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EXPLORING AGGREGATE ASSET PRICE FLUCTUATIONS ACROSS COUNTRIES

Measurement, determinants and monetary policy implications

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List of symbols used in the tables

Δ	change (first difference)
$\bar{R}^2$	adjusted R^2
SEE	standard error of the equation
DW	Durbin Watson statistic
LM(x)	Lagrange-multiplier test (p-value); x is the number of lags considered
CH(x)	Chow test (p-value); x is the year that splits the sample
*	significant at the 10% level
**	significant at the 5% level
***	significant at the 1% level
(.)	figures in brackets under coefficient estimates are t-statistics
–	not applicable
n.a.	not available
(c)	constrained coefficient: long-run elasticity equal to one
w.s.	wrong sign
AP	aggregate asset price index
P	price level
TC	total private credit
Y	nominal GDP
M	(broad) money stock
FE	forecast error
RL	long-term interest rate
RS	short-term interest rate
I	business sector profits
T	linear trend

AU	Australia
BE	Belgium
CA	Canada
DK	Denmark
FI	Finland
FR	France
DE	Germany
JP	Japan
NL	Netherlands
NO	Norway
SE	Sweden
GB	United Kingdom
US	United States

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Introduction[1]

Asset prices have undergone major medium-term fluctuations since the early 1980s, sometimes ending in sharp downward corrections. This has been true of equity prices: a generalised vigorous upswing preceded the global stock market crash of October 1987, while a more protracted cycle took place in Japan. It has also been true of real estate prices, as sizable movements in residential and commercial property prices have occurred in many industrialised countries (e.g. BIS (1990) and (1993)).

Such fluctuations are of course not new; the last similar episode took place in the early 1970s. Yet the recent cases have attracted particular attention on the part of economists and policy-makers. One reason is their impact on economic activity and on the soundness of financial institutions. It is widely believed that the boom-bust nature of asset price fluctuations has exacerbated the business cycle, fuelling the upswing, magnifying the downswing and slowing down the current recovery. And the disruption caused to balance sheets of economic agents, notably banks, has threatened or resulted in widespread financial distress: the experience of some Anglo-Saxon and Nordic countries as well as Japan are prominent examples (BIS (1991), (1992) and (1993)). A second reason is that the prolonged upswing, in contrast to that in the early 1970s, occurred against the backdrop of generally moderate and declining inflation and typically positive inflation-adjusted interest rates, often higher than output growth rates. Questions about the determinants of such asset price fluctuations and about the extent to which monetary authorities should pay attention

[1] A previous version of this paper was presented in Oxford at the John Hicks Foundation seminar on "Money, banking and macroeconomic policy" and at the Federal Reserve Board in the autumn of 1993; we are grateful to participants for their comments. We would especially like to thank Joseph Bisignano, Horst Bockelmann, Tony Courakis, John Kneeshaw, Carlo Monticelli and Philip Turner for their suggestions, and Stephan Arthur, Willi Fritz, Philippe Hainaut, Gerhard Randecker and Gerd Schnabel for statistical and graphical assistance. Any errors are the authors' sole responsibility.

to them in the formulation of policy have thus come to the forefront of debate.[2]

Against this background, the objective of the present study is threefold. Firstly, it is to develop an aggregate asset price index for several of the major industrialised countries so as to summarise the information contained in the separate movements of the three asset prices exhibiting major fluctuations, viz. residential property, commercial property and share prices.[3] Such an index facilitates the comparison of broad asset price movements over time and across countries, gives some empirical content to popular notions of general asset price "inflation" and "deflation" and may highlight patterns of behaviour that would otherwise remain undetected. Secondly, it is to begin to analyse what factors may explain the observed movements in the index. The approach tries to combine basic insights from microfinance theory and macroeconomics. Finally, it is to provide preliminary evidence on the usefulness of the aggregate asset price index as an input in the design of monetary policy.

The analysis is largely exploratory in nature. The theoretical underpinnings of the index and its construction could be refined; the development of a formal representation of the workings of the economy would permit a more unified treatment of the various issues addressed; greater attention to country-specific features and more thorough statistical testing would be needed to obtain more definitive answers. Tackling these aspects, however, would take the study well beyond its intended scope.

Section I briefly reviews the main characteristics of asset price movements during the last two decades; a detailed description of the construction of the aggregate price indices for the various countries is contained in Appendix I.

Section II looks at the possible determinants of the observed fluctuations in the aggregate index. After outlining some of the conceptual underpinnings of the analysis, the section provides a stylised comparison of fluctuations in the 1980s and 1970s. On the basis of an examination of very simple relationships between asset prices, output, profits, interest rates and credit, it is argued that a distinguishing feature of the more

[2] As, for instance, in the recent debate in the United States on the stance of monetary policy or the earlier discussion in Japan (e.g. Bank of Japan (1990) and Shadow Open Market Committee (1993)).

[3] The inspiration for this analysis was provided by two pieces of work in the Australian context, by Callen (1991) and Blundell-Wignall and Bullock (1993), which develop and use a variant of such an index. See also BIS (1993) for a cross-country perspective.

recent episode was the role played by the relaxation of credit constraints in the wake of financial liberalisation. This hypothesis is then subjected to more formal econometric tests.

Section III, by contrast, takes aggregate asset prices as given and considers their potential usefulness as an element in the design of monetary policy. Two popular types of analysis are performed. The first sub-section examines the extent to which the inclusion of the aggregate index improves the performance and stability of traditional demand for money functions; in several cases the improvement of the economic and statistical properties of the equations is substantial. The second sub-section explores the information content of the index with respect to inflation and output. Part of the analysis applies popular statistical techniques already extensively used in the assessment of other potential leading indicators, such as simple monetary aggregates, divisia indices, credit and various interest rate spreads (so-called "Granger-causality" tests). A fuller explanation of these tests is given in Appendix II. The section also examines the same question on the basis of the ability of aggregate asset price movements to explain the forecasting errors of a major international institution.

The conclusions briefly summarise the main findings of the paper. They also highlight some of the key lessons of the recent asset price fluctuations for central banks as the institutions responsible for the conduct of monetary policy but also as guarantors of the integrity of the financial system.

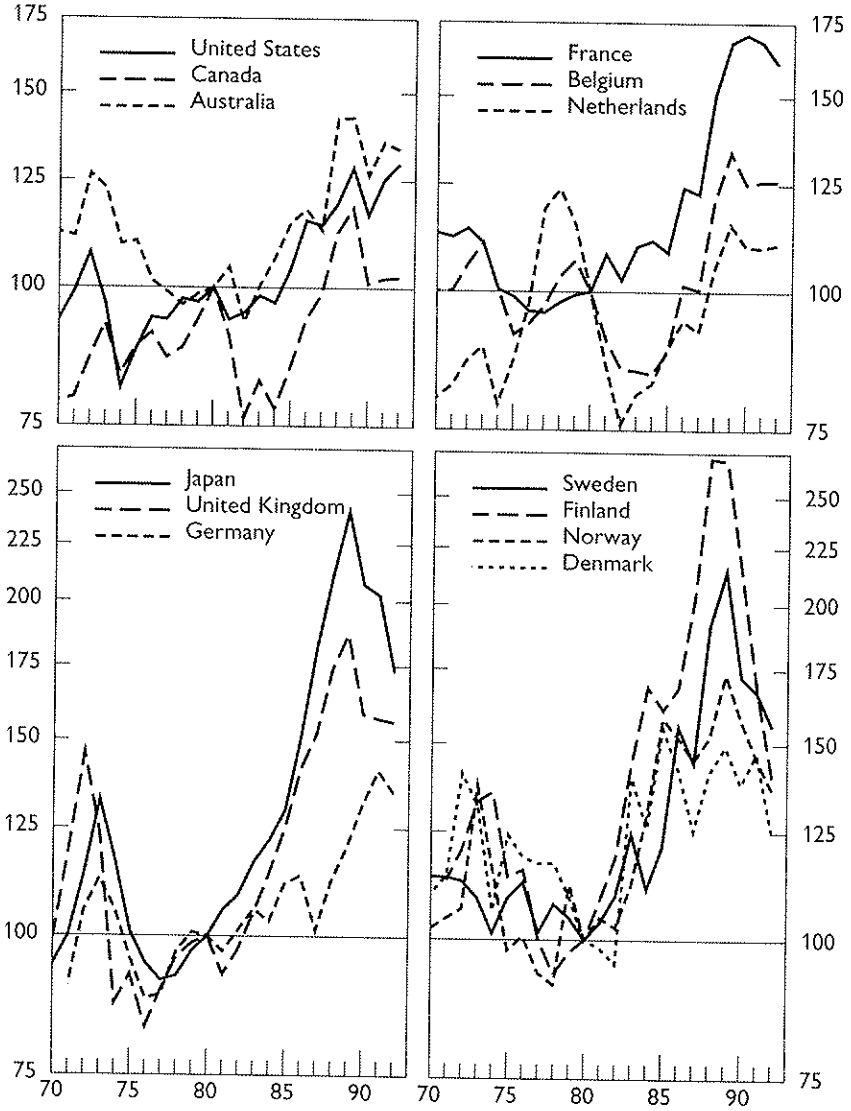
I. A bird's-eye view of asset price movements

The sharp movements in individual asset prices since the early 1980s have been amply documented (e.g. BIS (1988), (1990) and (1992)). Graph 1 provides an alternative perspective on these developments. It plots for each country a summary measure of asset prices, or aggregate asset price index, constructed as a weighted average of national price indices for equities and real estate, both residential and commercial. As explained in detail in Appendix I, the weights represent estimates of the shares of these assets in total private sector wealth. The index provides a number of insights into the behaviour of asset prices, both across countries and over time.

Graph 1

Real aggregate asset prices

1980 = 100; semi-logarithmic scales



Note: The real asset price index is a weighted average of equity and residential and commercial real estate price indices deflated by consumer prices. The weights are based on the composition of private sector wealth.

The graph indicates that over the last ten years a large number of countries have experienced a "cycle" in real aggregate asset prices, i.e. an upswing followed by a downswing in the index deflated by the price level (consumer price index). The severity of such movements, however, has varied widely. The sharpest fluctuations have taken place in some of the Nordic countries and in Japan. In Japan, Sweden and Finland asset prices rose by well over 100% between 1980 and 1989, only to see a considerable part of that increase reversed since then. Similar, though less pronounced, movements have occurred in Norway. In the United Kingdom the upswing can actually be traced back to the mid-1970s: an increase of some 120% from trough to peak was only moderately affected by the recession in the early 1980s. At the other end of the spectrum, asset price upswings have been far less marked in countries such as Belgium, the Netherlands and Germany.

A comparison of the aggregate asset price movements in the 1980s with those in the 1970s suggests a number of observations (see Tables 1 and 2). Certain similarities clearly exist: large movements occurred during both periods, they were a global phenomenon and, typically, the same set of countries experienced the sharpest fluctuations in each case.

Nevertheless, certain differences are also apparent. Firstly, the increases in the 1980s have generally occurred over a much longer period – at least five years compared with two or three at most in the early 1970s.[4] Secondly, their amplitude has typically been considerably greater; a notable exception is the Netherlands, where a relatively small upswing in the early 1970s was followed by a much larger one in the second half of the decade, out of step with virtually all the other countries and of greater amplitude than that in the 1980s. Thirdly, in most countries the downswing in real asset prices in the 1980s has involved larger declines in nominal terms than that in the previous decade, which no doubt partly explains the more severe impact of asset price deflation on the balance sheet of both financial and non-financial economic agents in recent years. Finally, the correlation of the index across countries is generally significantly higher in the 1980s (see Table 3).[5]

[4] An analysis of the movements in equity prices leading up to 1970 and other complementary indicators suggest that this conclusion is not a spurious result of the period for which the series are available. In Finland the upswing in the 1970s may have been as long as seven years, which is still somewhat shorter than that in the 1980s.

[5] As is the correlation of returns (percentage changes), which is not included.

Table 1

The two upswings in real aggregate asset prices

	1970s				1980s			
	Cumulative % change[1]	Years from trough to peak	Trough year[2]	Peak year	Cumulative % change[1]	Years from trough to peak	Trough year	Peak year
AU ...	14	1	1971	1972	53	7	1982	1989
BE	10	3	(1970)	1973	59	5	1984	1989
	17	4	1975	1979				
CA ...	18	3	(1970)	1973	52	5	1984	1989
DK ...	28	2	(1970)	1972	63	3	1982	1985[3]
FI	20[4]	3[4]	(1967)	1974	191	10	1978	1988[3]
FR	2	1	(1971)	1972	67	7	1982	1990[3]
DE	25	2	(1971)	1973	39	5	1987	1991
JP	114	7	1966	1973	164	12	1977	1989
NL	11	3	(1970)	1973	52	7	1982	1989
	57	4	1974	1978				
NO ...	34	3	(1970)	1973	73	9	1980	1989[3]
SE	11	2	1974	1976	114	9	1980	1989[3]
GB	47	2	(1970)	1972	102	8	1981	1989
US	15	2	1970	1972	37	8	1981	1989[3]

[1] From trough to peak. [2] Where the trough year could not be identified clearly because the aggregate price series did not extend sufficiently far back in time, the bracketed year corresponds to the most likely trough, on the basis of movements in the available component indices and independent information. [3] Upswing interrupted by at least a one-year downward movement. [4] On the basis of movements in the equity price index, the trough appears to have been in 1967. The change in the aggregate index is measured from the earliest year available, 1971.

Looking beyond the aggregate index to its components several points stand out. Equity prices generally exhibit the largest fluctuations, and commercial property prices are significantly more volatile than house prices (see Tables 4 and 5); nonetheless, because of the relative shares in the index, it is mainly residential property (65–70%) and equity (15–25%) prices that drive its movements (Table 6).

Real estate prices have in fact accounted for over half of the total change in the real aggregate asset price index in both upswings and downswings in a majority of countries, but their dominance was more marked in the 1970s. Similarly, the upswing in the overall index in the 1980s has a distinct pattern, being mainly driven by equity prices in the first half of the decade and by real estate prices in the second. By comparison with the

Table 2

The two downswings in aggregate asset prices*

	In real terms						In nominal terms	
	1970s			1980s			1970s	1980s
	Cumulative % change	Years from peak to trough	Trough year	Cumulative % change	Years from peak to trough	Trough year	Cumulative % change	
AU ...	–24	6	1978	–11	1	1990	54	– 5
BE	–17	2	1975	– 6	3	–	6	3
	–21	5	1984				12	
CA ...	–10	1	1974	–15	1	1990	1	–10
DK ...	–25	2	1974	–19	2	1987	– 2	–12
FI	–31	4	1978	–48	4	–	8	–38
FR	–16	5	1977	– 6	2	–	38	– 1
DE	–22	3	1976	– 4	1	–	–10	– 1
JP	–31	4	1977	–28	3	–	10	–23
NL	–11	1	1974	– 5	2	1991	– 2	3
	–39	4	1982				–23	
NO ...	–34	5	1978	–21	3	–	4	–14
SE	–10	1	1977	–27	3	–	2	–12
GB	–43	4	1976	–17	3	–	7	– 2
US	–24	2	1974	– 9	1	1990	– 8	– 4

* The period is defined by the change in the real index from peak to trough or, where no trough was identified in the 1980s, to 1992.

upswing in the 1970s, the relative contribution of equity and commercial real estate prices was typically higher in the 1980s, mirroring a decline in that of residential property prices.

While it provides a useful basis for analysis, describing asset price movements by reference to the aggregate asset price index and national averages can understate the economic significance of asset price swings. The window over which the movements are measured corresponds to the troughs and peaks in the aggregate index rather than in the individual components; the variations in individual series may thereby be understated. For example, commercial real estate prices in the United Kingdom went through a major cycle in the 1980s, but the strength of the upswing is hardly reflected in the figures because they bottomed only in

Table 3

Cross-country correlations of real aggregate asset prices

Correlation 1980–92	AU	BE	CA	DK	FI	FR	DE	JP	NL	NO	SE	GB	US
	Change in the correlation between 1970–79* and 1980–92												
Australia		0.51	0.97	–0.09	0.03	0.05	0.11	0.09	1.61	0.20	0.48	0.12	0.59
Belgium	0.91		0.63	0.16	0.48	0.38	0.04	0.32	0.89	–0.03	0.90	0.25	0.44
Canada	0.83	0.90		0.15	0.81	1.06	0.20	0.73	0.49	0.28	0.91	0.96	0.72
Denmark	0.65	0.42	0.35		0.40	–0.04	0.19	0.18	0.66	0.64	0.11	–0.06	–0.03
Finland	0.77	0.62	0.66	0.66		0.18	–0.25	0.01	1.40	0.12	0.77	0.59	0.92
France	0.91	0.95	0.75	0.54	0.66		0.38	0.28	1.47	0.18	0.32	–0.06	0.32
Germany	0.75	0.80	0.49	0.56	0.33	0.88		–0.19	1.09	–0.22	0.77	0.18	0.76
Japan	0.92	0.89	0.82	0.62	0.87	0.92	0.68		1.45	–0.06	0.91	0.44	0.91
Netherlands	0.87	0.97	0.91	0.43	0.55	0.88	0.77	0.82		1.09	1.17	1.18	0.69
Norway	0.80	0.63	0.57	0.84	0.82	0.70	0.57	0.83	0.62		0.83	0.49	0.78
Sweden	0.92	0.87	0.82	0.66	0.88	0.88	0.65	0.97	0.79	0.82		0.42	0.27
United Kingdom	0.94	0.87	0.82	0.67	0.87	0.88	0.67	0.97	0.82	0.88	0.96		0.16
United States	0.92	0.92	0.81	0.58	0.63	0.90	0.81	0.89	0.88	0.75	0.88	0.93	

* For Finland and Germany, 1971–79.

Table 4

The two upswings in real aggregate asset prices: individual components[1]

	1970s upswing[2]			1980s upswing								
				Total			First half[3]			Second half[4]		
	Residential property	Commercial property	Equities	Residential property	Commercial property	Equities	Residential property	Commercial property	Equities	Residential property	Commercial property	Equities
	Cumulative percentages changes											
AU..	4	1	56	33	16	155	10	8	98	22	8	29
BE ..	1[5]	28[5]	8[5]	15	102	106	– 3	7	24	19	89	66
	49[6]	–23[6]	–22[6]									
CA..	25	n.a.	4	60	n.a.	34	5	n.a.	16	52	n.a.	15
DK..	22	1	77	50[7]	70[7]	75[7]	50[7]	70[7]	75[7]	–	–	–
FI ...	17	30	26	103	366	389	32	235	99	54	39	145
FR ..	1	– 1	13	25	292	199	–17	119	112	52	79	41
DE..	39	14	–19	28[8]	65[8]	29[8]	–	–	–	28[8]	65[8]	29[8]
JP ...	129	82	70	59	51	471	32	8	114	21	40	166
NL..	15[5]	32[5]	–27[5]	14	41	178	– 6	3	117	14	37	28
	74[9]	25[9]	13[9]									
NO .	33	53	30	1	102	228	– 1	129	150	2	–12	31
SE...	15	5	9	–2	27	462	–28	– 8	162	35	39	114
GB..	52	n.a.	41	84	20	150	16	–13	77	59	37	41
US ..	10	n.a.	22	13	–16	110	1	– 1	44	12	–15	46

[1] The figures correspond to the period defined by the trough and peak in the aggregate price index, not in each individual component; see Appendix I for the historical graph of each series. [2] From trough to peak as defined in Table 1. [3] From the trough identified in Table 1 to 1985. [4] From 1985 to the peak identified in Table 1. [5] 1970–73. [6] 1975–79. [7] 1982–85. [8] 1987–91. [9] 1974–78.

Table 5

The two downswings in real aggregate asset prices: individual components*

	1970s			1980s		
	Residential property	Commercial property	Equities	Residential property	Commercial property	Equities
	Cumulative percentage change					
Australia	– 8	–44	–59	– 4	– 9	–28
Belgium	0	–32	–31	16	–13	–27
	–35	7	10			
Canada	2	n.a.	–37	–12	n.a.	–22
Denmark	– 7	–32	–44	–12	22	–40
Finland	–25	–43	–52	–44	–41	–61
France	– 5	–24	–55	3	–36	4
Germany	–24	–29	1	5	–17	–11
Japan	–30	–34	–21	4	7	–57
Netherlands	9	–36	–35	– 3	6	–12
	–44	–28	– 1			
Norway	9	– 9	–74	–26	–40	– 9
Sweden	3	–22	–26	–11	9	–41
United Kingdom	–22	n.a.	–66	–24	–55	– 4
United States	– 1	n.a.	–53	– 8	–10	–11

* The period is defined by the change in the aggregate index from peak to trough identified in Table 2.

1986, six years after the aggregate index (Table 4 and Graph AI.1, Appendix I). Moreover, regional variations in real estate price dynamics can be very large. In the United States, for example, major desynchronised swings occurred successively in the Mid-West, the North-East and the South-West during the 1980s. Similarly, London and Paris have seen booms and busts which are diluted in the country-wide measures.

Table 6

The two upswings in real aggregate asset prices: contributions of the components[1]

	1970s upswing[2]			1980s upswing								
				Total			First half[3]			Second half[4]		
	Residential property	Commercial property	Equities	Residential property	Commercial property	Equities	Residential property	Commercial property	Equities	Residential property	Commercial property	Equities
	In percentages											
AU . .	23	0	77	47	4	50	31	3	66	61	4	35
BE . .	6[5]	79[5]	16[5]	16	37	47	– 33	27	107	21	38	42
	161[6]	–40[6]	–21[6]									
CA . .	92	–	8	72	–	28	18	–	82	87	–	13
DK . .	36	1	62	38[7]	15[7]	47[7]	38[7]	15[7]	47[7]	–	–	–
FI . . .	60	31	10	42	33	24	33	55	12	48	19	33
FR . .	25	–16	91	29	43	28	–195	158	137	56	29	15
DE . .	97	13	–11	43[8]	39[8]	19[8]	–	–	–	43[8]	39[8]	19[8]
JP . . .	74	21	3	25	5	70	54	4	44	14	6	81
NL . .	72[5]	76[5]	–48[5]	19	15	67	– 25	3	122	41	20	39
	87[9]	10[9]	2[9]									
NO .	36	20	42	1	24	75	– 1	39	62	8	–32	123
SE . . .	68	10	22	–1	4	97	– 75	–7	182	16	7	77
GB . .	56	–	44	50	1	49	31	–4	72	59	4	38
US . .	37	–	63	24	–4	79	6	0	94	32	– 5	73

[1] The figures correspond to the period defined by the trough and peak in the aggregate price index, not in each individual component; the contributions may not add up to one hundred because of rounding. [2] From trough to peak as defined in Table 1. [3] From the trough identified in Table 1 to 1985. [4] From 1985 to the peak identified in Table 1. [5] 1970–73. [6] 1975–79. [7] 1982–85. [8] 1987–91. [9] 1974–78.

II. Explaining the aggregate asset price movements

Some conceptual underpinnings

What may have lain behind the observed aggregate asset price fluctuations? In order to answer this question some frame of reference is needed. A useful starting-point is the present value formula, familiar in finance theory. The formula states that the price of any asset price (AP) in terms of the general price level (P) may be written as a function (f(.)) of the real income received from the asset in any given period (I/P), the expected future nominal growth rate of that income (g) and the nominal discount rate (or required rate of return) (r), the sum of a risk-free rate plus a risk premium specific to the asset:[6]

$$\frac{AP}{P} = f\left(\frac{I}{P}, r, g\right)$$
$$(+)(-)(-)$$

A higher anticipated income from the asset tends to raise its price, a higher yield on alternative assets or a higher risk premium to reduce it. The basic idea behind this formulation is that arbitrage should ensure that, in equilibrium, the yield on all assets, adjusted for risk, is the same (Ross (1987)).

The present value benchmark has the merit of highlighting a set of variables of interest in explaining asset prices. However, it can only be an approximate guide to an empirical analysis: neither the ex ante required rate of return nor expectations about the future income from the asset are directly observable or explained by the model.[7] Moreover, the relationship is expected to hold only in equilibrium, and the costs of portfolio adjustment in certain markets, notably real estate, may result in significant short-run deviations of actual from "theoretical" prices.

[6] For an asset whose income and discount rate are expected to remain constant over time the formula becomes $\frac{AP}{P} = \frac{I}{P} \cdot \frac{1}{r-g}$ as long as $r > g$, the condition that ensures that the price is bounded. Note also that r and g may alternatively be defined in real terms, by subtracting and adding the inflation rate from the denominator of the expression.

[7] The determination of the risk premium calls for further assumptions about economic agents' risk preferences; that of expectations for some view about the expectation formation mechanism. Since neither expectations nor the ex ante required rate of return are directly observable, it is not possible to test the two hypotheses independently. This has been the source of considerable ambiguities in the interpretation of statistical exercises based on the formula.

In addition, the present value benchmark is not free of conceptual shortcomings. One drawback relates to its application to the explanation of residential property prices, one component of the composite asset: the demand for housing is partly driven by the desire to consume the services from the asset rather than by the expected pecuniary gains from the investment. A second drawback is the limited scope that the benchmark provides for identifying the influence of general monetary and credit conditions, which is confined to the discount factor. This ignores the possible effect that the availability, rather than the cost, of finance can have on economic agents' demand for assets. A few words may clarify this point.

Admittedly, much of the macroeconomic literature has viewed changes in monetary conditions as affecting asset markets and hence economic activity through induced changes in yields.[8] However, recent work has drawn closer attention to the relevance of non-interest-rate factors by pointing to information asymmetries in capital markets between funds users and suppliers. Under these conditions, interest rates and yields on assets (e.g. equities) may be inefficient mechanisms for the allocation of funds: they may fail to provide suppliers with sufficient safeguards to secure an appropriate ex ante return. For example, raising the interest rate charged on a loan would on average attract the worst risks to a lender unable to differentiate between the riskiness of a set of borrowers or projects. Since no repayment is forthcoming when the project fails, the demand for funds associated with riskier projects is less sensitive to increases in the contractual interest rate.[9] Therefore, higher contractual rates may after a point not raise expected returns to the lender at all and rationing of funds may result.

There are indeed many variations on this basic theme, depending on the particular financial instrument considered and the assumptions made about the distribution of information and the contractual possibilities

[8] This is true of both Keynesians and monetarists, although the spectrum of assets and hence relative yields considered varies: one interest rate, typically interpreted as a bond rate, is considered in the popular IS/LM model first developed by Hicks (1937); the analysis is extended to the return on equity by Tobin (1961) and to a wider spectrum of asset returns by e.g. M. Friedman (1956) and M. Friedman and Meiselman (1964).

[9] If the contractual rate is 10%, the expected cost to the borrower on a project with a 99% probability of failure and a 1% probability of meeting the repayment obligations is 0.1%. The cost is 10% on one that is guaranteed not to fail. The differential sensitivity implies that out of a given pool of projects with identical expected returns the safer projects will be the first to be deterred by a high contractual rate. See Stiglitz and Weiss (1981) and (1986).

open to the parties.[10] For present purposes only a few lessons from this strand of the literature are relevant. Firstly, the costs of external finance are typically higher than those of internal finance. Secondly, interest rates and yields may be a poor guide to the effective (opportunity) cost of funds, especially external funds. Other contract terms may be quite important, not least collateral. Finally, under these conditions the availability of internal and external funding is relevant, not just its cost as measured by the observed interest rate: agents may be finance-constrained.

This work has also led to a renewed focus on credit rather than money as the variable that best captures the impact of changes in financial conditions on the economy.[11] Together with internally generated cash flow or income, credit represents the main source of funds for the acquisition of goods, services and assets. Changes in the terms on which credit is granted are thus a crucial element in the transmission of monetary impulses.

Delving further into history, certain strands of thought have highlighted the role that changes in credit conditions may have in generating or amplifying the business cycle, partly by interacting with asset prices. Elements of this story, for example, can be found in authors of the Austrian tradition (e.g. Von Mises (1934)) and were more fully articulated in Fisher's (1932) theory of debt deflation.[12] The role of credit in fuelling asset price booms has been amply documented by Kindleberger (1978) and considered in some detail by Minsky (1982).

The relationship between credit and asset prices is multifaceted. The relaxation of credit constraints can have a direct and indirect effect on valuations. Agents may directly utilise credit to purchase real and financial assets. Indirectly, expenditures on goods and services tend to generate an upswing in economic activity, helping cash flows and brightening prospects for future income on assets, thereby buoying their valuation. In turn,

[10] On the equity market, see, for instance, Myers and Majluf (1984). Gertler (1988) and Borio (1990a) contain short overviews of the topic.

[11] See, for instance, Greenwald, Stiglitz and Weiss (1984), Bernanke and Blinder (1988), Bernanke and Gertler (1989) and, Greenwald and Stiglitz (1993) or Stiglitz and Weiss (1992). Traditionally, both monetarists and Keynesians have been quite willing to confront their views on the basis of paradigms that played down the autonomous role of credit. Despite this prevalent attitude, many economists have not neglected credit, regardless of any emphasis on rationing. See, most notably, Brunner and Meltzer (1974) and B. Friedman (1983).

[12] See also Keynes (1931) for the impact of declining asset values on banks' willingness to lend and hence on economic activity.

higher asset values, either induced by the credit expansion itself or in response to autonomous factors, strengthen the net worth of agents and hence their borrowing capacity, not least by increasing the value of collateral. A self-reinforcing process can easily develop.

Some authors have stressed the speculative nature of the later stages of the boom, when investment decisions may be primarily driven by anticipated capital gains rather than the income stream to be derived from the assets (e.g. Kindleberger (1978) and Minsky (1982)). Especially when those expectations become disconnected from underlying fundamentals in the real economy, the stage is then set for a period of falling asset prices, painful adjustments in the balance sheets of overstretched financial intermediaries and borrowers and declining or negative credit growth. The same factors that reinforced the upswing now operate in reverse, exacerbating the downswing. The experience of several countries in the recent business cycle has followed this scenario fairly closely.[13]

The foregoing analysis contains some useful clues as to the variables to be considered when explaining movements in aggregate asset prices. On the basis of the present value formula, some measure of the income from the assets should be included. Since the components of the aggregate are equities and real estate, in the absence of more precise statistics income from capital (which includes also rents) and GDP may be taken as proxies. In addition, GDP may help to capture that part of the demand for residential real estate that is driven mainly by the desire to consume housing services rather than by investment considerations. A long-term interest rate can proxy the yield on alternative assets. Finally, although both money and credit have a bearing on asset prices, credit merits particular attention.

The following pages provide a stylised comparison of the relationship between aggregate asset prices and the identified economic variables in the 1980s and 1970s. It is argued that the distinguishing characteristic of the 1980s has been the role played by credit as a result of the relaxation of credit constraints in the wake of liberalisation and heightened competition in the financial industry. This hypothesis is then subjected to more rigorous statistical tests.

[13] See, for example, Greenspan (1991a) and (1991b), Bank of England Quarterly Bulletin (1991), Okina and Sakuraba (1994), Blundell-Wignall and Bullock (1993) and, for an overview, O'Brien and Browne (1992). For evidence of a credit crunch beyond the banking sector, and more specifically in the US private placement market, see Carey et al. (1993).

Table 7

Real aggregate asset prices and economic growth in the two upswings[1]

	1970s	1980s
Australia	0.73	1.68
Belgium	0.52[2]	2.27
	1.03[3]	
Canada	0.86	1.57
Denmark	2.35	2.32
Finland	1.11	3.52
France	0.13	3.07
Germany	2.58	1.93
Japan	1.31	2.58
Netherlands	0.66[2]	1.89
	4.08[4]	
Norway	2.37	2.91
Sweden	3.08	5.20
United Kingdom	3.44	3.38
United States	1.09	1.25

[1] Trough-to-peak percentage increase in the real aggregate asset price index as defined in Table 1 divided by trough-to-peak percentage increase in real GDP. [2] 1970–73. [3] 1975–79. [4] 1974–78.

Sources: OECD and national data.

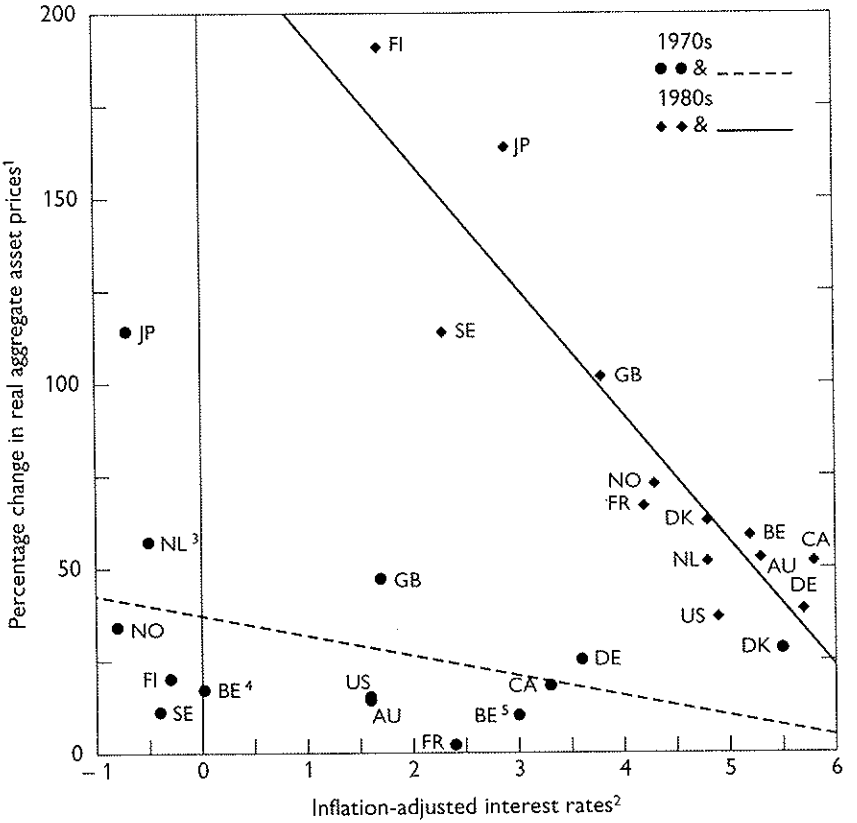
A suggested interpretation

No doubt the vigorous and prolonged economic expansion of the 1980s goes a long way towards explaining the larger cumulative rise in real asset prices during the period in comparison with that in the 1970s. But the ratio of the growth rate of the real asset price index to that of output was higher in the 1980s than in the 1970s (Table 7). The second upswing of the 1970s in the Netherlands is the clearest exception, the ratio being among the highest recorded in either period; other counter-examples are Germany, where it was somewhat higher in the 1970s, and the United Kingdom and Denmark, where it was not very different. This suggests that generally other factors must have been at work.

The explanation for the stronger upswing in asset prices can hardly lie with interest rates. True, in both episodes countries with relatively low inflation-adjusted interest rates appear to have experienced steeper asset price increases (Graph 2). But inflation-adjusted interest rates were generally low or even negative during the 1970s upswing and considerably

Graph 2

Real aggregate asset prices and inflation-adjusted interest rates



[1] Trough to peak. [2] Averages of quarterly ten-year government bond yields less an uncentred three-year moving average of consumer price inflation over the period defined by the movement in the real asset price index for each country. [3] 1974–78 (interest rate not available for the 1970–73 upswing). [4] 1975–79. [5] 1970–73.

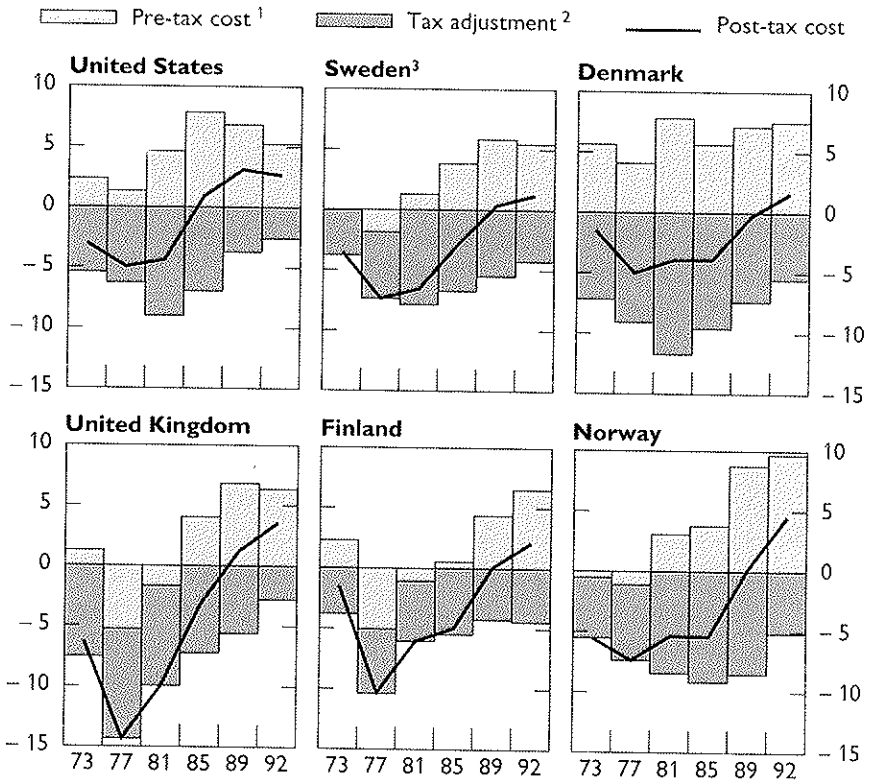
higher and positive during that in the 1980s. They tended to be lower than the growth rate of output in the first episode and higher in the second. On both counts asset price movements should thereby have been dampened.

Admittedly, adjusting for tax provisions can substantially reduce the opportunity cost of funds. This factor was particularly significant in countries with relatively high inflation, and hence typically higher nominal

Graph 3

Inflation-adjusted cost of borrowing for house purchases

In percentages



Four-year (for 1992, three-year) periods ending in the year indicated

[1] Defined as the pre-tax mortgage rate less the rate of consumer price inflation. [2] Based on the top personal income tax rate. [3] New series since 1986.

Sources: National data and authors' estimates.

interest rates, and for those agents able to deduct borrowing costs from their tax liability. For example, in the Nordic countries, where full deductibility of mortgage payments combined with persistent inflation, the post-tax cost of funds for the purchase of residential property was actually negative for much of the 1980s (Graph 3). The same is true of the United Kingdom. Yet, a favourable tax treatment existed also in the 1970s

and the post-tax cost was actually rising for most of the period preceding and accompanying the 1980s upswing. It was only in the late stages of the boom that prices appeared to respond to this increase, partly following a tightening of tax provisions. Therefore, *by themselves* tax factors do not appear to account for the change in the relationship between interest rates and asset prices between the two upswings.

Part of the explanation may lie with the behaviour of profits, defined also to include a rent component. The economic expansion of the past decade has generally been regarded as especially propitious for the income from capital. A rise in the share of national income accruing to profits could help to account for the greater sensitivity of asset prices to GDP. Higher rates of return could justify a lower responsiveness to interest rates.

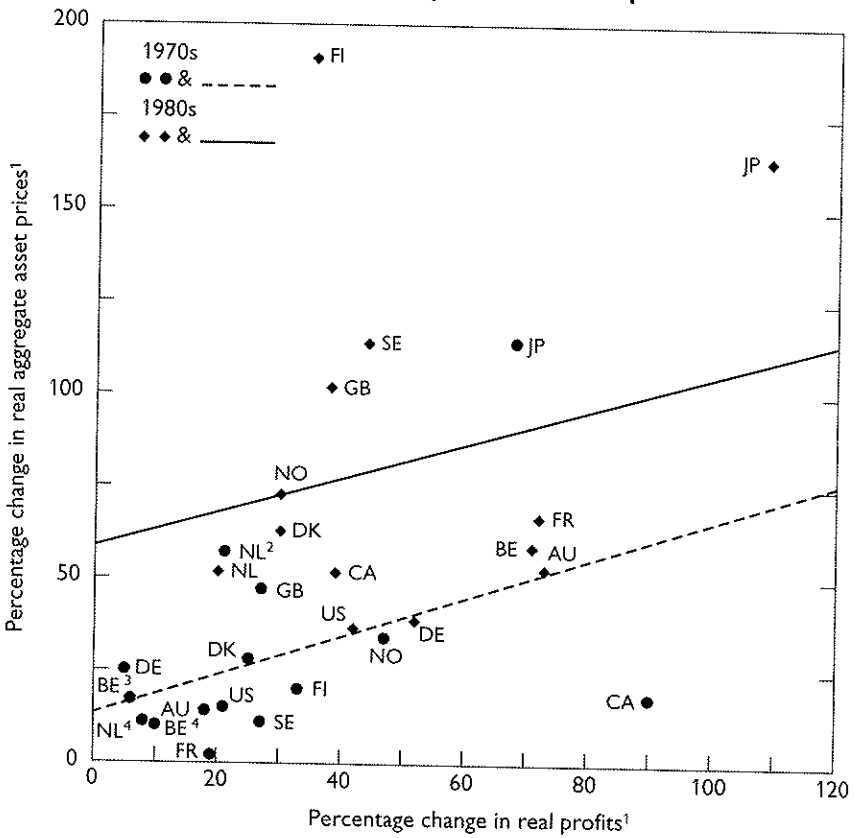
The available evidence suggests that this explanation may be relevant for some countries but not for all. Profits did tend to rise faster in the 1980s than in the 1970s (Table 8). Just as with interest rates, the behaviour of profits seems to account for part of the cross-country differences observed in the two periods (Graph 4). But the responsiveness of asset prices to profits was on average greater during the 1980s upswing. It was sharply higher in the three Nordic countries experiencing the largest asset price booms, namely Finland, Sweden and Norway. It was considerably lower only in Germany and Belgium (Table 8).

The above reasoning suggests that judging from traditional benchmarks for the assessment of asset values it is not easy to account for the upswing in the 1980s, at least if that in the early 1970s is taken as the basis for comparison. For some countries, notably Germany, where the recent upswing in asset prices has been relatively subdued by international standards, the strength of output and/or profits may by itself go a long way towards providing an answer. For others, however, especially those experiencing the sharpest movements, other significant factors appear to have been at work. The same may be said, exceptionally, of the second upswing in the 1970s in the Netherlands, which in some respects resembles that experienced by other countries in the subsequent decade.

Credit seems to have the necessary credentials to fill the gap in the explanation. As shown in Graph 5, at least in those countries where the asset price boom was most marked in the 1980s (Finland, Sweden, Norway, Japan and the United Kingdom) or where the disruption caused by the downward correction in valuations has caused great concern

Graph 4

Real aggregate asset prices and real profits



[1] Trough to peak. [2] 1974–78. [3] 1975–79. [4] 1970–73.

(Australia and the United States) there is a relatively close correlation between the ratio of private credit to GDP and asset price movements. In most of them this correlation appears closer than in the 1970s.

To a large extent, the major expansion of credit during the past decade reflected a relaxation of credit constraints in the financial industry in the wake of both market-driven and policy-determined structural developments.[14] Their end-result was greatly to increase competitive pressures in

[14] For a global perspective on these developments, see Bröker (1989), OECD (1992) and BIS ((1991) and (1992)).

Table 8

Real aggregate asset prices and real profits

	1970s		1980s	
	Profits[1]	Asset price sensitivity[2]	Profits[1]	Asset price sensitivity[2]
	Cumulative percentage change	Ratio of percentage changes	Cumulative percentage change	Ratio of percentage changes
Australia[3]	18	0.77	73	0.72
Belgium	6	1.08[4]	71	0.82
	10	2.66[5]		
Canada	90	0.20	39	1.34
Denmark	25	1.15	30	2.11
Finland	33	0.60	35	5.51
France	19	0.09	72	0.93
Germany	5	4.58	52	0.76
Japan	68	1.67	109	1.50
Netherlands[3]	21	1.33[4]	20	2.56
	8	2.66[6]		
Norway	47	0.73	30	2.49
Sweden	27	0.42	44	2.58
United Kingdom	27	1.76	38	2.67
United States	21	0.71	42	0.89

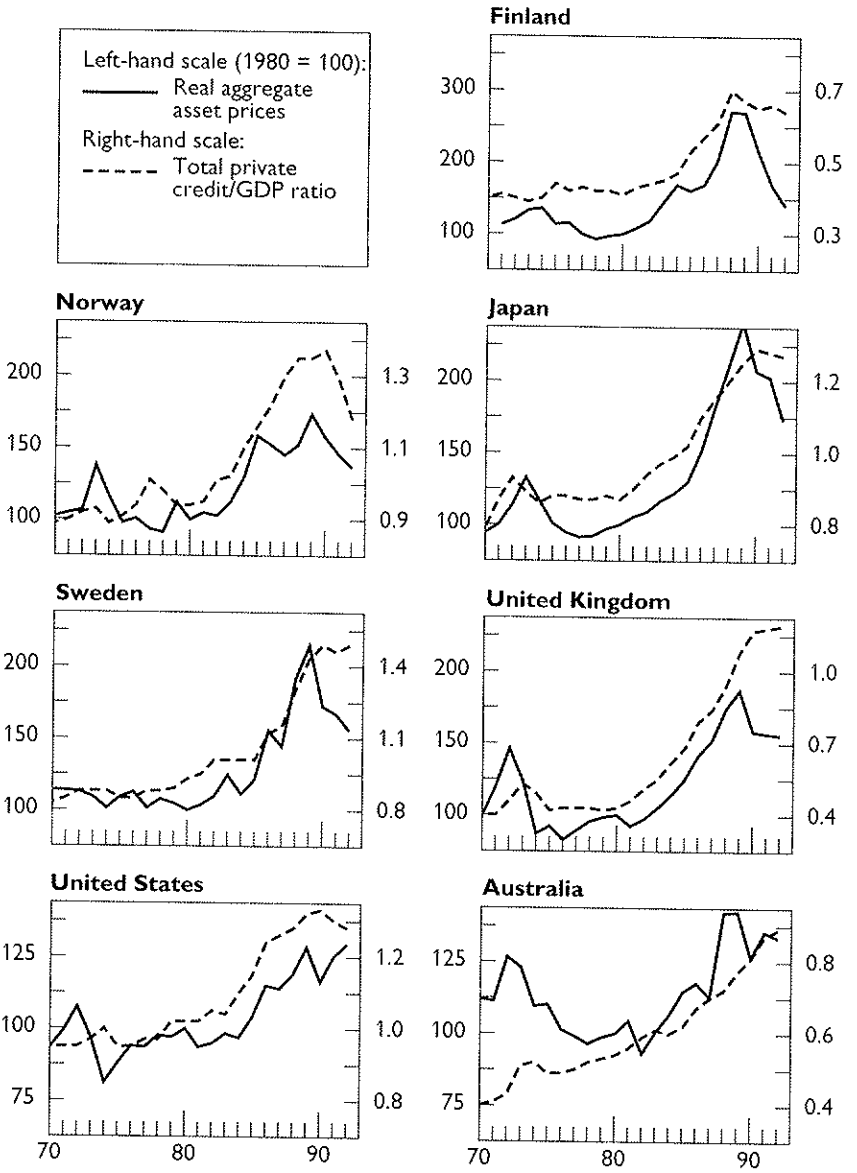
[1] Profits in the business sector divided by the corresponding deflator. [2] Trough-to-peak percentage increase in the real aggregate asset price index as defined in Table 1 divided by trough-to-peak percentage increase in real profits. [3] Real profits calculated as the profit share in the business sector multiplied by real GDP. [4] 1970–73. [5] 1975–79. [6] 1974–78.

Sources: OECD and national data.

the industry and to broaden the range of borrowing opportunities. In the process, they also heightened the impact of pre-existing tax provisions which encouraged indebtedness and which had been less powerful during the period when credit rationing was prevalent. The resulting environment provided fertile ground for a self-reinforcing spiral of credit and asset prices, with faster credit expansion raising asset prices and higher asset prices in turn relaxing credit constraints further. The likelihood of such a process is especially high in the transition period, as agents adjust to the newly-found freedom and a lack of familiarity with the new financial conditions leads to errors of judgement on the part of both lenders and borrowers.

Graph 5

Real aggregate asset prices and credit



Sources: National data and authors' estimates.

While quite general, the heightening of competitive pressures has not been uniform. The mixture of government and market forces as engines of the process has varied across countries. And so has the scope, timing and speed of the structural changes, depending on initial conditions and specific factors. It is precisely such differences that help explain the international pattern of asset price movements.

The countries where asset price movements have been comparatively greater, or at least more disruptive, have all seen significant structural changes in their financial system during the past decade. The impact of deregulation has been particularly strong in Norway, Sweden and Finland, all of which moved from a system where credit was rationed to one of open competition in the space of a few years around the mid-1980s. Deregulation was also particularly broad-ranging in Australia before 1985.[15] Though considerably more gradual, the cumulative deregulatory process has been important in Japan (Takeda and Turner (1992)). A significant step was the easing of restrictions on corporations' access to international capital markets beginning in the mid-1980s. This facilitated their speculative investments in both equity and property markets ("Zaitech").[16] Similarly, less regulated non-bank credit institutions thrived and became heavily involved in lending to the real estate market.

The case of the United Kingdom is rather unique, in that the financial conditions of the early 1970s and 1980s were similar in many respects. In particular, both periods were characterised by a heightening of competitive pressures, partly in the wake of deregulation. In the early to mid-1980s (direct and indirect) restrictions on credit were abolished and greater competition between banks and building societies was encouraged, thereby reinforcing an underlying market trend. In the early 1970s the lifting of interest rate and quantitative restrictions as part of the Competition and Credit Control Act of 1971 fuelled a credit expansion and a boom and bust cycle in asset prices, notably commercial real estate (e.g. BIS (1990)). The case of the Netherlands is also special: the major asset price cycle of the second half of the 1970s, which was driven by housing prices, was preceded by an intensification of competition among

[15] On Norway, see Solheim (1990) and Commission on the Banking Crisis (1992); on Sweden, Englund (1990); on Finland, Brunila and Takala (1993), Nyberg and Vihriälä (1993) and Bordes (1993); on Australia, MacFarlane (1989).

[16] On the changes in the financing and investment patterns of Japanese corporations, see Bank of Japan (1991).

credit intermediaries and a significant broadening of government mortgage guarantees for the acquisition of dwellings.[17]

In the United States a significant heightening of competitive pressures did occur in the 1980s in the wake of several deregulatory moves, notably as regards deposit rates and the lending powers of savings and loan institutions in the commercial property sector in the early to mid-1980s. But market forces were primarily responsible for the increase in competition between banks, on the one hand, and securities firms and capital markets more generally, on the other – the acceleration of a trend that dates back to the 1970s. One symptom of this process was the debt-financed takeover wave, a factor which contributed to the rise in stock prices.[18] Another was the greater eagerness of banks to take on risks in commercial real estate lending.

From a broader perspective, the heightening of competitive pressures has influenced asset prices not only within the narrow confines of domestic markets, but also through the linkages between them. The growth of cross-border capital flows has played a role. Following the liberalisation of capital controls, for instance, finance companies in Sweden were quick to expand their lending activities in the commercial real estate market in London, a source of subsequent heavy losses. The cross-border activities of Japanese banks and investors have helped to boost property prices in several countries. The internationalisation of finance is probably one factor behind the higher correlation of asset prices across national boundaries in the 1980s.

At the other end of the spectrum, in Germany, which has seen relatively little structural change, asset price movements have been more subdued. They have also been moderate in Denmark in comparison with its Nordic neighbours, consistently with its earlier and much more gradual deregulation process.

At the same time, it would be incorrect to attribute the credit expansion of the past decade solely to a structural heightening of competitive pressures. Monetary policy has to take a share of the responsibility. Admittedly, on balance, the impact of monetary policy on the amplitude of

[17] Banks had developed new mortgage structures with low initial downpayments and had become less conservative as regards minimum loan-to-value ratios. In July 1975 municipal governments introduced mortgage loan guarantees for the acquisition of existing residential property; until then the guarantees had been available only for newly-built dwellings.

[18] For a detailed analysis of such highly-leveraged transactions, including banks' involvement, see Borio (1990a and 1990b) and references therein.

asset price movements in the 1980s has arguably been less important than in the early 1970s. The earlier episode was marked by a generalised expansionary stance. This was in part connected with the Bretton Woods arrangements, which made it difficult for countries to insulate themselves from external monetary shocks. In the past decade, by contrast, monetary discipline was greater. Inflation gave way to disinflation, and inflation-adjusted interest rates were in general considerably higher.

Nevertheless, a comparatively easy monetary stance probably exacerbated the price movements in several countries, especially those exhibiting the largest asset price upswings. To different degrees, in Norway, Sweden and Finland domestic and/or external constraints on interest rate policy in the wake of deregulation provided ample liquidity for the asset price boom (e.g. Solheim (1990), Dennis (1993) and Currie (1993)). Policy in Japan was arguably not consistent with restraint in borrowing. The steep upswing was accompanied by declining interest rates, in part geared to checking the appreciation of the yen/dollar exchange rate following the Louvre Accord of 1987 (e.g. Takeda and Turner (1992)). Policy was comparatively easy also in the United Kingdom, at least when the pound shadowed the Deutsche Mark in the second half of the 1980s (e.g. George (1993)).

By contrast, the firm monetary discipline enjoyed by Germany, in conjunction with little structural change in its financial system, arguably goes a long way towards explaining the more muted asset price movements there. Part of this disciplining effect has undoubtedly filtered through to the other ERM countries. The tighter monetary policy pursued in Australia in comparison with that in some of the Nordic countries probably tempered the credit/asset price spiral that followed deregulation.

Formal statistical evidence

The interpretation of events just outlined implies a set of testable propositions which may be examined with the help of formal statistical tools. Firstly, to the extent that the asset price boom of the early 1970s was more closely associated with interest rates which were low in relation to the expected income stream from the assets than with credit availability, the explanatory power of credit may be expected to be generally higher in the 1980s. Secondly, the distinctive influence of credit in the 1980s should be clearest in those countries experiencing major structural

Table 9

Credit bivariate regression results

$$\log\left(\frac{AP}{P}\right)_t = \alpha + \beta\left(\frac{TC}{Y}\right)_t$$

	Whole period			1970s			1980s		
	β	t-statistic	$\bar{R}^2$	β	t-statistic	$\bar{R}^2$	β	t-statistic	$\bar{R}^2$
AU ...	0.51***	(2.96)	0.26	–1.16*	(1.94)	0.23	1.12***	(5.74)	0.73
BE	1.28***	(3.70)	0.38	0.29	(0.73)	0.06	2.20***	(3.61)	0.50
CA ...	0.61***	(2.96)	0.27	0.29*	(2.00)	0.25	1.12	(1.59)	0.11
DK ...	1.83**	(2.53)	0.21	1.68	(0.61)	–0.07	1.80*	(2.01)	0.22
FI	2.23***	(6.48)	0.66	–5.89**	(3.23)	0.54	2.16***	(4.34)	0.60
FR	1.74***	(6.98)	0.69	–0.88**	(3.01)	0.47	2.07***	(10.16)	0.89
DE ...	0.79***	(3.69)	0.40	–0.50	(0.34)	–0.12	1.75***	(4.39)	0.65
JP	2.31***	(13.74)	0.87	3.30***	(3.99)	0.52	1.92***	(11.64)	0.92
NL ...	0.32**	(2.24)	0.15	1.60***	(5.83)	0.79	0.96***	(4.16)	0.58
NO...	1.28***	(8.79)	0.81	–1.02	(1.03)	0.01	1.43***	(10.70)	0.90
SE	0.79***	(8.67)	0.77	–1.58*	(2.15)	0.29	0.87***	(5.52)	0.71
GB ...	0.86***	(7.43)	0.71	1.90*	(1.89)	0.22	0.93***	(7.22)	0.81
US....	0.77***	(8.24)	0.74	–0.93	(1.46)	0.09	0.87***	(7.18)	0.81

changes in their financial system and the largest asset price swings. Finally, since the relationship between total private sector credit and money has changed significantly during the past two decades following the liberalisation process, the period should also contain interesting clues as to the relative usefulness of the two variables in explaining aggregate asset price movements.

Simple bivariate relationships are broadly consistent with the hypotheses put forward regarding the relative importance of credit over time and across countries. This is indicated by the regression results of the (log of the) real asset price index on the ratio of total private sector credit to nominal GDP (Table 9). When the equation is estimated over the whole sample, the coefficient on credit is in fact invariably statistically significant and correctly signed. As judged from the fraction of the variability in the real asset price index "accounted for" by credit ($\bar{R}^2$), the explanatory power is generally highest (of the order of 70% or more) in those countries experiencing the largest asset price swings (Finland, Norway, Sweden, Japan and the United Kingdom) and in the United States. The results also suggest that the relationship is generally closer in

the 1980s than in the 1970s: virtually all the $\bar{R}^2$ are substantially higher and so are a majority of coefficients, some of which are actually incorrectly signed in the 1970s.

The evolution of the relationship can be better assessed by adding one observation at a time and plotting the recursively estimated coefficients (Graph 6). In countries where the financial environment changed profoundly in the 1980s (Finland, Norway, Sweden, Australia and the United States) there is a clear tendency for the responsiveness of asset prices to credit to rise during the period. In France this occurs mainly after 1987, the year in which the ceilings on bank credit ("encadrement de crédit") were lifted. In the Netherlands, where structural changes took place earlier, the main shift is in the mid-1970s. By contrast, in the remaining countries there is not much evidence of a clear break, though the relationship is typically estimated more precisely in the later period.[19] In the case of the United Kingdom, the relatively stable sequence of estimates is not inconsistent with the fact that the financial conditions surrounding the two booms were quite similar. More movement could have been anticipated for Japan, however.

In simple bivariate relationships the credit variable may also capture the explanatory power of other factors not explicitly included in the relationship to the extent that credit is correlated with them. A more reliable test should control for the influence of these omitted variables.

The natural benchmark to adopt is the present value formula described at the outset of the section. Accordingly, the real asset price can be written as a general function of the level of real profits[20] (I/P, the proxy for the income from the composite asset), nominal GDP growth (a proxy for its longer-term growth) and a nominal long-term interest rate (RL, the proxy for the discount rate). It is to this benchmark that a credit variable is added in the form of the ratio of total private credit to nominal GDP (TC/Y).[21] A linear trend (T) is also included to limit the risk of spurious correlation.

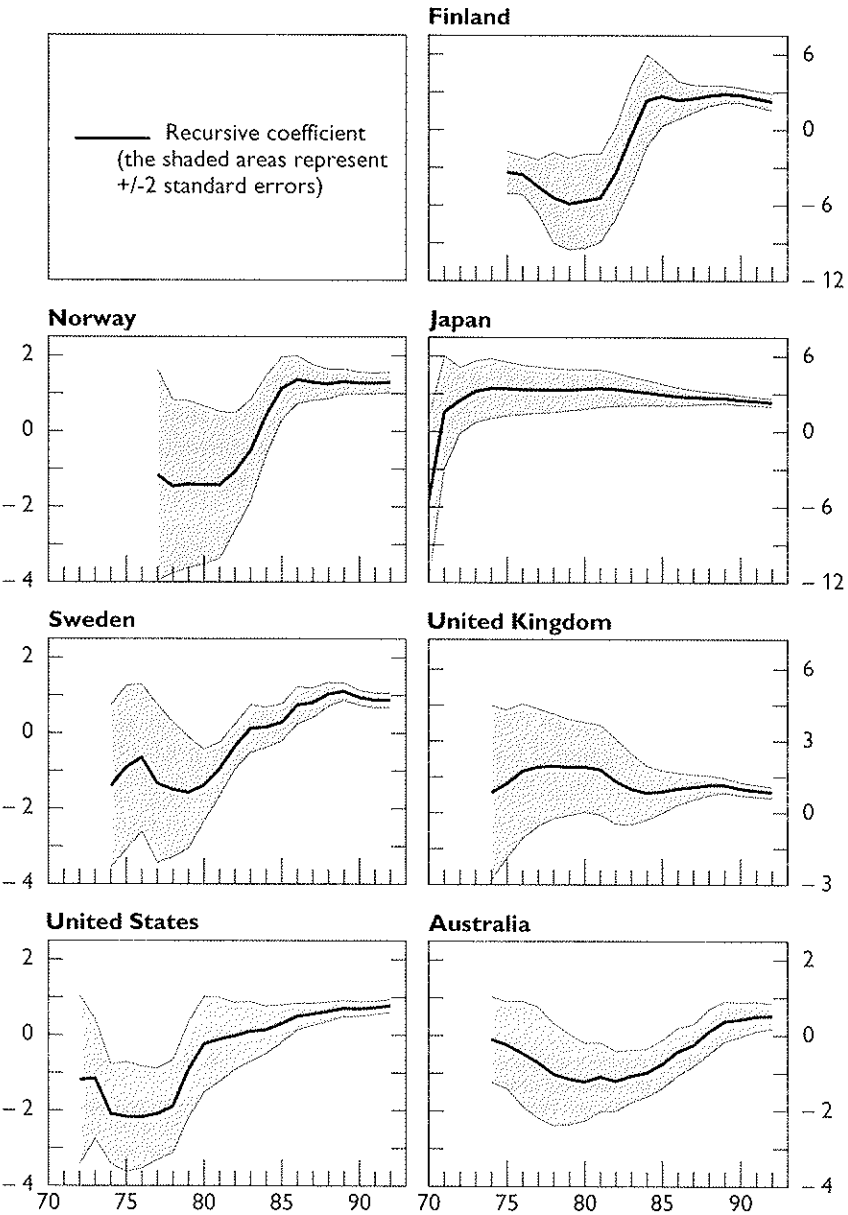
[19] As indicated by separate estimation over the two sub-samples, this finding is not just the result of the inclusion of additional observations (Table 9).

[20] For the Netherlands and Australia, in the absence of a sufficiently long and up-to-date series on business sector output this variable was approximated by the profit share times real GDP using OECD data. Since the ratio of business to total output has remained approximately constant over time or changed little, no significant biases should be introduced by this procedure.

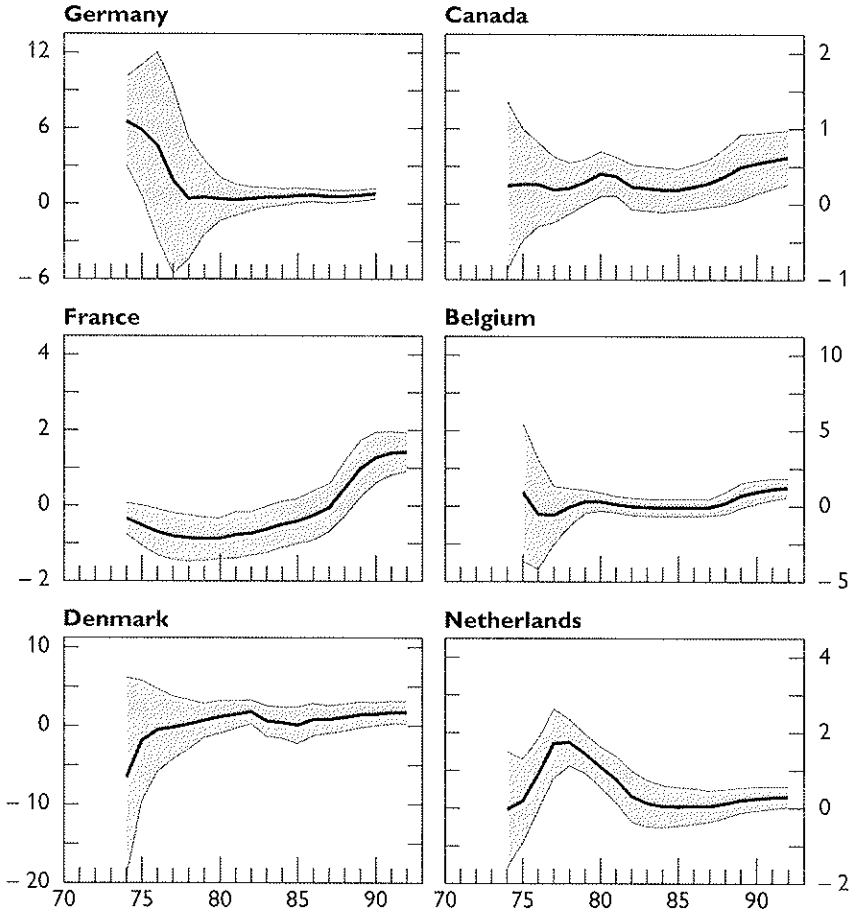
[21] For Denmark, only bank credit was available.

Graph 6

Recursive coefficients of the credit term: bivariate model



Graph 6 (cont.)



Sources: National data and authors' estimates.

The regressions are estimated on annual data. The specification used is a standard "error correction" model, which allows for considerable flexibility in the dynamic interaction of the variables. Up to one lag (i.e. one year) for each variable is included. Each variable is entered in (lagged) levels and (contemporaneous) first difference. The variable to be explained, i.e. the real asset price, is entered in first differences.[22] Because

[22] For Finland, however, the best equation was expressed only in the form of first differences.

Table 10

Credit and asset prices

	TC/Y		Δ(TC/Y)		SEE	$\bar{R}^2$	$\Delta\bar{R}^2$	Estimation period
	Coeffi-cient	t-statistic	Coeffi-cient	t-statistic				
AU .	–	–	–	–	0.05	0.53	–	1971–92
BE..	0.82**	(2.32)	2.17***	(6.48)	0.03	0.84	+0.41	1971–92
CA .	–	–	–	–	0.06	0.43	–	1971–92
DK .	–	–	–	–	0.05	0.86	–	1971–91
FI...	–	–	1.73**	(2.16)	0.10	0.54	+0.10	1973–92
FR..	–	–	1.27*	(2.02)	0.06	0.31	+0.11	1971–92
DE .	1.31***	(3.87)	–	–	0.05	0.53	+0.43	1972–90
JP...	–	–	1.16***	(2.93)	0.06	0.62	+0.14	1966–92
NO.	3.20***	(4.45)	1.04*	(2.12)	0.07	0.65	+0.45	1972–91
SE..	–	–	1.48***	(4.28)	0.06	0.65	+0.12	1971–92
GB .	0.50**	(2.43)	2.00***	(5.56)	0.04	0.87	+0.25	1971–92
US..	0.54***	(3.75)	–	–	0.05	0.35	+0.35	1969–92

Note: Statistics based on the regressions reported in Table AIII.1.

its logarithm is taken, it is the percentage rate of change of the real asset price which is to be explained. The general form of the regression therefore is

$$\Delta\log\left(\frac{AP}{P}\right)_t = \alpha + \Sigma\,\beta_i\,\Delta X_{it} + \Sigma\,\chi_i\,X_{it-1} + \delta\log\left(\frac{AP}{P}\right)_{t-1} + \omega T$$

where i = 1, 2, 3, 4

$X_i = \Delta\log Y,\ RL,\ \log I/P,\ TC/Y$

Two general points are worth noting. Firstly, the above specification uses actual growth rates of GDP as a proxy for the expected future growth of income from the asset[23] and does not model explicitly the risk premium. It is possible that part of any correlation detected between credit and the asset price index may be due to the fact that movements in credit may capture some of the expectational and risk elements not accounted for by the other variables. Secondly, as already discussed, the relationship between asset prices and credit is bi-directional: increases in

[23] Other specifications were tried but they did not improve the explanatory power of this variable.

credit tend to raise asset prices and higher asset prices contribute to the relaxation of credit constraints. Any observed contemporaneous correlation will capture both elements. This is not a serious shortcoming in the present context, however, since the hypothesis examined fully acknowledges the existence of mutually reinforcing effects.[24]

The complete regression results are reported in Appendix III, Table AIII.1.[25] The key findings concerning the relevance of the credit variable are summarised in Table 10. They are broadly consistent with those derived from bivariate relationships. Credit is again statistically significant in all the countries experiencing the largest asset price movements and in those where their behaviour has caused great concern; although it does not appear in the Australian equation, this is only the result of imposing a constant relationship over the whole sample, as will be shown shortly. Only in the case of Canada and Denmark is no statistically significant effect apparent.[26] For the Netherlands, it was not possible to obtain a reasonable equation for the period as a whole without allowing for shifts in the relationship in the mid-1970s (see below).

In order to identify a possible structural break, two types of test were performed. In the first, only the coefficients of the credit variables (level

[24] There are essentially two ways of disentangling the two effects. The first would be to estimate the regressions by some form of instrumental variable technique, which would help to single out the influence of credit on asset prices. The technique, however, entails a significant loss of precision in the estimates ("statistical efficiency"), a very serious problem given the few degrees of freedom of the regressions performed. Alternatively, a full model which endogenised both credit and asset prices could be developed. This, however, falls outside the scope of the present study.

[25] The regressions were estimated by OLS through a single-step procedure. The equations perform fairly well according to the usual econometric standards. The coefficients are correctly signed and generally highly significant and the $\bar{R}^2$s are mostly around 50% or higher. Only two regressions show some (weak) signs of serial correlation in the residuals, indicating that possibly some systematic information is not fully taken into account. The interest rate term is significant in the majority of equations. By contrast, the income growth terms (in levels or first differences) are often insignificant; in some countries the growth of earnings is perhaps better proxied by the first difference in the profit term (e.g. Australia, Belgium and Norway). Cointegration tests were also run for the variables appearing in the long-run solution of the equations, obtained by setting the first difference variables to zero. The Dickey-Fuller tests could not reject the existence of a cointegrating relationship only in the case of Denmark and the United States and (almost) France and Germany. By contrast, if, following Kremers et al. (1992), the significance of the coefficient on the lagged level of the dependent variable was used as a guide, the presence of cointegration could not so easily be rejected. Either way, the restricted number of observations available should caution against applying to the data results derived from asymptotic distribution theory. Moreover, the hypothesis tested does not necessarily imply the existence of a long-run relationship between credit and asset prices.

[26] This result proved to be robust to the inclusion of other variables of potential relevance, notably the inflation rate.

Table 11

Conditional stability of the credit coefficients[1]

	TC/Y				Δ(TC/Y)				Significance level[2]		
	1970s		1980s		1970s		1980s				
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	TC/Y	Δ(TC/Y)	Joint
AU..	1.22*	(1.96)	1.37*	(2.09)	–0.50	(0.69)	1.91	(1.71)	9.8*	5.8*	7.0*
	0.85	(1.55)	1.01	(1.74)	–	–	–	–	8.0*	–	–
BE...	1.13***	(3.15)	1.06***	(3.02)	1.43***	(3.04)	2.70***	(5.44)	13.2	9.2*	13.8
FI ...	–	–	–	–	–1.83	(1.07)	2.42***	(3.13)	–	3.7**	–
FR[3]..	–	–	–	–	0.63	(1.00)	3.36***	(3.24)	–	2.9**	–
DE..	0.67	(1.04)	0.79	(1.43)	–	–	–	–	26.0	–	–
JP ...	–	–	–	–	0.64	(1.35)	2.02***	(3.33)	8.4*	–	–
NL..	–0.36	(2.38)**	0.21**	(2.51)	–	–	–	–	0.02***	–	–
NO .	4.23***	(5.46)	4.22***	(5.59)	1.03	(1.11)	1.21**	(2.84)	96.2	85.8	98.3
SE ..	–	–	–	–	–0.74	(0.78)	1.75***	(5.43)	–	2.4**	–
GB..	0.35	(0.98)	0.48*	(1.81)	1.97**	(2.47)	1.60**	(2.42)	47.8	62.0	74.8
US ..	0.60***	(3.14)	0.59***	(3.41)	–	–	–	–	62.8	–	–

[1] Tested by the inclusion of multiplicative dummies on the credit variables in each of the two sub-periods. [2] Percentage probability of the incorrect rejection of the (null) hypothesis of equality of regression coefficients in the two sub-periods. [3] Dummy for 1988 onwards, representing the lifting of credit ceilings ("encadrement de crédit").

Table 12

Stability of the credit coefficients

	TC/Y				Δ(TC/Y)				$\bar{R}^2$	
	1970s		1980s		1970s		1980s		1970s	1980s
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic		
FI.	–	–	–	–	–2.10	(0.95)	2.14	(2.33)	0.18	0.62
NO	1.36	(0.81)	4.44***	(8.48)	0.24	(0.14)	1.08***	(4.83)	0.51	0.95
SE.	–	–	–	–	–0.40	(0.59)	1.62***	(3.72)	0.30	0.71
US.	0.38	(0.69)	0.85***	(3.28)	–	–	–	–	0.22	0.43

Note: All parameter estimates were allowed to vary over the two sub-samples. Some overlapping observations were allowed so as to increase the degrees of freedom.

and first difference) were permitted to differ between the 1970s and 1980s ("conditional stability" tests, Table 11). In the second, the whole equation was estimated over the two sub-periods, allowing for a few overlapping observations so as to increase the degrees of freedom ("unconditional stability" tests, Table 12).[27] The tables show only the resulting coefficients for credit and, unless of interest, just those associated with the equation where the statistically insignificant terms in credit (level or first difference) over the two sub-periods have been dropped. Table 12 illustrates only the more relevant country cases.

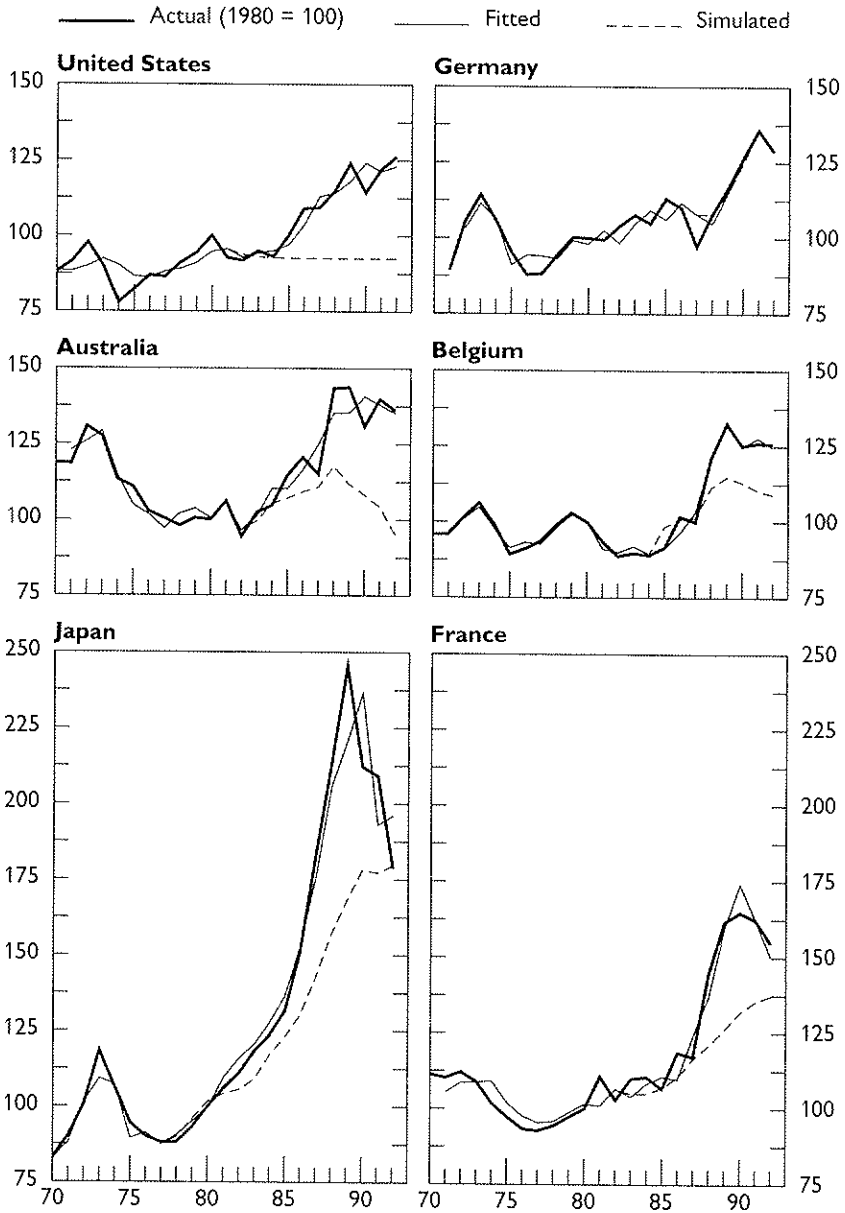
The results of the tests are broadly consistent with prior expectations. The conditional stability tests confirm the evidence of a statistically and economically significant break for most of the relevant countries, including Finland, Sweden, France (after 1987) and the Netherlands (since 1975), the absence of a change in the relationship in the United Kingdom and the failure of credit to have explanatory power in Canada and Denmark (Table 11). They now also reveal a break in Japan and signs of a significant and growing correlation between asset prices and credit in Australia.[28] They indicate that the significance of the credit ratio in Germany does not survive the separate estimation over the two sub-periods. Admittedly, the

[27] In both cases the non-credit variables retained in the regressions were those of the best regressions over the whole sample (Table AIII.1).

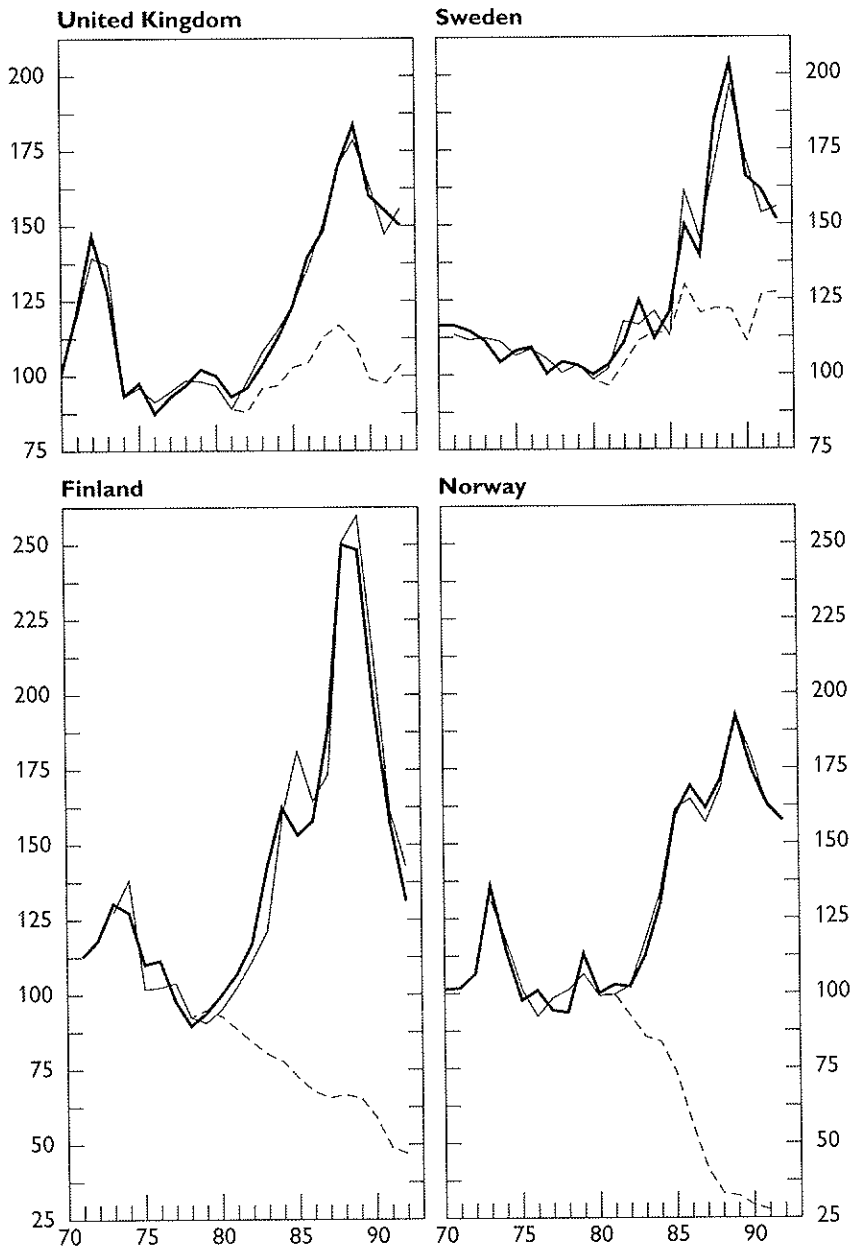
[28] Even if the first difference of the credit ratio is dropped, the level term is virtually significant at the 10% level (p-value equal to 10.2%). This is consistent with the findings of Blundell-Wignall and Bullock (1993).

Graph 7

Asset price simulations: constant credit ratio



Graph 7 (cont.)


United Kingdom
Sweden
Finland
Norway
200
175
150
125
100
75
250
225
50
25
70
75
80
85
90

hypothesis of a stable relationship cannot be rejected for the United States and Norway, but separate estimation of all the parameter estimates of the regression confirms the view that the relationship is stronger and better determined in the past decade, a pattern also evident for Finland and Sweden (Table 12). The country clearly at variance with a priori expectations is Belgium, for which there is evidence of a break, on balance raising the importance of credit.

How high is the explanatory power of credit? A useful way of assessing this is to keep the value of the ratio of credit to GDP constant at the level of the trough in the asset price preceding the 1980s upswing and to simulate the equation on the basis of the coefficient estimates from the 1980s. The estimated value of the asset price calculated using the historical observations of the credit ratio ("fitted") can then be compared with the simulated one, the difference representing the part of the movement accounted for by credit. This is done in Graph 7, which also shows the actual path of the asset price index: a comparison with the fitted value indicates how close the estimated equation tracks the observed fluctuations in the first place.[29] The simulations are dynamic: the simulated value in any given period is used as the basis for prediction in the following period. The effect can then cumulate over time.[30]

In all countries the fitted series tracks the actual path of the aggregate asset price reasonably well, suggesting that the estimated equations are a useful starting-point for the exercise. The explanatory power of credit is especially high in those countries where the asset price booms and/or the heightening of competitive pressures were most pronounced. In the case of Finland and Norway, the adjusted series actually falls, suggesting that other factors have an overall negative influence. In France, the two series diverge in the period following the removal of credit restrictions.[31] The only country for which the results do not conform with a priori expecta-

[29] Alternatively, the difference between the actual and fitted value, i.e. the errors in the original regressions, could have been used to adjust the simulated series. This could have allowed the direct comparison of the actual and simulated series, but at the cost of concealing any potential inadequacy of the fitted series as benchmark.

[30] The precise question asked is: what would the asset price have been had credit remained constant? Of course, to the extent that it is asset prices that drive credit rather than vice versa the question is somewhat misleading. As before, the exercise is best interpreted as capturing the overall impact of the credit/asset price process or as identifying the upper bound to the unilateral impact of credit.

[31] In the United States the simulated series is actually flat because credit was the only variable found to be significant in the regression.

Table 13

Money versus credit[1]

	Credit omitted	Credit and money included[2]	
	Money	Money	Credit
		Significance level[3]	
Australia	77.4	–[4]	
Belgium	0.6***	65.8	0.4***
Canada	81.7	–[4]	
Denmark	38.9	–[4]	
Finland	43.2	99.7	11.1
France	75.1	87.8	10.0*
Germany	94.7	70.5	1.1**
Japan	2.9**	71.8	8.6*
Norway	0.5***[5]	9.2*	7.6*[6]
Sweden	41.2	89.9	0.2***
United Kingdom	7.3*[5]	5.7* (w.s.)	0.4***
United States	52.4	89.6	0.4***

[1] The basic form of the regression includes the variables identified in the best regressions over the whole sample (Table AIII.1). Both the (simultaneous) first difference and (lagged) level of the ratio of broad money to GDP were tried. [2] The basic equation used to calculate the significance levels includes only the significant credit terms. [3] The significance level refers to the joint hypothesis that both terms can be omitted unless only one of them is significant. [4] Not applicable as credit was not statistically significant in the original equation and remained so after the inclusion of money. [5] The significance level relates to the equation that includes the insignificant level term; where the first difference is omitted the level term becomes significant but with the wrong sign. [6] The significance level relates to the equation that includes the insignificant credit term in first difference.

tions is again Belgium, for which the explanatory power of credit is considerable, though indeed generally lower than elsewhere. Even though the coefficient was not statistically significant when the whole period was split, a simulation was carried out for Germany. As the graph shows, the influence of credit is marginal in economic terms.

Finally, the relative explanatory power of credit and money may be tested by adding the ratio of money to GDP (M/Y) to the regressions with and without the credit ratio. In the light of the structural changes that have occurred during the period, it seems reasonable to use broad monetary aggregates. The results on balance suggest that the incremental explanatory power of money is negligible (Table 13). If the credit variables are not included, money is statistically significant in only four countries, viz. Belgium, Japan, Norway and the United Kingdom. Once credit is

included, a statistically significant effect survives only in the United Kingdom and Norway, but the sign is correct only in the latter. By contrast, credit remains significant in virtually all the regressions even if money is added, although sometimes the significance falls primarily because of the loss of degrees of freedom.[32] In Finland, credit becomes only marginally insignificant.

On balance, therefore, the statistical evidence presented here is consistent with the view that the relaxation of credit constraints, mainly in the wake of financial liberalisation, has played a significant role in facilitating the observed ample movements in the aggregate asset price index during the past decade. Both the cross-country and time series patterns of correlations are broadly supportive of this hypothesis.

III. Aggregate asset prices as inputs in the design of monetary policy

The above analysis has considered the determinants of movements in the aggregate asset price index. The separate question which the following section begins to address is the extent to which such an index may be useful as an input in the design of monetary policy.

It has now become more widely accepted that the primary goal of monetary policy should be price stability (Bockelmann and Borio (1990)). Granted, differences of opinion still exist and have recently been encouraged by a more hostile macroeconomic environment. Nonetheless, by and large there is a wider consensus that in the longer term "real" variables such as output and employment are not much affected by monetary factors while inflation is highly responsive to changes in monetary conditions. By contrast, there is less agreement, or at least greater uncertainty, about the time horizon over which the impact of monetary policy on the real economy may be disregarded, about the relationship between policy instruments and goals in the intervening period and about the very measurement of the monetary conditions consistent with price stability in

[32] Similarly, some tests were carried out to assess whether bank or total credit was the more relevant variable. The results suggested that the broader definition was more appropriate.

the longer term.[33] It is in this context that the asset price index is potentially most relevant.

A common tool of policy design is the demand for money, the relationship relating the money stock willingly held at any particular point in time to other economic magnitudes such as prices, output, wealth and the yields on alternative assets. This relationship has the merit of providing a constellation of mutually consistent values of several key variables. Depending on the specific conceptual and information framework in which it is embedded, it can thus serve a variety of useful functions. These range from the identification of the path of variables subject to observational lags (e.g. output) to the assessment of monetary conditions conducive to the achievement of medium-term inflation objectives. Since the aggregate asset price index can be used in measuring wealth and yields on non-monetary assets, its explanatory power in a typical demand for money relationship could be considerable.

Another policy tool consists in statistical exercises aimed more directly at evaluating the information which certain financial variables contain about future movements of economic magnitudes of interest, i.e. at identifying leading indicators. Though hardly sufficient by themselves, if complemented with a dose of good judgement such exercises can help the authorities to form a view about the likely evolution of the economy and to adjust their policy accordingly. Here again the aggregate asset price index may prove useful, since the component asset prices tend to influence, and to reflect expectations about, future economic developments.

Against this background, the following pages begin to examine the properties of the aggregate asset price index as an input in each of the two types of analysis highlighted. The first sub-section assesses the contribution that the index makes to the statistical and economic properties of standard demand for money functions relating the money stock to the general price level, output and interest rates. The second looks into the information content of the index as regards future inflation and output.

[33] Hence the long-standing debate on indicators of policy stance, proximate and intermediate targets and information variables. For a review, see B. Friedman (1990) and, especially, Courakis (1981). For an analysis of the types of statistical test consistent with the various categories of policy input, see Borio (1988a).

Aggregate asset prices and the demand for money

On a priori grounds, there are several reasons why asset prices might be expected to be relevant for the demand for money.[34] Higher aggregate asset prices are typically associated with a higher value of transactions in financial and real assets; higher money balances may be needed to carry out these transactions. More importantly, a rise in asset prices leads to a revaluation of the stock of wealth, which should have a positive influence on the demand for money, especially in the case of broad aggregates. Similarly, in general the demand for money will not be independent of the composition of the rest of the portfolio; the aggregate price index can summarise information about the valuation of a major portion thereof.[35]

In contrast to the impact of the level of asset prices, the rate of change of nominal asset prices, as a proxy for their rate of return, can be expected to have a negative influence on the demand for money. As the yield on alternative assets rises, the quantity of money demanded should fall. In practice, however, it may be difficult to isolate this effect from that of a slow adjustment to changes in wealth, so that the net impact is a priori ambiguous.[36]

Finally, it is possible that any observed correlation between the money stock and asset prices may in fact capture supply-side effects rather than the determinants of the demand for money. Some sectors of the economy tend to increase their borrowing from financial institutions as a direct consequence of the rise in asset prices and such asset price increases are also likely to facilitate lending owing to the higher net worth of potential borrowers. The expansion of the assets side of banks' balance sheet (credit) may then drive that of the liabilities side (the money stock). Since the breadth and depth of these effects is likely to be greater after a heightening of competitive pressures in the financial system, asset prices may act as a proxy for them. If so, however, we would expect the influence of asset prices to be detectable mainly in the 1980s. Thus, evidence of instability in the relationship may be interpreted as being consistent with the presence of a significant supply-side, rather than demand-side, effect.

[34] For a review of the theory of the demand for money that elaborates on some of these points, see e.g. Laidler (1993). For recent, albeit selective, reviews of the empirical literature, see Goldfeld and Sichel (1990) and Boughton (1992).

[35] See Courakis (1988) for an explanation of this effect in the context of a fully specified analysis of portfolio decisions.

[36] This results from perfect multicollinearity owing to underidentification in the absence of a carefully specified model.

While the role of wealth as a determinant of the demand for money has been widely noted in the theoretical literature, empirical attempts to incorporate wealth variables explicitly have been relatively few and have met with mixed results. The comparative dearth of such efforts relates in part to the paucity of comprehensive balance-sheet data, particularly for broader components of wealth, but perhaps also to a perception that wealth may yield only a marginal improvement over an income term.[37]

Wealth effects have been found to be significant in a number of countries, including the United Kingdom and Japan, as explanations of changes in velocity during the 1980s. In the United Kingdom, Grice and Bennett (1984) included a measure of non-bank private sector wealth.[38] The wealth term was expanded by Hall et al. (1990) to cover physical assets, largely housing, of the personal sector. In accounting for the trend decline in income velocity in Japan, Corker (1990) emphasised the role played by the rapid expansion of financial assets of the private, non-financial sectors while the Bank of Japan (1992) also included land prices, in both levels and changes, viewed as capturing wealth effects. Several different asset price variables have also been used in the UK studies: the capital gain on gilts (Grice and Bennett), stock prices (Hall et al.) and residential property prices (King (1992)).[39] However, in contrast to the results for Japan, these were generally found to have a negative sign and treated as an alternative rate of return.[40]

Is there any particular group of countries for which a marked influence of asset prices on the demand for money may be expected? As the relevance of wealth and other portfolio effects on the money stock is beyond

[37] Judd and Scadding (1982), for instance, reviewing the search for a stable money demand function, concluded that, at least for narrow definitions of money "these modifications may improve the performance of M_1 demand equations marginally, but [that] the solution probably does not reside in this area" (p. 1008). After all, distributed lags in income have often been used as approximations to "permanent income", itself thought of as a proxy for wealth.

[38] Grice and Bennett (1984) was the first attempt to incorporate wealth in a conventionally specified money demand function for the United Kingdom; more detailed and complete models of household portfolio behaviour had of course already used financial wealth for quite some time (e.g. Barret et al. (1975)). The estimation by Grice and Bennett was conducted prior to the publication by the Central Statistical Office of comprehensive national and sectoral balance-sheet data.

[39] There exist a number of earlier attempts in the United States, including Meltzer (1963) and Brunner and Meltzer (1964). See also Goldfeld (1976) for a review of that literature which is generally sceptical of the usefulness of wealth. A notable exception, over a more recent sample period, is B. Friedman (1978). M. Friedman (1988) considers the impact of stock prices. This work has generally employed narrow definitions of money.

[40] A comparison between the findings of the UK and Japanese papers, however, is not straightforward, given the significant differences in the variables employed.

doubt on theoretical grounds, there is in principle no reason why certain countries should be singled out. At the same time, in practice it is in those where the movements in asset prices have been largest that a statistically significant influence may be more easily detected.

A casual look at the behaviour of broad monetary aggregates during the past two decades is not obviously inconsistent with the potential relevance of the asset price index (Graph 8). The rate of growth of these aggregates generally outstripped that of nominal income during the 1980s: the ratio of nominal income to the money stock (the "income velocity of money") fell considerably in virtually all countries. For some, however, including Germany and Belgium, the decline was clearly the continuation of a trend dating back to the 1970s, while for others it marked a clear reversal of the experience in the previous decade. And this latter group comprises most of the countries experiencing the largest asset price increases in comparison with the late 1970s, including the United Kingdom, Finland, Norway and Australia. Sweden is a clear exception to this general pattern, as the velocity of money actually rose sharply during the 1980s. This may have reflected the marked shift from domestic to foreign currency denominated deposits by the non-bank public.

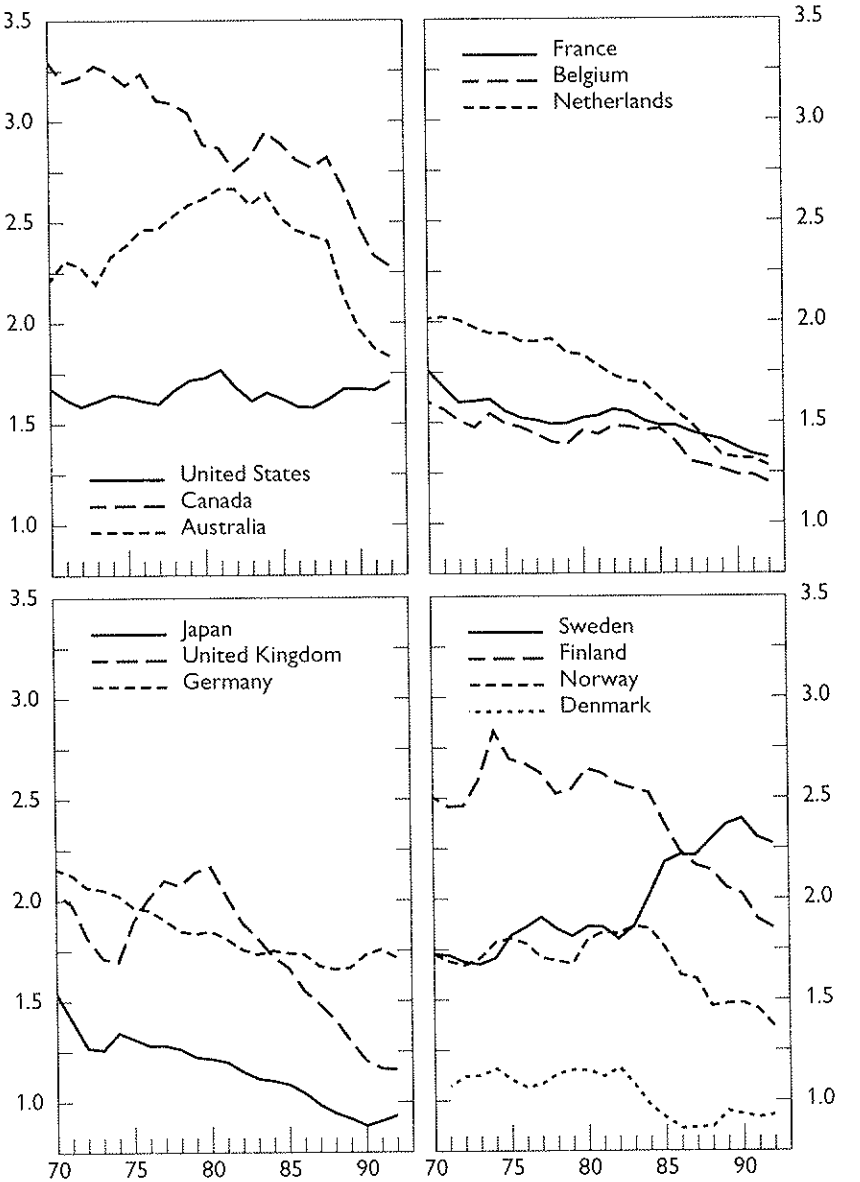
The prima facie case for including aggregate asset prices in the demand for money is supported by an examination of a simple bivariate regression of velocity on real asset prices (Table 14). A negative and statistically significant relationship is apparent in almost all countries. The exceptions are the United States and Germany, where the relationship is not statistically significant, and Sweden, where it is positive. In the case of Sweden this reflects the unique behaviour of velocity in the 1980s. In general, the explanatory power of the asset price variable is quite high. It is highest in Japan and the United Kingdom, where at least 70% of the variance in velocity is accounted for by real asset price movements. For Australia it is well in excess of 50%.

Evaluating the contribution of the asset price index to the demand for money calls for the choice of a benchmark specification. Given the specific objective of the analysis and its cross-country coverage, it seems appropriate to choose a very standard formulation and hence to relate the money stock (M) to the general price level (P), real GDP (Y/P) and some interest rates.[41] Both short-term interest rates (RS) and long-term

[41] In particular, the goal of the study is not to obtain the best possible specification for each country; rather, it is to evaluate the contribution of the aggregate index to standard equations.

Graph 8

Income velocity of broad money



Sources: National data and authors' estimates.

Table 14

Income velocity of money and real asset prices

$$\log\left(\frac{Y}{M}\right)_t = \alpha + \beta \log\left(\frac{AP}{P}\right)_t$$

	AP/P		$\bar{R}^2$	SEE	DW
	Coefficient	t-statistic			
Australia	–1.49***	(6.15)	0.63	0.15	0.82
Belgium	–0.71***	(6.35)	0.64	0.07	0.64
Canada	–1.46***	(4.36)	0.45	0.22	0.57
Denmark	–0.58***	(5.08)	0.54	0.07	1.22
Finland	–0.63***	(3.99)	0.42	0.21	0.48
France	–0.35***	(3.76)	0.37	0.08	0.27
Germany	–0.56**	(2.32)	0.17	0.13	0.22
Japan	–0.50***	(13.31)	0.88	0.07	0.57
Netherlands	–0.79**	(2.31)	0.17	0.23	0.12
Norway	–0.43***	(4.79)	0.50	0.10	0.45
Sweden	1.00***	(7.43)	0.71	0.13	0.78
United Kingdom	–1.19***	(7.37)	0.71	0.18	0.79
United States	0.04	(0.48)	–0.03	0.05	0.75

interest rates (RL) were considered; in some cases the difference between the two could be used as a proxy for the relative yield on money and fixed income assets. It is to this benchmark that the asset price term is added, also deflated by the general price level (GDP deflator). All variables except the interest rates are expressed as logarithms. The econometric equation allows for dynamic effects through the popular error correction formulation, including lagged values of the variables and at least their contemporaneous first differences.[42] The general specification can then be written as

$$\Delta \log M_t = \alpha + \Sigma \beta_i \Delta X_{it} + \Sigma \chi_i X_{it-1} + \delta \log M_{t-1}$$

where $i = 1, 2, 3$

$X_i = \log P, \log Y/P, RS, RL, \log AP/P$

The regressions were estimated on annual data, generally available since 1970.

[42] Where it was found appropriate, lagged first differences and a linear trend were also included.

Table 15

Real asset prices and the demand for money

	AP/P			Δ(AP/P)		SEE	$\bar{R}^2$	$\Delta\bar{R}^2$	Estimation period
	Coefficient	t-statistic	Long run	Coefficient	t-statistic				
AU..	0.50***	(6.08)	0.71	–	–	0.02	0.71	+0.52	1971–92
CA..	0.14***	(4.29)	0.44	–	–	0.01	0.86	+0.16	1971–92
FI ...	0.10***	(6.09)	0.24	–	–	0.01	0.91	+0.22	1972–92
JP ...	0.19***	(8.35)	0.29	–	–	0.01	0.96	+0.14	1969–92
NO .	0.05**	(3.20)	0.06	0.04	(1.77)	0.01	0.95	+0.04	1976–92
GB..	0.19***	(5.63)	0.68	–	–	0.02	0.74	+0.68	1971–92

Note: Statistics based on the regressions reported in Table AIII.2.

The "best" results that could be obtained through a search procedure narrowing down the general specification are reported in Appendix III, Table AIII.2.[43] For present purposes, however, Table 15, summarising the information which relates to the asset price term, is more useful. It shows that a statistically significant relationship between money and asset prices survives in as many as six of the eleven countries identified in the bivariate regressions: Australia, Canada, Finland, Japan, Norway and the United Kingdom.[44] In all of them the level of asset prices is significant, pointing to the existence of a long-run relationship. In addition, the rate of change has a detectable influence in Norway; the positive sign of this coefficient suggests that scale effects dominate.

Judged from the size of the coefficients, which captures the percentage point change in the dependent variable associated with a percentage point change in the real asset term ("elasticity"), the responsiveness of the money stock is highest in Australia and the United Kingdom and lowest in Norway.[45] The change in the explanatory power of the regression that results from dropping the asset price terms (the "marginal" $\bar{R}^2$) conveys a similar message.

[43] The regressions were estimated by OLS through a single-step procedure.

[44] Some, though less robust, evidence of a significant relationship was also found for the Netherlands and France.

[45] The considerable cross-country variation in the value of the long-run elasticity may partly depend on the fact that the asset price term captures a combination of wealth and portfolio composition effects. While the wealth effect is expected to be positive, the portfolio composition effect may be either positive or negative. This depends on whether the assets are complements or substitutes, which in turn is a function of the perceived variances and covariances of the returns on money and the composite asset.

The importance of the asset price terms over a specific time period is perhaps best evaluated by purging the path of the money stock of the movement accounted for by the actual variation in the index. As in Section II, this was done by simulating dynamically the preferred equations, fixing the level of the real asset price index at its value at the beginning of the estimation period. The resulting estimates for the velocity of money were then compared with the path of fitted and actual velocity; since the equations tracked the historical movements in velocity quite well, however, the actual and fitted values were very close (Graph 9).

With the exception of Norway, where the difference is marginal, the behaviour of adjusted velocity is considerably smoother than either the estimated or original series. Moreover, in sharp contrast to the other two series, in three countries adjusted velocity is basically flat for much of the period, viz. in Australia (1970–90), Japan (since the late 1970s) and the United Kingdom (in the second half of the 1980s). Asset prices thus appear to explain much of the observed decline in the last decade.

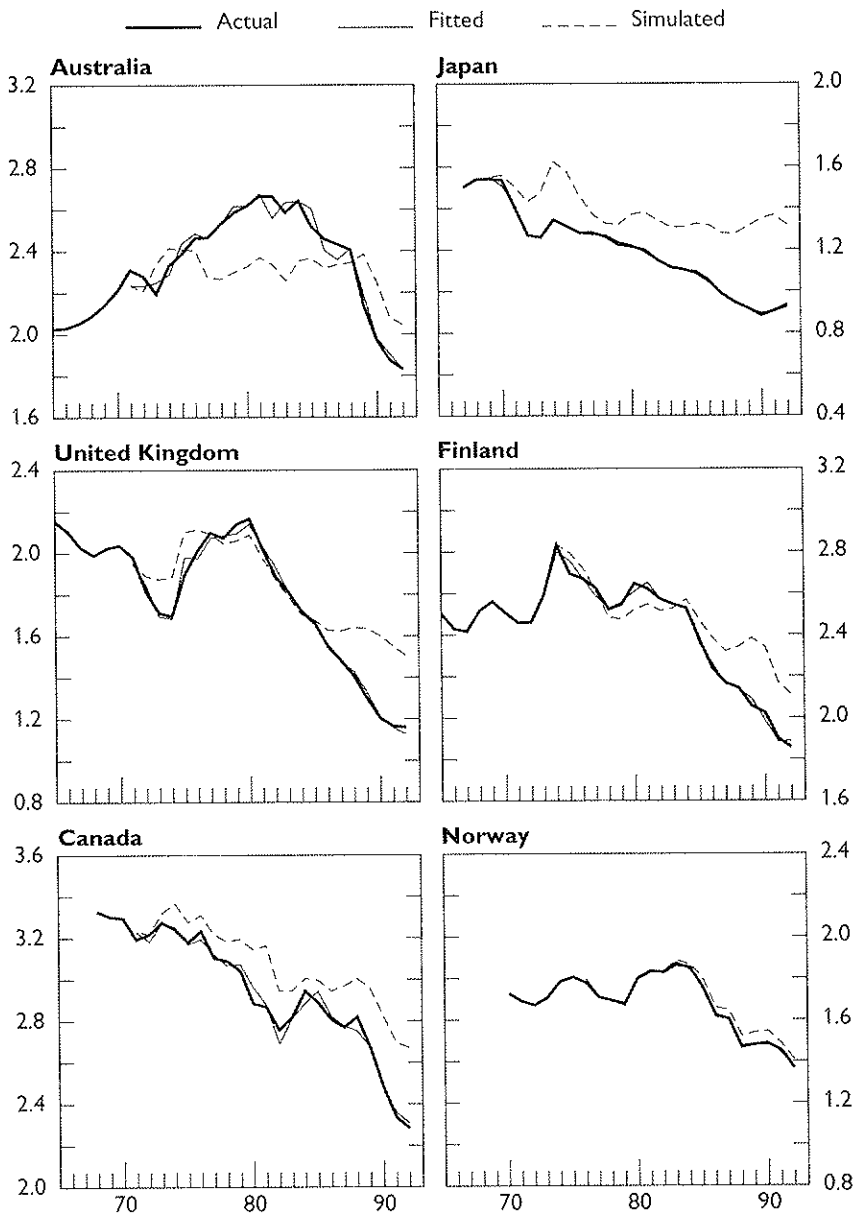
Do they also help to improve the economic properties of the money demand relationship? On theoretical grounds, the demand for money should be expected to exhibit a unit elasticity with respect to the general price level, at least in the long run (e.g. M. Friedman (1956)). Similarly, its elasticity with respect to real income should not exceed unity, unless income is itself used as a proxy for wealth.[46] In empirical work, however, unit price elasticities are often imposed rather than tested and a common but disconcerting finding is real income elasticities well in excess of unity.[47] Does the inclusion of the real asset price term make a difference in this regard?

[46] Models of the demand for money focusing on the transactions and/or precautionary motive generally produce elasticities below one and never higher (see e.g. Baumol (1952), Orr (1970), Miller and Orr (1966) and Akerlof and Milbourne (1980)). Models that view money as one asset in a portfolio stress wealth as a determinant of the demand for money. The implied wealth elasticities range between zero and in excess of unity, depending in particular on the risk preferences of agents (Courakis (1988) and (1989)). The elasticity exceeds unity, for instance, when increasing absolute risk aversion is assumed in a model where money is the safe (riskless) asset. M. Friedman's (1959) classic finding of an elasticity of around 1.8 (money being a "luxury good") was obtained in a model where (permanent) income was viewed as proxying wealth. See also Courakis (1984).

[47] See, for instance, Boughton (1992) and Monticelli and Strauss-Kahn (1992), who summarise part of the recent empirical evidence. Fase and Winder (1992) generally find that in EC countries unit elasticities are accepted with respect to income but not to the price level, in which case they are often lower.

Graph 9

Income velocity of money simulations: constant asset prices



The answer appears to be yes. Table 16 compares the price and income elasticities of the regressions that include the asset price index with the best regressions that could be obtained excluding it (the "basic" model, fully reported for completeness in Appendix III, Table AIII.3). In the "basic" model, a unit elasticity with respect to prices is rejected in the case of Japan and Finland, where it is considerably below unity, and Australia, where it is negative but statistically insignificant.[48] The income elasticities are well above unity in five of the six countries considered. In the United Kingdom the restrictions are jointly accepted but individually rejected. Only in Norway are both constraints accepted. By contrast, once asset prices are included, unit elasticities with respect to both income and prices are accepted in all cases and, except for Norway, much more comfortably ("extended model").[49,50]

Are the preferred equations stable? Tests for in-sample constancy of the whole relationship did not detect instability when the sample was split between the 1970s and 1980s or towards the end of the period (Table AIII.2). The behaviour of the real asset price term, conditional on the

[48] The pattern is mixed for the seven countries where the asset price term was not found significant (Table AIII.2). A unit price elasticity was rejected only in two cases (Denmark and the Netherlands) and a unit income elasticity in three (Belgium, the Netherlands and the United States). In two of these three cases (Belgium and the Netherlands) it exceeded unity; the result for Belgium is consistent with Jeanfils (1992). For the United States, it was less than one, though a unit elasticity has sometimes been accepted in recent work, albeit over somewhat different samples (see e.g. Hafer and Jansen (1991), Bordo and Jonung (1992) and Boughton and Tavlas (1991) and the estimates by Miller (1991)). The only countries for which unit elasticities were accepted for both prices and income were Germany, France and Sweden; in Sweden, however, this was conditional on the inclusion of a linear trend. The finding for Germany is consistent with Gerlach (1993).

[49] The studies previously cited that include wealth variables generally find income elasticities below unity, which is also consistent with theory. Unit price elasticities are typically imposed rather than tested.

[50] A few words about the other properties of the equations are relevant. A significant influence of the interest rate cannot be detected in either Canada or the United Kingdom; the result for the United Kingdom is consistent with the findings by Hall et al. (1990). As judged by the coefficient on the lagged money stock (equivalent to that on the lagged error correction term) the speeds of adjustment are rather low in some cases, such as the United Kingdom and Canada. Even though not very appealing conceptually, slow adjustment is not an uncommon finding. More importantly, the adjustment is invariably faster in the model that includes the asset price term, in some cases substantially so (e.g. Australia and Japan; see Tables AIII.2 and AIII.3). In the specific case of the United Kingdom, in particular, constraining both income and price elasticities to unity in the model without asset prices results in an extremely low adjustment speed. The only equation that actually passes the Dickey-Fuller or augmented Dickey-Fuller test for cointegration is Japan; no doubt the few degrees of freedom in the data make it difficult to pass these asymptotic tests. The inclusion of the asset price term, however, tends to improve the cointegration properties of the selected regressions in most countries, even in some for which it was not found to be statistically significant.

Table 16

Some long-run properties of alternative money demand equations[1]

	Basic model							Extended model[2]					
	Coefficients		Test of constraints[3]			$\bar{R}^2$	SEE	Test of constraints[3]			$\bar{R}^2$	SEE	DW
	Prices	Income	Prices	Income	Joint			Prices	Income	Joint			
AU ...	−0.07	4.56***	0.8***	0.4***	0.2***	0.57	0.03	97.0	77.8	21.0	0.71	0.02	2.21
CA ...	1.00[4]	1.33***	13.9	5.8*	2.2**	0.85	0.01	21.8	21.7	45.2	0.87	0.01	2.02
FI	0.64***	2.23***	0.5***	0.3***	1.2**	0.82	0.02	51.0	63.7	60.4	0.91	0.01	2.54
JA	0.65**	1.62***	0.2***	1.9**	0.7***	0.92	0.01	37.4	87.1	44.7	0.96	0.01	2.11
NO ...	1.00[4]	1.00[4]	97.5	80.6	47.1	0.92	0.01	23.2	13.5	24.7	0.95	0.01	2.03
GB ...	0.67**	3.11**	6.8*	7.0*	17.5	0.59	0.02	80.5	79.7	96.7	0.74	0.02	1.99

[1] See Tables AIII.2 and AIII.3 for the complete basic and extended models respectively. [2] In each case long-run price and income elasticities were constrained to be equal to unity. [3] Percentage probability of incorrect rejection of the (null) hypothesis of unit coefficients. [4] In each case the unconstrained coefficients are statistically significant at the 1% level, with the exception of Canada, where the price term is correctly signed but statistically insignificant.

constancy of the rest of the relationship, is considered in more detail in Table 17.[51] The evidence supports the hypothesis that the coefficient estimates are stable: the formal tests are comfortably passed and the size of the level coefficients, which determine the long-run elasticities, are generally very similar in the two periods.[52] In Norway they are better determined in the second.

The evidence of stability in the relationship is all the more telling given the major structural changes in the financial system that occurred during the 1980s. It also suggests that the effect captured in the equations is not likely to be the supply-side impact of credit expansion. For if it were, then the coefficient estimates would probably have been unstable in the 1980s in most of the countries considered. Rather, the results are more consistent with the standard and theoretically better grounded wealth and portfolio composition effects.

On balance, therefore, the evidence of the analysis indicates that the aggregate asset price index may indeed represent a useful addition to the variables considered in the context of the demand for money. For several countries in the sample it improves not only the statistical but also the economic properties of the relationship.

The information content of asset prices

There are in principle good reasons to expect asset prices to contain useful information about the future course of inflation and output. As mentioned in Section II, they help to influence economic activity not only through wealth and yield effects, but also by interacting with credit constraints. Above all, asset prices are "forward-looking", in the sense that they reflect expectations about future income streams. And in comparison with other prices such as the general price index or wages, they respond quickly to changes in economic conditions because of the nature of the markets where they are determined. Share prices, for example, react immediately to new information potentially relevant for their yield. Because of the relatively higher transactions costs, real estate

[51] Multiplicative dummies were used following a procedure analogous to that employed in Section II for the relationship between credit and asset prices.

[52] Allowing for a differential impact of the first difference term even in those countries where it was insignificant over the whole sample produced broadly similar results, except for some weak signs of greater significance in the 1980s for Australia and Canada.

Table 17

Conditional stability of the real asset price coefficients[1]

	AP/P				Δ(AP/P)				Significance level[2]		
	1970s		1980s		1970s		1980s				
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	AP/P	Δ(AP/P)	Joint
Australia	0.43***	(3.71)	0.54***	(5.70)	–	–	–	–	38.3	–	–
Canada	0.12*	(1.86)	0.14***	(4.18)	–	–	–	–	77.5	–	–
Finland	0.10**	(2.70)	0.10***	(4.72)	–	–	–	–	94.7	–	–
Japan	0.16**	(2.79)	0.19***	(8.13)	–	–	–	–	56.9	–	–
Norway	0.02	(0.23)	0.04**	(2.39)	0.01	(0.13)	0.05	(1.56)	75.0	47.5	75.6
United Kingdom	0.18***	(4.63)	0.20***	(4.41)	–	–	–	–	68.4	–	–

[1] Tested by the inclusion of multiplicative dummies in each of the two sub-periods. [2] Percentage probability of incorrect rejection of the (null) hypothesis of the equality of regression coefficients in the two sub-periods.

prices are not as responsive, but their adjustment is also comparatively fast.[53]

In order to investigate the information properties of the asset price index, two types of statistical exercise appear useful. Both of them test whether the index helps to predict future movements in the variable of interest after controlling for other relevant information available at the time the forecasts are made. In the first case, the relevant information is assumed to be the past history of the variable of interest itself and, perhaps, that of a few others ("Granger-causality" tests). Such simple statistical representations of the data are typically found to have good forecasting properties and are the most common test employed in the literature. In the second case the set of information is represented by the forecast made by a well-known international institution, which combines the use of a large-scale econometric model with judgemental modifications. Forecasts of this kind are particularly influential and generally bear a relatively close resemblance to those made by national bodies.

Asset prices and inflation

Little attention has been paid to the signalling properties of either of the main components of the aggregate price index with respect to inflation.[54] This probably reflects the view that on a priori grounds the relationship between these variables is ambiguous. In theory, whether the (expected) inflation rate is positively or negatively associated with (nominal) asset prices depends on the correlation between inflation and the income from the asset. At a macro level, this means essentially the correlation between inflation, real output and interest rates. In turn, this depends crucially on the environment accompanying inflation. If, for instance, the inflation observed over a particular period is primarily the result of an expansionary monetary policy, then output growth will tend to be rapid and interest rates low, at least at the short end of the maturity spectrum. Asset prices would then be more likely to predict inflation. By contrast, if inflation was mainly connected with negative shocks to the

[53] The extent to which asset prices can be good leading indicators depends also in part on whether the expectations on which they are based accurately reflect economic fundamentals. There has recently been growing scepticism as to whether asset prices are "informationally efficient" in this sense. For recent reviews of the literature, see Le Roy (1989) and Kupiec (1993). Borio (1988b) also includes a theoretical critique. Kennedy and Andersen (1994) do some simple tests for housing prices with equally sceptical conclusions.

[54] One recent exception is Bank of England Quarterly Bulletin (1993).

productive potential of the economy (e.g. aggressive wage demands or an oil shock) or with fiscal expansion not accommodated by monetary policy, over that particular time horizon the predictive power of asset prices could be poor.

Such general arguments apply to both equity and real estate prices. On empirical grounds, however, real estate prices, the main component of the index, have typically proved to be a better hedge against inflation.[55] Moreover, the aggregate index is probably a superior proxy for wealth effects on aggregate expenditure than either of its components. And similar ambiguities about the strength of the relationship have not deterred the serious consideration of the predictive power of commodity prices by both policy-makers and academics in the recent past.[56]

Table 18 contains the results of time series tests of the predictive content of the aggregate asset price index with respect to inflation where only information about these two variables is taken into account (see Appendix II for details). Two sub-periods are also considered separately in those cases where statistically significant evidence of a break in the relationship was found (through a standard Chow test). The two sub-periods are labelled 1970s and 1980s for convenience since the break was typically around the end of the earlier decade. Unfortunately, because of data limitations, only annual data could be used.

On balance the results are mixed. They indicate that asset price movements have contained additional information about the future path of inflation in most countries, but not in all sample periods. In Australia[57] a significant relationship emerges only in the 1970s; in the United Kingdom only in the 1980s. In Canada, Denmark, Finland, Japan and the United States their predictive power survives for the whole period, but appears to derive mainly from either the 1970s or the 1980s.[58] Only in Norway is there evidence of a clear and stable relationship. Where the link is statistically significant, it is invariably positive: faster changes in nominal asset prices herald a future rise in the inflation rate.

[55] On the relationship between equity prices and inflation, see Modigliani and Cohn (1979), Gultekin (1983), Solnik (1983) and DeFina (1991). On the relative hedging properties of equities and real estate, see in particular Sirmans and Sirmans (1987). On housing prices, see Kennedy and Andersen (1994) and references therein.

[56] See, for instance, Angell (1991), Boughton et al. (1989) and Von zur Muehlen (1990).

[57] Using a similar methodology but on quarterly data, Blundell-Wignall et al. (1992) find no evidence of information content over the whole period (1970s-80s) and signs of a structural break in the 1980s. This is broadly consistent with the above results.

[58] For Denmark and Finland, the significance of asset prices over the whole period derives only from the inclusion of the lagged cointegration residual in the regression.

Table 18

Asset prices and inflation: bivariate time series tests

	Significance level[1]			Break?
	Whole period	1970s	1980s	
Australia	15.8	5.1*	45.4	1980
Belgium	16.1	19.1	26.9	1977
Canada	1.9**	10.6	8.1*	1976
Denmark[2]	24.0/0.9***	7.8*	70.4	1978
Finland[2]	11.1/0.1***	8.3*	58.4	1980
France	89.8	–	–	no
Germany	44.6	–	–	no
Japan	6.4*	8.4*	16.9	1976
Netherlands	69.0	–	–	no
Norway[2]	1.0***/1.1**	–	–	no
Sweden	20.6	–	–	no
United Kingdom	28.8	20.9	4.8**	1979
United States[2]	0.7***/0.03***	0.6***	33.7	1979

[1] Percentage probability (p-value) of the incorrect rejection of the hypothesis that asset prices have no information content. Values in excess of x% indicate that the variable is not statistically significant at the x% level. [2] Test regression includes lagged residual from cointegrating regression in Table AII.2. The significance level of that residual is shown after the slash.

The same methodology was then extended to consideration of a model that also included money, real output and interest rates (Table 19). The results are broadly similar, in that there is considerable overlap in the groups of countries for which a significant and invariably positive relationship can be found. Now, however, the information content of asset prices does not survive in Australia, the United Kingdom and Japan and emerges in Sweden.[59]

One drawback of the above results is that the methodology is quite sensitive to the lag structures chosen, the inclusion of information about long-term relationships between variables and other technical aspects of the tests. The plethora of findings on the relationship between money and income, for instance, is a vivid reminder of the limitations of this approach (e.g. Feldstein and Stock (1993)). Nor is it clear what the power of the tests is when few, albeit annual, observations are available.

[59] Only significant terms for the controlling variables were retained in the equations. As a result, for Denmark, France and Norway the bivariate representations were still valid.

Table 19

Asset prices and inflation: multivariate time series tests[1]

	Significance level[2]			Break?
	Whole period	1970s	1980s	
Australia	49.4	17.7	54.3	1980
Belgium	39.8	14.1	70.0	1977
Canada	2.0**	21.5	2.1**	1980
Denmark[3]	24.0/0.9***	7.8*	70.4	1978
Finland	97.8	0.7***	65.2	1980
France[3]	89.8	–	–	no
Germany	77.9	–	–	no
Japan	58.6	92.8	67.8	1979
Netherlands	70.2	–	–	no
Norway[3]	1.0***/1.1**	–	–	no
Sweden	4.5**	–	–	no
United Kingdom	62.7	67.5	24.4	1980
United States	6.5*	–	–	no

[1] Marginal contribution made by the change in the log of the nominal asset price index lagged one period to the best fit regression of the change in consumer price inflation on lagged changes in money growth, output and interest rates. Only significant terms were retained. [2] Percentage probability (p-value) of the incorrect rejection of the hypothesis that asset prices have no information content. Values in excess of x% indicate that the variable is not statistically significant at the x% level. [3] No multivariate representation: the results reported are those of the bivariate tests.

A complementary test consists in checking whether the inflation forecast errors (FE) of professionals can be partly explained by the asset price index. For simplicity, the tests here were limited to consideration of the forecasts of a well-known international organisation (OECD) and to some of the countries experiencing the most prominent asset price movements, viz. Australia, Finland, Japan, Norway, Sweden and the United Kingdom. For all of them the previous time series tests had detected evidence of a predictive content of asset prices in at least one sample period.

As before, only annual observations were used. The percentage (or percentage point) errors in the one-year-ahead inflation forecasts were regressed on the percentage change in the nominal asset price index in the previous year.[60] Dummies were added to some of the equations to

[60] The forecasts were those published in the various OECD Economic Outlook issues and went back to 1971. They were then compared with the actual series contained in the BIS data base.

Table 20

Asset prices and inflation: analysis of forecast errors[1]

$FE_t = \alpha + \beta \Delta \log AP_{t-1}$

	Coefficient	t-statistic	$\Delta\bar{R}^2$
Australia[2,3]	10.2	(1.7)	0.06
Finland[2]	1.1**	(2.2)	0.19
Japan[2,3]	1.8	(0.3)	–0.02
Norway[4]	2.7**	(2.7)	0.02
Sweden[2,5]	1.0**	(2.4)	0.25
United Kingdom[2]	1.0**	(2.1)[6]	0.34

[1] Regression of the percentage point error in the OECD one-year-ahead forecast of the GDP deflator (actual minus forecast) divided by the forecast of the change in the log of the nominal asset price index lagged one period. [2] Regression includes dummy for oil shock in the early 1970s. [3] The forecast error is not divided by the forecast level because the level is at times zero or negative. [4] Regression includes dummy for 1986 and 1989, two large outliers. [5] Second lag also significant at 5% level. [6] Second lag.

account for the large forecasting errors that occurred around the time of the first oil shock.[61]

The results reinforce the view that the aggregate asset price index may indeed contain useful information (Table 20). The coefficient was statistically significant in all cases except Australia, where it was almost so, and Japan. Invariably, the coefficient on the asset price was positive: above-average increases in the index were associated with underprediction of the inflation rate.

Asset prices and output

The predictive content of asset prices with respect to real output has received rather more attention. In particular, the information value of equity prices has long been recognised.[62] Share prices are a component of statistical leading indicators of economic activity in several countries. On a priori grounds, real estate prices should also be relevant. However, data limitations have militated against their active use.

[61] In addition, for Norway there were large forecast errors in two years in the 1980s for reasons that appear to involve large ex post revisions to the data. These were also dummied out.

[62] For evidence on US data, see e.g. Fama (1981) and Fischer and Merton (1984). Stock and Watson (1989a), however, argue that their additional explanatory power is limited in the context of their preferred leading indicator.

Table 21

Asset prices and real GDP: bivariate time series tests

	Significance level[1]			Break?
	Whole period	1970s	1980s	
Australia	1.2**	–	–	no
Belgium	11.0	3.2**	6.1*	1977
Canada	18.4	–	–	no
Denmark	0.6***	0.3***	13.3	1982
Finland	5.1**	46.9	0.2***	1981
France	38.3	1.3**	48.3	1979
Germany	75.6	–	–	no
Japan	58.0	9.9* (w.s.)	42.6	1974
Netherlands	0.1***	15.1	2.3**	1977
Norway	75.1	77.9	61.2	1981
Sweden	22.9	–	–	no
United Kingdom	0.3***	–	–	no
United States[2]	0.4***/50.8	–	–	no

[1] Percentage probability (p-value) of the incorrect rejection of the hypothesis that asset prices have no information content. Values in excess of x% indicate that the variable is not statistically significant at the x% level. [2] Test regression includes lagged residual from cointegrating regression in Table All.3. The significant level of that residual is shown after the slash.

The procedure followed to test for the predictive power of asset prices in the bivariate representations of output growth is analogous to that employed for the inflation rate.[63] The main difference is that real, as opposed to nominal, asset prices are used as predictors.

The results confirm the existence of a statistically significant relationship in most countries, though not necessarily in all periods (Table 21). Among the countries experiencing the most prominent asset price movements, there is clear evidence that asset prices have information content in the United Kingdom, Finland and Australia. Norway, Sweden and Japan, however, did not belong to this group. Consistently with theory, the significant relationships detected were always positive, with faster changes in the real asset price index heralding higher output growth.

The predictive power of the asset price index appears more general when judged from an examination of the OECD forecast errors regarding output growth (Table 22). In four of six countries on which the test was

[63] See Appendix II for details.

Table 22

Asset prices and real output: analysis of forecast errors[1]

$$FE_t = \alpha + \beta \Delta \log \left(\frac{AP}{P}\right)_{t-1}$$

	Coefficient	t-statistic	$\Delta\bar{R}^2$
Australia	6.6	(1.3)	0.02
Finland[2]	8.2*	(2.1)	0.15
Japan[3]	1.2*	(1.7)[4]	0.07
Norway[2]	3.5	(0.8)	0.01
Sweden[2]	4.8*	(1.8)	0.10
United Kingdom[2]	9.4***	(3.2)	0.32

[1] Regression of the percentage point error in the OECD one-year-ahead forecast of real GDP growth (actual minus forecast) divided by the change in the log of the real asset price index lagged one period. [2] The forecast error is not divided by the forecast level because the level is at times zero or negative. [3] Regression includes dummy for oil shock in the early 1970s. [4] Second lag.

performed, there is evidence of a statistically significant, always positive effect. Now some information content can also be detected in Japan and Sweden, but none in Australia. Confirming the findings of the time series analysis, the explanatory power is highest in the United Kingdom.

In sum, the statistical evidence indicates that the aggregate asset price index does contain information about future movements in inflation and output. The strength and regularity of the relationship, however, are open to question. The evidence is encouraging if interpreted as highlighting a comparatively neglected field where careful further work could prove useful. It is a healthy reminder, though, that while it may be unwise to neglect the information contained in asset prices, it is also very difficult to read it correctly. Hard and fast rules are clearly inappropriate;[64] considerable judgement is called for.

[64] Such a rule appears to have been recently advocated by Goodhart (1993), who argues that it would be conceptually appropriate to redefine the inflation price index on which central banks focus to include asset prices. See also the original idea developed by Alchian and Klein (1973).

Conclusion

This study has argued that a distinguishing feature of the pronounced medium-term asset price fluctuations observed since the early 1980s has been the role of credit. The major expansion of credit in the wake of a substantial heightening of competitive pressures in the financial industry appears to have been a significant factor in facilitating and sustaining the upswing. It may also have exacerbated the downswing. In comparison with the experience of the early 1970s, the contribution of easy monetary policy, as judged by traditional standards, has been generally smaller.

This conclusion is supported by a broad range of evidence. In comparison with the episode of large asset price swings in the 1970s, for several countries it is not easy to explain the aggregate asset price increases of the 1980s exclusively on the basis of traditional benchmarks for assessing asset values, notably output growth, income to capital (including real estate) and the level of inflation-adjusted interest rates. This appears to be true at least for those countries experiencing the largest asset price swings (Finland, Sweden, Norway, the United Kingdom and Japan) and for those where such swings have caused considerable concern (Australia and the United States). The behaviour of credit appears to contribute significantly to completing the explanation, as confirmed by multivariate regressions where the impact of other factors is controlled for.

The relaxation of credit constraints has reflected in part the operation of market forces and, in some countries, a relatively accommodating monetary policy. But a major force has been the deregulatory process that gathered momentum in the last decade, most notably in the Nordic countries, Australia and the United Kingdom. The ensuing difficulties of adjustment faced by market participants and policy-makers tended to exacerbate the natural mutually reinforcing process between greater credit availability and higher asset prices.

To the extent that the especially large asset price fluctuations of the 1980s reflected the costs of adjustment to a liberalised, much more competitive financial environment, they are not likely to recur. While the picture is not uniform across countries, much of the deregulatory process has run its course. At the same time, advances in the elaboration and dissemination of information are bound to continue. And a liberalised financial environment is also one in which credit demands can be more easily accommodated. By the same token, so can speculative pressures. Therefore, the likelihood of further credit/asset price spirals should not be underestimated. It is thus especially important for central banks to learn how to take asset prices into account when setting policy. As ultimate guarantors of the integrity of the financial system, it is equally important for them to understand how to limit the risk of large, unsustainable asset price movements that may lead to financial distress. Recent experience in several countries has been a painful reminder of their disruptive potential.

Historically, the best safeguard against instability in asset prices has been a firm long-term commitment to fighting inflation. Easy monetary conditions can provide fertile ground for both financial excesses in asset markets and general inflation in the markets for goods and services. They also typically set the stage for higher and more volatile interest rates, an important source of instability.[65] The recent experience of the Nordic countries that have faced a banking crisis is a good case in point. So are the crises in the US thrift industry and in lending to highly indebted developing countries in the early 1980s, both triggered by a sharp increase in the level and volatility of interest rates connected with anti-inflation efforts. The same could also be said of the difficulties encountered by financial institutions in several countries following the asset price boom in the early 1970s, most notably in the United Kingdom.

At the same time, recent experience has indicated that a firm anti-inflation policy may not be sufficient. Not all disruptive booms have their root cause in monetary policy. And those activities driven by expectations of large capital gains, where the gap between anticipated returns and the cost of finance is largest, are likely to be relatively less responsive to a tightening in overall monetary conditions.

[65] For a cogent exposition of this view, see Schwartz (1988).

The difference in the responsiveness of asset prices and the inflation rate to credit conditions can pose a serious dilemma for the monetary authorities. The tightening consistent with stability in the asset markets may risk excessive deflation in the product markets and hence in the real economy. Dilemmas such as these were faced by the monetary authorities of many of the countries experiencing the sharpest asset price increases in the 1980s. This was most obvious in Japan, where evident signs of speculative excesses coexisted with low inflation.

Admittedly, a particularly vigilant and enlightened monetary authority may in principle be able to mitigate such a risk by quickly adjusting the monetary policy stance so as to nip speculative excesses in the bud. With hindsight, it may appear deceptively easy to recognise such excesses. It is, however, extraordinarily difficult to do so as they develop, especially in their early stages. Considerable judgement is called for. Even then, their identification may typically come too late to prevent tension between different policy goals.

The conflict between policy objectives can be alleviated by appropriate action at the micro level. One possibility is to alter those tax provisions that tend to encourage indebtedness. Another, more fundamental one, is to strengthen prudential regulation and supervision. Looking back at the events of the past decade one lesson in particular stands out: prudential safeguards should be considerably strengthened in a deregulated, more competitive environment so as to limit the risk of the emergence of financial distress.[66] The banking crises in some of the Nordic countries and, earlier, in the US thrift sector are clear illustrations of this proposition. Prudential regulation and supervision cannot necessarily be counted on to prevent speculative excesses, for much the same reasons that numb the effectiveness of monetary policy. It can, however, be trusted to mitigate those excesses and to make the financial system more capable of withstanding them. Consistent action at the micro level, therefore, can help to relieve the demands on the monetary authorities. Internationally, the strengthening of capital standards since the late 1980s is a step in this direction. Nationally, all the countries where financial distress has emerged have taken action to upgrade their prudential safeguards.

The existence, under certain circumstances, of a potential conflict between the needs of price and financial stability does not necessarily

[66] On this, see BIS ((1991), (1992), and (1993)) and Lamfalussy (1992). For an overview of the theoretical and empirical literature, see Davis (1992).

deprive asset prices of a role to play in the pursuit of the traditional macroeconomic goals of monetary policy. In fact, this study indicates that aggregate asset price indices could represent a welcome addition to the set of variables considered in its formulation.

The most useful role of aggregate asset prices is unlikely to be that of leading indicators. There is indeed evidence that the asset price index contains information about future movements in inflation and output. The strength and regularity of this relationship, however, are open to question. While the findings may be interpreted as pointing to the desirability of further work in this neglected area, they underscore the difficulties in reading the movements in asset prices correctly and hence in devising a proper policy response.

It is in the context of the demand for money that the asset price index appears to be most useful. During the past decade the setting of monetary policy has been complicated by the "breakdown" of traditional money demand functions, relating monetary aggregates to the price level, real income and interest rates. The inclusion of the asset price index helps to solve the mystery: for several countries it improves significantly the stability and economic properties of the relationship, which survives the major structural changes taking place in the financial system. Indeed, in the cases of Australia, Japan and the United Kingdom, while the ratio of money to nominal income ("velocity") falls sharply during the 1980s, the same ratio adjusted for the effect of the asset price index remains flat for much of the period. From this perspective, the asset price index can best be regarded as capturing wealth and portfolio composition effects.

Looking ahead, more work is clearly necessary to establish the actual policy usefulness of an aggregate asset price index; the present analysis is simply intended to point towards a new line of enquiry. The construction of the index, especially the weights, can be refined. The quality of the underlying data may be improved, at least as regards real estate prices. Above all, the frequency of the statistics could be increased: in many countries the data are only annual and may become available with a considerable lag. This drawback is not so important when evaluating past events, although it clearly reduces the statistical power of the tests; but it is damaging when assessing current and prospective economic developments. No doubt these statistical deficiencies result in part from a certain neglect bred by an underestimation of the potential policy significance of the data. If so, there is hope that they may be corrected in the future.

Appendix I

The construction of the aggregate asset price indices

The starting-point of this paper is the construction of a summary measure of movements in asset prices over time for thirteen countries. The objective is to identify the key characteristics of broad swings in asset prices that may be masked by differences in the behaviour of individual prices so as to highlight their relationship to macroeconomic performance and monetary policy. Owing to data limitations, constructing any such index for a single country, let alone for several, involves difficult choices regarding scope and methods of estimation. This appendix describes in some detail the methodology followed and, where possible, assesses the sensitivity of the statistical properties of the resulting index to the estimates made. On balance, it would appear that the comparative time series behaviour of the aggregate asset price indices is fairly robust. The resulting indices and the individual components are shown in Graph AI.1.

Scope and conceptual issues

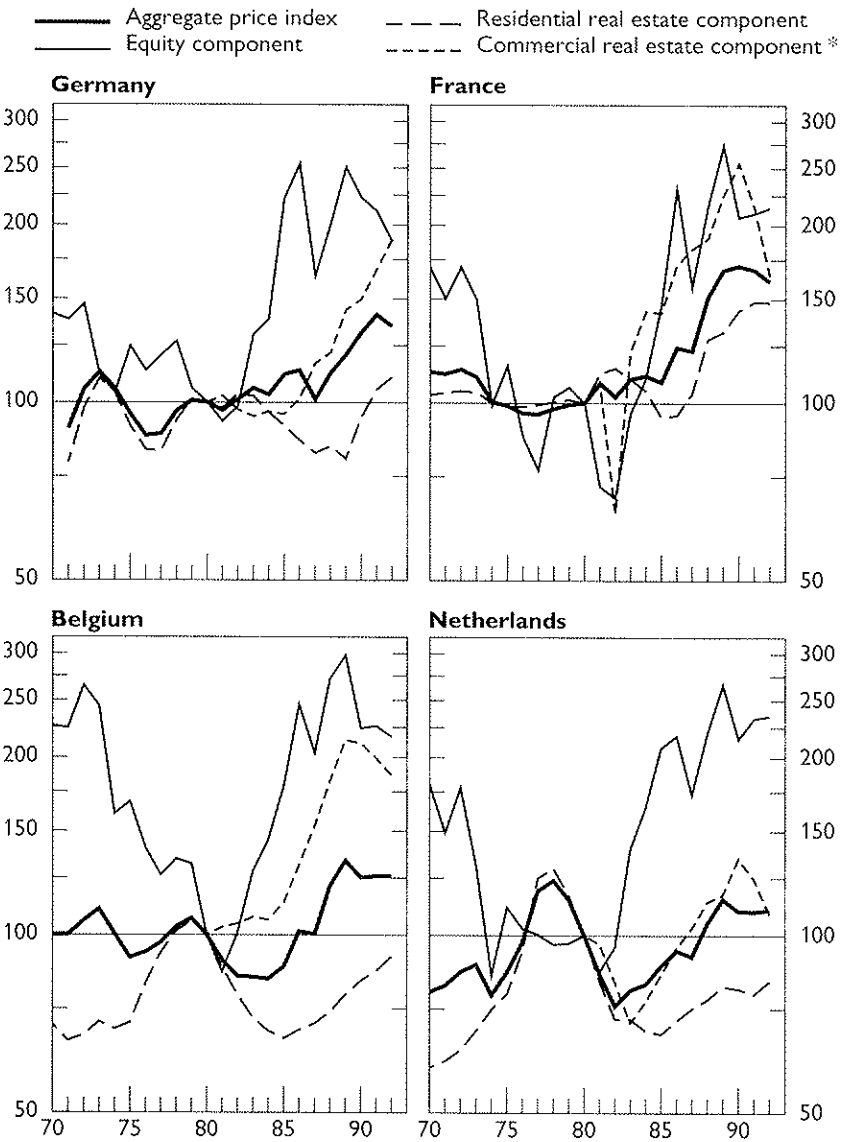
The two basic criteria for selecting the assets included in the index were, firstly, that they should make up a sizable proportion of private sector wealth and, secondly, that they should be traded with some frequency on well-organised markets. A sizable share of total wealth guarantees a good coverage; trading in a secondary market provides some comfort about the quality of the price data.

Private sector wealth is composed of numerous assets. However, a feature common to many countries is that the lion's share is made up of three asset classes, viz. residential property, non-rural commercial property and non-rural business assets (equipment and inventories). For those countries covered in this study for which comprehensive balance-sheet information is available (United States, United Kingdom, Japan, Canada

Graph AI.1

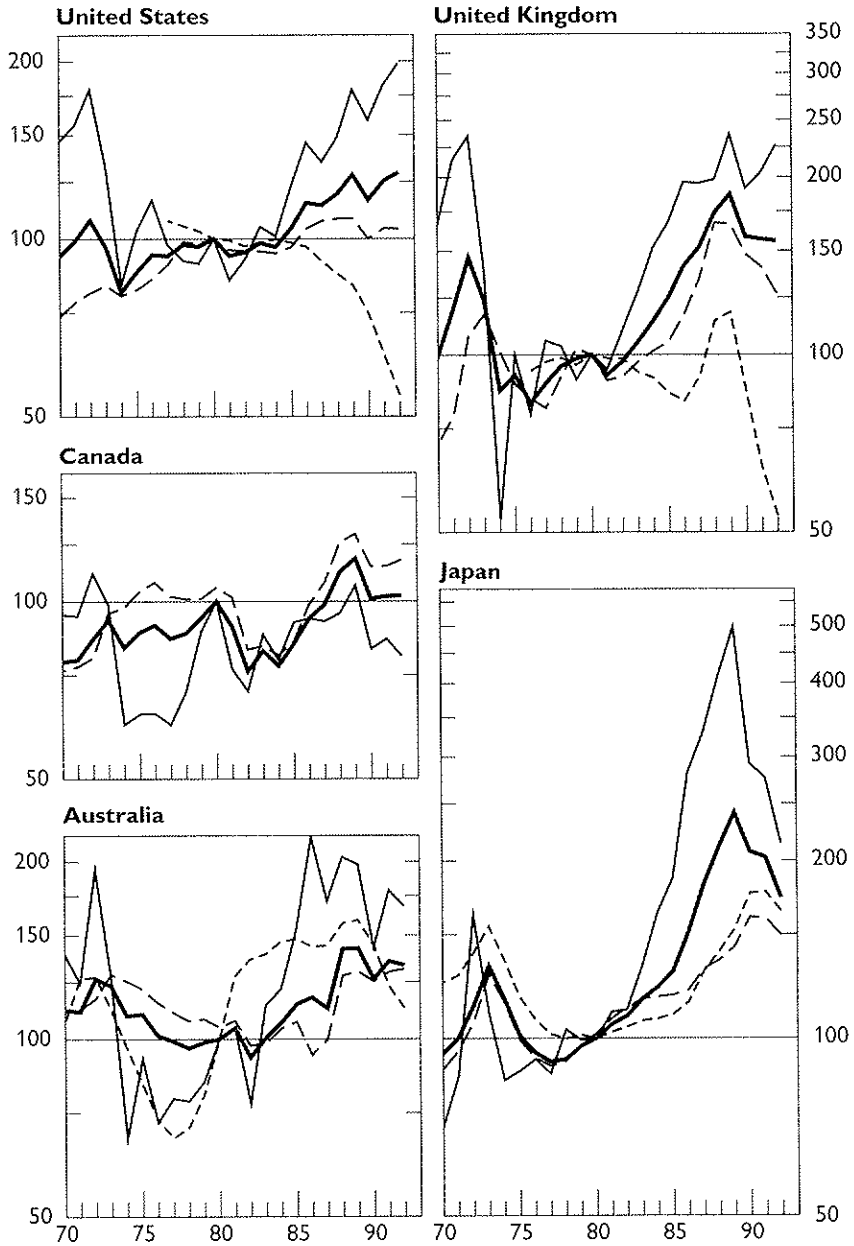
Real asset prices: aggregate and components

1980 = 100; semi-logarithmic scales

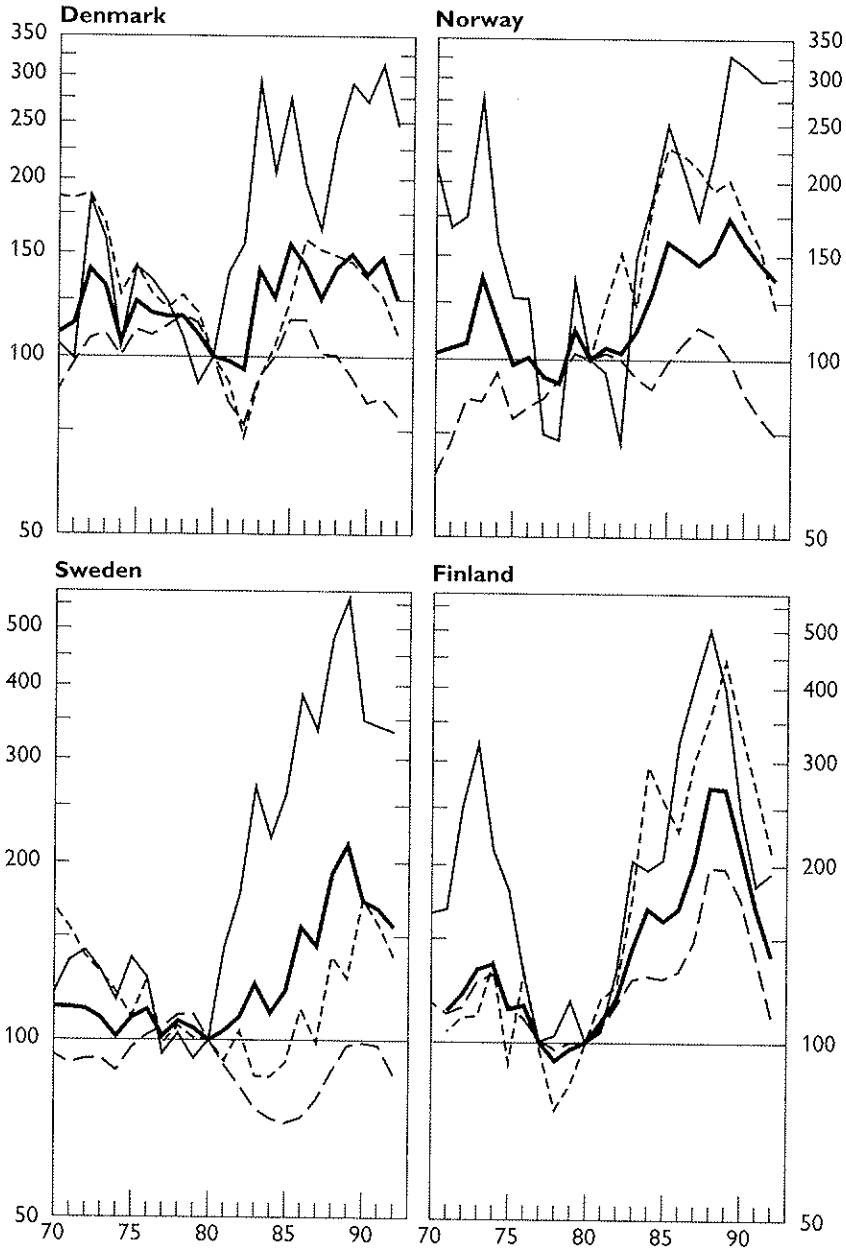


* Index not shown for the above countries and Norway in the 1970s as it is proprietary information.

Graph AI.1 (cont.)



Graph AI.1 (cont.)



and Australia), the data indicate that the share of these asset classes in total wealth is of the order of 85–90%. The remainder is generally composed of rural assets, household durable goods, notes and coin in circulation, net assets held abroad and non-official holdings of government fixed income securities.[67]

The coverage of the index was restricted to the three main asset classes; the others account for a relatively small share of private sector wealth and are in most cases not traded in well-organised markets.[68] Secondary markets for commercial and residential property are quite developed and trading is significant. Business equipment and inventories, of course, are not traded directly; but claims on them, in the form of equity shares of listed companies, have very active liquid markets.

The asset price index is a simple weighted average of the form:

$$AP(t) = \sum_i w(i,s)\, p(i,t)$$

where p(i,t) is the price index of asset i at time t and w(i,s) is the corresponding weight. The weights are allowed to vary somewhat over time, s (approximately every five years),[69] so as to capture the main changes in the composition of the portfolio.

There are at least two possible ways of defining and constructing the index. One is to define the asset price index as a measure of the values of the underlying assets. This is, for example, the method used by Callen (1991) in developing the index for Australia. In this case, the weights to be attached to the components should reflect the relative shares of private sector holdings of residential and commercial property and non-property business assets.

Constructing the index in this manner, however, creates a serious complication. In contrast to residential and commercial property, for which indices exist, the value of business assets cannot be measured directly. It can only be estimated on the basis of the equity price index. But then the fact that business assets are only partly backed by equity, i.e. that they are "leveraged", introduces a bias. An example makes this clear.

[67] There are, of course, arguments against classifying government securities as net wealth. See Barro (1974).

[68] Moreover, while government securities are traded assets, there are no reliable price, as opposed to yield, data.

[69] This was carried as far back as possible. For Sweden, however, only the weights for one year (1983) were available. See Table AI.2.

If the ratio of equity to assets is 50%, a 10% increase in the value of business assets would, ceteris paribus, be associated with a rise in the equity index which is twice as large, or 20%:[70] since equity reflects the full absolute increase in the value of the underlying assets, the percentage increase cannot be the same when the company is partly leveraged.[71] Thus, the equity price index would have to be adjusted for the aggregate debt/asset ratio so as to measure correctly the rate of change in the value of the underlying business assets. Statistics of this kind do not exist for all thirteen countries and those that are available are subject to sizable measurement error.

An alternative possibility is to define the asset price index as a measure of the change in the value of real estate and corporate equities themselves. This is the approach followed here. There is some independent justification for defining the index in this manner. The equity market is arguably a country's most visible and important asset market. Partly for this reason, wealth effects are typically viewed as working primarily through the value of equities rather than through that of the underlying business assets, at least for the household sector. Banks often lend on the basis of equity, not on that of non-property business asset values. And the equity market is the most obvious candidate for experiencing speculative booms and busts. Finally, data on private sector holdings of corporate equities, which serve as the basis for the corresponding weight in the index, are more readily available and subject to less measurement error.

Construction

Price indices

Table AI.1 shows the asset price indices for listed corporate equities, residential property and urban commercial real estate collected for each country and their sources. Generally, indices for all the components could be obtained going back to at least 1970–71. Exceptions were the commercial property indices for the United Kingdom, the United States and Canada, which begin in 1976, 1977 and 1984 respectively.[72] The aggregate

[70] This assumes, for simplicity, that the source of the rise does not affect the market value of such an adjustment.

[71] Callen (1991) makes no such adjustment.

[72] The country-wide residential property index for France was partly estimated. See Kennedy and Andersen (1994).

Table AI.1

Data sources for price indices

Country	Residential property	Commercial property	Equities
Australia	Index of median dwelling prices *Source:* Central bank	Sydney CBD capital value index *Source:* Central bank	All-industries index
Belgium	Weighted sales prices of small and medium-sized dwellings *Source:* Anhyp SA	Capital value price index for Brussels *Source:* Jones Lang Wootton (JLW)	Total share index
Canada	Multiple listing service price index of existing homes *Source:* Central bank	n.a.	Toronto stock exchange 300 composite index
Denmark	Price index for residential houses *Source:* Central bank	Cash price index for production/storage commercial property *Source:* Central bank	Industrials index
Finland	National house price index *Source:* Central bank	Price Index for Prime Office Space in Helsinki CBD *Source:* Central bank	All-share UNITAS index (linked with HEX index in February 1991)
France	Kennedy and Andersen (1994)	Capital value price index for Paris *Source:* JLW	INSEE index
Germany	Average sales prices of owner-occupied dwellings in Frankfurt, Munich, Hamburg and Berlin *Source:* Ring Deutscher Makler	Capital value price index for Frankfurt, Munich, Hamburg and Berlin *Source:* JLW	Overall index of share prices
Japan	National average of residential housing prices *Source:* Central bank	National average commercial property index *Source:* Central bank	Tokyo stock price index (TOPIX)
Netherlands	Prices of residential buildings *Source:* Central bureau of Statistics	Capital value price index for Amsterdam *Source:* JLW	All share price index
Norway	Secondary market national house price index *Source:* Central bank	Capital value price index for Oslo *Source:* JLW	Oslo stock exchange industrials index
Sweden	"Purchase coefficient" of house prices *Source:* Central bank	Index of commercial buildings *Source:* Central bank	Overall share price index
United Kingdom	Index of house prices (all dwellings) *Source:* Department of the Environment	Office capital value index *Source:* Richard Ellis	FT 750 ordinary share index
United States	Median sales price of existing single-family homes *Source:* National Association of Realtors	Russell-NCREIF Commercial property index *Source:* NCREIF	Standard & Poor's 500 composite index

asset price indices for the United Kingdom and the United States were therefore calculated excluding commercial property prices over the period for which no data was available; that for Canada, given the few observations available, excluded these prices altogether. This exclusion, however, is unlikely to have resulted in a significant bias in the overall indices, given the relatively small weight that commercial property carries in these three countries (less than 10%, see below).

As the focus of the paper is on movements in asset prices for the whole economy, country-wide indices were used whenever possible. In a few cases, however, property price indices relating to one or more major cities had to be employed. Since the prices in major cities are apt to be more volatile than national averages, these differences should be borne in mind when interpreting the movements in the aggregate index.

Fortunately, country-wide indices for residential real estate were available for all countries except Germany, where they are the average of four cities (Berlin, Frankfurt, Munich and Hamburg). Data limitations were more severe in the case of the less significant commercial real estate component: the corresponding index covered the same four cities in the case of Germany[73] and only the largest city in Finland, Norway, Belgium, the Netherlands, France and Australia. By contrast, the coverage of the equity indices is invariably nationwide. When a choice had to be made (the Netherlands and Finland), the index relating only to domestic companies was selected.

In comparison with the indices of equity prices, those of real estate prices are inevitably more heterogeneous, and not just in terms of geographical coverage. Differences exist with respect to the assets considered and their quality. In particular, some commercial property indices cover only offices, others include retail property as well as property used for production and storage.[74] Differences also relate to more technical aspects. These include the particular way in which the sample is collected (e.g. how the weights are constructed to combine different localities and qualities of property) and the method of calculation (e.g. whether the mean or median price in the sample is chosen). Overall, it is hardly possible to gauge the combined importance of these differences. However, there is some comfort in the fact that they are especially

[73] These data limitations in the case of Germany imply that the fluctuations in the aggregate index are likely to have been overstated in comparison with other countries.

[74] The Danish index covers only property in the latter category.

significant for commercial property, generally the asset class with the smallest weight in the aggregate index. Moreover, to the extent that they are constant over the sample period, they have less of an effect on the comparative time series behaviour of the index.

Balance-sheet weights

That commercial property is the least significant of the three asset classes is confirmed by a look at Table AI.2, which presents the weights used for each country. For all countries residential property is by far the most important component of the index; the corresponding weight typically ranges between 60 and 75%. Equities are generally the second most important category. In countries with comparatively more developed stock exchanges, their weight is of the order of 20–35%; in the others, it has been between 10 and 25% since the mid-1980s. The weight of commercial property exceeds that of equities only in Finland and Germany,[75] marginally in the more recent sub-period. As equity markets have become more developed over time, their weight has tended to rise at the expense of those of residential and commercial property. This pattern appears to be particularly pronounced in Japan, Finland and Germany.

The calculation of these weights involved two steps. The first, and by far most important, is the estimation of the proportions of the three basic asset categories that make up private sector wealth ("gross" weights). The second, fine-tuning step is to eliminate any double-counting that may arise from the fact that listed companies may themselves own commercial real estate ("net" weights). In this case, to include both the change in the price of real estate and that in the equity index would amount to double-counting.

As regards the calculation of the gross weights, three groups of countries can be identified. For the first group (the United States, the United Kingdom, Canada, Japan and Australia)[76] the source of information was the private sector balance sheets published in the national flow-of-funds accounts. These are the most complete source, containing information on the value of buildings, the underlying land and corporate shares. For the second group (Germany, Sweden and Finland), data on the stocks of

[75] It does so in Japan too in the 1970s.

[76] For Australia, the weights are those estimated by Callen (1991).

Table AI.2

Weights used in the aggregate asset price indices

	Residential property	Commercial property	Equities
Based on flow-of-funds accounts:			
Australia			
1970–82	0.77	0.06	0.17
1983–87	0.75	0.06	0.19
1988–92	0.71	0.08	0.21
Canada			
1970–82	0.71	0	0.29
1983–87	0.66	0	0.34
1988–92	0.70	0	0.30
Japan			
1960–77	0.74	0.21	0.05
1978–82	0.76	0.20	0.04
1983–87	0.62	0.16	0.21
1988–92	0.56	0.13	0.31
United Kingdom			
1968–76	0.70	0	0.30
1977–84	0.63	0.10	0.27
1985–92	0.59	0.07	0.34
United States			
1968–76	0.73	0	0.27
1977–82	0.68	0.07	0.25
1983–87	0.65	0.08	0.27
1988–92	0.61	0.08	0.31
Based on UN Standardised National Accounts:			
Finland			
1970–82	0.73	0.22	0.05
1983–87	0.71	0.20	0.09
1988–92	0.68	0.17	0.15
Germany			
1970–78	0.71	0.20	0.09
1979–82	0.75	0.17	0.08
1983–87	0.72	0.15	0.13
1988–92	0.69	0.16	0.15
Sweden			
1970–92	0.58	0.18	0.24
Based on weights for other countries:			
Denmark		as Sweden	
Norway		"	
Belgium		as Germany	
France		"	
Netherlands		"	

residential and commercial buildings from the UN Standardised National Accounts (Table 2.13) were combined with figures on private sector holdings of corporate equities from the OECD Financial Statistics (Part 2). For the third group (France, Belgium, the Netherlands, Denmark and Norway), neither national flow-of-funds nor UN SNA data were available to calculate estimates of the weights to be attached to property but the OECD Financial Statistics contained data on holdings of corporate equities.

For those countries for which national flow-of-funds account balance sheets were available, the following procedure was used to calculate the weights of the three price indices. First, the total value of wealth held by the private sector in the two types of tangible assets, residential dwellings and commercial property, was determined. Where the breakdown was not provided in the balance-sheet accounts, an estimate was made of the value of the land underlying the buildings in the two separate asset classes.[77] Finally, the value of total private sector holdings of corporate equities[78] was used in conjunction with those of residential and commercial property to derive the weights to be attached to the three indices.

For those countries for which the UN SNA accounts served as the basis for the estimation of private sector holdings of residential and commercial property (Germany, Sweden and Finland), the problem was that the information covered only holdings of reproducible fixed assets; it did not include the value of the land on which the buildings stood. Excluding land from the estimates would of course bias downwards the proportion of residential and commercial property held by the private sector. US and UK national balance sheets revealed that the building-to-land ratio for the private sector was 2:1. It was therefore assumed that this ratio held for the three countries for which only UN accounts were available.

For those countries for which neither national balance sheets nor UN SNA accounts were available, some rather arbitrary assumptions had to

[77] Only the UK accounts present a breakdown of the value of the underlying land and buildings by different categories of property and sectors of the economy (households, non-financial and financial sectors); for the United States, Japan and Canada only overall figures are available. For each of these three countries, therefore, it was assumed that the building-to-land ratio was the same for both residential and commercial property. In addition, for the United States and Japan it was assumed that the household sector held only residential property.

[78] For the United States, private sector holdings are reported net of inter-corporate holdings. The ratio of total dividends received to those paid by the corporate sector was used to proxy the percentage of outstanding corporate equity held by the corporate sector. See French and Poterba (1991).

be made. It was assumed that the proportions of the three asset classes held by the private sector in Denmark and Norway was the same as in Sweden; and those in France, Belgium and the Netherlands the same as in Germany.

In moving from gross to net weights, some notion of the proportion of total commercial property held by listed companies for each country was needed (henceforth this ratio will be denoted by α for short). For most countries it is difficult to obtain reliable estimates of α. In constructing the aggregate asset price index for Australia, Callen (1991) estimated that this ratio was approximately 0.6. The US flow-of-funds accounts also provide some guidance: they indicate that the proportion of total business sector equity accounted for by listed companies was 68% in 1991. In the absence of any other data it was assumed that α was equal to this ratio. The value of α for the United Kingdom was assumed to be equal to that for the United States. For Japan, α was assumed to be the same as for Australia. For the other countries, it was reasoned that their rather less capitalised stock markets implied that α would be somewhat lower, at 50%.

Sensitivity analysis

Since several assumptions are typically needed to construct an aggregate price index, it is worth examining the robustness of the final outcome to changes in the methods of construction. The following paragraphs consider the sensitivity of the time series behaviour of the overall index to three different factors, viz. the choice of asset classes (corporate equities against underlying business assets), the source of information (flow of funds, UN Standardised National Accounts, neither) and different values of α.

Corporate equities against underlying business assets

As discussed earlier, there are significant conceptual and measurement problems in trying to estimate changes in the value of business assets rather than in the equity component. Nevertheless, as a purely practical matter, it would be of interest to know whether the differences in methodology produce substantial differences in the implied behaviour of the aggregate index over time.

To examine this question, an asset price index based on Callen's (1991) methodology was calculated for ten of the thirteen countries under study and the resulting series were then compared with those used in the

Table AI.3

Sensitivity of the aggregate index: corporate equities against business assets

	Correlation coefficient*		Correlation coefficient*
Australia	0.90	Japan	0.98
Canada	0.95	Norway	0.89
Denmark	0.93	Sweden	0.99
Finland	0.95	United Kingdom	0.96
Germany	0.84	United States	0.95

* Correlation coefficient between original and alternative series.

present paper.[79] As might be expected, because of the comparatively larger weight of the equity price index that they imply, the indices that attempt to capture the changes in value of the underlying assets without adjusting for leverage were more volatile. Nevertheless, the movements over time of the two types of index are substantially similar (Table AI.3): with the exception of Germany, the correlation coefficient between the two is of the order of 0.90 or higher, and at least 0.95 in a majority of countries, including those experiencing the largest asset price movements. Thus, despite the conceptual differences between the two methodologies, in practice the impact on the time series behaviour of the resulting indices does not appear to be so great.

Basic sources of information for the weights

As mentioned previously, the weights for the United States, the United Kingdom, Japan, Canada and Australia were calculated on the basis of national flow-of-funds balance sheets; for Germany, Sweden and Finland, UN SNA accounts were used instead. Differences in the methodology behind the preparation of these accounts could introduce biases in the final constellation of weights. On first inspection of the final weights in Table AI.2 this does not appear to be the case. There seem to be no systematic differences between the weights calculated for the two groups of countries. As a further check the weights for two countries for which flow-of-funds accounts were available, the United States and the United

[79] Asset price indices so calculated can be found in BIS (1993).

Table AI.4

Sensitivity of the aggregate index: alternative data sources*

	Balance-sheet weights					
	National flow-of-funds accounts			UN Standardised National Accounts		
	Residential property	Commercial property	Corporate equities	Residential property	Commercial property	Corporate equities
United Kingdom						
1982	0.51	0.27	0.22	0.48	0.32	0.20
1987	0.50	0.21	0.29	0.47	0.24	0.29
United States						
1980	0.58	0.21	0.21	0.61	0.21	0.18
1985	0.55	0.21	0.23	0.57	0.23	0.20
1989	0.52	0.21	0.27	0.55	0.21	0.24

* The weights shown are before adjustment for the proportion of commercial property held by listed companies. They are therefore not directly comparable with those shown in Table AI.2.

Kingdom,[80] were recalculated on the basis of the UN SNA accounts and compared with the original ones. The resulting differences were minor (Table AI.4).

To examine the sensitivity of the asset price index for France, Belgium and the Netherlands to the choice of the German configuration of weights, their asset price indices were re-estimated on the basis of those for the United Kingdom. Although the overall pattern of weights across countries is generally quite similar, the differences between Germany and the United Kingdom appear to be the largest. A similar exercise was performed for Norway and Denmark (the weights had been assumed to be the same as those for Sweden), recalculating the asset price indices on the basis of the configuration for Germany. Once again, the different methods of calculation did not generate substantial differences in the movements in the asset price indices, as the correlation coefficient is generally at least equal to 0.90 (Table AI.5). The only exception is the Netherlands, for which it is lower.

[80] Such an exercise was not possible for Canada since the relevant UN SNA table was not available. It was also felt inappropriate to perform it for Japan, given the vastly different land-to-building ratio in that country.

Table AI.5

Sensitivity of the aggregate index: balance-sheet weights

	Correlation coefficient[1]		Correlation coefficient[1]
Belgium[2]	0.927	Netherlands[2]	0.738
Denmark[3]	0.900	Norway[3]	0.940
France[2]	0.979		

[1] Correlation coefficient between original and alternative series. [2] DE weights (this study) and GB weights (alternative): 1977–92. [3] SE weights (this study) and DE weights (alternative): 1970–92.

Table AI.6

Sensitivity of the aggregate index: values of α[1]

	Correlation coefficient[2]		Correlation coefficient[2]
Australia[3]	0.998	Japan[4]	0.998
Belgium[3]	0.978	Netherlands[3]	0.985
Denmark[5]	0.984	Norway[3]	0.995
Finland[3]	0.998	Sweden[3]	0.997
France[3]	0.997	United Kingdom[6] . . .	0.999
Germany[5]	0.993	United States[6]	0.999

[1] α = 0.3 rather than the values used in the study. [2] Correlation coefficient between original and alternative series. [3] Calculated for 1970–92. [4] Calculated for 1961–92. [5] Calculated for 1971–92. [6] Calculated for 1977–92.

On balance, therefore, the evidence suggests that different data sources are unlikely to introduce large and systematic biases into the aggregate index.

Proportion of total commercial property held by listed companies (α)

Private sector holdings of commercial property as a proportion of total holdings of residential and commercial property and corporate equities vary from 20 to 40% in the sample of countries considered in the paper. This means that changing α from, say, 70 to 50% raises the weight of the commercial property price index by 4–7 percentage points,

reducing those for equity and residential property price indices correspondingly. As Table AI.6 shows, choosing even a substantially different value of α from those used in the basic indices (0.3 rather than 0.7–0.5) results in only negligible changes in the time series properties of the aggregate index: the correlations with the original series are 0.98% or higher.

Appendix II

Time series analysis of asset prices, inflation and output

Granger-causality tests have become a popular tool in the econometrics armoury since the seminal papers by Granger (1969) and Sims ((1972) and (1980)). The original intention of the tests, as their very name indicates, was to detect causal relationships among different variables. As the subsequent heated debate has made clear, however, it is better to consider these exercises as attempts to establish the information content of certain variables (the "causing" factors) after proper allowance for the information already contained in others (including the "caused" variable), without specific claims regarding causality.[81]

The strength of the analysis lies in its comparative simplicity and in the generally good forecasting performance of time series representation of economic variables in comparison with more articulated econometric models. One weakness is that the results are typically quite sensitive to the specification of the tests. Recent work has paid particular attention to the dependency of the asymptotic properties of standard F-tests on the deterministic trends and stochastic orders of integration of the variables (Stock and Watson (1989b), Sims et al. (1990)). The general conclusion is that unless these are properly identified, the results of the tests may be vitiated. There is also some scepticism about the power of existing tools to detect correctly such time series characteristics, and about the relevance of these results in relatively small samples (e.g. Cochrane (1991)). Consequently, the findings of an analysis of this type should be interpreted with caution.

The general procedure to test for Granger-causality adopted in the paper was the following. Firstly, the orders of integration of the individual

[81] See, for example, Tobin (1970), Zellner (1979) and, more recently, Engle et al. (1983) and Hoover (1991).

series were tested for so as to limit the risk of introducing non-stationary regressors in the Granger-causality representations of the data. Dickey-Fuller and augmented Dickey-Fuller tests, including also a linear trend, were employed for that purpose. Secondly, the presence of cointegration between the variables in question was examined through an analogous procedure. As shown by Granger (1988), the existence of cointegration between two variables implies Granger-causality in at least one direction. This suggests including the (lagged) residual from the cointegrating relationship as an additional regressor (e.g. Feldstein and Stock (1993)). Intuitively, since two cointegrated variables cannot deviate from one another without bounds in the long run, the residual can contain useful information about the future movement of the variable to be predicted. Finally, the transformed (stationary) series were included in the standard Granger-causality regression. Each dependent variable (y) was regressed on its own history, past values of the variable whose predictive power was tested for (x) and, where appropriate, the lagged residual of the cointegrating relationship (E_{t-1}), a linear trend (T) and other controlling variables (Z_t). Up to two lags were tested for but the results with one lag proved generally superior. The general specification thus was:

$$y_t = \alpha + \sum_{i=1} \beta_i x_{t-i} + \sum_{i=1} \chi_i y_{t-i} + \delta T + \Phi E_{t-1} + \sum_{i=1} \omega_i Z_{t-i}$$

The final outcome of the tests is included in the main text. The following paragraphs give more information on the preliminary steps.

Unit root tests indicated that the general price level[82] was integrated of order 2 (I(2)); output and the nominal as well as real aggregate asset price index were found to be I(1) (Table AII.1). No significant differences emerged across countries. These findings for output and prices are broadly consistent with the existing literature. The behaviour of the asset price index also parallels the time series properties of commodity prices as identified by Boughton et al. (1989).

As regards the long-run relationship between asset prices and inflation, given the different orders of integration and economic theory, the possibility of cointegration between the level of asset prices and the inflation rate was tested for (Table AII.2). A statistically significant cointegrating vector was identified in four countries, viz. Denmark, Finland,

[82] Measured by the consumer price index.

Table AII.1

Unit root tests[1]

	Form and statistical significance of integrating relationship			
	P I(2)[2]	Y/P I(1)[2]	AP I(1)[2]	AP/P I(1)[2]
Australia	(T,0)***	(c,0)**	(T,0)***	(T,0)***
Belgium	(c,0)***	(c,0)***	(c,0)**	(c,0)***
Canada	(c,0)***	(c,0)**	(c,0)***	(c,0)***
Denmark	(c,0)***	(c,0)***	(c,0)***	(c,0)***
Finland	(c,0)***	(c,1)**	(c,0)***	(c,0)**
France	(c,0)***	(c,0)***	(c,0)**	(c,0)***
Germany	(c,0)***	(c,0)**	(c,0)***	(c,0)***
Japan	(c,0)***	(n,0)*	(c,0)***	(c,0)**
Netherlands	(c,0)***	(n,0)*	(c,0)***	(c,0)***
Norway.	(c,0)***	(c,0)**	(c,0)***	(c,0)***
Sweden	(c,0)***	(c,1)**	(c,0)***	(c,0)***
United Kingdom .	(c,0)***	(c,0)**	(c,0)***	(c,0)***
United States . . .	(n,1)***	(c,0)**	(c,0)**	(c,0)***

[1] The table reports the statistical significance and the form of the integrating relationship. The symbols (x, y) describe the form of the integrating relationship: x = c (constant), T (time trend), n (no constant, no time trend) refers to the presence of a constant or time trend in the cointegrating regression. y refers to the presence (y = 1) or absence (y = 0) of a first difference error term in the test regression. Asterisks indicate as usual the level of significance.
[2] Uniform across all countries.

Norway and the United States; the corresponding (lagged) residual of the cointegration regression was thus added to the general regression testing for the information content of the asset price index. The ADF statistic was almost significant at the 10% level in the case of the United Kingdom. Similar cointegration tests were then run between real asset prices and real GDP (Table AII.3). Statistically significant evidence of cointegration was found only for the United States and the Granger-causality regression for this country was modified accordingly.

Table AII.2

Cointegration tests: inflation rate and asset prices

Cointegrating equation: $\Delta \log P_t = \alpha + \beta \log AP_t + \epsilon_t$

	Augmented Dickey-Fuller test statistic[1]		Augmented Dickey-Fuller test statistic[1]
Australia	–2.9	Japan	–2.7
Belgium	–3.2	Netherlands	–2.0
Canada	–2.4	Norway[2]	–3.3*
Denmark[2]	–4.2**	Sweden	–2.9
Finland	–4.6***	United Kingdom	–3.2
France	–2.2	United States	–4.0**
Germany	–2.4		

[1] Unless otherwise indicated, t-statistic on β in the regression:
$\Delta\epsilon_t = \beta_1\epsilon_{t-1} + \beta_2\Delta\epsilon_{t-1} + \mu_t$.
[2] t-statistic on β in the regression: $\Delta\epsilon_t = \beta\,\epsilon_{t-1} + \mu_t$.

Table AII.3

Cointegration tests: real output and asset prices

Cointegrating equation: $\log (Y/P)_t = \alpha + \beta \log AP/P_t + \epsilon_t$

	Dickey-Fuller test statistic[1]		Dickey-Fuller test statistic[1]
Australia	–1.6	Japan	–1.3
Belgium	–1.9	Netherlands	–1.2
Canada	–1.6	Norway	–1.7
Denmark	–1.5	Sweden	–2.7
Finland	–1.3	United Kingdom	–2.6
France	–2.2	United States	–4.7***
Germany	–2.8		

[1] t-statistic on β in the regression:
$\Delta\epsilon_t = \beta\,\epsilon_{t-1} + \mu_t$.

Appendix III

Detailed econometric results

Table AIII.1

Asset price determination: selected multivariate regressions

	AU	BE	CA	DK	FI[1]	FR	DE	JP	NL[2]	NO	SE	GB	US
$\Delta\Delta\log Y_t$	–	–	–	–	1.74***	–	2.22***	1.18**	1.50**	–	–	1.53***	–
					(3.12)		(3.04)	(2.17)	(2.93)			(3.95)	
$\Delta\log Y_{t-1}$	–	–	–	1.24**	–	–	3.99***	–	2.90***	–	–	1.07**	–
				(2.42)			(3.86)		(5.95)			(2.46)	
ΔRL_t	–0.03**	–	–0.02*	–0.03***	–	–	–	–	–0.05***	–0.06**	–0.04***	–0.04***	–
	(2.57)		(1.76)	(4.89)					(4.50)	(2.11)	(3.44)	(3.17)	
RL_{t-1}	–	–	–0.03***	–0.02***	–	–	–	–0.02**	–0.05***	–	–	–0.05***	–
			(3.57)	(4.43)				(2.10)	(7.23)			(5.04)	
$\Delta\log(I/P)_t$	0.47**	0.91***	–	0.79***	–	–	–	–	–	0.62**	–	–	–
	(2.83)	(7.08)		(4.18)						(2.48)			
$\log(I/P)_{t-1}$	0.79***	0.63***	0.34***	0.56***	–	0.46***	–	0.40**	–	1.25***	0.25*	–	–
	(3.54)	(3.56)	(3.19)	(3.32)		(3.45)		(2.76)		(4.48)	(1.98)		
$\Delta(TC/Y)_t$	–	2.17***	–	–	1.73**	1.27*	–	1.16***	–	1.04*	1.48***	2.00***	–
		(6.48)			(2.16)	(2.02)		(2.93)		(2.12)	(4.28)	(5.56)	
$(TC/Y)_{t-1}$	–	0.82**	–	–	–	–	1.31***	–	–0.36**/0.22***	3.20***	–	0.50**	0.54***
		(2.32)					(3.87)		(2.38)(2.51)	(4.45)		(2.43)	(3.75)
$\log(AP/P)_{t-1}$	–0.56***	–0.78***	–0.56***	–1.16***	0.38**	–0.57***	–0.75***	–0.40***	–0.27**	–0.80***	–0.40***	–0.77***	–0.59***
	(3.52)	(3.96)	(3.22)	(5.66)	(2.16)	(3.25)	(3.82)	(4.15)	(2.89)	(4.21)	(4.25)	(3.53)	(3.42)
T	–0.02***	–0.01**	–	–	–	–	–	–	–	–0.13***	–	–	–
	(3.12)	(2.81)								(4.44)			
$\bar{R}^2$	0.53	0.84	0.43	0.86	0.54	0.31	0.53	0.62	0.82	0.65	0.65	0.87	0.35
$\Delta\bar{R}^2$	–	0.41	–	–	0.10	0.11	0.43	0.14	0.30	0.45	0.12	0.25	0.35
SEE	0.05	0.03	0.06	0.05	0.10	0.06	0.05	0.06	0.04	0.07	0.06	0.04	0.05
DW	2.48	2.39	2.26	2.06	1.88	2.50	1.88	2.22	2.56	2.45	2.88	2.13	1.76
LM(1)	(0.14)	(0.19)	(0.45)	(0.71)	(0.97)	(0.17)	(0.86)	(0.20)	(0.29)	(0.08)*	(0.04)**	(0.71)	(0.46)
CH(80)	(0.27)	(0.76)	(0.58)	(0.33)	(0.36)	(0.51)	(0.53)	(0.41)	–	(0.29)[3]	(0.43)	(0.36)	(0.63)
CH(88)	(0.29)	(0.95)	(0.44)	(0.56)	(0.38)	(0.21)	(0.95)	(0.00)***	(0.29)	(0.82)	(0.12)	(0.63)	(0.62)
Period	1971–92	1971–92	1971–92	1971–91	1973–92	1971–92	1972–90	1966–92	1971–92	1972–91	1971–92	1971–92	1969–92

[1] In contrast to the other countries, the lagged term in the real asset price denotes its first difference, not its level. [2] Two multiplicative dummies were added to the credit term, the first equal to one up to and including 1974 and zero thereafter, and the second equal to zero up to and including 1974 and one thereafter. [3] CH(81).

Table AIII.2

The demand for money: selected regressions[1]

	AU	BE	CA	DK	FI[1]	FR	DE	JP	NL[2]	NO	SE	GB	US
$\Delta logP_t$	0.28 (1.65)	0.41** (2.53)	0.52*** (4.13)	–	–	0.71*** (6.33)	–	–	1.76*** (4.26)	0.16* (1.93)	0.42* (1.98)	–	0.77*** (2.94)
$\Delta logP_{t-1}$	–	–	–	–	–	–	–	–0.46*** (4.55)	–	–	–	–	–
$\Delta log(Y/P)_t$	–	–	–	0.52* (2.06)	0.54*** (4.63)	0.47 (1.71)	0.57*** (3.23)	0.53*** (5.01)	–	–0.53*** (3.92)	1.22*** (3.50)	0.31* (1.77)	0.85*** (4.58)
$\Delta log(Y/P)_{t-1}$	–	–	–	–	–	–	–	–0.87*** (7.95)	–	–	–	–	–
ΔRS_t	–0.004 (1.62)	–0.003* (2.02)	–	–	–0.005* (2.89)	–0.004** (2.84)	–	–	–	0.02*** (5.12)	–	–	–
ΔRL_t	–	–	–	–0.012*** (5.07)	–	–	–0.009** (2.87)	–	–		–	–	–0.014*** (3.36)
$\Delta log(AP/P)_t$	–	–	–	–	–	–	–	–	–	0.04 (1.77)	–	–	–
$logM_{t-1}$	–0.70*** (5.15)	–0.32** (2.47)	–0.32*** (5.46)	–0.88*** (6.86)	–0.41*** (9.54)	–0.17** (2.73)	–0.32*** (10.08)	–0.65*** (10.08)	–0.62** (3.03)	–0.79*** (12.84)	–0.55*** (4.17)	–0.28*** (6.64)	–0.41** (2.82)
$logP_{t-1}$	(c)	(c)	(c)	1.49*** (7.72)	(c)	(c)	(c)	(c)	0.76** (2.88)	(c)	(c)	(c)	(c)
$log(Y/P)_{t-1}$	(c)	0.45* (2.29)	(c)	(c)	(c)	(c)	(c)	(c)	0.95*** (3.74)	(c)	(c)	(c)	0.34** (2.35)
RS_{t-1}	–0.004* (2.03)	–0.011*** (6.91	–	0.036*** (6.20)	–0.005* (2.73)	–0.004** (2.47)	0.008** (2.56)	0.01*** (3.30)	0.03*2 (2.04)	0.04*** (11.48)	0.02*** (3.65)	–	–
RL_{t-1}	–	–	–		–	–	–0.016*** (3.57)		–0.01***3 (3.81)			–	–
$log(AP/P)_{t-1}$	0.50*** (6.08)	–	0.14*** (4.29)	–	0.10*** (6.09)	–	–	0.19*** (8.35)	–	0.05** (3.20)	–	0.19*** (5.63)	–
$\Delta logM_{t-1}$	–	–	–	–	–	–	–	0.62*** (8.60)	–	–	0.89*** (4.42)	–	–
T	–	–	–	–0.05*** (6.33)	–	–	–	–	0.02* (2.13)	–	–0.01*** (4.66)	–	–

Table AIII.2 (continued)

The demand for money: selected regressions[1]

	AU	BE	CA	DK	FI[1]	FR	DE	JP	NL[2]	NO	SE	GB	US
$\bar{R}^2$	0.71	0.81	0.86	0.88	0.91	0.89	0.88	0.96	0.87	0.95	0.66	0.74	0.75
SEE (%)	2.32	1.48	1.40	2.03	1.23	1.10	0.88	1.00	1.50	0.70	2.06	1.78	1.50
DW	2.21	1.90	2.02	1.76	2.54	1.62	2.01	2.11	2.46	2.03	2.36	1.99	1.71
LM(1)	39.2	86.3	85.2	69.2	12.9	43.5	76.1	59.3	10.8	69.2	21.5	68.1	89.2
CH(80)	18.9	45.7	98.6	69.7	47.7	1.4**	10.8	73.0	–	–	50.8	23.2	2.60**
CH(88)	27.0	85.8	44.9	5.643*	18.3	33.2	33.2	49.4	60.4	53.9	38.6	23.8	13.0
Period	1971–92	1971–92	1971–92	1972–92	1972–92	1971–92	1972–90	1969–92	1973–92	1976–92	1971–92	1971–92	1970–92

Note: The closed parenthesis indicates the difference between the own and long-term rate.

[1] The money stock data used are as follows: Denmark, M_1 plus quasi-money; Canada, Finland, Norway and the United States, M_2; Japan, M_2 plus certificates of deposit; Australia, Belgium, France, Germany, Netherlands and Sweden, M_3; United Kingdom, M_4. [2] Own rate. [3] Short-term rate.

Table AIII.3

Basic model results

	Australia	Canada	Finland	Japan	Norway	GB(a)	GB(b)
$\Delta logM_{t-1}$	–	–	–	0.56***	–	0.43**	0.55***
				(3.43)		(2.51)	(3.18)
$\Delta logP_t$	0.37	0.76***	–	–	–	–	–
	(1.33)	(5.81)					
$\Delta(Y/P)_t$	1.18***	–	0.85***	0.70***	–0.58***	0.67***	0.53**
	(3.38)		(5.88)	(3.32)	(3.27)	(3.00)	(2.38)
$\Delta(Y/P)_{t-1}$	–	–	–	–0.90***	–	–	–
				(5.12)			
ΔRS_t	–	–	–0.005*	–	0.019***	–	–
			(2.07)		(4.13)		
ΔRL_t	–	–	–	–		–	–
$logM_{t-1}$	–0.31**	–0.24***	–0.34***	–0.46***	–0.69***	–0.17**	–0.08**
	(2.46)	(3.03)	(5.50)	(3.39)	(10.42)	(2.72)	(2.67)
$logP_{t-1}$	–0.02	(c)	0.22***	0.30**	(c)	0.12**	(c)
	(0.30)		(3.81)	(2.36)		(2.41)	
$log(Y/P)_{t-1}$	1.42***	0.32***	0.76***	0.74***	(c)	0.53**	(c)
	(3.29)	(3.07)	(4.63)	(3.09)		(2.20)	
RS_{t-1}	–	–	–	–	0.037***	–	–
RL_{t-1}	–	–0.006***	–	–0.012***	(8.28)	–	–
		(2.99)		(3.28)			
$\bar{R}^2$	0.57	0.84	0.82	0.92	0.91	0.59	0.54
SEE (%)	2.83	1.54	1.75	1.48	0.93	2.26	2.38
DW	2.14	1.94	2.15	1.80	1.55	1.65	1.50
LM(1)	73.9	81.9	73.6	90.0	55.1	26.2	19.5
CH(80)	60.0	53.3	5.9*	72.5	–	3.2**	71.7
CH(88)	11.6	31.7	6.8*	2.3**	45.4	65.9	31.9
Period	1971–92	1971–92	1972–92	1969–92	1976–92	1971–92	1971–92

Note: The closed parenthesis indicates the difference between the own and long-term rate.

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