts on output in market-based economies. It is clearly easier to use monetary policy in the larger market based economies than in bank-based economies, and an increasing reliance on monetary policy for stabilisation strengthens the case for moving toward market-based finance for both

consumption and investment in Europe. The case for using monetary policy for stabilisation is strengthened by the lack of systematic evidence for even a short-term impact of the deficit on output. In 6 bank based economies, including France, Germany and Italy, an improvement in the fiscal position is systematically associated with an increase in output, suggesting that in these economies fiscal policy is ineffective for stabilisation purposes. In the UK and the US, the dominant market based economies, the association between an improved fiscal position and output is initially positive, as we would expect if automatic stabilisers are at work, but after a few quarters the association is negative, as we would hope if fiscal policy were to be useful as a policy instrument in the short to medium term.

The autonomy of equity prices in our VARs along with the strength of their impacts indicates that careful liberalisation of equity markets would help expand demand and output in the bank based economies of continental Europe. This liberalisation would aid the effectiveness of both monetary and fiscal instruments for stabilisation purposes. However, in no case would we expect these instruments to become significant determinants of output in liberalised economies.

Appendix Estimation results – cointegrating vector 1986:1-2003:4

Normalised on log real equity prices	UK	France	Germany	Nether-lands	Spain	Italy	US
LREQP (-1)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LY(-1)	0.8	-0.7	-1.8	-0.05	-3.9	33.3	-0.84
	(0.9)	(0.6)	(3.3)	(0.1)	(5.8)	(4.4)	(3.5)
GBR(-1)	-0.1	0.006	-0.35	-0.2	-0.015	-0.49	-0.14
	(3.1)	(0.1)	(7.1)	(7.1)	(0.4)	(3.2)	(8.3)
RR(-1)	0.23	0.15	0.07	0.06	-0.07	0.33	0.12
	(3.6)	(2.2)	(1.5)	(2.9)	(2.3)	(1.6)	(6.0)
C	-11.6	3.2	9.7	-0.37	19.0	-188	6.6
Cointegration specification	2	3N	3N	2	2	2	2
Normalised on log real equity prices	Belgium	Denmark	Finland	Ireland	Austria	Portugal	Sweden
LREQP (-1)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LY(-1)	0.14	-13.0	45.6	-3.5	24.9	-2.7	15.0
	(0.1)	(3.9)	(4.1)	(8.7)	(2.2)	(6.0)	(2.1)
GBR(-1)	-0.25	-0.19	-0.6	-0.07	-1.1	0.11	0.18
	(5.4)	(2.0)	(3.7)	(5.4)	(1.9)	(2.8)	(1.6)
RR(-1)	-0.25	-0.54	2.0	-0.006	2.0	0.15	2.6
	(6.4)	(4.1)	(5.3)	(0.6)	(3.0)	(4.0)	(6.7)
C	-0.98	165	-476	26.5	-270	8.0	-207
TREND				0.048			
				(7.5)			
Cointegration specification	3N	2	2	4	2	3	2

* Key to cointegration specifications: specification 2 is intercept in CE and no intercept in VAR, specification 3 is intercept in CE and VAR, and specification 4 is intercept and trend in CE and intercept in VAR.

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