

**SHOCKS AND SHOCK ABSORBERS:
THE INTERNATIONAL
PROPAGATION OF EQUITY MARKET
SHOCKS AND THE DESIGN OF
APPROPRIATE POLICY RESPONSES**

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Introduction

- Equity prices and equity markets are both sources of shocks and channels of propagation of shocks to the global economy
- Stock market falls in the last three years have been comparable to those in the early 1970s, and remarkably similar across the G-7
- We seek to calibrate impact of these falls and assess appropriate policy responses to absorb them
- Methodology is to undertake simulations with NiGEM global macromodel

Structure of the paper

1. The macroeconomic importance of equity markets
2. Modelling the impact of equity prices
3. The current bear market in historical perspective
4. Analysing the impact of equity prices in the major industrial countries
5. Appropriate policy responses

The macroeconomic importance of equity prices

- Wealth effects on consumption – not just in US but across the G-7 (net financial wealth or “illiquid” wealth)
- Importance of equities in wealth, and hence decline in wealth/income ratios over recent bear market, varies...
- ...reflecting differences in sectoral pattern of equity holdings and importance of equity as a means of finance
- Wealth coefficients in consumption functions also vary due to scope of guarantees (defined benefit pensions, life insurance)
- Impact on investment may also be anticipated, via Tobin’s Q and debt-equity ratio (financial accelerator)

Table 1: Household wealth-income ratios

Net financial wealth/personal disposable income							
	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							
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							
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

Modelling the impact of equity prices

- NiGEM model features
 - estimated model with ‘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 modelled separately
 - forward-looking wages, consumption, exchange rates and long-term interest rates
 - complete demand and supply sides, stock-flow consistency and extensive monetary and financial sector
 - monetary and fiscal policy rules which may be suspended
- International transmission occurs via net trade and effect of domestic and foreign financial asset prices on consumption, as well as risk premium in investment

Trade Equations

Exporters compete against other exporters via relative prices (RPX), demand is given by the imports in the markets to which the country has previously exported (S)

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

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

$$\Delta M = \lambda[M(-1) - d*TFE(-1) + b*RPM] + c1*\Delta M(-1) + c2*\Delta TFE + \text{error}$$

Forward looking asset prices

- Long rates are the forward convolution of short-term interest rates
- $(1+LR_t) = \Pi_{(j=1 \text{ to } T)} (1+SR_{t+j})$ (raised to power $1/T$)
- Exchange rates have to look one period forward along the arbitrage relation involving domestic and foreign interest rates (SRH and SRF)
- $RX(t) = RX(t+1) (1+SRH(t))/(1+SRF(t))$
- Equity prices are solved out from the infinite forward recursion and depend on profits and the expected equity price next period
- $EQP(t) = Profits(t) + EQP(t+1)$ discounted

Consumption and Wealth

- Consumption depends on income and net financial wealth, and on leads and lags in consumption growth

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

- Based on an Euler equation approach with the discount factor as the coefficient on the lead in consumption
- The determination of wealth is important and is generally forward looking as shown on the previous slide, but there is little separate evidence for interest rate effects

Wealth Accumulation and Domestic Equity Prices

- *Domestic Equity Prices* revalue the proportion of the domestic share of the portfolio that is held in equities. 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
- *Domestic Bond Prices* Use the maturity structure of government debt and the revaluation formula for a representative 6 year bond. Belgium and Italy have high proportions of government debt attracting the current short rate.

Foreign Assets and Liabilities

- Have information on 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
- 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.

Production

- CES production function with underlying factor demand equations:

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

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

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

- Investment influenced by equity risk premium, which enters the cost of capital

Policy Rules

- Fiscal policy depends on targets
 - There is a feedback rule for the direct tax rate
 - $\text{Tax}(t) = \text{Tax}(t-1) + \phi [\text{GBRT} - \text{GBR}]$
- Monetary rules determine interest rates
- The ECB adopts a two pillar strategy with a feedback on expected inflation and a nominal aggregate

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

- As our main focus is on propagation of shocks we wish to use the ECB rule for Europe We do not want differences between countries to depend on their rules as well as other factors so we use the same rule everywhere

Model residuals for equity prices, income and consumption

- Useful to evaluate the cross country correlation of unexplained components of key variables involved in consumption determination, to find the scope of contagion in “normal times”
- Look at consumption, compensation and equity price residuals for the period 1991q1 to 1999q4
- Only equity prices show marked cross-country correlation - suggests transmission of shocks affecting consumption occurs indirectly via asset prices and not consumption or incomes directly

Table 3: Correlation of structural shocks with US

	Consumption	Compensation	Equity prices
FR	0.121	0.454	0.513
GE	0.048	-0.189	0.334
IT	-0.038	-0.158	0.352
UK	-0.499	0.241	0.646
JP	-0.072	-0.307	-0.098
CN	0.118	0.112	0.551

The current bear market

- Marked decline in prices comparable with 1970s
- One key difference is level of inflation, affecting real share prices
- High and rising volatility comparable to 70s, and much higher international correlations
- 1970s saw greater deterioration in fundamentals – stronger evidence for overvaluation in late 1990s, notably risk premium

Table 7: Correlation of share prices with world indices

	UK	US	Germany	Japan	Canada	France	Italy	Country averages
1972	0.74	0.83	0.47	0.63	0.66	0.17	0.22	0.53
1973	0.64	0.96	0.51	0.65	0.88	0.45	0.03	0.59
1974	0.59	0.95	0.39	0.09	0.78	0.80	0.50	0.59
1975	0.72	0.96	0.51	0.72	0.72	0.50	0.69	0.69
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

Source: MSCI

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

Stock Market Contagion

- We start with a risk premium shock in the US which reduces equity prices by 35 percent.
 - US Premium
- We look at stock market contagion using NiGEM
 - Contagion of a US shock to other equity markets
 - All Premia and All Equities
 - historical correlations are too weak for the bear market)
 - Contagion of a financial shock to real investment
- The absorption and propagation of the shock is partly from exchange rates and real and nominal interest rates

Contagion to The Rest of the World

- US interest cuts cause a 5% fall in the US effective exchange rate, rates rise elsewhere
- The larger the equity price contagion the larger and more sustained are GDP effects elsewhere
- Falls in GDP are more sustained in Canada and the UK because of larger equity and trade effects
- Long real rates fall markedly in the US because the fall in the valuation of the capital stock changes saving behaviour

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

(percentage point difference from baseline level)

		2003	2004	2005	2006
Canada	<i>U S P rem ium</i>	-0.70	-1.16	-1.00	-0.66
	<i>A ll P rem ia</i>	-1.15	-1.89	-1.66	-1.17
	<i>A ll E quity P rices</i>	-1.52	-2.54	-2.10	-1.18
Euro Area	<i>U S P rem ium</i>	-0.56	-0.28	0.17	0.48
	<i>A ll P rem ia</i>	-0.69	-0.41	0.15	0.57
	<i>A ll E quity P rices</i>	-0.91	-0.90	-0.30	0.30
Japan	<i>U S P rem ium</i>	0.38	0.50	0.18	-0.08
	<i>A ll P rem ia</i>	0.47	0.62	0.24	-0.08
	<i>A ll E quity P rices</i>	0.42	0.13	-0.50	-0.69
U K	<i>U S P rem ium</i>	-0.62	-0.50	-0.32	-0.21
	<i>A ll P rem ia</i>	-0.74	-0.82	-0.61	-0.36
	<i>A ll E quity P rices</i>	-0.83	-1.08	-0.78	-0.29
U S	<i>U S P rem ium</i>	-1.95	-2.03	-1.07	-0.37
	<i>A ll P rem ia</i>	-2.03	-2.09	-1.00	-0.21
	<i>A ll E quity P rices</i>	-2.39	-2.51	-0.90	0.40

Table 10: U S E ffective E xchange R ate and L ong R ates

percentage points difference from baseline in 2003

	Long rate	Real long rate	U S E ffective E xchange R ate
U S Prem ium	-1.40	-1.25	-4.81
A ll Prem ia	-1.50	-1.35	-4.35
A ll E quity P rices	-1.02	-1.12	-2.63

Table 11 Im pacts on E xchange R ates in 2003

Percent difference from baseline

	C anada		E uro A rea		J apan		U K	
		<i>D ollar</i>		<i>D ollar</i>		<i>D ollar</i>		<i>D ollar</i>
U S Prem ium		-2.39		-6.10		-9.13		-8.65
A ll Prem ia		-1.12		-5.85		-9.47		-7.13
A ll E quity P rices		0.14		-3.74		-6.43		-4.88

Contagion to US Investment

- Spreading the equity premium shock to investment gives a larger impact in the US but long rate falls are larger
- The UK and Canada are affected by trade and wealth
- The Euro Area is helped by lower real long rates and hence higher bond prices raising 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

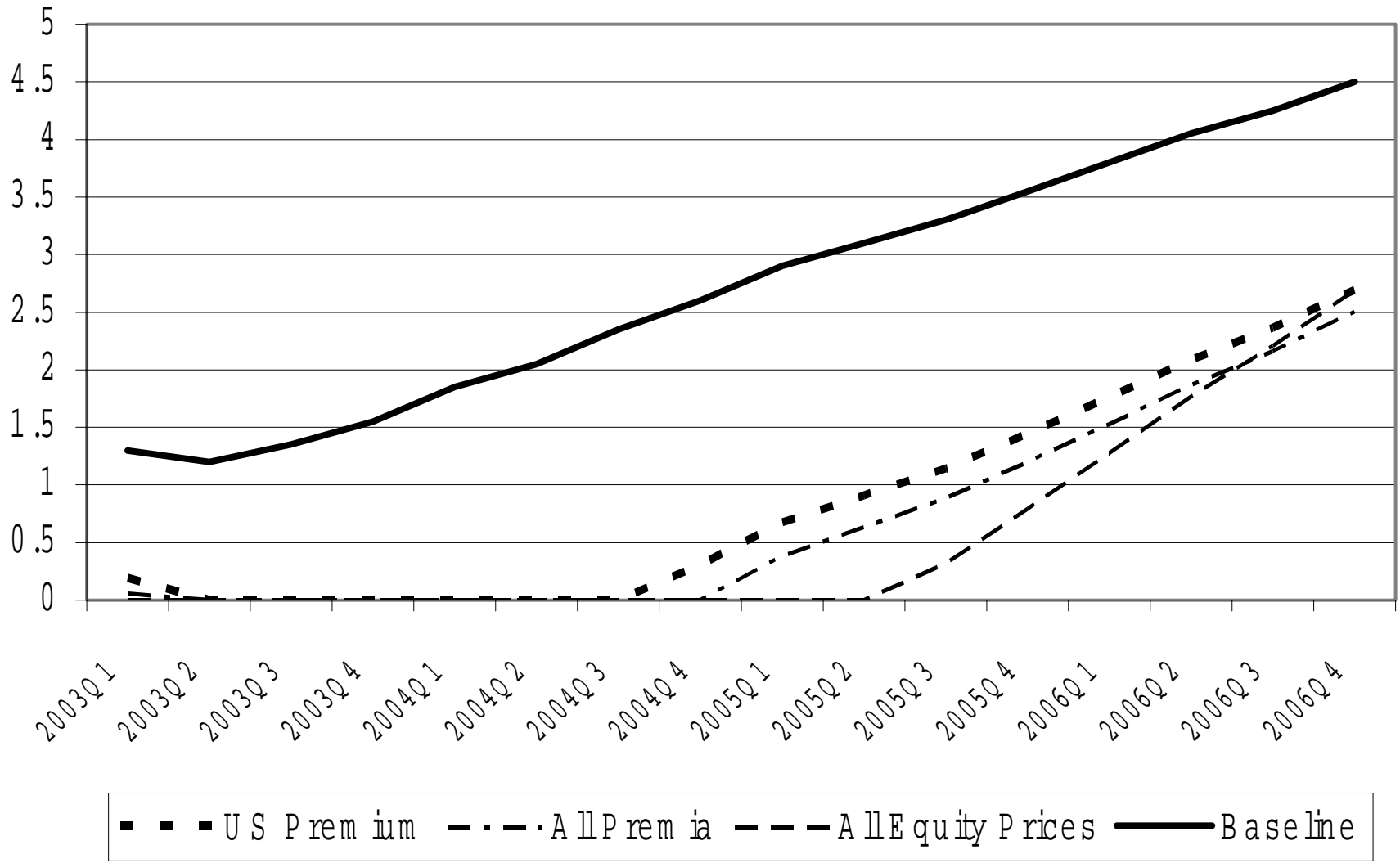
Contagion in Equity Market Risk Premia

- If the shock to the US equity premium spreads to the premia in other markets the impact is increased significantly, depending on how we model it.
- Equity prices fall 30% in the UK and around 25% in the Euro Area if we have contagion to premia
 - expected future profits are less affected because wealth effects have a less significant impact on output
- Real and nominal long interest rates fall more
 - bond prices rise, offsetting equity effects on wealth especially in the Euro Area

Policy Responses to the Shock

- We adjust the automatic responses
- Monetary responses could be stronger
 - The US and Japan are liquidity trapped
 - The Euro Area, the UK and Canada can double response to lower inflation and output
- Fiscal policy can be loosened in the US
 - We can turn solvency rules off for 5 years
 - Higher deficits mean higher real interest rates

Chart1: US Short Rates in Premium and Equity Shocks



Doubling the Inflation Feedback

- Canada can offset 20% of the shock because trade links matter much more
- The Euro Area can offset more than half in the first year, and all within 2 years
- The UK can offset 25% to 40% in the first two years

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

Turning Off Solvency

- Allowing a tax based fiscal response in the US takes time but removes 20% of the shock in the second year
- If spending were used impacts would be more immediate
- Trade Effects benefit Canada, and Japan most

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

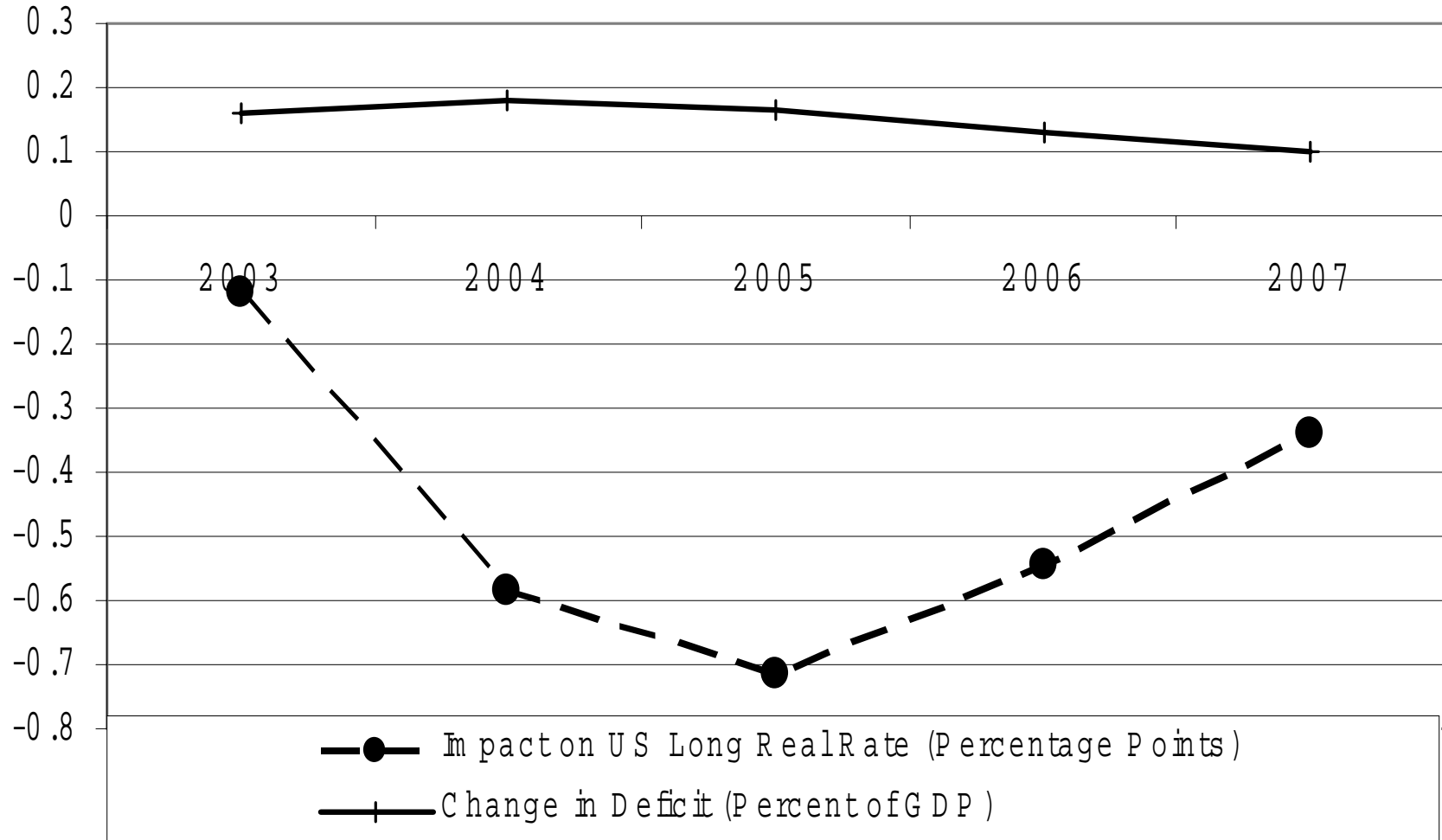
(Percentage difference in GDP from US Equity Premium results)

	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

Fiscal Impacts and Long Rate Feedbacks

- The real long rate is 0.10 to 0.18 higher in response to an increase in the US deficit of 0.45% of GDP over 5 years.
- The US budget has moved from a surplus of around 1.5% of GDP in 2000 to a deficit of 3 1/4% of GDP in 2002
- After cyclical adjustment for the 2 per cent difference in the output gap the fiscal expansion is 2.5 - 3% of GDP
- This 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



Conclusion For Patterns of Contagion

- The major impact of equity market falls is in the US because wealth matters more and is more weighted to equities
- The shock to the US is absorbed by lower long rates and a lower exchange rate
- Links in wealth stocks help absorb the shock in the short run reducing impacts everywhere
- Links in equity premia help increase the shock, but the contagion we have seen appears larger than historical links or common premia shocks

The Carriers of Contagion

Some Correlations

- Wealth effects alone have little relationship to patterns of contagion
 - Direct equity holding matter (-.67)
 - All Equity holdings matter (-.68)
- Trade patterns are important in propagation
 - Openness and output effects (-.87)
 - GDP trade share with US (-.77)
- Correlations with changes in output gaps 2000-2 are lower (-.47, -.27, -.31, -.42 respectively)
- There were many other factors at work

Conclusions

- Recent fall in share prices comparable to 70s
- Falling equity prices can impact on consumption and investment and hence be a driving factor in the business cycle.
- Recent falls would slow output noticeably if sustained
- Suspension of policy rules may be needed to cushion the impact