SHOCKS AND SHOCK ABSORBERS: THE INTERNATIONAL PROPAGATION OF EQUITY MARKET SHOCKS AND THE DESIGN OF APPROPRIATE POLICY RESPONSES[1]

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Abstract: Equity prices and equity markets are major sources of shocks to the world economy and major channels for the propagation of these shocks. In this paper we attempt to calibrate their effects in current circumstances and assess what policy responses can best absorb them. We first discuss the evidence for the effects of equity prices on real economic activity. We then outline our framework for analysis, which is the National Institute Global Econometric Model NiGEM. Besides its structure per se, outturns in terms of the residuals on forward looking structural equations for equity prices and consumption also provide relevant background. We then look at key features of the recent bear market, viewed in the light of the last major one in 1972-5. There is some evidence that equity markets were overvalued in the late 1990s, and that the equity premium had shrunk to historically low levels. There has also been a very high level of correlation between markets during the bear period. We then assess the macroeconomic implications in the context of NiGEM. We present simulations on the model that give us some idea of the scale of the transnational impact of recent equity market falls, viewed in the context of the high degree of correlation, and also the effect of differing policy responses.

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Introduction

Equity prices and equity markets are major sources of shocks to the world economy and major channels for the propagation of these shocks. In this paper we attempt to calibrate their effects in current circumstances, and assess what policy responses can best absorb them. We first discuss the evidence for the effects of equity prices on real economic activity. We then outline our framework for analysis, which is the National Institute Global Econometric Model NiGEM. Besides its structure per se, outturns in terms of the residuals on forward looking structural equations for equity prices, consumption and real income also provide relevant background. We then look at key features of the recent bear market, viewed in the light of the last one in 1972-5. There is some evidence that equity markets were overvalued in the late 1990s, and that the equity premium had shrunk to historically low levels. There has also been a very high level of correlation between markets during the bear market. We then assess the implications in the context of NiGEM. We present simulations on the model that give us some idea of the scale of the impact of recent equity market falls, viewed in the context of the high degree of correlation, and also the effect of differing policy responses.

1 The Macroeconomic Importance of Equity Markets

There is a significant literature investigating the impact of wealth – itself driven partly by share prices - on consumption. A recent example is Davis and Palumbo's (2001) study of the consumption function, which attempts to determine whether changes in wealth affect the growth rate of US 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 the 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. Further utilising the approach adopted in that paper, Lettau and Ludvigsen (2001) went on to find that deviations from this common trend are a powerful predictor of excess returns on aggregate stock market indexes for US data.

Showing that financial wealth matters in the determination of consumption in the US is not sufficient for our purposes. We need to be able to extend the approach to other countries, and to specify whether equity-related wealth is important. For example, Barrell, Byrne and Dury (2003) 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 the core Europeans, France, Germany, the Netherlands

and Austria have similar consumption behaviour with significant wealth effects[4]. Byrne and Davis (2003a) analysed the impact of disaggregated wealth on consumption for G-7 countries, and found that, contrary to earlier empirical work, illiquid financial wealth, (equities, bonds, pensions and mortgage debt) as a proportion of 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) as a proportion of PDI across the G-7. They suggested that this pattern reflects a shift from liquidity constrained to life cycle behaviour following financial liberalisation. It may also reflect a more disaggregated pattern of wealth holding relative to the 1970s (i.e. with wealth less concentrated among few individuals). Results were robust in SURE analysis, tested in a nested manner, using varying definitions of liquid assets and using non-property income instead of personal disposable income. Wald tests indicated similar long-run behaviour for all EU countries including the UK, despite the differences in financial structure.

Table 1: Household wealth-income ratios

Net financial wealth/personal disposable income ratio							
	UK	US	Germany	Japan	Canada	France	Italy
1998	3.87	3.96	1.54	2.96	2.45	2.45	2.83
1999	3.34	4.42	1.65	3.27	2.46	2.92	3.03
2000	3.35	4.09	1.62	3.30	2.43	2.83	2.98
2001	2.82	3.41	1.59	3.32	2.36	2.56	2.63
Net illiquid financial wealth/personal disposable income ratio							
1998	2.95	2.75	0.46	1.22	1.81	1.59	2.12
1999	2.60	3.22	0.58	1.42	1.85	2.02	2.39
2000	2.56	2.70	0.60	1.38	1.88	2.00	2.27
2001	2.02	2.19	0.57	1.31	1.86	1.74	1.91
Memo: Personal sector direct equity holdings/personal disposable income ratio							
2001	0.59	0.85	0.36	0.34	0.99	1.08	0.62
Memo: Total direct plus indirect equity holdings/total financial wealth %							
2000	53.4	48.5	27.1	13.1	39.8	47.8	30.5

Source: National flow-of-funds balance sheet data, Datastream

Table 1 shows the ratio of wealth to personal income in the major economies, used in the Barrell et al work cited above, and also gives net illiquid wealth (securities, pensions and mortgage debt) used in Byrne and Davis. Net illiquid assets are particularly high in the US, UK and Italy, and particularly low in Germany and France. As regards changes in wealth which could impact on consumption, falls in the UK and US over 1999-2001 were already up to 100% of GDP, and are likely to be much greater at the time of writing. Falls in France and Italy were around half those in the UK and US, while the data up to 2001 showed relatively small declines in Germany, Canada and Japan. Note from the memo line that the direct holdings of equity are largest in France, Canada and the US and lowest in Germany and

[4] The failure to include Belgium in the pool reflects data problems with wealth rather than different behaviour.

Japan. The large difference between this figure and illiquid financial wealth is largely a consequence of the importance of institutional investors, albeit also in some countries reflecting bond holdings. The bottom line in the table (total direct and indirect equity holdings as a proportion of the total), from Byrne and Davis (2003b), makes a correction for institutional holdings on behalf of households. It shows that portfolio shares of equity are quite comparable across the G-7, with the outliers being Japan and to a lesser extent Germany and Italy. The ratio of direct to total equity holdings is a good indicator of the immediate visibility of equity price changes to consumers, and might be expected to affect the speed of response to a change in equity prices, which we might expect to be greater in the US than elsewhere.

As further background to assessing the response of consumption, we show the sectoral holding of these equities in Table 2. If we look at all equities, including unquoted shares we can see that the US, Canada and Italy have the highest proportion held by households, while elsewhere it is comparable at around 20%. As regards holdings in the financial sector, mainly indicating ultimate claims by households, these are highest in the US and the UK (40%) while in Canada, France and Italy they are around 20%. In the UK life insurers and pension funds dominate holdings in the financial sector, while elsewhere banks and mutual funds (often run by banks) are the key players. Note that mutual funds and defined contribution pension funds transmit the impact of equity prices directly to household wealth, while life insurers and defined benefit pension funds cushion this impact via guarantee features, and banks provide a highly indirect impact.

Table 2: Corporate equity holders by sector end-2000 (*percent of total)*

	UK	US	Germany	Japan	Canada	France	Italy
Households	20	35	17	19	41	25	35
Companies	4	14	31	21	25	25	28
Public sector	0	1	3	14	3	2	6
Foreign	37	9	16	15	6	27	14
Financial	39	41	33	31	25	20	17
Banks	2	2	12	10	3	9	8
Life/pension	27	23	8	13	12	4	4
Mutual funds	9	16	13	2	8	4	6

Source: Byrne and Davis (2003b). "Financial auxiliaries" used for mutual funds in Germany

Byrne and Davis (2003b) discuss the importance of quoted and unquoted shares in various countries, which could also matter for the impact of wealth on consumption since unquoted shares are less liquid. For example, the proportion of unquoted shares[5] in France and Italy is large, with nearly 70% of the equity outstanding for French companies being unquoted and

50% in Italy; elsewhere it is below 30%. Nevertheless, the stock of equity for French quoted companies is still over 100% of GDP, above that in Germany, Japan and Italy, albeit well below that in Canada, the UK and US. Sectoral holdings data are available for unquoted shares separately in France, the UK, Germany and Japan. In France, domestic households and companies hold the bulk of unquoted shares, while financial institutions hold 28% of quoted but only 16% of unquoted. These figures are most closely comparable to the UK, although UK companies are less important holders of either type of share than in France, and financial institutions more so. In Germany and Japan, companies and financial institutions hold most quoted shares and for unquoted shares it is companies (Germany) and the public sector (Japan).

Our main focus in this paper is on the response of consumption to share prices. However, we also present results of a model simulation showing the impact of a shift in the equity risk premium on investment. As shown in IMF (2003), declines in investment often have a substantial impact on GDP growth after equity price falls, and falls in investment were sizeable in the current bear market, partly linked to the high level of corporate debt and reliance on external finance generally in the bull period. Some international analysis of single-equation investment functions suggests a marked impact of equity prices, via the valuation ratio (Tobin's Q) or the debt-equity ratio. Recent work on the G-7 by Ashworth and Davis (2001) suggests a broad range of financial variables, consistent with the valuation ratio, financial accelerator and credit channel approaches, are relevant determinants of business fixed investment over and above those variables normally included in traditional macroeconomic investment functions. Particularly notable was a widespread effect of the debt-equity ratio, implying that the financial accelerator or net worth channel, linked to credit rationing and "precautionary" variations in credit demand is of widespread importance at a macro level. The results for the UK, Germany and France were particularly close in magnitude, despite the different financing structures in those countries. The credit channel, as indicated by the ratio of loans to total debt, was less widespread, featuring only in the US and Japan where non-bank sources of funds are relatively well developed. The results indicated a wider incidence of these financial effects on investment than the existing literature, focused as it is on the US, would otherwise indicate. A complementary panel study using firm level data by Catao reported in IMF (2003) found a more marked effect of the debt/equity ratio on investment in the euro area than the US, notably during bear markets. This result was attributed to greater bank dependence of Continental European firms than American firm.

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[5] The value of unquoted shares is typically undertaken on a "fair value" basis, for example by cumulating retained earnings (Bank of Japan 2000).

2 Modelling the Impact of Equity Prices

In our strategy for modelling equity prices in the wider economy we have to ensure that we have a sound theoretical structure with a good empirical basis. Over the last 15 years, NIESR has developed the global macro model NiGEM for use in policy analysis[6]. NiGEM is an estimated model, which uses a 'New-Keynesian' framework in that agents are presumed to be forward-looking but nominal rigidities slow the process of adjustment to external events. All countries in the OECD are modelled separately. All economies are linked through the effects of trade and competitiveness. There are also links between countries in their financial markets as we model the structure and composition of wealth, emphasising the role and origin of foreign assets and liabilities. There are forward-looking wages, consumption, and exchange rates, while long-term interest rates are the forward convolution of short-term interest rates. The model has complete demand and supply sides and there is an extensive monetary and financial sector. NiGEM contains expectations and uses the Extended Path Method to obtain values for the future and current expectations and iterate along solution paths

International propagation of shocks in the model relies on two main sets of channels. Those due to model structure, namely trade and the effects of financial asset prices on consumption, propagate the shock through US demand for foreign output or through the impact on the demand of foreign residents for all output. We detail aspects of the underlying equations below. In addition policy responses can be part of the propagation of the shock. If both demand and inflation in the US fall then the Federal Reserve can be expected to cut short term interest rates. This will help to absorb the shock, but it will also cause the value of the dollar to fall. The depreciation of the dollar improves US competitiveness and also helps to absorb the shock. It will raise US exports and reduce imports as compared to where they would otherwise have been without the improvement in competitiveness. The improvement in competitiveness must be matched elsewhere by a deterioration in other countries competitiveness, and this propagates the shock to other countries.

Shocks are not only absorbed by the automatic operation of policy rules, but also by the market mechanism. The policy response reduces interest rates, and causes the long term interest rate to fall, inducing a rise in bond prices that should partly offset the impact on wealth of the fall in equity prices. A decline in US consumption driven by a fall in equities and hence wealth raises US saving, and this reduces the equilibrium real interest rate in the economy over the medium term. The long term real interest rate in our model, which drives the user cost of capital, will fall in the US and elsewhere as a result of changes in the saving

and investment balance. This gives a potential boost to investment both in the US and elsewhere and reduces the impact of a rise in the risk premium.

2.1 The Structure of NiGEM

Trade. These equations depend upon demand and relative competitiveness effects, and the latter are defined in similar ways across countries. It is assumed that exporters compete against others who export to the same market via relative prices (RPX), and demand is given by the imports in the markets to which the country has previously exported (S)

$$\Delta X = \lambda[X(-1)- S(-1) + b*RPX] + c1*\Delta X(-1) + c2*\Delta S + \quad + error$$

while imports depend upon import prices relative to domestic prices (RPM) and on demand (TFE)

$$\Delta M = \lambda[M(-1)- b1*TFE(-1) + b2*RPM] + c1*\Delta M(-1) + c2*\Delta TFE + \quad + error$$

As exports depend on imports, they will rise together in the model. A similar pattern of linkages is used for trade in services. Both systems of trade equations are 'closed' to ensure that the World balance of trade adds up, at least to its normal degree of accuracy, in any simulation. Of particular relevance for this paper we can be certain that if US imports fall that will be reflected in declines in exports elsewhere in the world. The equations are estimated in equilibrium correction form.

Financial markets Forward looking nominal long rates and long real rates have to look T periods forward using expected short term nominal and real interest rates respectively using

$$(1+LR_t) = \Pi_{j=1,\,T}\,(1+SR_{t+j})^{1/T}$$

Forward looking exchange rates RX have to look one period forward along the arbitrage relation involving domestic and foreign interest rates (SRH and SRF)

$$RX_t = RX_{t+1}\,(1+SRH_t)/(1+SRF_t)$$

Forward looking equity prices are solved out from the infinite forward sum of expected discounted profits (∏), which is the difference between nominal GDP (PGDP) and labour income (W*E) after allowing for depreciation of the capital stock (KDEP), divided by the real stock of capital (K). The discount factor is made up of the nominal interest rate, r, and the risk premium on equity holding decisions, rpe.

$$EQP_t = \Sigma_{i=1}^{\infty}(((PGDP_{t+i} - W_{t+i} * E_{t+i} - KDEP_{t+i})/(K_{t+i}))/((1+r)(1+rpe)$$

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[6] See NIESR (2003) for a description of the model, and Barrell, Kirsanova and Hurst (2003) for a brief description.

This can be written as an infinite forward recursion that depends only on current profits and the expected equity price next period which embeds information on profits in future periods.

$$EQP_t = \prod_t + EQP_{t+1/}\ (1+r)(1+rpe)$$

The equity price will jump when any of its future determinants changes, and the risk premium is set at its recent value unless reset in the experiment, as it is here.

Wealth and asset accumulation. The wealth and accumulation system allows for flows of saving onto wealth and for revaluations of existing stocks of assets in line with their prices determined as above. In the medium term, personal sector liabilities are assumed to rise in line with nominal personal incomes, and if there are no revaluations, gross financial wealth will increase by the nominal value of net private sector saving plus the net increase in nominal liabilities. Revaluations come from three sources, and the scale of revaluations depends upon the structure of assets, and these will differ between countries as we describe above. The private sector holds government bonds (both domestic and foreign), financial sector assets that are fixed in nominal value (for instance bank deposits), and equities in domestic and foreign companies. As noted, many of these assets are held through pension funds and other intermediaries with guarantee features, and hence we cannot expect the change in asset prices to affect consumption very rapidly. Portfolio shares are calibrated from recent data before revaluation factors are calculated, as follows:

1. *Domestic Equity Prices.* These revalue the proportion of the domestic share of the portfolio that is held in equities, both quoted and unquoted. We assume that unquoted shares rise in line with quoted shares. Data on Gross Liabilities in the Balance of Payments data includes an estimate of the equity stock of the domestic production sector that is held abroad.

2. *Domestic Bond Prices* The scope of revaluations to bonds is calculated using information on the maturity structure of government debt. When long rates jump down bond prices jump up. The revaluation formula for a representative 6 year bond is employed, but the proportion taking this factor depends in particular on the proportion of government debt attracting the current short rate. This is high in Belgium and Italy for instance. Data are available on the proportion of debt held abroad, and this is used in revaluations.

3. *Foreign Assets and Liabilities* There is information on the structure of liabilities to foreigners, and hence when equity and bond prices change, the value of Gross Liabilities also changes. When one country's Gross Liabilities change because of

domestic revaluations, other countries have their Gross Assets changed in order that the Gross Assets equals Gross Liabilities relationship holds. Countries receive revaluations in proportion to their stock of Gross Assets as a share of the world total after factoring out banking sector deposit assets. Hence a change in US (and other) equity prices affects Gross Assets and hence wealth in other countries 'correctly', as do changes in the value of US (and other) government bonds held abroad.

Cross-country differences in the importance of assets as a percent of income, and in the structure of assets, as well as the responsiveness of consumption to them are important factors driving the results below.

Consumption and Personal Income. The consumption relations are based on an Euler equation for a consumer who is not liquidity constrained. The Euler equation embeds an optimising error correction on the long run, preference driven, consumption, income and wealth relationship. The long run parameters have been calibrated from Barrell, Byrne and Dury (2003)[7] and adjustments speeds are estimated in a panel context. We may write the change in consumption, C as depending on the equilibrium correction between consumption, incomes (RPDI) and real net wealth (RNW). Adjustment costs are assumed to be quadratic, and behaviour is forward looking. The coefficient on the forward change in consumption is the rate of time preference. The resulting equation with all variables in logs;

$$\Delta C = \lambda[C(-1) - a*RPDI(-1) - (1-a)*RNW(-1)] + \delta\Delta C(+1) + error$$

As outlined above, it is assumed that besides being cumulated saving, wealth is affected by financial market activity through equity and bond prices, and if these markets 'expect' something in the future then it will be reflected in prices. News that changes expectations will cause wealth to be revalued, and hence will affect behaviour now. Published data on Net Financial Wealth[8] are used, and the ratios of wealth to income and of wealth to consumption will influence the properties of the model.

Production. For each country there is an underlying CES production function which constitutes the theoretical background for the specification of the factor demand equations for

[7] In that paper the authors estimate error-correction consumption equations using disposable income and net financial wealth in a panel context for the European economies. Several similar groups of economies are found within Europe, and the long term wealth and income parameters from these groups are used in calibrated and estimated forward looking consumption equations. For example, NiGEM uses the result that the wealth and income coefficients in France, Germany, Netherlands and Austria are the same. For other countries such as the UK and the US individual backward looking estimates are used to calibrate forward looking equations.

[8] Data for the G7 are discussed in Byrne and Davis (2003b), and is generally available, for instance in OECD sources. For some small countries in the Euro Area we have constructed data in consultation with the Central Bank.

employment and the capital stock, and which forms the basis for unit total costs and the measure of capacity utilisation which then feed into the price system. A CES production function that embodies labour augmenting technological progress (denoted λ) with constant returns to scale can be written as:

$$Q = \gamma\left[s(K)^{-\rho} + (1-s)(Le^{\lambda t})^{-\rho}\right]^{-1/\rho}$$

γ and s are production function scale parameters, and the elasticity of substitution, σ, is given by $1/(1+\rho)$. Variables K and L denote the net capital stock and labour input measured in terms of employee hours. The parameters of the production function vary across countries and w, c and p denote respectively labour costs per head, nominal user costs of capital and the price of value added (at factor cost) and β denotes the mark-up. With long-run constant returns to scale, we obtain log-linear factor demand equations of the form:

$$Ln(L) = \left[\sigma \ln\{\beta(1-s)\} - (1-\sigma)\ln(\gamma)\right] + \ln(Q) - (1-\sigma)\lambda t - \sigma \ln(w/p)$$

$$Ln(K) = \left[\sigma \ln(\beta s) - (1-\sigma)\ln(\gamma)\right] + \ln(Q) - \sigma \ln(c/p*(1+rp))$$

The parameters are used in the construction of an indicator of capacity utilisation which affects the mark-up of prices over unit total costs. The capital stock adjustment equation depends upon the long run equilibrium, and the user cost of capital is influenced by the forward looking real rate, as well as by taxes and by depreciation. The speed of adjustment to equilibrium in the investment/capital stock adjustment equations also depends upon the short term real interest rate, with the effects being similar across countries. The user cost of capital variable c/p is calculated from data, but individual firms take account of the risk (the risk premium is the rp in (1+rp), and is determined by the user in simulations) on their investments when undertaking projects. If the risk premium is high then the equity market valuation of the capital equipment will be lower, and hence one can link Tobin's q and equity market effects to the level of investment by shifting the risk premium in the cost of capital. We present simulations with and without this feed through to investment in Section 4. Of course, an equity price shock will also affect investment via output itself.

Labour markets. It is assumed that employers have the power to manage, and hence the bargain in the labour market is over the real wage. In the long run, wages rise in line with productivity, all else equal. Given the determinants of the trajectory for real wages, if unemployment rises then real wages fall relative to trend, and conversely. The equations were estimated in an Equilibrium Correction format with dynamics estimated around the long run. Both the determinants of equilibrium and the dynamics of adjustment can changeover time

and adjustment, especially in Europe, is slow. We assume that labour markets embody rational expectations over the inflation rate and we assume that wage bargainers use model consistent expectations, either for the immediate period ahead or over a longer term horizon. These compensation equations are discussed at some length in Barrell and Dury (2003) and all these equations are dynamically homogenous.

2.2 Policy rules

Fiscal and monetary policy rules are important in 'closing the model' and the rules are discussed at greater length in Barrell and Dury (2000). We use simple rules that are designed to reflect policy frameworks rather than optimal rules.

Fiscal Policy rules Budget deficits are kept within bounds in the longer term, and taxes rise to do this. This simple feedback rule is important in ensuring the long run stability of the model. Without a solvency rule (or a no Ponzi games assumption) there is no necessary solution to a forward-looking model. The simple fiscal rule can be described as

$$Tax_t = Tax_{t-1} + \phi\,[GBRT - GBR]$$

Where Tax is the direct tax rate, GBR and GBRT are the government surplus target and actual surplus, ϕ is the feedback parameter which is designed to remove an excess deficit in less that five years.

Monetary Policy Rules It is assumed that the monetary authorities adopt simple targeting rules that stabilise the price level or the inflation rate in the long term. The policy rules on the model use the one step ahead Consumer Price Index (CPI) inflation rate. The European Central Bank (ECB) has been set the objective of maintaining price stability in the medium term. It has set itself a target of 0 to 2 percent for inflation within the constraints of a nominal target for the stock of money, and it describes this as the two-pillar strategy[9]. A combined policy of nominal aggregate and inflation rate targeting would give:

$$r_t = \gamma_1 (P_t Y_t - P^*_t Y_t^*) + \gamma_2 (\Delta P_{t+j} - \Delta P_{t+j}^*)$$

The combined rule is chosen as the default monetary policy rule because it represents the mixed framework that is used in Europe by the European Central Bank (ECB). We choose to use it elsewhere as responses are dominated by the proportional controller on inflation. If we

[9] European Central Bank (2001). We do not target money, as this is a poor indicator of the underlying target, which we take to be nominal GDP.

use different rules in different countries then some of the difference we observe would depend on that policy choice[10].

2.3 Model residuals for equity prices, consumption and income

In assessing the behaviour of the global economy during the bear market using the model it is important to evaluate the cross country correlation of unexplained components of key variables involved in consumption determination. We define the unexplained component in our economic relationships as structural shocks. There are many sources of structural shocks and we can address their changing nature by looking at a selected set of structural equation shocks from NiGEM. We look at consumption, compensation (the main component of personal income) and equity price residuals for the period 1991q1 to 1999q4 in Table 3 below to see if there are noticeable correlations across countries. Specifications of these equations are as described in Section 2.1[11].

Table 3 looks at the correlation of these structural shocks across countries between 1991q1 and 1999q4. We present correlations with the US which is our main interest in the present context of the transmission from the US to the rest of the G-7. It is evident that the correlation between countries for consumption and for the compensation variable is low. On the other hand the correlation of the unexplained component of the equity price equation is high over this period except for Japan. It is especially high for France, the UK and Canada vis a vis the US equity market. This suggests that transmission of shocks affecting consumption tends to occur indirectly via asset prices and not consumption or incomes directly.

Table 3: Correlation of structural shocks between US and others

	Consumption	Compensation	Equity Prices
	US	US	US
France	0.121	0.454	0.513
Germany	0.048	-0.189	0.334
Italy	-0.038	-0.158	0.352
UK	-0.499	0.241	0.646
Japan	-0.072	-0.307	-0.098
Canada	0.118	0.112	0.551

[10] We chose not to implement the 'industry standard' Taylor rule in part because of the ECB's position, but also because the standard has not yet been agreed for multi country models and shocks that change the world equilibrium real interest rate. The standard Taylor rule is designed for a small open economy which takes the world real interest rate. The real interest rate is the intercept in the Taylor rule, and we would use the model steady state (or long term forward looking) real interest rate. The results would not be vastly different within this model, but this approach is not yet standard.

[11] See also Barrell, Becker, Byrne, Gottschalk Hurst and van Welsum (2003) for a discussion of these equations and of model properties.

3 The current bear market

Equity markets have fallen markedly in the last three years, and it is clear that we have witnessed a bear market comparable to that of the early 1970s. In this section, we use the earlier experience of the 1970s to help us to calibrate the current collapse. Equity prices of course should reflect the expected discounted and risk-adjusted value of future dividends. In the 1970s there were good reasons to believe that the outlook for future profits and related uncertainty had worsened around the time of the oil crisis, not only because of the change in input prices but also because of the rise in labour unrest in a number of countries. It is not so clear that there were such good reasons for revisions in expectations of risk and profits in the US and elsewhere in the last few years. It seems more likely that there was a prior overvaluation of shares, as indicated by the virtual disappearance of the risk premium over bonds, partly reflecting overoptimistic forecasts of profit growth, no doubt partly linked to the dot.com boom and the spread of ENRON style accounting.

Table 4: Changes in share prices from mid-1970s peak

	UK	US	Germany	Japan	Canada	France	Italy
Peak of share prices	Aug-72	Dec-72	Jul-72	Jan-73	Dec-72	Apr-73	Jun-73
Fall to trough in nominal terms (date of trough)	68.5% (Dec-74)	48.4% (Sep-74)	34.4% (Sep-74)	40.2% (Oct 74)	35.5% (Sep-74)	52.7% (Sep-74)	42.9% (Dec-74)
Return to original nominal level	Sep-77	Nov-80	Mar-76	Jan-79	Jan-79	Sep-79	Oct-80
Fall to trough in real terms (date of trough)	77.2% (Dec-74)	56.1% (Sep-74)	43.0% (Sep-74)	56.2% (Oct-74)	46.7% (Dec-74)	68.1% (Apr-77)	82.4% (Dec-77)
Return to original real level	May-87	Aug-93	Jun-85	Feb-85	Oct-96	Aug-86	Aug-86

Source: MSCI official price indices in local currency, Datastream

Table 5: Changes in share prices from 1999-2000 peak

	UK	US	Germany	Japan	Canada	France	Italy
Peak of share prices	Dec-99	Mar-00	Feb-00	Mar-00	Aug-00	Aug-00	Oct-00
Trough to date	Sep-02	Sep-02	Sep-02	Oct-02	Sep-02	Sep-02	Sep-02
Nominal fall to trough	43.5%	47.9%	65.3%	47.8%	48.9%	56.0%	50.1%
Nominal fall to December2002	40.3%	43.7%	63.7%	48.8%	45.2%	52.5%	45.5%
Real fall to November 2002	40.6%	43.6%	60.2%	44.4%	48.2%	50.5%	45.7%

Source: See Table 4

Tables 4 and 5, drawn from Davis (2003), provide basic information on trends in share prices during the two bear periods[12]. Looking first at the mid-1970s period in nominal terms, it can be seen that prices in the UK and Germany peaked first, with France and Italy peaking a year later. The pivotal market, the US, peaked in December 1972, as did the world index, of which the US is the main component. Whereas the peaks were dispersed in time, the troughs were much more closely aligned, between September and December 1974 as the oil crisis and other economic and financial events took their toll. Nominal declines were sizeable in all markets, with the UK experiencing the largest fall of 68.5% (also at the time of the miners' strike, power cuts and the three day week). The rest of the G-7 were in the range 33%-53%, with the US, France and Italy being relatively harder hit. Recovery of nominal share prices from the 1974 trough was rapid in Germany, where it only took 18 months, and also in the UK. Elsewhere, the recovery of nominal values to its 1972-3 level took 6-7 years to be completed.

Of interest as these nominal declines are, they ignore the fact that inflation was high in the 1970s. Measuring real share prices by the change in the MSCI index divided by the national CPI, the falls in many countries were much larger than the nominal declines. In the UK, France and Italy, the troughs of real share prices were around 70-80% below their previous peaks, while in the US, Canada, Germany and Japan, the falls were a still-sizeable 40-60%. Shares took an extremely long time to recover their original real value (noting again that we are abstracting from dividends). The earliest to regain their previous peak levels were Germany and Japan, dynamic economies at the time, where the recovery took 11 years to 1985. Only the UK, France and (briefly) Italy, other than these, recovered their previous real value in the 1980s. The US market measured by the MSCI index only recovered its end-1972 real value in August 1993 and Canada in October 1996. The severity of the mid-1970s bear market is thus underlined.

The current bear market is still ongoing, so much of the above detail cannot be reproduced for it. Suffice to note that, as shown in Table 4, the peaks were somewhat closer together, with the UK being the earliest and Italy last to enter the bear phase. Declines up to September 2002 were comparable to those in the mid-1970s in nominal terms, with the decline being 45-65%. Although there has been some recovery since, its durability remains an open question, and shares are still far down from their peaks. There appears to be much closer similarity in terms of the decline experienced. Given the low level of inflation, nominal share price falls are comparable to real declines.

[12] The data used for share prices are from MSCI "official price indices". In most of the article, the data exclude dividends, given the main interest is in changes in share prices per se.

As regards risk per se, one may distinguish unconditional volatility of share prices (total volatility, as measured by the variance or standard deviation of changes in prices) and conditional or expected volatility (that is, the level of volatility which may be predicted given background features such as volatilities' own past history). An analysis of patterns of the latter is required to determine whether market responses to shocks, as opposed to the changing distribution of random and unanticipated shocks themselves, are responsible for rises in volatility. It is also a key determinant of the risk premium, discussed below.

Table 6 derived from Davis (2003) shows that unconditional volatility exhibited a steady rise over 1972-5 with conditional (measured using GARCH(1,1) estimation) starting higher and rising less. Unconditional and conditional volatility saw a peak in 1998 after which unconditional volatility declined sharply before rising again, while conditional volatility was also on a gradual uptrend albeit never recovering the level of 1998. The differences between the two types of volatility are potentially instructive. In 1972, unconditional volatility was below conditional, suggesting uncertainty in markets at the sustainability of the bull market. Thereafter conditional volatility fell somewhat short of unconditional, especially for the US in 1974 and the UK in 1975 when markets were hit by unpredictable and uncorrelated shocks such as the oil shock as well as expected volatility. Similarly, in 1998 the markets may not have anticipated the level of volatility seen in the Russia/LTCM crisis and hence unconditional was highest, but thereafter as the bear market took hold it was conditional volatility that tended to be higher till 2002 when unconditional was again higher.

Table 6: Average volatility of share prices in the G-7 (per cent)

	Standard deviation	Conditional volatility	Difference
1972	3.68	5.23	-1.55
1973	5.57	5.47	0.10
1974	6.85	6.50	0.34
1975	7.13	6.98	0.16
1998	7.23	6.16	1.08
1999	4.81	5.65	-0.85
2000	5.08	5.79	-0.71
2001	5.97	5.82	0.15
2002	6.85	6.22	0.63

Source: MSCI

The correlation of domestic share prices with world indices tends to increase in bear markets, reducing the seeming diversification benefits of international investment. Typically, this pattern is thought to reflect common behaviour of institutional investors (often repatriating their holdings) as well as common fundamentals across the world. Global financial integration has ensured a much higher level of average correlations than in 1975 at the trough of the

earlier bear market (Table 7), the highest correlation is again apparent late in the bear market in 2001 and 2002, with all countries except Japan having correlations of 0.88 or more with the world index. Besides investor behaviour and correlated fundamentals, the increased covariance of equity markets in the current bear market may also reflect common factors in the re-evaluation of profits.

Table 7: Correlation of share prices with world indices

	UK	US	Germany	Japan	Canada	France	Italy	Country averages
1998	0.92	0.94	0.87	0.75	0.93	0.81	0.72	0.85
1999	0.71	0.97	0.88	0.61	0.85	0.86	0.54	0.77
2000	0.78	0.96	0.44	0.54	0.81	0.66	0.22	0.63
2001	0.96	0.98	0.95	0.72	0.89	0.95	0.90	0.91
2002	0.98	0.99	0.95	0.40	0.88	0.97	0.95	0.88
Memo item:								
1975	0.72	0.96	0.51	0.72	0.72	0.50	0.69	0.69

Source: MSCI

Key background to the bear market are trends in risk premia. There are generally substantially higher returns to saving in shares than other forms of asset holdings, but risk aversion and the need for liquid assets for precautionary and transactions purposes ensures that these holdings never dominate entirely. Theoretical portfolio models often predict a level of risk aversion which is much lower than that necessary to explain the level of share holdings (for recent evidence see Haliassos and Michaelides, 2000). In particular the equity premium puzzle suggests that over the past century or so, stocks were not sufficiently riskier than bonds to explain the spread in their returns, the so-called equity premium (Mehra and Prescott, 1985).

Evidence from the 1990s suggested that the risk premium had declined or disappeared, possibly due to the institutionalisation of portfolios (Blanchard (1993)), although there may also have been a cyclical element in the recent equity bull market, whereby risk premia fell everywhere for reasons that may not have been fully justified. Madsen and Davis (2003), for example, suggest that the response of share prices to productivity shocks was inappropriate, since the impact of the latter on profitability is temporary. The bear market may in this context be viewed partly as a correction of unsustainably low risk premia. On the other hand, the degree to which risk premia were misaligned prior to the share price fall varied between markets. In this context, it is important to be able to evaluate the impact of risk premium contagion, as we do below.

As shown by Jagannathan et al (2000) the risk premium can be proxied by the dividend yield plus expected dividend growth less the real bond yield. IMF (2001) argue that the growth in potential output can be used to proxy expected earnings and dividend growth. Accordingly,

Table 8 below shows a measure of the risk premium using a Hodrick Prescott filter on GDP growth to proxy dividend growth. The stylised fact that premia declined in the 1980s and virtually disappeared in the 1990s is confirmed. The sizeable estimated risk premium in the low-inflation 1960s shows that the decline is not merely a consequence of the impact of disinflation on real bond yields. The peaks of the bull markets in 1972 and 1999 show vast differences in estimated risk premia, albeit in each case generally below the decade-average, underpinning the suggesting of a bubble in 1999. The US and France showed particularly low risk premia, although in all the countries shown it was below 1%.

Table 8: Estimated risk premia

	Germany	US	UK	France	Canada
1960-69	7.6	4.4	4.5	6.6	5.1
1970-79	5.8	7.5	9.4	11.4	7.6
1980-89	2.3	1.8	3.2	4.1	1.1
1990-94	0.8	1.7	1.9	-0.3	-1.2
1995-99	0.4	0.4	1.6	-0.1	-0.6
Memo: 1972	5.9	3.5	4.3	8.9	5.3
Memo: 1999	0.0	-0.4	1.0	-0.4	-0.1

4 Analysing the Impact of Equity Prices

Using the NiGEM model we undertook a number of simulations to assess the impact of the equity price decline and the appropriate policy responses. Our first concern was to assess the impact of a US stock market decline on the US and on other economies, and our discussion focuses on international propagation. This can take place through trade, through the impact of US equity prices on wealth in other countries and through contagion to other countries' equity markets.

1) We first undertook a simulation using the NiGEM model of a re-evaluation of future profits in the US equity markets, engineering a fall of 34 percent immediately in the US Following Barrell (2002) we have a temporary increase in the perceived risk premium, with it slowly declining back to historical levels after 14 years. This large equity price shock in the US spreads to the rest of the world through trade and asset holdings, and is denoted *US Premium* in the tables. We assume that this simulation involves only a re-evaluation of the US equity price, and does not affect the risk premium in investment decision making. Hence it works only through wealth effects. We return to this issue below.

    a) We attempted to look at the impact of the collapse of equity prices on demand in the US and its impact on trade. Some of the potential impact of the fall on the US is absorbed by diversified portfolios, and spreads to wealth elsewhere. We undertake a

simple analysis using the model to scale the importance of foreign holdings of US equities for both the US and other economies.

b) It is possible that the re-evaluation of the US equity risk premium could also affect the investment decision, although we are of the opinion that some at least of the overvaluation of the stock market was purely a financial bubble based on market perceptions of profitability that were not shared by firms undertaking investment[13]. We shift the investment risk premium by half of the amount of the change in the equity premium in order to replicate the decline in the level of investment in the US from that we saw from that in 2000 to that seen in 2002. Our fall is from the level we saw in 2002 to a new, lower level in 2004.

2) Contagion to other countries takes place through equity markets as well as through trade and the impact on the value of foreign holdings of US assets. We can define such contagion in three ways, and we simulate them in turn. We can see from these simulations that the experience of the last three years, discussed above, is outside the rage of correlations observed in the 1990s (Table 3), although there are similarities in the patterns, with Japan being less connected to equity price movements in the US than are the Europeans.

a) We used historical correlations of structural residuals to calibrate the usual change in the equity premium we would see in the UK, the Euro Area countries, Japan and Canada in response to a shift in the equity premium in the USA. The historical relationships given above would generate falls of equity prices of 21 per cent in the UK, 16 per cent in Canada and 9 per cent in the Euro Area on average as compared to 33 in the US. As equity price falls in other countries are significantly lower than in the US in these circumstances, we cannot regard this as an adequate description of recent events and hence we look for further patterns.

b) Then we simulated a fall in the risk premium of the same magnitude everywhere, and this is noted as *All Premia* in the tables. Equity price falls are lower in other countries than in the US, reflecting in part the greater impact of equity prices on the US economy and hence greater second round effects on equity prices[14]. In particular the greater the impact of the shock on output, the proportionately greater the impact is on future profits, and hence their discounted future value changes more. Similar declines

[13] Equivalently we might say that the managers of companies such as ENRON were aware of the implications of their accounting practices, and did not allow the inflated equity price to affect their investment decisions.

[14] UK equity prices fall by 30 percent initially in this simulation, whilst those in the Euro Area decline on average by just over 20 percent.

in equity premia generate falls of equity prices of 30 per cent in the UK, 26.5 per cent in Canada and 18.5 per cent in the Euro Area on average as compared to 33 per cent in the US. This is not consistent with recent events which show equity price falls comparable to or greater than the US for all countries, at least to the end of 2002.

3) Thus, we did a further simulation with a fall of 35% in share prices everywhere except in Japan, where the fall was 40% of that elsewhere. This simulation is designed to reflect the pattern of correlation in equity prices that we have seen in the most recent bear market which suggest that in the last four years the equity risk premium has risen more in Europe than it has in the US. This simulation is noted as *All Equity Prices* in the tables

4.1 Equity Shocks

As shown in Table 9, the US is harder hit than the other countries in all cases, reflecting larger wealth effects. In the case of the rise in the US equity premium alone, the results for other countries are driven by lower US demand as well as effects of US shares in foreign portfolios. As would be expected, the effects are much greater when foreign share prices also decline in line with a common shock to the risk premium, or by the full 35%. There are marked disinflationary effects of the shocks, especially in the US. Over the first four years of the simulation US inflation is on average 0.7 percentage points a year lower than it would otherwise have been if the shock is just to the US, and 1.1 percentage points lower a year lower than it would otherwise have been if all equity prices fall together.

Table 9: GDP Effects of Equity Premia and Equity Price Shocks

(percentage point difference from baseline level)

		2003	*2004*	*2005*	*2006*
Canada	*US Premium*	-0.70	-1.16	-1.00	-0.66
	All Premia	-1.15	-1.89	-1.66	-1.17
	All Equity Prices	-1.52	-2.54	-2.10	-1.18
Euro Area	*US Premium*	-0.56	-0.28	0.17	0.48
	All Premia	-0.69	-0.41	0.15	0.57
	All Equity Prices	-0.91	-0.90	-0.30	0.30
Japan	*US Premium*	0.38	0.50	0.18	-0.08
	All Premia	0.47	0.62	0.24	-0.08
	All Equity Prices	0.42	0.13	-0.50	-0.69
UK	*US Premium*	-0.62	-0.50	-0.32	-0.21
	All Premia	-0.74	-0.82	-0.61	-0.36
	All Equity Prices	-0.83	-1.08	-0.78	-0.29
US	*US Premium*	-1.95	-2.03	-1.07	-0.37
	All Premia	-2.03	-2.09	-1.00	-0.21
	All Equity Prices	-2.39	-2.51	-0.90	0.40

If we restrict the spread of wealth effects then the impact of the equity price fall on wealth is 2.25 per cent greater in the US in the first year of the simulation. As a result, the impact on US output is greater, with US output being 2.25 and 2.5 percentage points below baseline in the first two years in turn, as compared to the 2 percentage points in Table 9 for the US premium shock. Wealth in the UK is 2 per cent higher, in Canada it is 3.25 per cent higher, and in the Euro Area it is on average 1 per cent higher than it would have been in the first year if we had allowed contagion through wealth. The effects on output are noticeably larger in the UK than in the Euro Area if we turn off the wealth contagion effect, because of the greater dependence of the UK on US trade, and also because European wealth falls are much more moderate because of the smaller importance of foreign assets and a greater proportion of bonds in wealth. If the wealth shock is kept within the US then long rates fall more and bond prices rise more, and the Euro Area countries relatively benefit.

We can see from Table 9 that contagion to other equity markets increases the scale of the shock in the US, with a 20 per cent greater decline in output as compared to base in the first year. This reflects both the trade effects of lower output elsewhere and the impact of lower wealth in the US because of a decline in the value of foreign assets. The impact of the equity market collapse is doubled in Canada if equity prices fall everywhere by the same amount as in the US. Euro Area output drops between a 1/3 and 2/3 of a percentage point more below baseline if equity prices fall by similar amounts everywhere. The change in the impact in Germany is about 50% bigger than that in France, reflecting changing trade effects which dominate the smaller wealth effect in Germany.

Table 10 shows that US nominal and real long rates also fall in each simulation, along with the effective exchange rate. All these changes help absorb the shock. Table 11 gives the changes in exchange rates under the set of shocks. In general countries other than the US appreciate, and this propagates the shock to them through competitiveness in addition to the demand and wealth effects. However, the appreciation is less when the equity price shock propagates to other countries, and this helps absorb some the extra shock suffered outside of the US.

Table 10: US Effective Exchange Rate and Long Rates

percentage points difference from baseline in 2003

	Long rate	Real long rate	US Effective Exchange Rate
US Premium	-1.40	-1.25	-4.81
All Premia	-1.50	-1.35	-4.35
All Equity Prices	-1.02	-1.12	-2.63

Table 11 Impacts on Exchange Rates in 2003

Percent difference from baseline

	Canada	Euro Area	Japan	UK
	Dollar	*Dollar*	*Dollar*	*Dollar*
US Premium	-2.39	-6.10	-9.13	-8.65
All Premia	-1.12	-5.85	-9.47	-7.13
All Equity Prices	0.14	-3.74	-6.43	-4.88

The nominal long rate in the US falls because demand is lower, and hence inflation and output fall below baseline and the monetary authority is expected to cut nominal rates now and in the future. As equity based wealth is permanently lower as a ratio of GDP then saving has to rise to achieve the wealth income ratio embedded in the Euler equation for consumption. This changes the saving and investment balance and if the real interest rate does not fall investment will be less than saving. If this happens nominal rates will be cut as inflation and output will be below target. Nominal rates will be cut until demand reaches capacity and inflation settles on target, and this requires that the real interest rate is lower period by period than it is on our baseline. Hence the long real rate is also lower. Long real rates fall elsewhere, but not by as much. Euro Area rates fall by 75% of the US fall, for instance. Canadian and Euro Area inflation rates fall by between 0.4 percentage points and 0.5 percentage points over the first four years of the simulation, increasing with the impact on income, but moderated by the smaller appreciations associated with equity price contagion.

4.2 Contagion to Investment in the US

If the increase in the equity market risk premium changes perceptions of future profits within firms or the cost of finance to firms, the effects of a fall in equity prices will be larger. As we can see from Table 12, output would be 1 per cent further below baseline in 2003 in the US if there were contagion to investment, and by 2005 it would be around 4 per cent lower than if we had just pricked an equity bubble that had not figured in firms' investment decisions[15]. The impact on US GDP is sustained for longer, and output is below baseline for two more years if there is contagion to investment. US long rates fall more if there is contagion to investment. In our baseline they are 4.0 in 2003, and would fall to 21/2 per cent in the US Premium scenario and to under 1 per cent in the contagion to investment scenario. Long real rates fall markedly, but by less than nominal rates as inflation also falls over the medium term.

The contagion effects to other countries are partly offset by larger falls in long rates which raise bond prices boosting consumption, and lower long real rates which raise investment.

[15] However, in neither case do we generate a sustained recession. Output growth is negative for 2 quarter in 2003 in our US Premium scenario and negative for 3 quarters in our contagion to investment scenario.

The increase in impact is greatest for Canada which has the closest trade ties with the US. The effect on the UK is noticeably larger than for the Euro area countries, in part because more of their wealth is held in bonds which increase in value, but also because trade ties are stronger. Increased contagion to all European countries comes through lower demand in the USA and lower net exports as well as lower wealth.

Table 12 Output Impacts of Contagion to Investment in the US

Percent difference from US Premium

	Canada	Euro Area	Japan	UK	US
2003	0.33	-0.05	0.91	-0.44	-1.09
2004	-0.25	0.29	1.54	-0.48	-3.30
2005	-1.08	0.46	1.13	-0.58	-3.93
2006	-1.56	0.58	0.34	-0.59	-3.36

4.3 Policy Responses to the Shock

The impact of the shock is not given solely by the behavioural relationships of the private sector, asset price dynamics and the pattern of trade and asset holdings, but also depends on the policy response of the authorities. NiGEM has inbuilt rules which target inflation in the case of monetary policy and seek budget balance over 5 years in the case of fiscal policy. The monetary policy rules use the short term interest rate as an instrument, and long term interest rates are determined by the market in the light of their expectations of future short term tares given their knowledge of the feedback rule and the structure of the economy. For example, long term interest rates in the US tend to fall by over 1 percentage point because the markets are aware that the authorities will reduce rates in response to lower demand and inflation. Interest rates also fall elsewhere in response to the propagation of the shock, with the size of the cut being dependent on the size of the shock.

It is useful to analyse the impact of 'winding up' the inflation response of the authorities by changing the coefficients of the monetary rules. However such a scenario of a larger US monetary response in cutting interest rates beyond the rule to stimulate demand runs into a liquidity trap as shown in Chart 1 below. Hence we concentrate on the monetary response in the rest of the world. We assume in the extra monetary response scenario that the coefficient on inflation in the feedback rule used by all central banks outside the US is doubled[16]. Given the disnflationary impact of the equity price shock, interest rates are cut further. Table 13 shows that the impact on GDP of the US equity price shock can be attenuated by a monetary response, notably in the Euro area. Prices, and hence inflation rates, are higher in the case of further monetary easing in Canada and the Euro area, and in the UK in the medium term.

[16] We used r =0.75(inflation – target)+ .5(Nominal output –target) and then we raised 0.75 to 1.5

Chart 1: US Short Rates in Premium and Equity Shocks

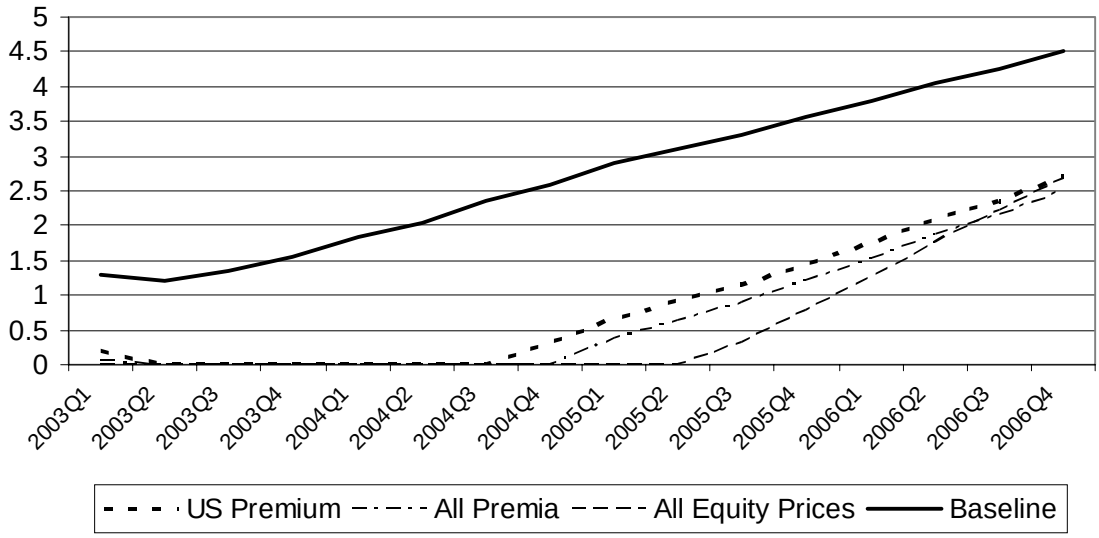


Table 13: Impacts on Output of a Larger Monetary Reaction outside the US

(Percentage difference in GDP from US Equity Premium results)

	2003	*2004*	*2005*	*2006*
Canada	0.16	0.23	0.20	0.15
Euro Area	0.37	0.60	0.40	0.15
Japan	0.03	0.02	0.00	0.02
UK	0.14	0.21	0.04	-0.07
US	-0.02	0.03	0.05	0.02

Table 14: Impacts on Prices of a Larger Monetary Reaction outside the US

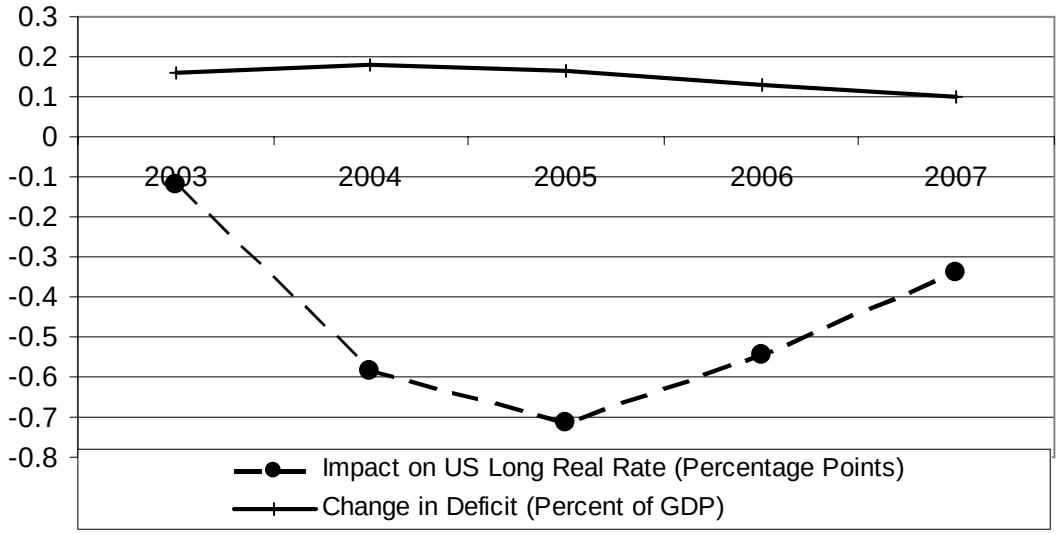
(Percentage difference in consumer prices from US Equity Premium results)

	2003	*2004*	*2005*	*2006*
Canada	0.20	0.36	0.46	0.54
Euro Area	0.03	0.10	0.26	0.43
Japan	0.00	0.00	0.00	0.01
UK	-0.03	-0.11	0.02	0.23
US	-0.05	-0.08	-0.05	0.02

Although the US does not have the possibility of significant changes in monetary policy, except from working down the yield curve, it still has the possibility of loosening its fiscal stance. Our standard mode of operation has a fiscal feedback rule in place from the start of the run, and this will induce a rise in direct taxes in response to the reductions in revenues and increases in spending that come from the reduction in demand and output that follow fro the equity shock. There are various ways to change the fiscal response in the US, but the simplest is to assume that the fiscal feedback rule does not operate for the first five years of the scenario. This will induce an increase in the budget deficit, and after 6 years the US debt stock

would be more than 2 percent of GDP higher than it would otherwise have been. As can be seen from Chart 2 the real long term interest rate is 0.10 to 0.18 higher than it would otherwise have been in response to an increase in the US deficit of 0.45 per cent of GDP on average over 5 years. It would be possible to simulate a direct fiscal response to the decline in equity prices, and indeed we may have seen that in the US, where the budget has moved from a surplus of around 1.5 per cent of GDP in 2000 to a deficit of 31/4 per cent f GDP in 2002. A change of this scale, even after cyclical adjustment for the 2 per cent difference in the output gap, would induce a rise in long term real rates of over 1 percentage point.

Chart 2: Turning off Solvency:
The Impact of Fiscal Policy on Real Interest Rates



The impact of the fiscal loosening on GDP is given in Table 15. Clearly, the US is the main beneficiary, and output would be 1.5 per cent below where it would otherwise have been in 2004, instead of being 2 per cent below as in the US premium shock (the difference in the table is 0.44 in that year). Output attenuation from a US fiscal response is greatest in Canada because of the scale of the trade links and the direct impact on demand. However, some of the potential expansionary effects will be offset by higher real interest rates in the US ad elsewhere, and this is sufficient to offset the demand effects in the UK and the Euro Area, and to a lesser extent in Japan

Table 15: Impact on Output of Turning Solvency off in the US

(Percentage difference in GDP from US Equity Premium results)

	2003	*2004*	*2005*	*2006*
Canada	0.04	0.19	0.29	0.26
Euro Area	0.07	0.08	0.03	-0.04
Japan	0.13	0.07	-0.12	-0.19
UK	0.08	0.05	-0.02	-0.05
US	0.15	0.44	0.46	0.23

4.4 Summary of the scope of contagion

We have looked at a sequence of shocks and concerned ourselves with propagation mechanisms. We used our model NiGEM to show that a US equity market shock is propagated in a number of ways. If we cut off wealth effects then US output falls considerably more, and trade effects pass through quickly to other countries, and in the first year of the scenario everywhere output is lower than it would be if direct effects on wealth in other countries were present. This in part reflects the speed at which wealth feeds into consumption in the US as compared to other countries, and we may describe the overall effect of interlinking wealth as spreading risks and reducing the impact of shocks, much as theory would suggest. If the equity risk premium shock spreads to US investment then the impact on output in the US would be much larger, but some of the impact elsewhere would be absorbed by lower long term nominal interest rates raising wealth through bond prices and lower long term real interest rates raising investment as compared to where it would other wise have been.

We may summarise the scale and roots of contagion by looking at charts that plot the fall on output over the first 3 years of our first scenario, which involves a rise in the US equity premium with no contagion to US investment or to other equity prices. There is clearly little relationship across countries between the size of the fall in output and the wealth to income ratio, as we can see from Chart 3. However, we can decompose the wealth effect, and look at the relationship of output to direct equity holdings in Chart 4. The pattern is relatively clear, and there is a correlation of -0.67 between the two. The same pattern holds in Chart 5 with total direct and indirect equity holdings where the correlation is -0.68. Clearly the composition of wealth matters more than its size, and our model attempts to allow for this.

We can also correlate the structural factors we have discussed with the change in the (NIESR forecast and filter based) output gap estimator between 2000 and 2002 for the G7 economies[17]. During this period the US output gap is estimated to have opened by 2.0, Canada by 1.5, the Euro Area (as a whole) by 1.4, Japan by 1.1, and the UK by 0.75. Of course there were many shocks that drove these changes, but equity markets were an important factor, and propagation from the US equity market was central to the cycle. There is little correlation between the rise in the gap and wealth to income amongst the G7 economies, but the correlation with directly held equities is -.47, whilst with all equities it is -0.27.

[17] See Barrell and Mitchell (2003) for a discussion of these Approximate Band Pass filter estimates of the output gap which uses data from the 1960s through to the end of our forecast base in the 2020s/

Chart 3 Output and Wealth Effects

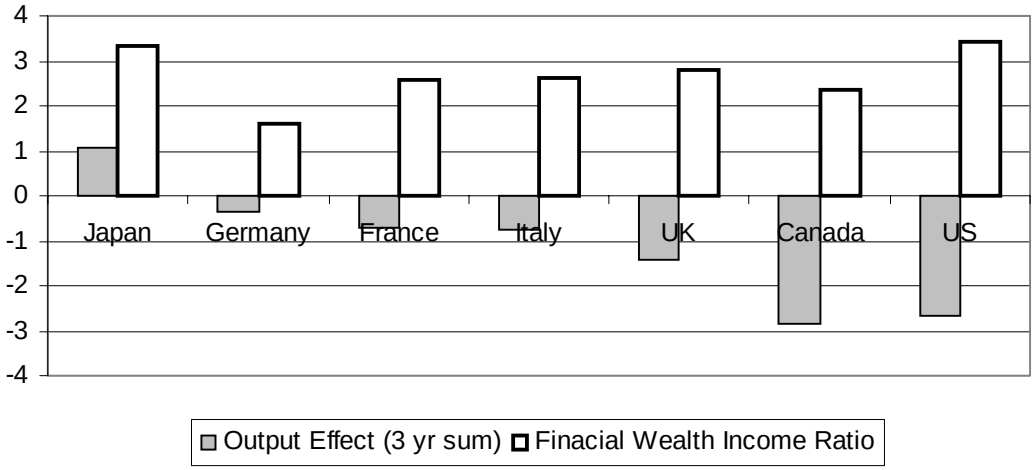


Chart 4 Output Effect and Equity Holding

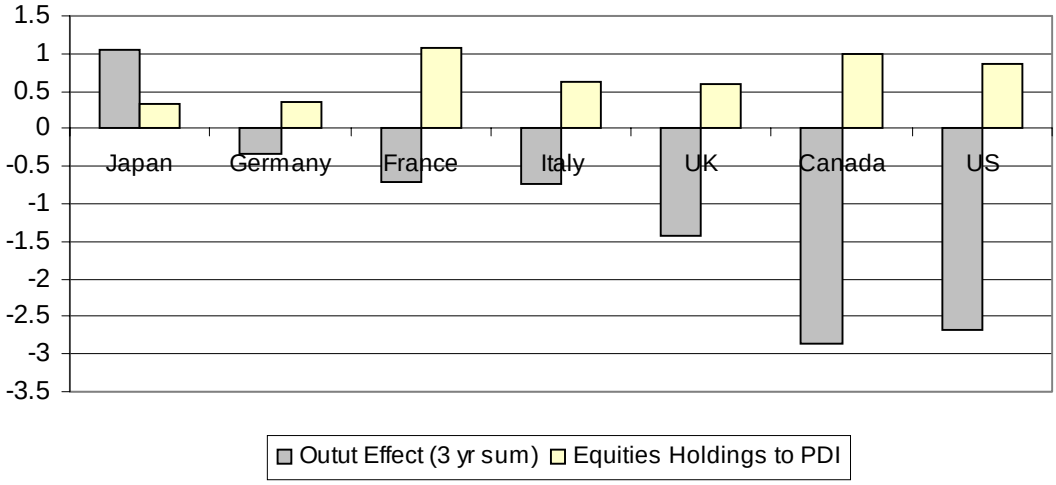


Chart 5 Output Effect and Total Equity Holdings

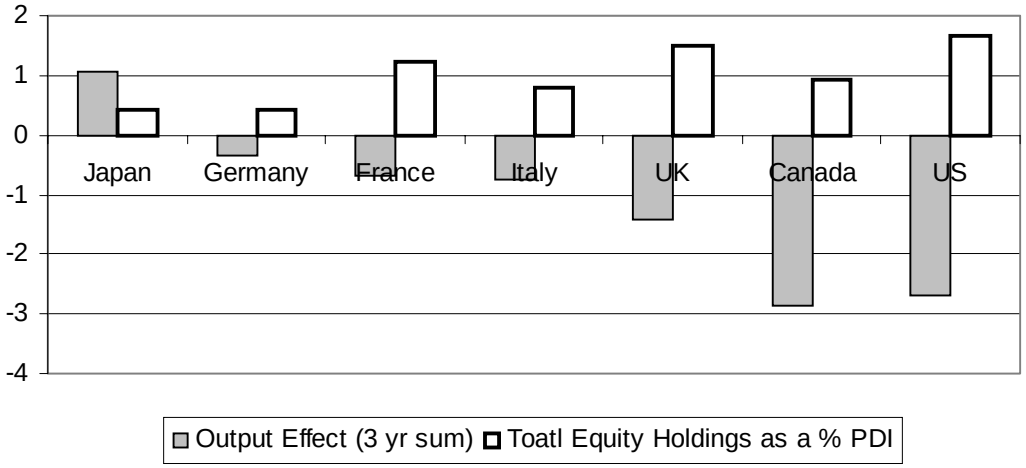


Chart 6 Output Effect and Openness
Correlation = -.85 excluding the US

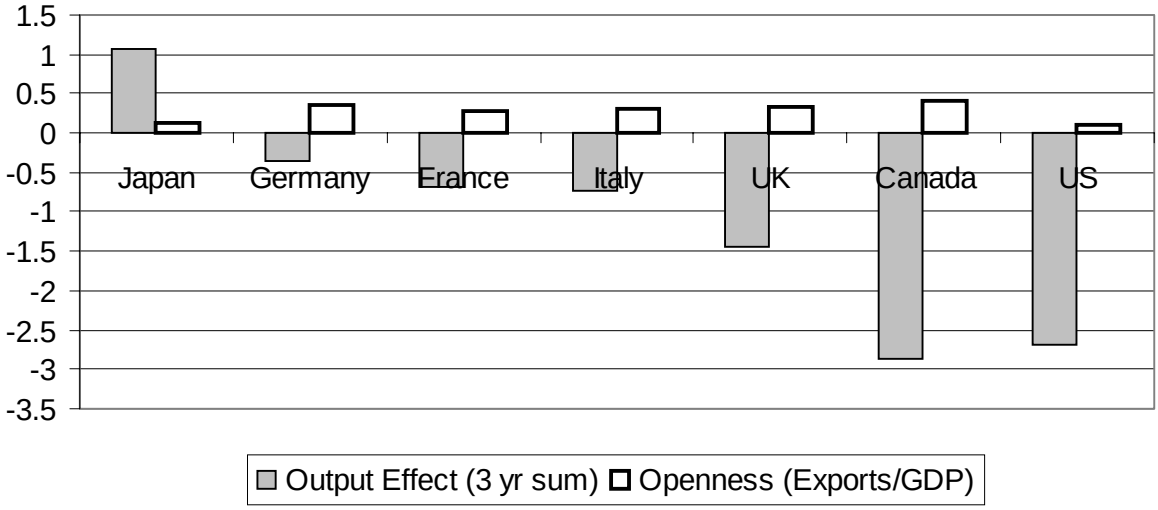
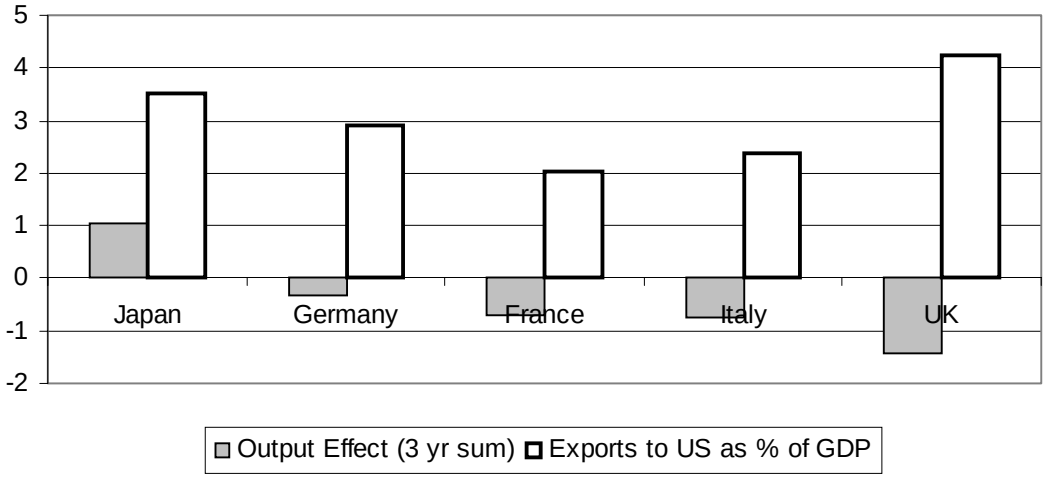


Chart 7 Output Effect and Exports to the US



Our model also reflects the pattern of trade, and we plot two indicators in Charts 6 and 7 below. The correlation between the output effect outside the US and exports as a percent of GDP is strong at -0.87 as can be seen from Chart 6. However, trade with the US also matters, and the correlation there (including Canada, which we do not plot because around 1/3rd of GDP is exported to the US) is -0.77. Of course direct trade patterns are not the only channel of trade related contagion, and the model will take account of second and third round impacts on trade. We also allow for major impacts to come through changes in competitiveness which in the short run help absorb the shock in the US and propagate it to the rest of the world because the US dollar falls markedly. These patterns are not dissimilar to those seen between 2000 and 2002, where the correlation outside the US between the opening of the output gap and our openness indicators is -0.31 for all trade and -0.42 for US trade as a per cent of GDP.

5 Conclusions

We have shown that falls in equity prices have been comparable to the bear market of the mid 1970s, although evidence of a bubble is much stronger in recent years (given the low level of the risk premium) and correlations between equity markets have been much stronger. Based on estimated relationships, recent falls in equity prices have been significant in slowing the world economy down, and further falls would produce similar consequences. However, policy reactions would be constrained by the liquidity trap in the US and Japan, and potentially also in the Euro Area, although interest rates are higher there. Fiscal policy loosening can also help offset the effects of a collapse in equity prices, but it will mean higher long term real interest rates and hence it does moderate one of the automatic shock absorbers provided by the market mechanism. In the US we have probably seen a fiscal loosening on a scale that is almost sufficient to offset the impact on real interest rates of the fall in equity prices between 2000 and 2002.

Overvalued equity markets are difficult to deal with, especially if they are associated with structural imbalances in the economy, and there is perhaps little that the Federal Reserve could have done once the bubble got under way. However, loose monetary policy in response to the Russia/LTCM crisis in 1998 was perhaps sustained too long and pushed up the equity market. The inflationary consequences of the policy were perhaps hidden by structural capital inflows into the US that also buoyed up equity prices and through the strong exchange rate helped keep inflation low. The benign years of the late 1990s are perhaps the mirror of the last few lean years, and we would argue that there is little the US can do to stave off its problems, although more active monetary responses elsewhere can help isolate other economies from such a shock even if their own equity markets also collapse.

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