WORKING PAPER

17-05

Monetary Policy, Asset Prices and Economic Growth in the World Economy over the 1995-2004 Period

A counterfactual simulation with the NIME Model

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In this Working Paper, we assess the worldwide macroeconomic implications of an interest rate rule whereby the major central banks of the world target not only changes in the traditional consumer price index but also changes in asset prices. We do this by simulating the NIME model over the 1995-2004 period with an interest rate rule similar to the well-known Taylor rule, but augmented for changes in asset prices. This counterfactual simulation indicates that a broad-based interest rate rule would have pushed the euro area's GDP above its historical level by about 0.3 per cent by the end of the 1995-2004 period and would have reduced US GDP by about 0.6 per cent by the end of the same period. Japanese GDP would have come out 1.3 per cent above its historical baseline level by the end of the 1995-2004 period, mainly due to strong gains in exports resulting from the weakening of the yen in the wake of the rising foreign interest rates.

Keywords: macroeconometric world model, monetary policy, euro area, world economy

JEL codes: C15, C5, E17, E5, F2

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Executive summary

Over the 1995-2004 period, the evolution of stock market indices in the United States and Europe exhibited a distinct boom-and-bust pattern, rising dramatically during the second half of the 1990s and falling sharply at the turn of the century. These changes in asset prices affected household wealth and the financing cost of investments, so that the period of rising asset prices was also characterised by strong economic growth, while the period of falling asset prices saw weaker growth. As equity markets were largely driven by "irrational exuberance" in the second half of the 1990s[1], it is sometimes argued that, in order to foster a more balanced growth path, the monetary authorities in the United States and the euro area should have targeted changes in a price index which not only includes contemporaneous consumer prices but also asset prices.

In this Working Paper we assess the worldwide macroeconomic implications of an interest rate rule whereby the major central banks of the world target not only changes in the traditional consumer price index but also changes in asset prices. We do this by simulating the NIME model over the 1995-2004 period with an interest rate rule similar to the well-known Taylor rule, but augmented for changes in asset prices[2].

The paper is organized as follows. First, we give a quick overview of the major macroeconomic developments in the euro area, the United States and Japan over the 1995-2004 period, highlighting that changes in asset prices were not a major concern of the monetary authorities as they set the short-term interest rates. Next, starting form a broad price index and a functional form similar to the traditional Taylor rule, we specify an interest rate rule whereby monetary authorities target not only consumer price inflation and the output gap, but also changes in asset prices and changes in the output gap. Finally, we use the global macroeconometric NIME model to calculate how the macroeconomic variables of the major economic areas would have behaved over the 1995-2004 period, had the monetary authorities of these areas implemented such a broad-based interest rate rule.

The results of the counterfactual simulation can be summarised as follows. Had the interest rate rule proposed in this Working Paper been adopted by the major central banks over the 1995-2004 period, interest rates in Europe and the United States would most likely have come out above their historical baseline for most of the 1995-2000 period. For example, the US short-term interest rate would have been 1.4 percentage-points above its historical baseline in 1999, while the short-term interest rate of the euro area would have come out 0.9 percentage-point

1. See for instance Shiller (2005) and Greenspan (1996).
2. The NIME model is a macroeconometric world model developed by economists of the Belgian Federal Planning Bureau. See Appendix A for more details regarding the NIME model.

above its baseline in 2000. The rate hikes in the euro area and the United States would have lowered these areas' domestic demand by increasing the cost of investment and lowering household wealth. However, as the rate hikes would have been highest in the United States, the US dollar would have appreciated against other major currencies, thereby restraining US export growth but stimulating export growth from Europe and, especially, from Japan. After 2000, the implementation of this alternative interest rate rule would most likely have led to a fall in interest rates relative to their historical baseline in the euro area and the United States; over this period, domestic demand in these areas would have come out above their historical baseline level. Once again, the effect of the interest rate cuts on exchange rates is not straightforward, as all areas except Japan would have made important rate cuts. In Japan such cuts would not have been possible, due to the fact that the Japanese zero interest rate policy and the policy of quantitative easing had already brought nominal interest rates down to their lower bound.

The counterfactual simulation indicates that a broad-based interest rate rule would have pushed the euro area's GDP above its historical level by about 0.3 per cent by the end of the 1995-2004 period and would have reduced US GDP by about 0.6 per cent by the end of the same period[1]. Japanese GDP would have come out 1.3 per cent above its historical baseline level by the end of the 1995-2004 period, mainly due to strong gains in exports resulting from the weakening of the yen in the wake of the rising foreign interest rates. Nevertheless, implementing the alternative interest rate rule would have reduced output volatility somewhat.

Finally, as a caveat, it should be noted that although the new interest rate rule lowers output variability, the rule we implement is based on target values obtained through a filtering process applied to a historical outcome. In real-time however, defining targets for asset prices may not be straightforward and be surrounded by great uncertainty.

1. Measured as the discounted cumulative deviations of these variables from their baseline levels.

I Introduction and summary

A. Selected stylised facts for the 1995-2004 period

Over the 1995-2004 period, the evolution of stock market indices in the United States and Europe showed a distinct boom-and-bust pattern (see Table 1). In the euro area, stock market indices increased on average by 22.5 per cent per annum between 1995 and 2000, only to fall at an annual average rate of 20.2 per cent between 2001 and 2003, followed by a 20.6 per cent increase in 2004. In the United States, the S&P500 index increased on average by 21 per cent per annum over the 1995-2000 period. It then fell at an annual average rate of 12 per cent between 2001 and 2003, but subsequently rebounded by 17.2 per cent in 2004. At the same time, euro area real GDP grew at an average rate of 2.5 per cent per annum over the 1995-2000 period, compared with just 1.3 per cent over 2001-2004. In the United States, real GDP growth averaged 3.9 per cent over the 1995-2000 period, compared with 2.5 per cent over 2001-2004 period. Moreover, inflation remained fairly low and stable throughout the whole period, averaging 1.9 per cent per annum in both the euro area and the United States[1] (see Table 1).

TABLE 1 - Selected macroeconomic variables for the 1995-2004 period
(period average, growth rates - unless otherwise specified)

	Euro area		Western non-euro EU		United States		Japan	
	1995 2000	2001 2004	1995 2000	2001 2004	1995 2000	2001 2004	1995 2000	2001 2004
Gross domestic product	2.5	1.3	3.0	1.9	3.9	2.5	1.4	1.0
Private consumption	2.4	1.2	3.3	2.6	4.1	3.2	0.9	0.8
Gross fixed capital formation	3.7	-0.4	5.9	2.9	7.8	1.9	0.9	-1.2
Private consumption price	1.8	2.1	2.6	1.7	1.8	1.9	-0.1	-0.9
Short-term interest rate (level)	4.8	3.0	6.1	4.1	5.8	2.1	0.6	0.1
Long-term interest rate (level)	6.2	4.5	6.5	4.8	6.1	4.5	2.2	1.2
Equity price	22.5	-10.0	12.8	-7.6	21.0	-4.7	-1.5	-8.4
Residential building price	2.7	7.0	8.9	11.9	5.3	9.0	-2.6	-4.8

Against this background, interest rates were kept fairly low for most part of the 1995-2004 period, when compared with the average rates prevailing since the 1970s. In the euro area, the nominal short-term interest rate fell from 7.1 per cent in 1995 to 3.2 per cent in 1999, after which it was raised abruptly to 4.5 per cent in 2000 before declining to 2.1 per cent in 2004. In the United States, the nominal short-term interest rate stood at 6 per cent in 1995, fell to 5.4 per cent in 1999, before jumping to a peak of 6.5 per cent in 2000. The US rate subsequently declined to just 1.2 per cent in 2003 and rose to an average of 1.6 per cent in 2004.

1. Measured as the change in the consumer price deflator.

While equity prices showed signs of what was coined as "irrational exuberance" in the second half of the 1990s[1], economic policy makers generally adopted an attitude of benign neglect with respect to asset price developments; this appears clearly from the testimony of Federal Reserve Board Chairman Alan Greenspan (1999) before the Committee on Banking and Financial Services in July 1999: "The danger is that in these circumstances, an unwarranted, perhaps euphoric, extension of recent developments can drive equity prices to levels that are unsupportable even if risks in the future become relatively small. Such straying above fundamentals could create problems for our economy when the inevitable adjustment occurs. *It is the job of economic policy makers to mitigate the fallout when it occurs and, hopefully, ease the transition to the next expansion.*" (italics added).

This given, it is interesting to investigate how the US and euro area economies might have evolved had these areas' central banks not only targeted changes in the consumer price index but also changes in asset prices. We do this by simulating the NIME model[2] over the 1995-2004 period, with an interest rate rule similar to the Taylor rule but augmented for changes in asset prices[3].

The inclusion of changes in asset prices in the new interest rate rule is motivated by the fact that the household sector's intertemporal utility depends not only on contemporaneous prices and income, but also on future prices and income. Indeed, if equity prices rise above (fall below) their fundamentals, households tend to consume more (less) than if equity prices increase in line with their fundamentals. However, if equity prices rise above (drop below) their fundamentals, a future fall (rise) in equity prices will be necessary to restore stock market equilibrium and this future correction in asset prices will entail a future drop (increase) in private consumption. The size of the response of the short-term interest rate to the deviation of asset price inflation from its target rate is primarily determined by the weight of each expenditure item in the household's overall budget, as well as by the parameter values of the monetary authorities' loss function.

B. A counterfactual simulation for the 1995-2004 period

The results of the counterfactual simulation can be summarised as follows. Had an interest rate rule such as the one proposed in this Working Paper been adopted over the 1995-2004 period by the world's major central banks, interest rates in Europe and the United States would have come out above their historical baseline levels up to 2000. For example, the US short-term interest rate would have been 1.4 percentage-points above its historical baseline in 1999, while the short-term interest rate of the euro area would have been 0.9 percentage-point above baseline in 2000. The rate hikes in the euro area and the United States would have lowered these areas' domestic demand by increasing the cost of investment and reducing household wealth. However, as the rate hikes would have been highest in the United States, the US dollar would have appreciated against the other major currencies, thereby restraining export growth in the US and stimulating export growth from Europe and, especially, from Japan. After 2000, the implementation of the alternative interest rate rule would have led to a fall in interest rates below

1. See for instance Shiller (2000) and Greenspan (1996).
2. The NIME model is a macroeconometric world model developed by economists of the Belgian Federal Planning Bureau. See Appendix A for more details regarding the NIME model.
3. See Taylor (1993) or Meyermans (2002.b) for more details regarding the Taylor rule.

their historical baseline levels in the euro area and the United States; during this period, domestic demand in both areas would have come out above their historical baseline. Once again, the effect of the interest rate cuts on exchange rates is not straightforward as all areas except Japan would have benefited from significant interest rate cuts. In Japan, such cuts would not have been possible, as Japanese monetary authorities had already pushed historical nominal interest rates down to their lower bound.

On balance, the counterfactual simulation indicates for instance that a broad-based interest rate rule would have pushed the euro area's GDP above its historical level by about 0.3 per cent by the end of the 1995-2004 period and would have reduced US GDP by about 0.6 per cent by the end of the same period[1]. Japanese GDP would have come out 1.3 per cent above its historical baseline level by the end of the 1995-2004 period, mainly due to gains in exports stemming from the weakening of the yen in the wake of rising foreign interest rates (see Table 2). Nevertheless, Table 2 also shows that the implementation of the alternative interest rule would have reduced output volatility[2] somewhat.

TABLE 2 - Macroeconomic performance during the 1995-2004 period Summary of the counterfactual outcome

	Euro area	Western non-euro EU	United States	Japan
Discounted cumulative deviations from baseline level over 1995-2004				
Private consumption	0.1	-1.0	-0.8	0.3
Gross fixed capital formation	0.5	-0.3	-0.2	0.4
Exports	0.7	3.0	-2.6	8.9
Imports	-0.5	0.4	-2.2	-0.1
Gross Domestic Product	0.3	0.2	-0.6	1.3
Standard deviation over 1995-2004				
Historical GDP	0.9	0.7	1.3	1.5
Counterfactual GDP	0.8	0.7	1.0	1.4

Finally, we wish to mention a number of limitations inherent to our analysis. First, it should be noted that although the new interest rate rule lowers output variability, the rule itself is based on target values obtained through a filtering process applied to a historical outcome. In real-time however, formulating targets for asset prices may not be straightforward and be surrounded by great uncertainty.[3]

Second, the new interest rate rule focuses only on two specific asset prices, i.e. the price of equities and the price of residential buildings. In proceeding in this manner, we ignore for instance the exchange rate as a possible supplementary target of the monetary authorities. Indeed, our analysis uses the household intertemporal utility function to define an alternative interest rate rule, and it would not have been trivial to determine the weight of an exchange rate target in a new interest rate rule derived in this manner. Indeed, a change in the exchange rate affects household utility directly through its effect on the price of imports; it also affects household utility indirectly through the changes it may bring to employment, resulting from the output effect of a change in competitiveness. Third, by focusing exclusively on a broad price index for the household sector, and given the highly aggregated nature of the business sector in the NIME model, we give little weight

1. Measured as the discounted cumulative deviations of these variables from their baseline levels.
2. Measured by the standard deviation of real GDP.
3. This kind of informational problem, associated with the implementation of Taylor-type interest rate rules, is not only related to asset prices but also with output gaps. See Orphanides (2001), Dupor (2005), and Robinson and Stone (2005).

to the distorting effect that asset price bubbles may have on the allocation of investment within the business sector. Fourth, our analysis assumes that our alternative interest rate rule does not affect the underlying trend values, including trend inflation, trend productivity growth, and the equilibrium interest rate, thereby ignoring possible hysteresis effects. Fifth, it is assumed that the underlying forces which drive the rise and fall of stock prices are exogenous and that interest rates affect stock prices only to the extent that they modify the rate at which the (exogenous) expected dividends are discounted, thereby ignoring for instance the signalling effects that interest rate changes may have on the private sector's dividend outlook.

The rest of this Working Paper is organized as follows. First, we give a quick overview of the major macroeconomic facts of the 1995-2004 period and we show that developments in asset prices did not seem to be a major concern of the major central banks. Next, starting from a broad price index and a functional form similar to the traditional Taylor rule, we specify an interest rate rule whereby the monetary authorities not only target consumer price inflation and the output gap, but also changes in asset prices as well as changes in the output gap. Finally, we use the NIME model to simulate how the macroeconomic variables of the major economic areas would have evolved over the 1995-2004 period, had monetary authorities implemented such a broad-based interest rate rule.

II Selected stylised facts for the 1995-2004 period

In the first section of this chapter, we summarise the main macroeconomic developments in the major economic areas of the world over the 1995-2004 period. In the second section, we examine to what extent the central banks of these areas took asset price inflation into account when setting their short-term interest rates.

A. Asset price inflation and economic fluctuations

1. Some empirical regularities

Table 3 illustrates for the major economic areas of the world to what extent fluctuations in the main economic aggregates are correlated with fluctuations in equity prices, the deflator of residential buildings and interest rates[1].

In all areas the correlation between the fluctuations in real equity prices and business investment is fairly high, while the correlations between equity prices and the other components of aggregate demand are also not negligible. The correlation between equity prices and real GDP is highest in the US and lowest in the euro area.

The fluctuations in real estate prices show a distinctively high positive correlation with the fluctuations in household consumption and residential investment, especially in the Western non-euro EU member states[2]. In the euro area, this correlation is lower than in the other major areas, possibly indicating the presence of more strictly regulated financial markets that limit the possibilities that households have of borrowing against their assets.

Finally, the correlation between fluctuations in the real interest rate and the components of demand are negative in all cases except for US business sector investment and imports. We may note that the correlation between interest rates and real GDP is usually markedly higher in the euro area than in the other major economic areas of the world.

1. A fluctuation is defined as a deviation from trend. Trend values are obtained applying a Hodrick-Prescott filter to the historical data series. Prices and interest rates are deflated by the price indice of gross private sector output. Expenditure items are given per capita. The sample size is 1970-2004. Data is annual.
2. This area comprises Denmark, Sweden and the United Kingdom.

The previous statistics summarize a number of co-movements between fluctuations in macroeconomic aggregates and asset prices over a relatively long time period. Let us now have a closer look at the developments in each of the areas over 1995-2004. We focus on the developments in Europe, in the United States, and in Japan.

TABLE 3 - Price-quantity correlations for the 1970-2004 period

	Euro area	Western non-euro EU	United States	Japan
	Equity price			
GDP	0.24	0.34	0.37	0.33
Private consumption	0.23	0.31	0.36	0.13
Business investment	0.40	0.41	0.37	0.46
Residential investment	0.16	0.17	0.27	0.40
Imports	0.25	0.37	0.47	0.26
Exports	0.04	0.27	0.15	-0.19
	Deflator of residential buildings			
GDP	0.00	0.68	0.61	0.57
Private consumption	0.17	0.86	0.55	0.35
Business investment	0.01	0.62	0.09	0.66
Residential investment	0.20	0.79	0.47	0.60
Imports	0.05	0.65	0.30	0.54
Exports	-0.34	0.04	0.20	-0.26
	Long-term interest rate			
GDP	-0.45	-0.18	-0.23	-0.23
Private consumption	-0.28	-0.22	-0.17	-0.27
Business investment	-0.32	-0.13	0.00	-0.33
Residential investment	-0.10	-0.10	0.02	-0.17
Imports	-0.44	-0.27	0.07	-0.53
Exports	-0.21	-0.05	-0.50	-0.14

2. Europe and the United States over the 1995-2004 period

a. The evolution of asset prices

Equity prices in Europe and the United States have shown a distinct boom-and-bust pattern over the 1995-2004 period, with a strong rise in the late 1990s followed by a sharp correction following the turn of the century.

In the euro area, stock market indices increased on average by 22.5 per cent per annum between 1995 and 2000, only to fall at an annual average rate of 20.2 per cent between 2001 and 2003, followed by a 20.6 per cent increase in 2004[1]. At the same time, real estate prices increased by 4.4 per cent over the 1995-2004 period, growing somewhat faster after the turn of the century than in the second half of the 1990s (see Figure 1 and Table 4).

In the United States, the S&P500 index increased on average by 21 per cent per annum over the 1995-2000 period. It then fell at an annual average rate of 12 per cent between 2001 and 2003, only to rebound by 17.2 per cent in 2004. Throughout the whole period, real estate prices showed a robust annual increase of 6.8 per cent (see Figure 2 and Table 6).

1. The GDP-weighted average of the German Dax, the French CAC40, the Italian MIBtel and the Belgian Bel20.

FIGURE 1 - Asset prices in the euro area: 1995-2004
(growth rates)

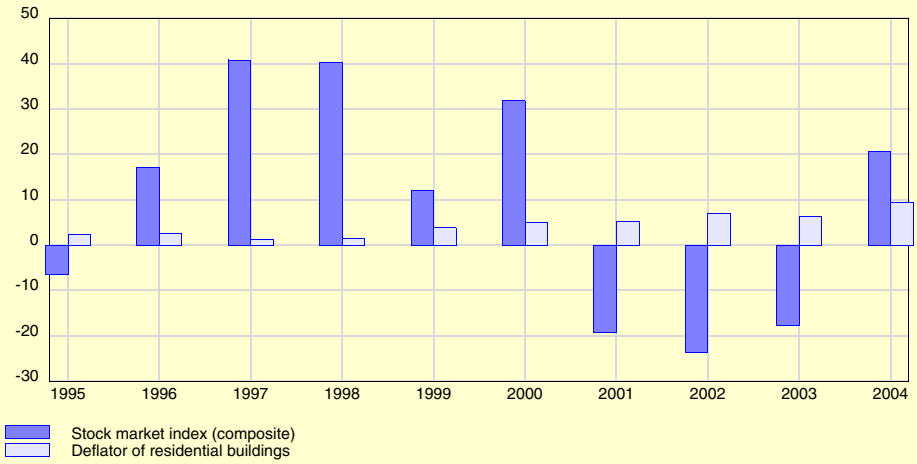


FIGURE 2 - Asset prices in the United States: 1995-2004
(growth rates)

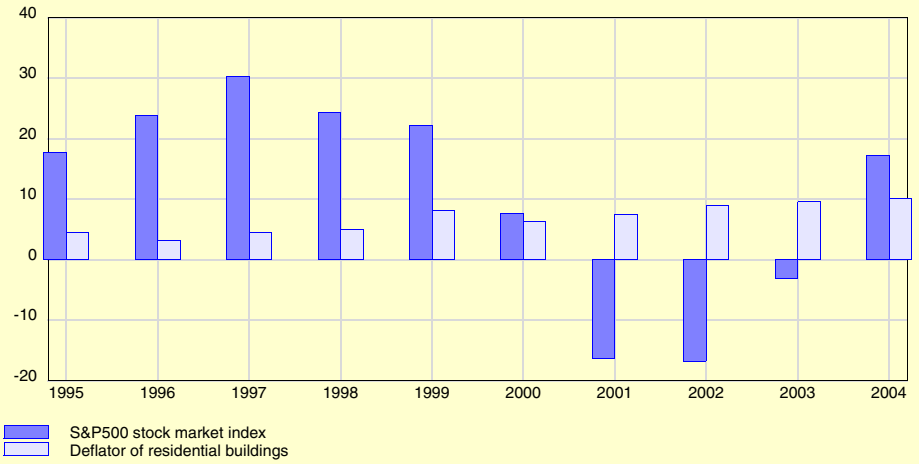
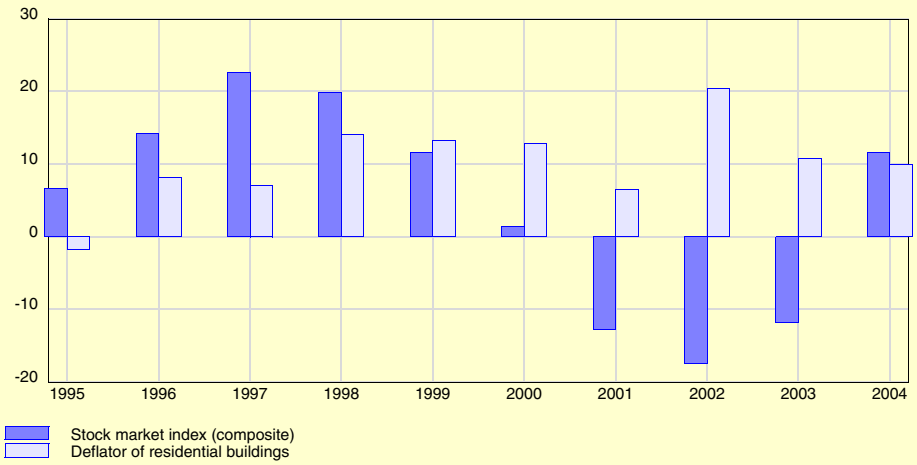


FIGURE 3 - Asset prices in the Western non-euro EU Member States: 1995-2004
(growth rates)



A composite stock market indice for the Western non-euro EU Member States[1] increased on average by 12.8 per cent during the 1995-2000 period and fell on average by 7.6 per cent per annum over the 2001-2004 period, thereby yielding an annual average increase of 4.6 per cent over the whole 1995-2004 period. Moreover, in this area, real estate prices were especially strong in later years, rising at an annual average rate of about 12 per cent over 2000-2004 (see Figure 3 and Table 5).

b. The evolution of final demand

While stock markets in Europe and the United States displayed distinct boom-and-burst patterns over the 1995-2004 period, aggregate demand and its components showed a similar - albeit more tempered - evolution.

In the euro area, real GDP growth averaged 2.5 per cent per year from 1995 to 2000, compared with only 1.3 per cent from 2001 to 2004 (see Figure 4). At the same time, private consumption growth came out on average at 1.9 per cent over the 1995-2004 period, reaching a high of 3.5 per cent in 1999 and a low of 0.6 per cent in 2002. Business sector investment increased on average by 3.1 per cent over the entire period, rising by up to 7.3 per cent in 1998 and falling by up to 3 per cent in 2002. Over the 1995-2004 period, euro area exports and imports rose on average by 5.8 and 5.9 per cent respectively. However, export growth reached a peak of 18.1 per cent in 2000 and fell by -2.1 per cent in 2003. Imports grew by 16.5 per cent in 2000 and fell by -0.7 per cent in 2002 (see Figure 5 and Table 4).

US real GDP grew on average by 3.9 per cent per annum over the 1995-2000 period, compared with 2.5 per cent over 2001-2004, resulting in an average growth rate of 3.3 per cent over the whole 1995-2004 period (see Figure 6 and Table 6). Business sector investment grew on average by 9.7 per cent per year over 1995-2000, before falling to an average growth rate of 0.4 per cent over 2001-2004. Private consumption was also relatively robust over the 1995-2000 period as it increased on average by 4.1 per cent, compared with 3.2 per cent over the 2001-2004 period (see Figure 7 and Table 6).

In the Western non-euro EU Member States, real GDP grew on average by 2.6 per cent over the 1995-2004 period, reaching a high of 3.7 per cent in 2000 and a low of 1.3 per cent in 2002 (see Figure 8 and Table 5). Private consumption and business sector investment grew at annual average rates of 3 and 5.7 per cent, respectively, over the 1995-2004 period. Over 1995-2000 they increased by 3.3 and 8.7 per cent respectively, compared with 2.6 and 1.2 per cent respectively over the 2001-2004 period (see Figure 9 and Table 5).

1. This area comprises Denmark, Sweden and the United Kingdom.

FIGURE 4 - Real GDP and consumer price inflation in the euro area: 1995-2004
(growth rates)

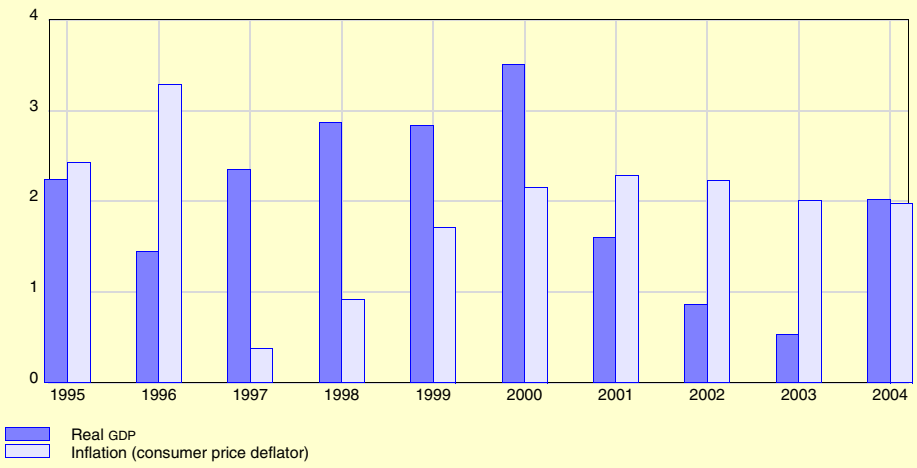


FIGURE 5 - Components of demand in the euro area: 1995-2004
(growth rates)

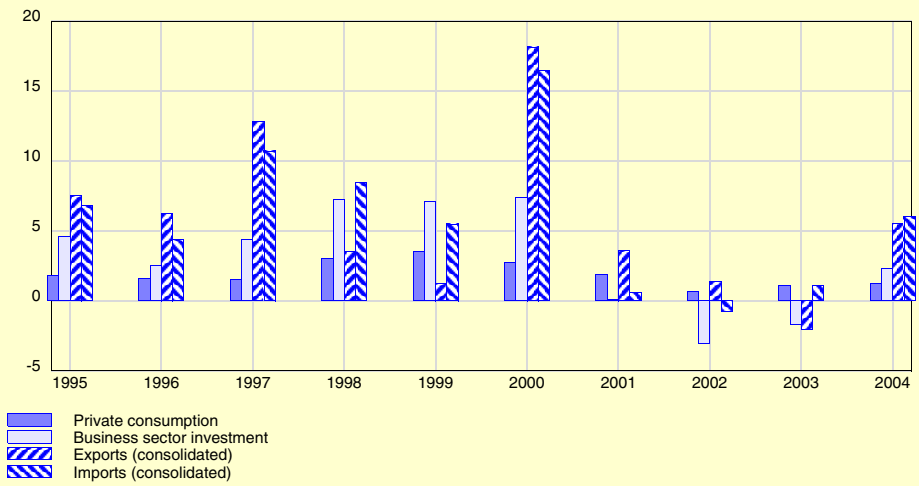


FIGURE 6 - Real GDP and consumer price inflation in the United States: 1995-2004
(growth rates)

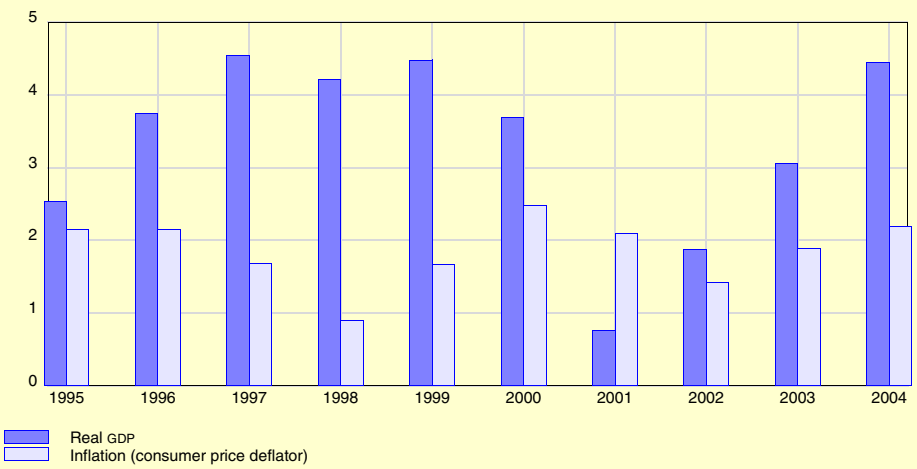


FIGURE 7 - Components of demand in the United States: 1995-2004
(growth rates)

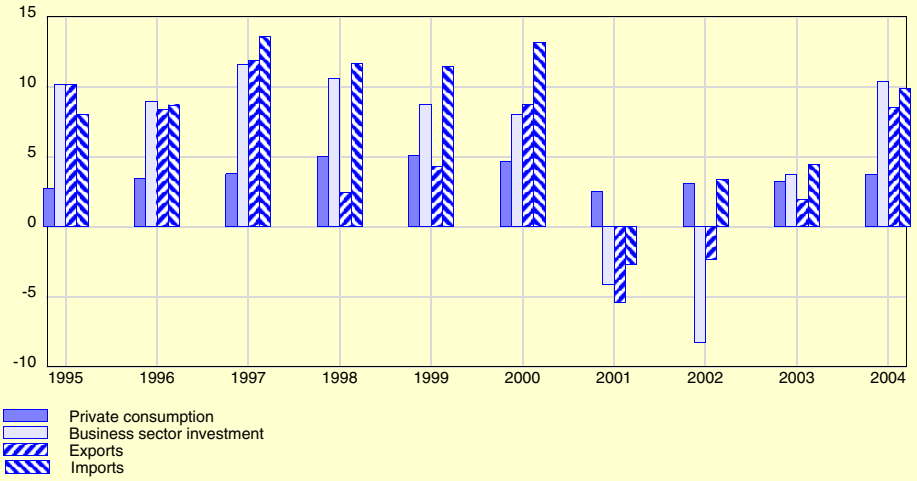


FIGURE 8 - Real GDP and consumer price inflation in the Western non-euro EU Member States: 1995-2004
(growth rates)

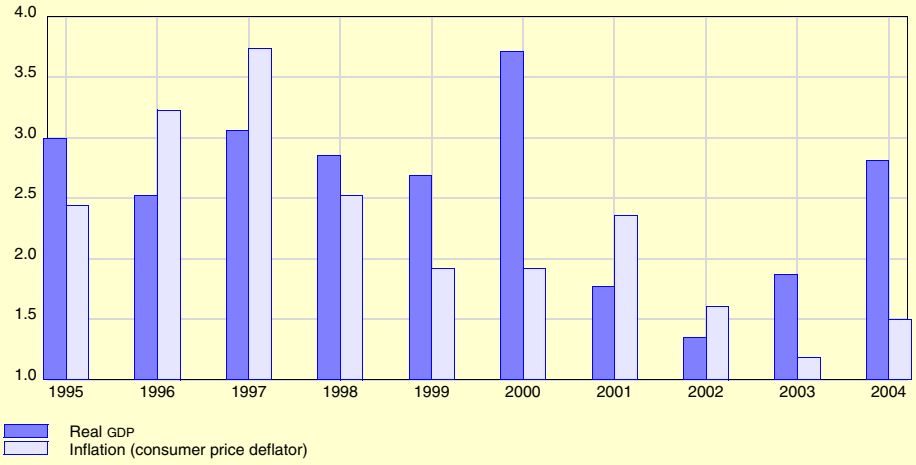
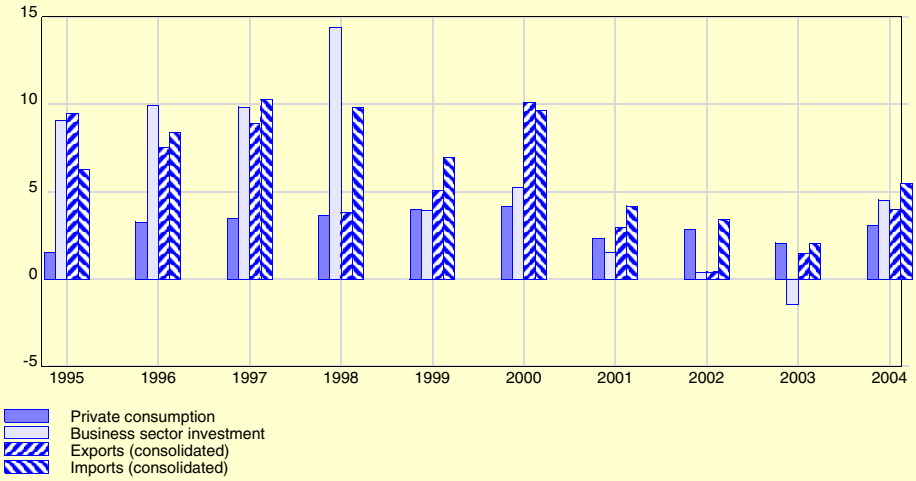


FIGURE 9 - Components of demand in the Western non-euro EU Member States: 1995-2004
(growth rates)



c. Prices

Inflation remained fairly low in Europe and the United States over the 1995-2004 period. In the euro area, the consumer price deflator increased on average by 1.9 per cent per annum between 1995 and 2004, with a high of 3.3 per cent in 1996 and a trough of 0.4 per cent in 1997.

In the United States, the consumer price deflator increased on average by 1.8 per cent during the 1995-2000 period and by 1.9 per cent during the 2000-2004 period, though price inflation showed more volatility over the course of the first period, reaching a high of 2.2 per cent in 1996 and a low of 0.9 per cent in 1998.

In the Western non-euro EU Member States, consumer price inflation averaged 2.3 per cent per annum over the entire 1995-2004 period, coming out at an average of 2.6 per cent per annum over 1995-2000 and 1.7 per cent over 2001-2004.

d. Interest rates

The short-term interest rate averaged 4.1 per cent in the euro area over the 1995-2004 period, with a high of 7.1 per cent in 1995 and a low of 2.1 per cent in 2004. At the same time, the real short-term interest rate - defined as the nominal short-term interest rate deflated by the GDP deflator - averaged 2.3 per cent per annum, with a high of 4.8 per cent in 1997 and a low of 0.2 per cent in 2003 and 2004. The long-term interest rate stood on average at 6.2 per cent over 1995-2000, compared with 4.5 per cent during the 2001-2004 period (see Figure 10).

In the United States, the short-term interest rate averaged 4.3 per cent over the whole period, reaching a high of 6.5 per cent in 2000 and a low of 1.2 per cent in 2003 (see Figure 12).

In the Western non-euro EU Member States, the short-term interest rate averaged 5.3 per cent, falling from an average of 6.1 per cent during the 1995-2000 period to an average of 4.1 per cent during the 2001-2004 period (see Figure 12).

FIGURE 10 - Interest rates in the euro area: 1995-2004
(levels, in per cent)

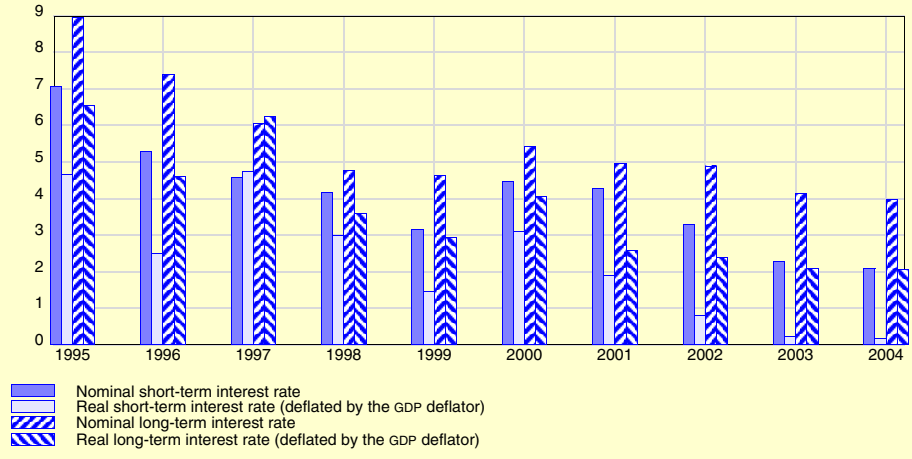


FIGURE 11 - Interest rates in the United States: 1995-2004
(levels, in per cent)

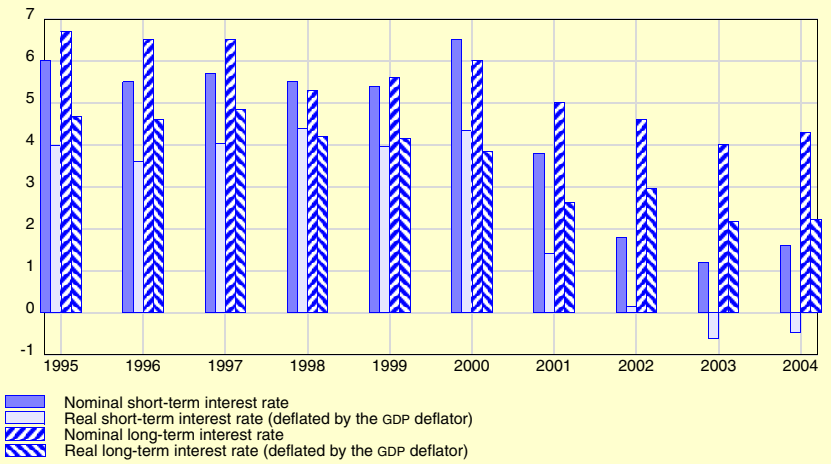
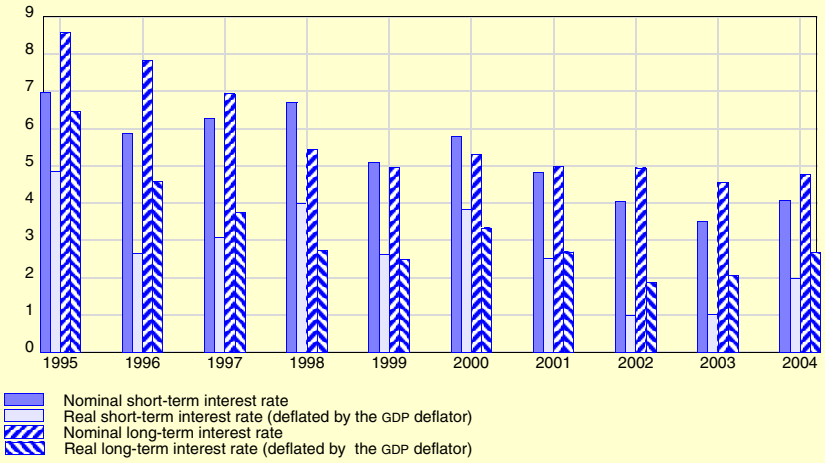


FIGURE 12 - Interest rates in the Western non-euro EU Member States: 1995-2004 *(levels, in per cent)*



3. Japan over the 1995-2004 period

Japanese equity prices pursued their downward trend throughout most of the 1995-2004 period, falling at an average annual rate of 1.5 per cent over 1995-2000 and at 8.4 per cent over 2001-2004 (see Figure 13 and Table 7).

Over the 1995-2004 period, consumer prices fell on average by 0.4 per cent per annum. At the same time, real GDP grew at an average annual rate of just 1.2 per cent (see Figure 14 and Table 7). Business sector investment growth in Japan averaged 2.5 per cent per annum, while private consumption increased by 0.9 per cent (see Figure 15 and Table 7).

The nominal short-term interest rate tended to decline throughout the whole period, reaching its lower bound of near-zero as of 2002. However, the decline in consumer prices as of 1999 pushed real interest rates up above the nominal rates with the real short-term interest rate averaging 0.8 per cent and reaching a high of 1.3 per cent in 2002 (see Figure 16 and Table 7).

FIGURE 13 - Asset prices in Japan: 1995-2004
(growth rates)

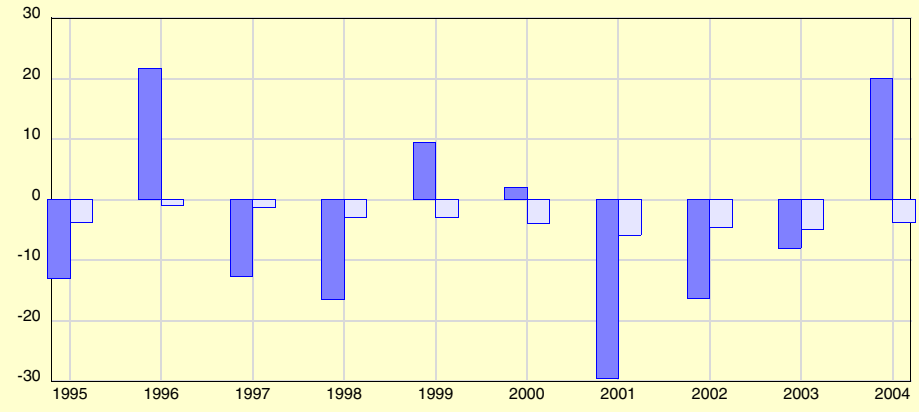


FIGURE 14 - Real GDP and consumer price inflation in Japan: 1995-2004
(growth rates)

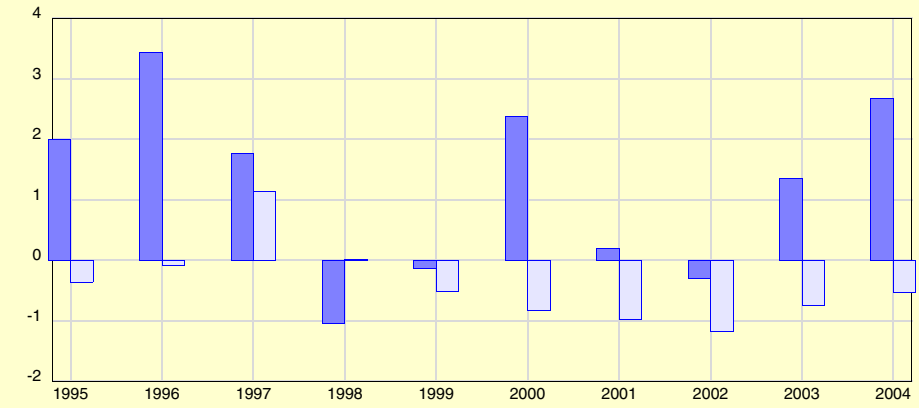


FIGURE 15 - Components of demand in Japan: 1995-2004
(growth rates)

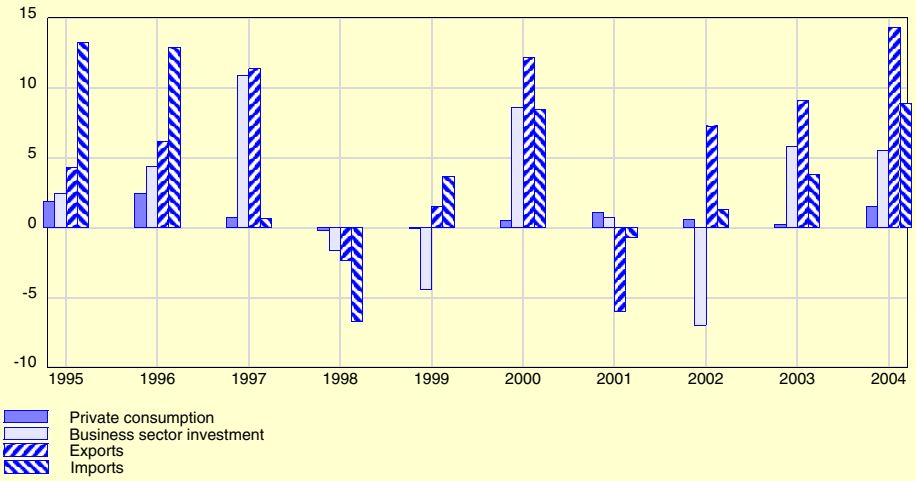
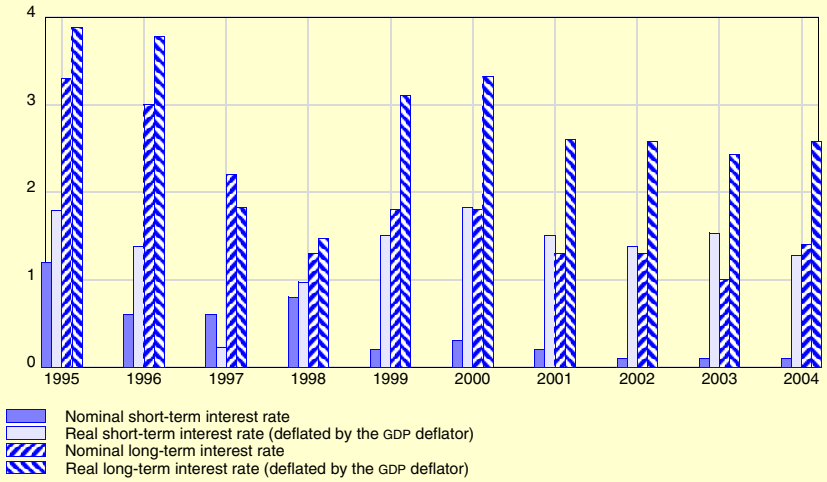


FIGURE 16 - Interest rates in Japan: 1995-2004
(levels, in per cent)



4. Detailed tables: The historical macroeconomic baselines of the major economic areas over the 1995-2004 period

TABLE 4 - Historical macroeconomic baseline of the euro area: 1995-2004
(growth rates - unless otherwise indicated)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Average 1995 2004	Average 1995 2000	Average 2001 2004
Demand/supply (in constant prices)													
Private consumption	1.8	1.6	1.5	3.0	3.5	2.8	1.9	0.6	1.1	1.2	1.9	2.4	1.2
Public consumption	0.8	1.7	1.4	1.4	1.8	2.3	2.5	3.1	1.6	1.6	1.8	1.6	2.2
Gross fixed capital formation	2.4	1.3	2.4	5.2	6.0	4.9	-0.3	-2.7	-0.6	1.9	2.1	3.7	-0.4
of which business sector	4.6	2.5	4.4	7.3	7.1	7.4	0.1	-3.0	-1.7	2.3	3.1	5.5	-0.6
Exports (consolidated)	7.6	6.3	12.8	3.5	1.2	18.1	3.6	1.4	-2.1	5.5	5.8	8.3	2.1
Imports (consolidated)	6.8	4.4	10.7	8.4	5.5	16.5	0.6	-0.7	1.1	6.0	5.9	8.7	1.7
Gross domestic product	2.2	1.4	2.3	2.9	2.8	3.5	1.6	0.9	0.5	2.0	2.0	2.5	1.3
Gross private sector output	2.9	1.7	3.5	4.0	3.4	5.7	1.5	0.4	0.5	2.8	2.6	3.5	1.3
Contributions to real GDP growth													
Total domestic expenditure	2.1	1.0	1.7	3.5	3.4	3.0	0.9	0.3	1.1	2.0	1.9	2.5	1.1
Net exports	0.2	0.3	0.5	-0.6	-0.6	0.5	0.6	0.4	-0.6	0.0	0.1	0.0	0.1
Deflators													
Gross domestic product	2.4	2.8	-0.2	1.2	1.7	1.4	2.4	2.5	2.1	1.9	1.8	1.6	2.2
Private consumption	2.4	3.3	0.4	0.9	1.7	2.2	2.3	2.2	2.0	2.0	1.9	1.8	2.1
Exports	-2.5	2.0	2.0	1.1	0.1	3.3	1.5	0.7	-1.5	1.1	0.8	1.0	0.5
Imports	-3.2	1.6	3.2	-1.6	0.4	10.0	0.2	-2.1	-2.8	1.7	0.7	1.7	-0.8
Price of oil (US$ per barrel)	17.1	20.4	19.1	12.7	17.7	28.6	24.4	25.0	28.9	38.3	23.2	19.3	29.1
Labour market													
Total employment	0.6	0.6	0.8	1.9	1.8	2.2	1.4	0.6	0.2	0.6	1.1	1.3	0.7
of which private sector	0.7	0.5	1.0	2.0	1.9	2.3	1.4	0.6	0.3	0.7	1.1	1.4	0.7
Unemployment rate (level, % of labour force)	10.5	10.7	10.6	10.1	9.2	8.2	7.8	8.2	8.7	8.8	9.3	9.9	8.4
Nominal wage, private sector	3.0	3.0	0.3	0.8	2.7	2.8	3.0	2.3	2.2	2.1	2.2	2.1	2.4
Take home real wage, private sector	0.4	-0.7	-0.2	0.2	0.9	0.6	1.2	0.6	0.6	0.2	0.4	0.2	0.7
Producer real wage, private sector	1.2	0.5	0.2	0.6	1.6	-0.4	0.7	0.8	1.1	0.4	0.7	0.6	0.7
Productivity (GDP per employee)	1.6	0.9	1.5	1.0	1.0	1.3	0.2	0.3	0.3	1.4	0.9	1.2	0.5
Financial sector													
Nominal short-term interest rate (level)	7.1	5.3	4.6	4.2	3.2	4.5	4.3	3.3	2.3	2.1	4.1	4.8	3.0
Nominal long-term interest rate (level)	8.9	7.4	6.1	4.8	4.6	5.4	5.0	4.9	4.1	4.0	5.5	6.2	4.5
Nominal effective exchange rate (-: apprec.)	-13.8	-10.7	-4.2	-6.4	-0.4	10.1	-1.2	-7.8	-12.1	-4.4	-5.1	-4.2	-6.4
Real effective exchange rate (-: apprec.)	5.9	4.7	17.8	-1.8	4.0	10.6	1.3	-5.3	-7.5	-2.0	2.8	6.9	-3.4
Stock market indice	-6.5	17.0	40.8	40.1	12.0	31.8	-19.2	-23.6	-17.7	20.6	9.5	22.5	-10.0
Deflator of residential buildings	2.3	2.5	1.2	1.6	3.8	5.1	5.3	6.9	6.4	9.3	4.4	2.7	7.0
Public finances													
Government net lending (% of GDP)	-5.0	-4.3	-2.7	-2.3	-1.3	0.1	-1.7	-2.4	-2.8	-2.7	-2.5	-2.6	-2.4
Government gross debt (% of GDP)	73.1	75.5	75.5	73.9	72.9	70.4	69.6	69.5	70.8	71.2	72.2	73.5	70.3
Household sector													
Total real available means	2.2	1.8	2.5	2.9	3.4	1.8	1.8	1.7	2.8	2.8	2.4	2.4	2.3
of which real disposable income	1.9	1.1	0.7	1.8	2.3	2.4	2.6	0.9	0.9	2.0	1.7	1.7	1.6
Net saving by households (level, % of disposable income)	12.4	12.0	11.3	10.3	9.2	8.9	9.5	9.7	9.6	10.3	10.3	10.7	9.8
International environment													
Foreign effective output	4.7	4.9	4.9	3.6	4.0	5.0	2.8	3.3	4.1	5.3	4.3	4.5	3.9
Foreign effective price level	19.8	19.6	25.4	6.0	4.6	3.8	4.1	3.6	3.6	3.6	9.4	13.2	3.7
Foreign effective interest rate (level)	8.3	7.6	8.2	7.8	7.1	7.6	5.2	3.0	2.1	2.6	6.0	7.8	3.2
Current account (level, % of GDP)	0.7	1.1	1.5	0.9	0.5	-0.3	0.3	0.9	0.3	0.4	0.6	0.7	0.5

TABLE 5 - Historical macroeconomic baseline of the Western non-euro EU Member States: 1995-2004
(growth rates - unless otherwise indicated)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Average 1995 2004	Average 1995 2000	Average 2001 2004
Demand/supply (in constant prices)													
Private consumption	1.5	3.3	3.5	3.6	4.0	4.1	2.3	2.8	2.1	3.1	3.0	3.3	2.6
Public consumption	1.1	1.5	-0.3	1.9	2.9	1.4	2.3	3.2	2.6	3.2	2.0	1.4	2.8
Gross fixed capital formation	5.1	5.3	6.3	11.6	2.5	4.4	2.4	2.2	1.5	5.6	4.7	5.9	2.9
of which business sector	9.1	9.9	9.8	14.4	3.9	5.3	1.5	0.4	-1.5	4.5	5.7	8.7	1.2
Exports (consolidated)	9.5	7.5	8.9	3.8	5.1	10.1	2.9	0.4	1.5	4.0	5.4	7.5	2.2
Imports (consolidated)	6.2	8.4	10.3	9.8	7.0	9.7	4.2	3.4	2.0	5.5	6.6	8.6	3.8
Gross domestic product	3.0	2.5	3.1	2.9	2.7	3.7	1.8	1.3	1.9	2.8	2.6	3.0	1.9
Gross private sector output	4.1	4.0	5.3	5.1	4.1	5.6	2.5	2.0	1.9	3.6	3.8	4.7	2.5
Contributions to real GDP growth													
Total domestic expenditure	2.1	2.7	3.4	4.8	3.4	3.8	2.3	2.5	2.2	3.6	3.1	3.4	2.6
Net exports	0.9	-0.2	-0.4	-1.9	-0.7	-0.1	-0.5	-1.2	-0.3	-0.8	-0.5	-0.4	-0.7
Deflators													
Gross domestic product	2.1	3.3	3.2	2.7	2.5	2.0	2.3	3.1	2.5	2.1	2.6	2.6	2.5
Private consumption	2.4	3.2	3.7	2.5	1.9	1.9	2.4	1.6	1.2	1.5	2.2	2.6	1.7
Exports	2.0	-1.2	-12.0	-5.7	-2.4	-1.4	2.4	1.0	5.4	-1.4	-1.3	-3.4	1.8
Imports	3.9	-2.2	-14.4	-7.2	-2.8	-0.4	2.8	-0.9	4.5	-1.5	-1.8	-3.8	1.2
Price of oil (US$ per barrel)	17.1	20.4	19.1	12.7	17.7	28.6	24.4	25.0	28.9	38.3	23.2	19.3	29.1
Labour market													
Total employment	1.2	0.8	1.4	1.2	1.3	1.4	1.1	1.0	0.8	0.7	1.1	1.2	0.9
of which private sector	2.0	1.3	1.6	1.2	1.0	1.3	1.1	1.1	0.9	0.8	1.2	1.4	1.0
Unemployment rate (level, % of labour force)	8.5	8.1	7.1	6.4	6.0	5.4	5.0	5.1	5.1	5.0	6.2	6.9	5.0
Nominal wage, private sector	2.2	3.9	6.2	6.2	4.8	6.8	4.7	2.6	2.7	3.6	4.4	5.0	3.4
Take home real wage, private sector	-1.0	0.6	3.4	2.5	2.4	4.4	3.0	2.2	1.2	1.4	2.0	2.1	1.9
Producer real wage, private sector	-0.4	2.2	8.1	6.4	4.5	5.4	2.0	0.9	0.0	2.6	3.2	4.4	1.4
Productivity (GDP per employee)	1.8	1.7	1.6	1.6	1.3	2.3	0.7	0.3	1.1	2.1	1.5	1.7	1.1
Financial sector													
Nominal short-term interest rate (level)	7.0	5.9	6.3	6.7	5.1	5.8	4.8	4.1	3.5	4.1	5.3	6.1	4.1
Nominal long-term interest rate (level)	8.6	7.8	6.9	5.4	5.0	5.3	5.0	4.9	4.6	4.8	5.8	6.5	4.8
Nominal effective exchange rate (-: apprec.)	-4.9	-6.1	-10.2	-7.0	-2.8	0.5	1.3	-6.0	-2.0	-5.4	-4.3	-5.1	-3.0
Real effective exchange rate (-: apprec.)	4.2	4.4	11.2	3.0	3.6	5.7	2.4	-3.9	-4.1	-0.9	2.5	5.3	-1.6
Stock market indice	6.7	14.2	22.7	19.8	11.6	1.4	-12.7	-17.4	-11.8	11.6	4.6	12.8	-7.6
Deflator of residential buildings	-1.8	8.1	7.1	14.1	13.3	12.8	6.5	20.4	10.8	10.0	10.1	8.9	11.9
Public finances													
Government net lending (% of GDP)	-5.6	-3.6	-1.8	0.4	1.4	3.9	1.1	-1.2	-2.5	-2.1	-1.0	-0.9	-1.2
Government gross debt (% of GDP)	58.0	57.9	55.0	51.6	48.6	44.3	41.4	40.9	41.9	43.0	48.3	52.6	41.8
Household sector													
Total real available means	2.0	2.9	5.3	3.2	5.3	2.6	1.4	3.6	4.0	3.3	3.4	3.6	3.1
of which real disposable income	2.2	2.2	2.9	0.5	2.3	4.4	4.4	1.7	2.6	3.1	2.6	2.4	2.9
Net saving by households (level, % of disposable income)	6.2	5.2	4.7	1.7	0.1	0.4	2.4	1.3	1.8	1.8	2.6	3.1	1.8
International environment													
Foreign effective output	4.1	3.8	4.4	3.7	3.9	5.5	2.3	2.3	3.1	4.6	3.8	4.2	3.1
Foreign effective price level	11.7	9.8	9.0	4.4	4.0	3.7	3.5	3.2	3.0	3.3	5.6	7.1	3.2
Foreign effective interest rate (level)	6.8	5.7	5.5	5.2	4.5	5.6	4.1	2.5	1.7	1.9	4.4	5.6	2.5
Current account (level, % of GDP)	-0.5	-0.1	0.3	0.0	-1.4	-1.3	-0.9	-0.5	-0.5	-0.3	-0.5	-0.5	-0.6

TABLE 6 - Historical macroeconomic baseline of the United States: 1995-2004
(growth rates - unless otherwise indicated)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Average 1995 2004	Average 1995 2000	Average 2001 2004
Demand/supply (in constant prices)													
Private consumption	2.7	3.4	3.8	5.0	5.1	4.7	2.5	3.1	3.3	3.8	3.7	4.1	3.2
Public consumption	0.1	0.5	1.4	1.7	3.3	1.9	3.3	4.4	3.2	2.3	2.2	1.5	3.3
Gross fixed capital formation	6.2	8.4	8.8	9.3	8.3	6.1	-1.9	-3.5	4.4	8.8	5.5	7.8	1.9
of which business sector	10.2	8.9	11.6	10.6	8.8	8.0	-4.1	-8.3	3.7	10.4	6.0	9.7	0.4
Exports	10.1	8.4	11.9	2.4	4.3	8.7	-5.4	-2.4	1.9	8.5	4.9	7.6	0.7
Imports	8.0	8.7	13.6	11.6	11.5	13.1	-2.7	3.4	4.4	9.9	8.2	11.1	3.8
Gross domestic product	2.5	3.7	4.5	4.2	4.5	3.7	0.8	1.9	3.1	4.5	3.3	3.9	2.5
Gross private sector output	3.4	4.7	6.0	5.4	5.7	5.3	-0.0	2.0	3.4	5.6	4.1	5.1	2.7
Contributions to real GDP growth													
Total domestic expenditure	2.4	3.9	4.9	5.4	5.6	4.6	0.9	2.5	3.5	5.2	3.9	4.5	3.0
Net exports	0.1	-0.1	-0.4	-1.3	-1.2	-1.0	-0.2	-0.9	-0.5	-0.8	-0.6	-0.7	-0.6
Deflators													
Gross domestic product	2.0	1.9	1.7	1.1	1.4	2.2	2.4	1.7	1.8	2.1	1.8	1.7	2.0
Private consumption	2.1	2.2	1.7	0.9	1.7	2.5	2.1	1.4	1.9	2.2	1.9	1.8	1.9
Exports	2.3	-1.3	-1.7	-2.3	-0.6	1.7	-0.4	-0.3	2.1	3.5	0.3	-0.3	1.2
Imports	2.7	-1.8	-3.6	-5.4	0.6	4.2	-2.5	-1.2	3.4	5.0	0.1	-0.5	1.2
Price of oil (US$ per barrel)	17.1	20.4	19.1	12.7	17.7	28.6	24.4	25.0	28.9	38.3	23.2	19.3	29.1
Labour market													
Total employment	1.9	1.7	2.2	2.4	2.2	2.2	-0.1	-0.8	0.0	1.1	1.3	2.1	0.1
of which private sector	2.2	2.1	2.5	2.6	2.3	2.2	-0.5	-1.3	0.0	1.1	1.3	2.3	-0.2
Unemployment rate (level, % of labour force)	5.6	5.4	4.9	4.5	4.2	4.0	4.7	5.8	6.0	5.5	5.1	4.8	5.5
Nominal wage, private sector	2.7	2.7	3.9	5.2	4.3	5.9	2.6	2.6	3.7	4.6	3.8	4.1	3.4
Take home real wage, private sector	0.1	-0.5	1.2	3.5	2.2	2.7	1.1	4.9	2.4	2.3	2.0	1.5	2.7
Producer real wage, private sector	0.4	1.2	2.9	4.9	2.9	3.5	0.8	1.8	1.6	2.1	2.2	2.6	1.6
Productivity (GDP per employee)	0.6	2.0	2.3	1.8	2.3	1.4	0.8	2.7	3.1	3.3	2.0	1.8	2.5
Financial sector													
Nominal short-term interest rate (level)	6.0	5.5	5.7	5.5	5.4	6.5	3.8	1.8	1.2	1.6	4.3	5.8	2.1
Nominal long-term interest rate (level)	6.7	6.5	6.5	5.3	5.6	6.0	5.0	4.6	4.0	4.3	5.5	6.1	4.5
Nominal effective exchange rate (-: apprec.)	-2.6	-6.6	-8.2	-10.2	-5.3	-4.6	-6.1	-4.8	6.0	4.5	-3.8	-6.2	-0.1
Real effective exchange rate (-: apprec.)	9.3	4.1	0.3	-2.7	0.1	-2.5	-1.9	-0.9	7.7	4.8	1.8	1.4	2.4
Stock market indice	17.7	23.8	30.3	24.3	22.2	7.6	-16.3	-16.7	-3.1	17.2	10.7	21.0	-4.7
Deflator of residential buildings	4.6	3.2	4.5	5.0	8.2	6.3	7.5	9.0	9.6	10.1	6.8	5.3	9.0
Public finances													
Government net lending (% of GDP)	-3.2	-2.2	-0.8	0.4	0.9	1.6	-0.4	-3.8	-4.6	-4.4	-1.6	-0.5	-3.3
Government gross debt (% of GDP)	74.8	74.0	71.4	68.2	64.5	58.6	58.3	60.5	62.9	63.8	65.7	68.6	61.4
Household sector													
Total real available means	3.1	2.4	3.3	3.0	4.6	0.3	1.6	3.9	5.0	3.5	3.1	2.8	3.5
of which real disposable income	2.5	3.0	3.4	3.9	4.3	3.3	2.6	4.4	3.6	4.2	3.5	3.4	3.7
Net saving by households (level, % of disposable income)	5.1	4.8	4.5	3.4	2.6	1.3	1.3	2.6	2.9	3.3	3.2	3.6	2.5
International environment													
Foreign effective output	4.7	4.8	4.6	3.1	3.7	5.4	2.9	3.1	4.1	5.2	4.2	4.4	3.8
Foreign effective price level	14.8	10.0	7.3	5.9	5.0	4.0	4.0	3.8	3.8	3.7	6.2	7.8	3.8
Foreign effective interest rate (level)	5.6	4.7	4.7	4.6	3.8	4.7	3.2	1.7	1.2	1.5	3.6	4.7	1.9
Current account (level, % of GDP)	-1.2	-1.3	-1.3	-2.2	-3.0	-4.1	-3.7	-4.4	-4.7	-5.4	-3.1	-2.2	-4.5

TABLE 7 - Historical macroeconomic baseline of Japan: 1995-2004
(growth rates - unless otherwise indicated)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Average 1995 2004	Average 1995 2000	Average 2001 2004
Demand/supply (in constant prices)													
Private consumption	1.9	2.5	0.7	-0.2	-0.0	0.5	1.1	0.5	0.2	1.5	0.9	0.9	0.8
Public consumption	4.4	3.0	1.1	2.2	4.7	4.9	3.0	2.6	1.2	2.7	3.0	3.4	2.4
Gross fixed capital formation	0.9	6.4	0.8	-3.8	-1.2	2.0	-1.4	-5.7	0.9	1.6	0.1	0.9	-1.2
of which business sector	2.4	4.4	10.9	-1.6	-4.5	8.6	0.7	-7.0	5.8	5.5	2.5	3.4	1.3
Exports	4.3	6.2	11.3	-2.4	1.5	12.1	-6.0	7.3	9.1	14.3	5.8	5.5	6.2
Imports	13.3	12.9	0.7	-6.7	3.7	8.5	-0.7	1.3	3.8	8.9	4.5	5.4	3.3
Gross domestic product	2.0	3.4	1.8	-1.0	-0.1	2.4	0.2	-0.3	1.4	2.7	1.2	1.4	1.0
Gross private sector output	2.7	4.3	1.6	-1.7	-0.0	2.8	0.0	-0.3	1.5	3.4	1.4	1.6	1.2
Contributions to real GDP growth													
Total domestic expenditure	2.5	3.9	0.7	-1.4	0.0	1.9	0.7	-1.0	0.7	1.9	1.0	1.3	0.6
Net exports	-0.5	-0.4	1.0	0.3	-0.1	0.6	-0.6	0.7	0.7	1.0	0.2	0.1	0.4
Deflators													
Gross domestic product	-0.6	-0.8	0.4	-0.2	-1.3	-1.5	-1.3	-1.3	-1.4	-1.2	-0.9	-0.7	-1.3
Private consumption	-0.4	-0.1	1.1	0.0	-0.5	-0.8	-1.0	-1.2	-0.7	-0.5	-0.4	-0.1	-0.9
Exports	-2.0	3.2	1.6	0.6	-8.5	-3.7	1.2	-1.0	-3.3	-1.6	-1.4	-1.5	-1.2
Imports	-1.7	8.8	6.3	-2.8	-8.5	2.2	3.8	-1.2	-0.8	2.2	0.8	0.7	1.0
Price of oil (US$ per barrel)	17.1	20.4	19.1	12.7	17.7	28.6	24.4	25.0	28.9	38.3	23.2	19.3	29.1
Labour market													
Total employment	0.1	0.4	1.0	-0.7	-0.8	-0.1	-0.6	-1.4	-0.3	0.2	-0.2	-0.0	-0.5
of which private sector	0.1	0.4	1.1	-0.7	-0.9	-0.1	-0.6	-1.4	-0.3	0.2	-0.2	0.0	-0.5
Unemployment rate (level, % of labour force)	3.1	3.4	3.4	4.1	4.7	4.7	5.0	5.4	5.3	4.7	4.4	3.9	5.1
Nominal wage, private sector	1.4	0.6	1.4	-0.2	-1.1	0.1	-0.5	-1.7	-0.6	-1.2	-0.2	0.4	-1.0
Take home real wage, private sector	2.2	0.2	0.0	0.9	-0.3	0.3	-0.5	0.2	-0.2	-1.3	0.2	0.6	-0.4
Producer real wage, private sector	2.3	0.7	0.4	1.1	0.8	1.1	0.5	-0.6	0.4	-0.4	0.6	1.0	-0.0
Productivity (GDP per employee)	1.9	3.0	0.7	-0.4	0.7	2.5	0.8	1.1	1.7	2.5	1.4	1.4	1.5
Financial sector													
Nominal short-term interest rate (level)	1.2	0.6	0.6	0.8	0.2	0.3	0.2	0.1	0.1	0.1	0.4	0.6	0.1
Nominal long-term interest rate (level)	3.3	3.0	2.2	1.3	1.8	1.8	1.3	1.3	1.0	1.4	1.8	2.2	1.2
Nominal effective exchange rate (-: apprec.)	-9.0	11.3	5.1	1.9	-16.4	-9.2	9.0	0.6	-3.1	-3.7	-1.4	-2.7	0.7
Real effective exchange rate (-: apprec.)	1.8	15.3	8.9	4.9	-5.4	-2.5	11.2	4.5	3.4	1.1	4.3	3.8	5.0
Stock market indice	-13.1	21.7	-12.8	-16.5	9.5	2.0	-29.5	-16.3	-8.0	20.1	-4.3	-1.5	-8.4
Deflator of residential buildings	-3.7	-1.0	-1.3	-2.9	-2.9	-3.9	-5.9	-4.6	-5.0	-3.8	-3.5	-2.6	-4.8
Public finances													
Government net lending (% of GDP)	-4.7	-5.1	-3.8	-10.8	-7.2	-7.5	-6.1	-7.9	-7.7	-7.0	-6.8	-6.5	-7.2
Government gross debt (% of GDP)	87.1	93.9	100.3	112.2	125.7	134.1	142.3	149.5	157.5	163.2	126.6	108.9	153.1
Household sector													
Total real available means	1.5	1.3	0.8	1.3	1.8	-0.0	-0.5	1.3	0.1	0.3	0.8	1.1	0.3
of which real disposable income	1.2	0.2	0.7	0.6	-0.6	-0.9	-2.2	1.1	0.5	1.8	0.2	0.2	0.3
Net saving by households (level, % of disposable income)	12.6	10.6	10.6	11.3	10.8	9.5	6.5	7.1	7.3	7.6	9.4	10.9	7.2
International environment													
Foreign effective output	4.2	4.5	5.2	4.3	4.6	5.5	1.8	2.6	3.7	5.3	4.2	4.7	3.3
Foreign effective price level	9.7	6.9	5.3	3.6	3.5	3.4	3.2	2.8	3.1	3.2	4.5	5.4	3.1
Foreign effective interest rate (level)	6.4	5.7	5.7	5.5	5.1	6.2	4.1	2.2	1.5	1.8	4.4	5.8	2.4
Current account (level, % of GDP)	2.1	1.4	2.3	3.0	2.6	2.5	2.1	2.8	3.2	3.7	2.6	2.3	2.9

B. Asset price inflation and interest rate rules

This section examines to what extent short-term interest rate policy might have been affected by changes in asset prices in the past.

1. The Taylor rule

The Taylor rule has become a conventional tool for the study of monetary policy (see Taylor (1993)). According to this rule, the monetary authorities increase (decrease) the nominal short-term interest rate more than proportionally in response to increases (decreases) in inflation, thereby increasing (decreasing) real interest rates as inflationary pressures rise (fall). Under a Taylor rule the monetary authorities also keep the short-term interest rate below (above) the equilibrium interest rate if demand is below (above) potential output.

In its general form, the Taylor rule reads as:

(1) SI = HP_LI + si_1 (INFL_PCH - TARGETINFL_PCH) + si_2 OUTPUTGAP

where SI is the nominal short-term interest rate, HP_LI the equilibrium nominal interest rate, OUTPUTGAP the output gap, INFL_PCH consumer price inflation and TARGETINFL_PCH the target inflation rate. A useful benchmark for the parameter values is provided in Taylor (1993), in which parameter values of 0.5 for si_1 and of 1.5 for si_2 are suggested for the US economy.

In the default version of the NIME model, interest rate changes are smoothed by embedding the Taylor rule (1) in a partial adjustment scheme, so that the interest rate rule reads as:

(2) SI = si_sl (HP_LI + si_1 (INFL_PCH - TARGETINFL_PCH) + si_2 OUTPUTGAP)

- (1-si_sl) SI_{-1}

with $0 \leq si\_sl \leq 1$.

2. Asset prices and interest rate responses in the past

In this section, we test the hypothesis that monetary authorities of the major economic areas targeted only the output gap and consumer price inflation (while smoothing interest rate changes), against the alternative hypothesis that they targeted the output gap, consumer price inflation as well as a measure of asset price inflation (while smoothing interest rate changes). We do this by adding to equation (2) a variable capturing the change in equity prices (relative to a targeted change), as well as a variable capturing the change in the price of residential buildings (relative to a targeted change).

We estimated the following equation:

(3) $SI = si\_sl\ (HP\_LI + si\_1\ (INFL\_PCH - TARGETINFL\_PCH) + si\_2\ OUTPUTGAP)$

$- (1\text{-}si\_sl)\ SI_{-1}$

$+ si\_s3\ (INFL\_PCAOE - TARGETINFL\_PCAOE)$

$+ si\_s4\ (INFL\_PCIR - TARGETINFL\_PCIR)$

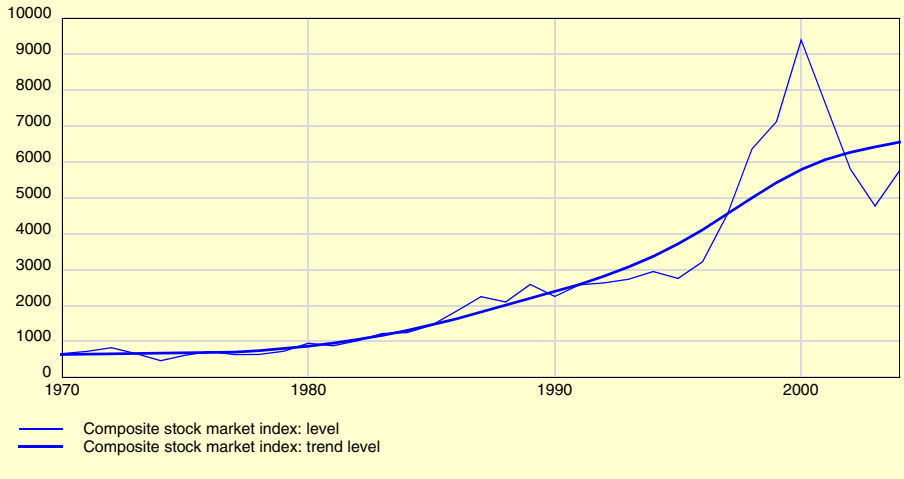
$+ SI\_V$

where the variable INFL_PCAOE is a measure of the increase in the equity price, INFL_PCIR is a measure of the increase in the price of residential buildings, TARGET_PCAOE is the targeted increase in price of equity, and TARGET_PCIR is the targeted increase in the price of residential buildings. The targeted price increases, as well as the equilibrium interest rate, are obtained by applying a Hodrick-Prescott filter to the corresponding historical series (see also figures 17 and 18). The variable SI_V is a stochastic variable capturing randomness in human behaviour.

The parameters si_s3 and si_s4 are expected not to be significantly different from zero[1], indicating that asset price inflation was not a significant determinant of past monetary policy.

Table 5 shows the instrumental variables estimation results for the period 1975-2004 of equation (3). Clearly, the point estimates for si_s3 and si_s4 in Table 5 support the hypothesis that asset price inflation was not a major concern of the monetary authorities in setting past interest rate policy.

FIGURE 17 - The composite stock market indice in the euro area: 1970-2004



1. H_O: $si\_s3 = si\_s4 = 0$
   H_1: $si\_s3, si\_s4 > 0$

FIGURE 18 - The S&P500 indice in the United States: 1970-2004

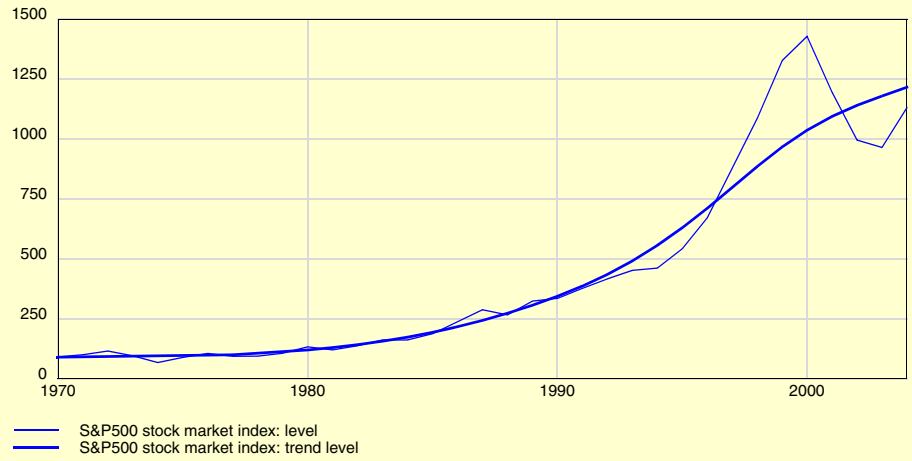


TABLE 8 - Estimation results for equation (3)

	Euro area	Non-euro EU	United States	Japan
si_s1	1.50	1.50	1.50	1.50
	-.-	-.-	-.-	-.-
si_s2	0.50	0.50	0.50	0.50
	-.-	-.-	-.-	-.-
si_sl	0.31	0.44	0.33	0.52
	(0.18)	(0.17)	(0.14)	(0.09)
si_s3	0.04	0.05	0.02	0.01
	(0.04)	(0.07)	(0.04)	(0.01)
si_s4	0.26	-0.07	-0.10	-0.04
	(0.34)	(0.10)	(0.21)	(0.05)
R2-adjusted	0.85	0.76	0.78	0.86
Durbin Watson	1.42	1.44	1.14	1.00

Note: sample size from 1975 until 2004, standard errors between brackets.

Instrumental variables estimation. Instruments include for each area its equilibrium interest rate, lagged inflation rate, lagged output gap, lagged interest rate, lagged asset prices and the contemporaneous trend asset prices (Japan: ordinary least squares estimates).

The hypothesis that monetary authorities did not explicitly take asset price inflation into account in implementing their interest rate policy is also supported by statements made by various leading central bankers. For example, Federal Reserve Chairman Greenspan (2004) states: "There is little dispute that the prices of stocks, bonds, homes, real estate, and exchange rates affect GDP. But *most central banks have chosen, at least to date, not to view asset prices as targets of policy,* but as economic variables to be considered through the prism of the policy's ultimate objective." (italics added). On the side of the ECB, President Duisenberg (2003), declared: "However, *the importance of asset price bubbles and their potentially distorting impact on economic and financial processes does not mean that central banks should make asset prices an explicit goal for their monetary policies*. This idea has been refuted by many, and rightfully so. Asset prices are predominantly driven by real factors such as technological and demographic developments and preferences, which cannot be controlled by monetary policy." (italics added).

III Results of the counterfactual simulation for the 1995-2004 period

The discussion presented in the previous chapter indicates that in the past, the monetary authorities of the major economic areas did not target asset price inflation in a systematic way when setting the short-term interest rates. In this chapter, we present results from a simulation carried out with the NIME model on how the main macroeconomic aggregates of the major economic areas of the world might have evolved over the 1995-2004 period had the central banks of these areas included asset price inflation in their interest rate rule.

In the first section of this chapter, we specify an alternative interest rate rule, based on a broad price index and a functional form similar to the standard Taylor rule. The use of such a broader price index is motivated by the fact that the household sector's intertemporal (indirect) utility depends not only on contemporaneous prices and income, but also on future prices and income. In the second section, we present the results of a counterfactual simulation based on the broad-based interest rate rule specified in the first section.

A. A broad-based interest rate rule

In this section, we specify a broader-based interest rate rule. Our starting point is the assumption that household utility depends not only on the contemporaneous consumption of goods and services, but also on the contemporaneous consumption of other services (such as liquidity services generated by currency balances or housing services rendered by real estate) as well as the future consumption of these goods and services. Consequently, any price index which measures the welfare cost of price changes should reflect the depth of these choices.

1. The intertemporal allocation problem of the household sector

In the NIME model, the household sector allocates its total available means over goods and services, money balances (which generate liquidity services), residential buildings (which provide housing services) and financial assets (other than money, which provide future purchasing power), maximizing its intertemporal utility subject to its intertemporal budget constraint.

In Appendix A of Meyermans and Van Brusselen (2000.a), it is shown that the intertemporal optimization problem of the household sector can be characterised in terms of a goods vector Y:

(4.a) $$Y' = (CPO, \frac{M}{PCH}, CIRO, Z)$$

and a price vector Π:

(4.b) $$\Pi' = (PCH, \frac{LIC}{(1+LIC)} PCH, \frac{LIC + \rho_{iro} - \left(\frac{PCIR_{+1}}{PCIR} - 1\right)(1-\rho_{iro})}{1+LIC} PCIR, \frac{PCH_{+1}}{1+LIC})$$

where CPO is private consumption, M nominal money balances, PCH the consumer price, CIRO the stock of residential buildings, Z assets generating future purchasing power, LIC an interest rate[1], PCIR the price of residential buildings, and ρ_{iro} the rate of depreciation of residential buildings. The variable Z, measuring future purchasing power, is defined as:

(4.c) $$Z = (M+CIRO(1-\rho_{iro})\,PCIR_{+1} + INVHO\,(1-\rho_{invh})\,PINVH_{+1} + CAOU\,(1+LIC) + ZY_{+1})/PCH_{+1}$$

where INVHO is inventories held by households, PINVH the price of inventories, CAOU the stock of financial assets (equity and bonds) and ZY is expected future non-asset income[2].

For notational convenience, we rewrite the price vector in short-hand notation as[3]:

(4.d) $$\Pi' = (PCH, PM, USERIR, PZ).$$

The interpretation of the prices in equations (4.b) and (4.d) are as follows (see also Meyermans and Van Brusselen (2000.a)). In order to acquire one unit of real money balances, M/PCH, one has to spend PCH units of the currency. By holding PCH units of money instead of an interest-bearing financial asset, one foregoes a yield equal to LIC PCH. The present value of this is:

$$PM = \frac{LIC}{(1+LIC)} PCH.$$

1. LIC is a weighted average of the short-term and long-term interest rate.
2. In Meyermans and van Brusselen (2000.a) it was assumed that real estate, bonds, and human capital are perfect substitutes. In this Working Paper, we relax this assumption. See Appendix B.
3. We define:

$$PM = \frac{LIC}{(1+LIC)} PCH$$

$$USERIR = \frac{LIC + \rho_{iro} - \left(\frac{PCIR_{+1}}{PCIR} - 1\right)(1-\rho_{iro})}{1+LIC} PCIR$$

$$PZ = \frac{PCH_{+1}}{1+LIC}.$$

The interpretation of the user cost of residential buildings, USERIR, is as follows. Buying one unit of housing costs PCIR. Using this house during one period will depreciate its value by gir_rh per cent, so that one will get a price equal to $PCIR_{+1}(1 - gir\_rh)$ when one sells that house in the next period. The present value of the latter is equal to $\frac{PCIR_{+1}(1 - gir\_rh)}{1 + LIC}$. In other words, the user cost of owning the house during one period is equal to:

$$USERIR = PCIR - \frac{PCIR_{+1}(1 - gir\_rh)}{1 + LIC}$$

which can also be rewritten as:

$$USERIR = \frac{(1 + LIC) - \left(\frac{PCIR_{+1}}{PCIR}\right)(1 - gir\_rh)}{1 + LIC} PCIR.$$

Finally, bonds[1] are a means of transferring purchasing power from one period to another. Bonds have an interest rate equal to LIC. The expected purchasing power in the next period of one unit bought today is equal to $(1+LIC)/PCH_{+1}$. Hence, if one wants to obtain one real unit of purchasing power in the next period by holding bonds, one has to pay today the unit price:

$$PZ = \frac{PCH_{+1}}{1 + LIC}.$$

2. An overall price index within an alternative interest rate rule

Given that household utility depends on the consumption of a broad range of goods and services, as reflected in the quantity and price vectors (4.a) and (4.b), the appropriate price index of the household sector, P, is defined as:

(5.a) $\ln(P) = w\_cpo \ln(PCH) + w\_m \ln(PM) + w\_ciro \ln(USERIR) + w\_z \ln(PZ)$

with the weights satisfying:

(5.b) $0 < w\_cpo, w\_m, w\_ciro, w\_z < 1$,

and

(5.c) $w\_cpo + w\_m + w\_ciro + w\_z = 1$.

1. "Bonds" refers here to all other assets of the household sector.

Taking first differences of equation (5.a), the overall rate of inflation, INFL, is then equal to:

(6) $INFL = d \ln(P)$

$$= w\_cpo\ d \ln(PCH) + w\_m\ d \ln(PM) + w\_ciro\ d \ln(USERIR) + w\_z\ d \ln(PZ)$$

In Section 1 of Appendix B, the definition of the broad price index is refined even further by assuming that bonds, equities and real estate are imperfect substitutes[1].

If we now define the interest rule (2) of the previous chapter in terms of the change in the broader price index, we obtain:

(7) $SI = si\_sl\ (HP\_LI + si\_1\ OUTPUTGAP + si\_2\ (INFL - TARGETINFL)) - (1-si\_sl)\ SI_{-1}$

with INFL defined in equation (6) and TARGETINFL obtained by evaluating equation (6) for the targets of the individual components.

As shown in Section 2 of Appendix B, replacing INFL and TARGETINFL in equation (7) by the expression in equation (6), and using equations (4.b) and (4.d), as well as equations (A.6) and (A.7) of Appendix A[2], and rearranging terms, we obtain:

(8) $SI = si\_sl\ \{HP\_LI + si\_1\ [d \ln(PCH) - G\_PCH] + si\_2\ OUTPUTGAP\} - (1- si\_sl\ )\ SI_{-1}$

$$+ si\_sl\ si\_s1\ \{p\_1\ [d\ LIC - d\ HP\_LI]$$

$$+ p\_2\ [d \ln\left(\frac{PCIR}{PCH}\right) - GQ\_PCIR]$$

$$+ p\_3\ (1-pch\_sl)\ (pch\_sw-1)\ pch\_s1\ d\ OUTPUTGAP$$

$$+ p\_4\ (1-pcir\_sl)\ (pcir\_sw-1)\ [d \ln(PCIR) - (G\_PCH + GQ\_PCIR)]$$

$$+ p\_5\ (1-pcaoe\_sl)\ (pcaoe\_sw-1)\ [d \ln(PCAOE) - G\_PCAOE]$$

$$- p\_3\ pch\_sl\ d\ G\_PCH$$

$$+ p\_4\ [(1-pcir\_sl)\ pcir\_sw\ -1]\ d\ (G\_PCH + GQ\_PCIR)$$

$$+ p\_5\ [(1-pcaoe\_sl)\ pcaoe\_sw\ -1]\ d\ G\_PCAOE\}$$

$$+ SI\_V$$

1. See equations (B.6.a)-(B.6.c) of Appendix B:
$$\ln(PZ) = wz\_zy \ln\left(\frac{PCH_{+1}}{1 + LIC}\right) + wz\_ciro \ln\left(\frac{PCH_{+1}\ PCIR}{PCIR_{+1}(1 - \rho_{iro})}\right) + wz\_cooe \ln\left(\frac{PCH_{+1}\ PCAOE}{PCAOE_{+1}}\right)$$
with $0 < wz\_zy, wz\_ciro, wz\_cooe < 1$ and $wz\_zy + wz\_ciro + wz\_cooe = 1$.
2. Equations (A.6) and (A.7) of Appendix A describe changes in equity prices and real estate prices, respectively.

where G_PCH is the targeted change in the consumer prices, GQ_PCIR the targeted change in the real price of residential buildings, G_PCAOE the targeted change in equity prices, and HP_LI the equilibrium nominal interest rate. For purposes of empirical estimation, the targets are obtained by applying a Hodrick-Prescott filter to the corresponding historical series.

Equation (8) indicates that the monetary authorities not only target consumer price inflation, the output gap and the long-term interest rate, but also changes in the output gap, changes in the real price of residential buildings, changes in the long-term interest rate, changes in equity prices and changes in real estate prices[1]. Indeed, if asset prices rise above (fall below) their fundamentals, households tend to consume more (less) than if equity prices increase in line with their fundamentals. However, if asset prices rise above (drop below) their fundamentals, a future fall (rise) in asset prices will be necessary to restore stock market equilibrium and this future correction in asset prices will bring about a drop (increase) in consumption. Policy makers must weigh the contemporaneous gains (losses) from an excessive increase (decrease) in asset prices against the future losses (gains) entailed by the necessary subsequent correction of asset prices; by limiting the fluctuations of asset prices around their fundamentals, monetary authorities reduce fluctuations in household consumption expenditures. In addition, the short-term interest rate will also be increased (decreased) pre-emptively when the output gap narrows (widens) as this change in the output gap will cause higher (lower) inflation in the future. Finally, equation (8) also indicates that a change in the targets gives rise to a (temporary) change in the short-term interest rate.

The parameters of interest rate rule (8) are determined by the parameters of the original Taylor rule (i.e. the parameters si_s1, si_s2 and si_sl), the budget shares of the various expenditure items in the household budget (i.e. the parameters p1, ..., p5) and the parameters of the price equations[2]. The parameter values of equation (8) are summarised in Table 9. Of particular interest are the numbers in the third last row which show that in the euro area a 1 per cent increase (above the targeted increase) in equity prices would induce a 0.2 percentage-point increase in the short-term interest rate in the medium run and an increase of 0.1 percentage-point (=0.2 x si_sl x si_s1) on impact [3].

1. Note that equation (8) encompasses a traditional Taylor rule. Indeed, if p1=...=p5=0, we obtain equation (2); if we also set si_sl equal to zero, we obtain equation (1).
2. The parameters 0<pch_sl, pch_sw<1 refer to the price-setting scheme of PCH, whereby parameter px_sl is the fraction of the composite private consumption good for which the price is kept at its preceding price due to menu costs, and the parameter px_sw is the fraction of the composite price that is revised according to a rule-of-thumb due to information costs. Similar considerations hold for 0<pcir_sl, pcir_sw, pcaoe_sl, and pcaoe_sw<1. See also Appendix A.
3. Bernanke and Gertler (2001), for instance, suggest a parameter value ranging between 0 and 0.2 .

TABLE 9 - Parameter values for the augmented Taylor rule (equation 8)

	Euro area	Non-euro EU area	United States	Japan
si_s1	1.5	1.5	1.5	1.5
si_s2	0.5	0.5	0.5	0.5
si_sl	0.4	0.3	0.3	0.5
p1	0.0	-0.4	-0.2	-0.9
p2	0.0	0.0	0.0	0.0
p3	0.9	0.9	0.9	1.0
p3*(1-pch_sl)*(pch_sw-1)*pch_s1	0.2	0.3	0.2	0.4
p4*(1-pcir_sl)*(pcir_sw-1)	0.0	0.0	0.0	0.0
p5*(1-pcaoe_sl)*(pcaoe_sw-1)	0.2	0.1	0.2	0.0
p4*((1-pcir_sl)*pcir_sw-1)	0.0	0.1	0.0	0.0
p5*((1-pcaoe_sl)*pcaoe_sw-1)	0.4	0.1	0.2	0.0

Source: Table 17, Appendix B.

B. Main results of the counterfactual simulation

In this section, we present the main results of a counterfactual simulation based on the alternative interest rate rule as derived in equation (8).

The counterfactual simulation is carried out as follows. First, we use the default version of the NIME model to perform a within-sample simulation for the 1995-2004 period. This default version of the model includes, for each of the four major economic areas of the world an interest rate rule driven by a consumer price inflation target, an output gap, and the lagged short-term interest rate (see equation 2). Next, we calculate the forecast error of each behavioural equation for each observation unit. Finally, for each of the major economic areas, we replace the traditional interest rate rule (2) by the new broader-based interest rate rule (8) and we re-run the NIME model over the period 1995-2004, adding the error terms calculated in the first round to the behavioural equations.[1]

The main results of this counterfactual simulation are given in figures 19 to 34 and in tables 10 to 13. The numbers in these figures and tables are deviations from the historical baseline level in per cent, unless otherwise specified.

1. The euro area

Table 10 and figures 19 to 22 summarise the results of the counterfactual simulation for the euro area.

In the counterfactual simulation, the short-term interest rate of the euro area rises well above the historical baseline from 1997 to 2000, reaching a high of 0.9 percentage-point above the baseline in 2000. These interest rate hikes are a direct response of monetary policy to the sharp rise in equity prices, with the composite euro area stock market index increasing on average by 31.2 per cent per annum.

1. The short-term interest rate of the rest of the world bloc follows the US short-term interest rate. The values for trend productivity, the equilibrium real interest rate, secular inflation, population growth, tax rates and US dollar denominated oil prices are kept at their historical level.

After 2000, as equity prices fall, the counterfactual short-term interest rate drops and comes out at 0.9 percentage-point below baseline in 2003 and 0.3 percentage-point below baseline in 2004.

Assuming that the dividend outlook which underpinned the historical movements in equity prices is exogenous and that asset prices are equal to the present value of these dividends, asset prices are primarily affected by the rate at which the future dividends are discounted. As a consequence, equity prices in the counterfactual simulation fall below their baseline level between 1997 and 2000, as interest rates rise above baseline, and equity prices rise above baseline as of 2001, as interest rates fall below their baseline level.

As the interest rate hikes in the euro area are initially somewhat smaller than the rate increases elsewhere in the world, the euro area's nominal effective exchange rate depreciates with respect to the historical baseline, falling by 0.5 per cent below baseline in 1999. As of 2001, the euro interest rate falls below its baseline level and its fall is more pronounced than the rate reductions elsewhere in the world, leading to a continued depreciation of the euro area's nominal effective exchange rate relative to the historical baseline.

The various components of domestic demand are directly affected by the changes in interest rates. From 1997 to 2000, private consumption falls 0.4 per cent below baseline, primarily because the interest rate hikes reduce household wealth and raise the incentive to save. As of 2001, as interest rates fall below the euro area's historical baseline, private consumption rebounds and comes out 0.6 per cent above baseline in 2003 and 0.4 per cent above baseline in 2004. Business sector investment is also affected by the changes in interest rates, directly by changes in the user cost of capital and indirectly by changes in the output level. As interest rates rise over the latter part of the 1990s, business sector investment falls and comes out at 1.1 per cent below the historical baseline in 2000. However, the subsequent interest rate cuts then raise enterprise sector investment by 1.8 per cent above baseline in 2003 and by 1.3 per cent above baseline in 2004.

Exports remain almost unaffected over the first years of the counterfactual simulation, as the positive effects of the real exchange rate depreciation and the negative effects of the decline in foreign effective demand roughly cancel each other out. However, as of 2002, the euro area's real effective exchange rate depreciation and the rise in the area's foreign effective demand push exports 0.4 per cent above baseline. Over the 1997-2001 period, imports move in line with the exchange rate depreciation and the weaker domestic demand, falling 0.5 per cent below the historical baseline in 2000. However, as of 2002, interest rates are cut, domestic activity rebounds above its baseline level and euro area imports come out 0.4 per cent above baseline in 2003 and 2004.

During the 1995-2000 period, the impact of lower domestic demand on real GDP is mitigated by the positive evolution of the area's consolidated net exports, and real GDP falls by no more than 0.3 per cent below baseline. In 2001, as nominal interest rates fall below their historical baseline, domestic demand is bolstered and real GDP increases to 0.6 per cent above the historical baseline in 2003 and 0.4 per cent in 2004.

Table 2 indicates that, on balance, the implementation of the alternative broad-based interest rate rule would have raised the euro area's GDP level by approximately 0.3 per cent by the end of the 1995-2004 period[1]. Of the main components of aggregate demand, private consumption would have been least affected over the whole period, as its cumulative deviation from baseline amounts to only 0.1 per cent; the effect would have been the greatest on the area's net exports, producing a cumulative deviation of up to 1.3 per cent above baseline.

Throughout the simulation period, the general price level, labour demand and real wages would have been relatively unaffected.

FIGURE 19 - Interest and exchange rates in the euro area: counterfactual outcome for the 1994-2004 period
(deviation from historical baseline)

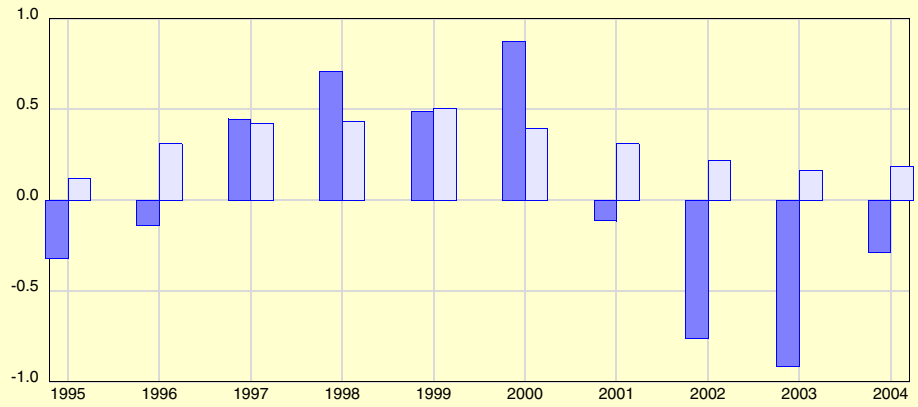
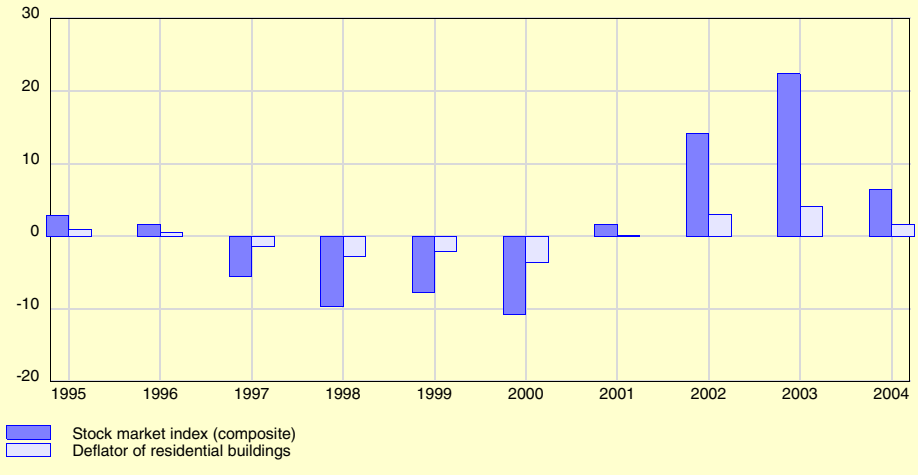


FIGURE 20 - Asset prices in the euro area: counterfactual outcome for the 1994-2004 period
(deviation from historical baseline, in per cent)



1. Measured as the discounted cumulative deviation from the baseline level.

FIGURE 21 - Macroeconomic aggregates in the euro area: counterfactual outcome for the 1994-2004 period
(deviation from historical baseline, in per cent)

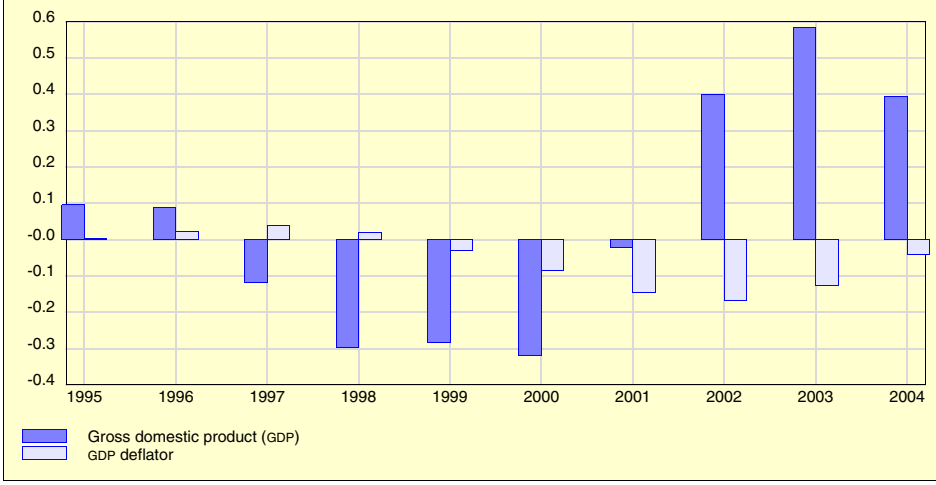
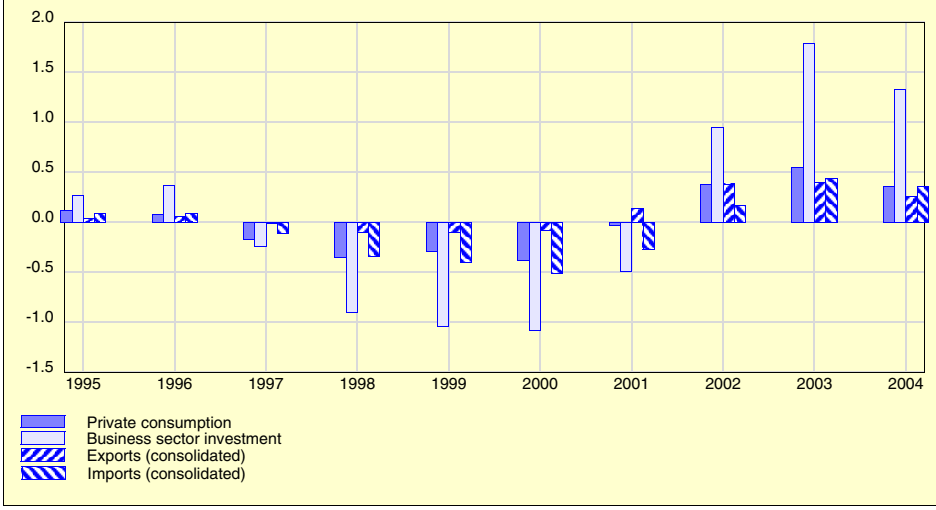


FIGURE 22 - Components of aggregate demand in the euro area: counterfactual outcome for the 1994-2004 period
(deviation from historical baseline, in per cent)



2. The Western non-euro EU Member States

Table 11 and figures 23 to 26 show the results for the Western non-euro EU Member States. This area comprises Denmark, Sweden and the United Kingdom.

In the Western non-euro EU Member States, the short-term interest rate rises above its historical baseline as of 1996, reaching a maximum deviation of 0.6 percentage-point from 1998 to 2000. As of 2001, the short-term interest rate falls below its historical baseline, reaching its largest deviation from baseline in 2003 with a 0.3 percentage-point decline. These relatively limited rate cuts compared with those in both the United States and the euro area, are explained not only by the smaller response of the monetary authorities to changes in equity prices (see Table 9) but also by the relatively stronger surge in real estate prices in this area.

Initially, the interest rate hikes are not big enough to prevent the effective nominal exchange rate from depreciating relative to its historical baseline; the decline reaches 2.6 per cent in 2000. However, as of 2003, the nominal effective exchange rate appreciates by up to 0.9 per cent relative to its baseline, reflecting smaller cuts in the domestic interest rate than in foreign interest rates.

The initial interest rate hikes reduce private consumption, which falls to 0.4 per cent below baseline between 1998 and 2000. As of 2001, interest rates are cut only marginally relative to their baseline, leaving private consumption to settle also at levels very close to its historical baseline. Business sector investment falls to 0.4 per cent below its historical baseline in 1998 and 1999; it then recovers gradually, reaching 0.3 per cent above baseline in 2003.

Initially, the area's consolidated exports benefit from the exchange rate depreciation and rise by up to 1 per cent above baseline in 2002. However, as of 2003, the nominal effective exchange rate begins to appreciate and exports lose much of their gains, receding to only 0.1 per cent above baseline in 2004. Initially, imports remain fairly close to their baseline level, but jump to 0.6 per cent above baseline in 2003 as domestic activity recovers and the exchange rate appreciates relative to the baseline.

Throughout the simulation period, labour demand, real wages and prices remain relatively unaffected by the alternative interest rate rule.

Table 2 indicates that the implementation of the alternative interest rate rule would have reduced the cumulative level of private consumption by a whole 1 per cent below its historical baseline level at the end of the simulation period. However, it would also have pushed the cumulative level of the area's net exports up 3.4 per cent above baseline, leaving the area's aggregate real GDP level 0.2 per cent above baseline at the end of the period.

FIGURE 23 - Interest and exchange rates in the Western non-euro EU Member States: counterfactual outcome for the 1994-2004 period
(deviation from historical baseline)

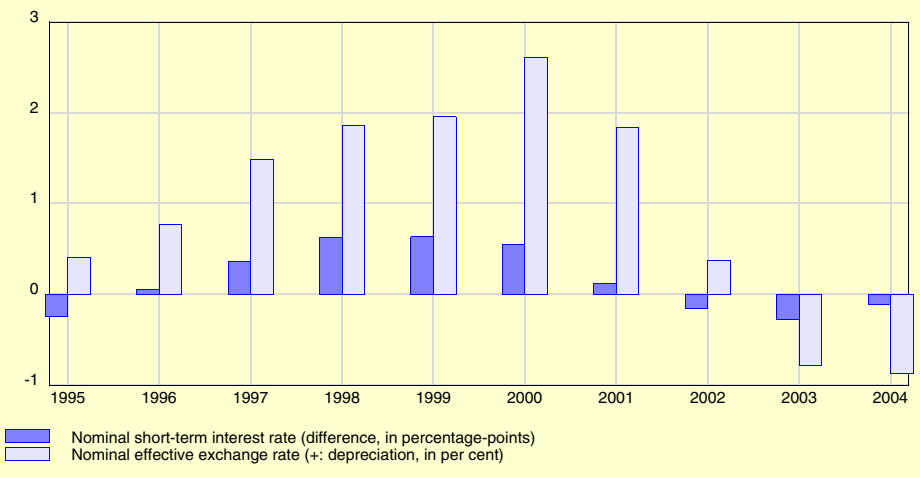


FIGURE 24 - Asset prices in the Western non-euro EU Member States: counterfactual outcome for the 1994-2004 period
(deviation from historical baseline, in per cent)

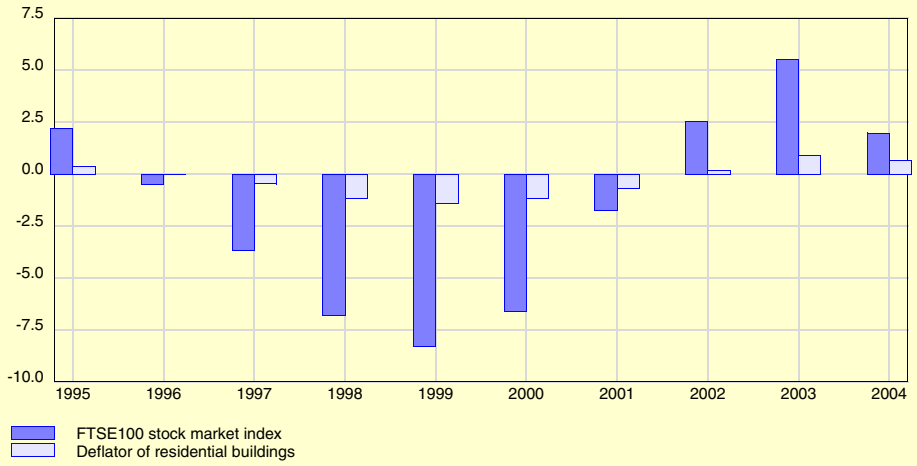


FIGURE 25 - Macroeconomic aggregates in the Western non-euro EU Member States: counterfactual outcome for the 1994-2004 period
(deviation from historical baseline, in per cent)

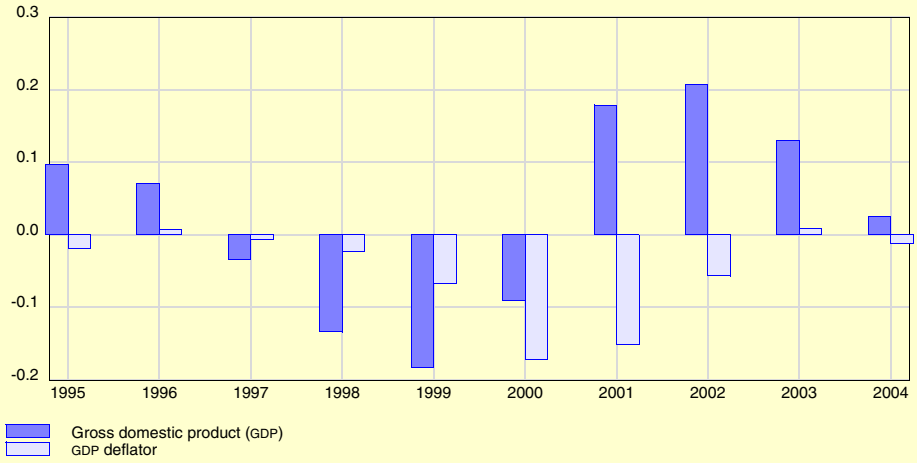
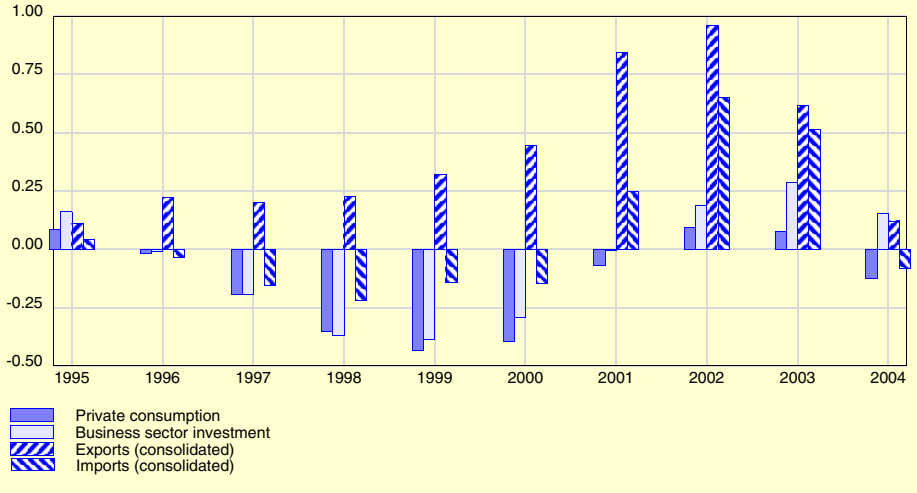


FIGURE 26 - Components of aggregate demand in the Western non-euro EU Member States: counterfactual outcome for the 1994-2004 period
(deviation from historical baseline, in per cent)



3. The United States

Table 12 and figures 27 to 30 present the main counterfactual simulation results for the United States.

Under the alternative interest rate rule, the US short-term interest rate rises above its historical baseline over the 1995-2000 period. The short-term rate reaches a maximum deviation of 1.4 percentage-points above baseline in 1999. From 2001 to 2004, the short-term interest rate comes out below its historical baseline level, hitting a trough of 0.8 percentage-point below baseline in 2002.

The stronger rise in interest rates rise in the United States than in the other major economic areas between 1997 to 2000 leads to a 1.7 per cent appreciation of the US nominal effective exchange rate relative to its historical baseline level in 2000. However, as of 2001, interest rates are also cut more aggressively in the US than in the rest of the world. This leads to a gradual depreciation of the dollar, with the nominal effective exchange rate falling by 0.3 per cent against its baseline level in 2002. The stock market index falls as interest rates rise but the course is reversed in 2001, as interest rates begin to fall below baseline.

Private consumption falls below its baseline level between 1995 and 2000, reaching a low point of 0.7 per cent below the historical baseline in 1999. As of 2001, the relative decline in nominal interest rates provides a boost to private consumption, which comes out 0.6 per cent above baseline in 2003. Total gross fixed capital formation falls by 1 per cent below baseline in 1998 and 1999, only to rebound to 1.7 per cent above baseline in 2002 and to 0.8 per cent above baseline in 2004.

From 1995 to 2002, the counterfactual rise in US interest rates leads to an appreciation of the dollar which, along with the reduction in foreign effective demand, drives exports down below their historical baseline level. The deviation between the counterfactual simulation and the historical baseline is largest in 2000, when exports lie 1.2 per cent below baseline. As of 2003, exports jump above baseline as economic activity in the rest of the world rebounds relative to its historical baseline level, and as the appreciation of the dollar becomes less marked. Between 1995 and 2001, imports come out below their baseline level primarily due to the fall in domestic activity. As of 2002, imports rise above baseline, following the relative pick-up in GDP growth.

With declining net exports and falling domestic demand over the 1995-2000 period, US real GDP falls to 0.4 per cent below baseline in 1997 and reaches 0.7 per cent below baseline in 1999. However, as of 2001, interest rates are cut sharply, allowing for a recovery in real GDP, which rises to 0.7 per cent above baseline in 2001 and to 0.4 per cent above baseline in 2004.

On balance, Table 2 indicates that the implementation of such a broader-based interest rate rule over the entire 1995-2004 period would have lowered the level of all components of domestic demand and thus have reduced the level of US GDP by 0.6 per cent relative to the historical baseline by 2004[1].

1. I.e. the discounted cumulative deviation from baseline level.

Inflationary pressures in the United States are tempered by the fall in effective demand and by the relatively strong effective appreciation of the dollar, leaving the US GDP deflator 0.8 per cent below its historical baseline level in both 2000 and 2001. However, once demand recovers and the dollar begins to weaken, prices tend to rise and the GDP deflator returns to its baseline level in 2004.

Finally, the fall in aggregate demand lowers labour demand marginally during the first years. However, as of 2001, domestic output rebounds and private sector labour demand rises above its historical baseline, reaching a high of 0.4 per cent above baseline in 2002. In 2004, private sector labour demand settles at just 0.2 per cent above baseline.

FIGURE 27 - Interest and exchange rates in the United States: counterfactual outcome for the 1994-2004 period
(deviation from historical baseline)

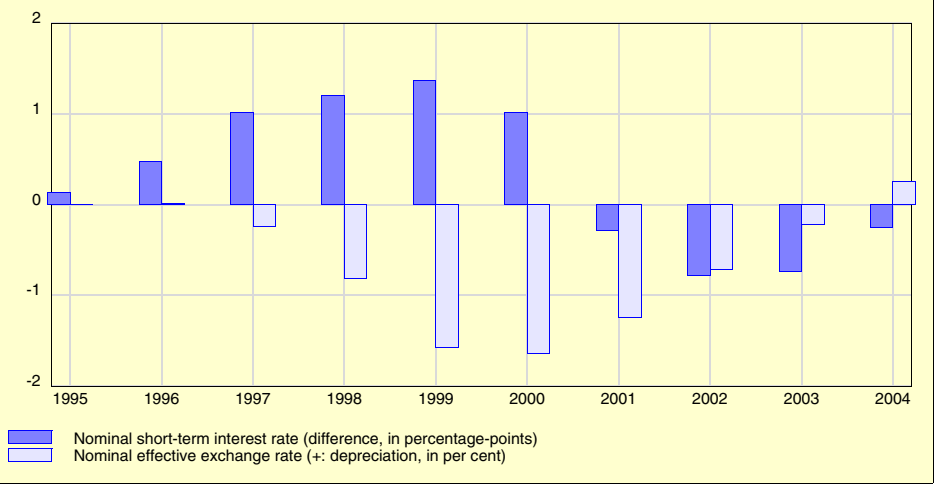


FIGURE 28 - Asset prices in the United States: counterfactual outcome for the 1994-2004 period
(deviation from historical baseline, in per cent)

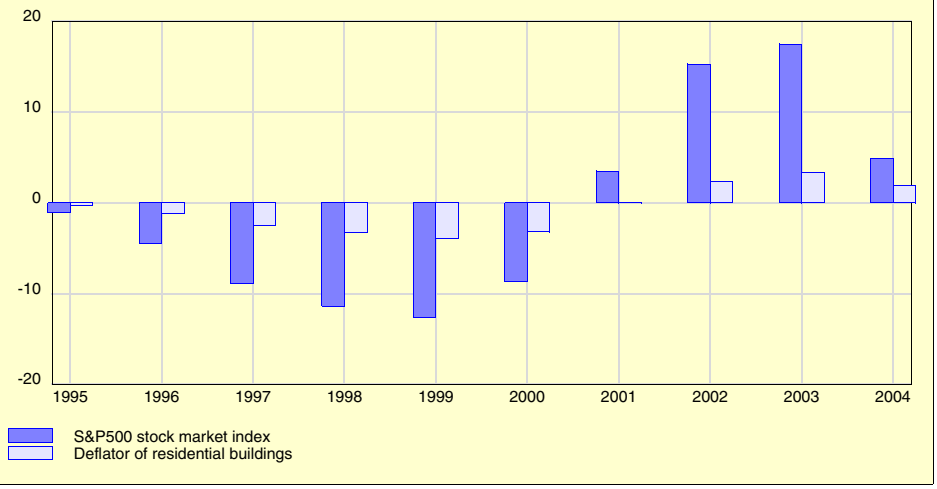


FIGURE 29 - Macroeconomic aggregates in the United States: counterfactual outcome for the 1994-2004 period
(deviation from historical baseline, in per cent)

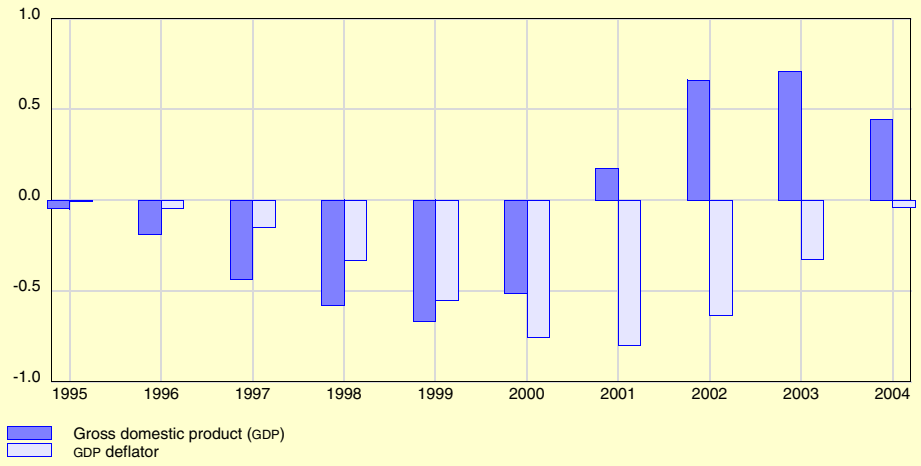
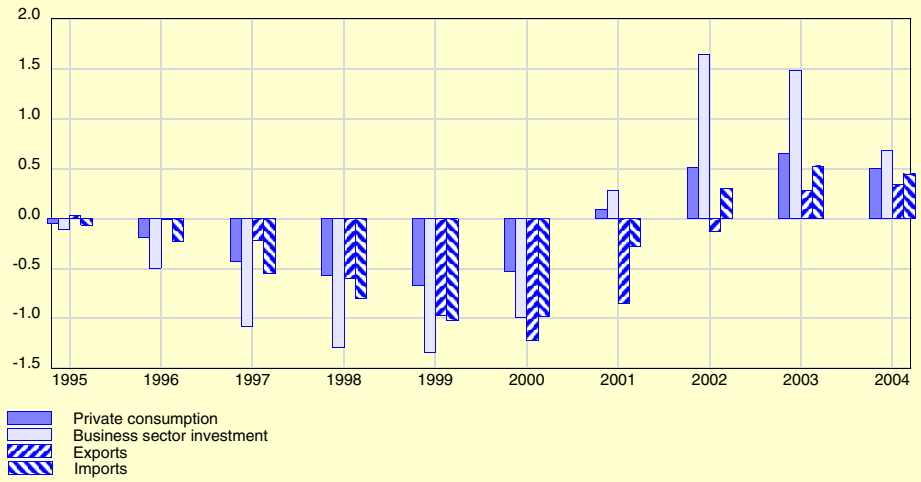


FIGURE 30 - Components of aggregate demand in the United States: counterfactual outcome for the 1994-2004 period
(deviation from historical baseline, in per cent)



4. Japan

Table 13 and figures 31 to 34 show the main counterfactual simulation results for Japan.

In Japan, the behaviour of the short-term interest rate differs somewhat from what is observed in the other main economic areas. First, as nominal interest rates were already very low during most of the 1995-2004 period, there was not much room for further interest rate cuts in Japan. Second, in contrast to what was happening in the other major economic areas, the Japanese stock market indices fell steadily throughout most of the 1995-2004 period. Third, as indicated in Table 9, under the alternative interest rate rule the responses of Japanese monetary au-

thorities to changes in equity prices are relatively small, reflecting the low share of expenditures on equity in households' outlays.

For the other major economic areas, the counterfactual simulation results indicate that the short-term interest rate deviates most from its historical baseline level in 1999 and 2000, with the short-term interest rate 0.9 percentage-point above baseline in the euro area and 1.4 percentage-points above baseline in the United States. In contrast, the Japanese short-term interest rate is cut by 0.1 percentage-point in 1999, while the historical baseline interest rate already stood at a low of 0.2 per cent that year[1]. The most important effect of this asymmetric evolution of interest rates between Japan and the other major economic areas is the sharp relative depreciation that it induces for the Japanese nominal effective exchange rate between 1998 and 2002. Indeed, during this period the nominal effective exchange rate depreciates by up to 7.4 per cent relative to the historical baseline in 2000. As of 2001, interest rates fall below baseline in the other major economic areas, while the Japanese interest rate already lies on its lower bound. This leads to a reduction in the interest rate differential and a gradual return towards baseline of the Japanese nominal effective exchange rate, which even appreciates relative to its historical baseline level as of 2003. As of 2002, Japan's real effective exchange rate appreciates due to the rise in the general price level between 2000 and 2004 brought about by stronger demand.

Private consumption rises to 0.2 per cent above its historical baseline level in 1998 and 1999, but then falls to 0.3 per cent below baseline in 2004 as higher domestic prices erode the purchasing power of households' financial assets. Gross fixed capital formation rises to 0.4 per cent above baseline in 1999, but falls 0.4 per cent below baseline in 2004.

Japanese international trade is primarily affected by the changes in the exchange rate. Indeed, after an initial loss between 1995 and 1997, exports rise and climb to 3.6 per cent above baseline in 2001. However, in 2004, exports fall back below baseline as the rebound in foreign effective demand no longer suffices to offset the negative effects of the real currency appreciation. Imports remain close to baseline as the effects of the changes in the real effective exchange rate and in domestic demand cancel each other out.

All in all, the counterfactual simulation indicates that a broader interest rate rule would have driven Japanese real GDP up above its historical baseline from 1998 to 2002. More specifically, in 1999, when GDP in other areas would have hit their trough, real GDP in Japan would have come out 0.4 per cent above baseline, mainly due to the boost to exports resulting from the strong depreciation of the yen. However, in 2004, exports would have fallen below baseline and real Japanese GDP would have sank 0.4 per cent below baseline.

Summarizing the results, Table 2 shows that the implementation of the alternative interest rate rule would have increased the level of Japanese GDP by 1.3 per cent above baseline by the end of 2004[2], mainly due to the 8.9 per cent surge in the cumulative level of exports by the end of the period.

1. Note that 0.1 per cent is the technical lower bound for nominal interest rates in the NIME model.
2. Measured as the discounted cumulative deviations of these variables from baseline levels.

FIGURE 31 - Interest and exchange rates in Japan: counterfactual outcome for the 1994-2004 period
(deviation from historical baseline)

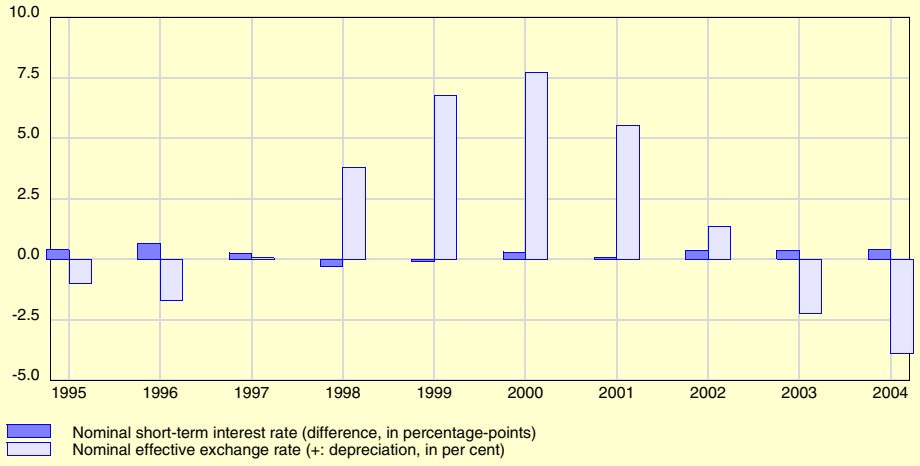


FIGURE 32 - Asset prices in Japan: counterfactual outcome for the 1994-2004 period
(deviation from historical baseline, in per cent)

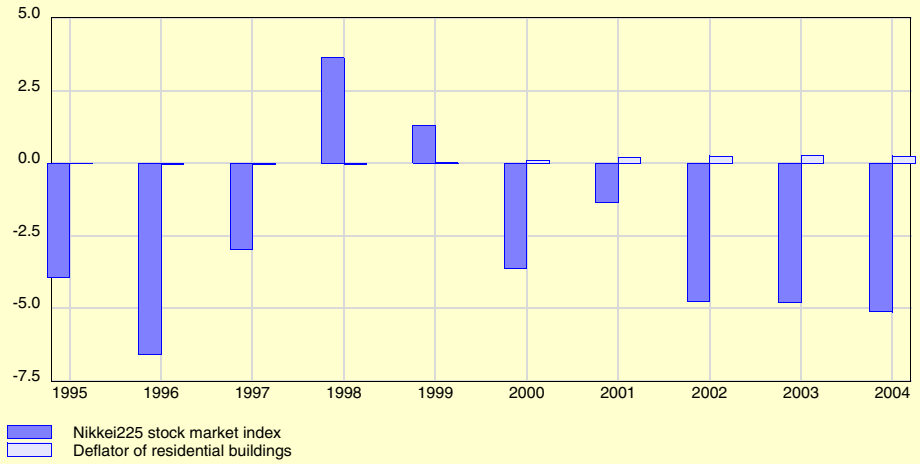


FIGURE 33 - Macroeconomic aggregates in Japan: counterfactual outcome for the 1994-2004 period
(deviation from historical baseline, in per cent)

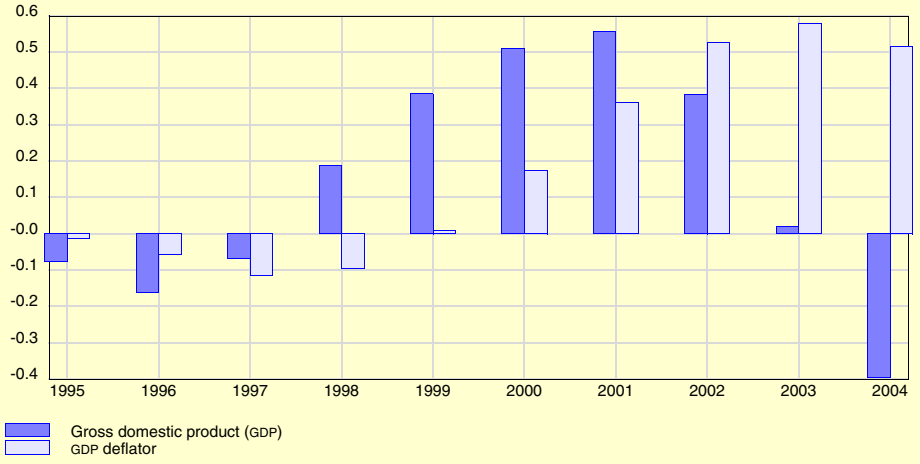
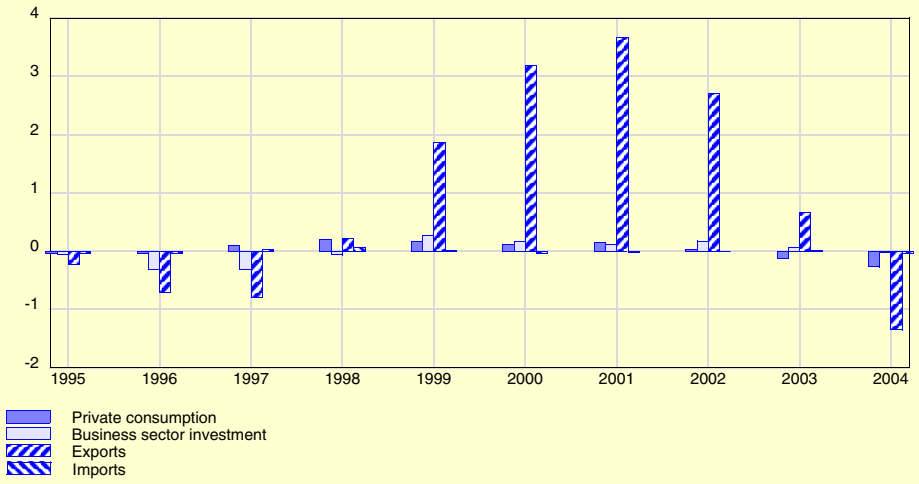


FIGURE 34 - Components of aggregate demand in Japan: counterfactual outcome for the 1994-2004 period
(deviation from historical baseline, in per cent)



5. Detailed tables: The counterfactual outcome for the major economic areas over the 1995-2004 period

TABLE 10 - A counterfactual simulation for the euro area: 1995-2004
(deviation from baseline level, in per cent or percentage-points)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Demand & supply (in constant prices)										
Private consumption	0.1	0.1	-0.2	-0.4	-0.3	-0.4	-0.0	0.4	0.6	0.4
Public consumption	-0.0	0.0	0.0	-0.0	-0.0	-0.1	-0.1	-0.1	-0.0	0.0
Gross fixed capital formation	0.2	0.2	-0.2	-0.6	-0.7	-0.8	-0.3	0.7	1.3	1.0
of which business sector	0.3	0.4	-0.2	-0.9	-1.0	-1.1	-0.5	0.9	1.8	1.3
Exports (consolidated)	0.0	0.1	-0.0	-0.1	-0.1	-0.1	0.1	0.4	0.4	0.3
Imports (consolidated)	0.1	0.1	-0.1	-0.3	-0.4	-0.5	-0.3	0.2	0.4	0.4
Gross domestic product	0.1	0.1	-0.1	-0.3	-0.3	-0.3	-0.0	0.4	0.6	0.4
Gross private sector output	0.1	0.1	-0.1	-0.3	-0.3	-0.4	-0.0	0.4	0.6	0.4
Deflators										
Gross domestic product	0.0	0.0	0.0	0.0	-0.0	-0.1	-0.1	-0.2	-0.1	-0.0
Private consumption	0.0	0.0	0.0	0.0	-0.0	-0.1	-0.2	-0.2	-0.1	0.0
Exports	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
Imports	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	-0.0	-0.0
Labour market										
Total employment	0.0	0.0	-0.0	-0.1	-0.0	-0.0	0.0	0.1	0.1	0.0
of which private sector	0.0	0.0	-0.0	-0.1	-0.0	-0.0	0.0	0.1	0.1	0.0
Unemployment rate (level, % of labour force)	-0.0	-0.0	0.1	-0.0	-0.3	-0.5	-0.8	-0.8	-0.7	-0.6
Nominal wage, private sector	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.2	-0.0	0.2	0.3
Take home real wage, private sector	0.0	0.0	-0.0	-0.1	-0.1	-0.1	0.0	0.2	0.3	0.3
Producer real wage, private sector	0.0	0.0	-0.0	-0.1	-0.1	-0.1	-0.1	0.1	0.3	0.3
Productivity (GDP per employee)	0.1	0.1	-0.1	-0.2	-0.2	-0.3	-0.1	0.3	0.5	0.4
Financial sector										
Nominal short-term interest rate (level)	-0.3	-0.1	0.4	0.7	0.5	0.9	-0.1	-0.8	-0.9	-0.3
Nominal long-term interest rate (level)	-0.2	-0.1	0.2	0.4	0.3	0.5	-0.1	-0.4	-0.5	-0.2
Nominal effective exchange rate (-: apprec.)	0.1	0.3	0.4	0.4	0.5	0.4	0.3	0.2	0.2	0.2
Real effective exchange rate (-: apprec.)	0.1	0.3	0.3	0.3	0.4	0.3	0.2	0.1	0.1	0.2
Stock market indice	2.9	1.6	-5.5	-9.6	-7.7	-10.7	1.7	14.2	22.4	6.4
Deflator of residential buildings	1.0	0.6	-1.5	-2.8	-2.1	-3.6	0.2	3.0	4.2	1.6
Public finances										
Government net lending (% of GDP)	0.0	0.1	-0.0	-0.2	-0.2	-0.2	-0.1	0.1	0.3	0.2
Government gross debt (% of GDP)	-0.1	-0.2	-0.0	0.3	0.5	0.7	0.6	0.2	-0.2	-0.4
Household sector										
Total available means	0.2	0.1	-0.3	-0.6	-0.5	-0.8	0.1	0.7	1.1	0.5
of which real disposable income	0.0	0.0	-0.0	-0.1	-0.1	-0.1	-0.0	0.2	0.3	0.3
Net saving by households (level, % of dispos. income)	-0.1	-0.0	0.1	0.2	0.2	0.3	0.0	-0.1	-0.2	-0.1
International environment										
Foreign effective output	0.0	-0.0	-0.1	-0.2	-0.2	-0.2	0.1	0.3	0.4	0.2
Foreign effective price level	0.0	0.0	-0.0	-0.0	-0.1	-0.1	-0.1	-0.1	-0.0	0.0
Foreign effective interest rate (level)	0.1	0.5	1.0	1.0	1.0	0.9	-0.1	-0.8	-0.9	-0.2
Current account (level, % of GDP)	-0.0	-0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	-0.0

TABLE 11 - A counterfactual simulation for the Western non-euro EU Member States: 1995-2004
(deviation from baseline level, in per cent or percentage-points)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Demand & supply (in constant prices)										
Private consumption	0.1	-0.0	-0.2	-0.4	-0.4	-0.4	-0.1	0.1	0.1	-0.1
Public consumption	-0.0	0.0	0.0	0.0	-0.0	-0.0	-0.0	0.0	0.0	0.1
Gross fixed capital formation	0.1	-0.0	-0.2	-0.4	-0.4	-0.3	0.1	0.3	0.3	0.1
of which business sector	0.2	-0.0	-0.2	-0.4	-0.4	-0.3	-0.0	0.2	0.3	0.2
Exports (consolidated)	0.1	0.2	0.2	0.2	0.3	0.4	0.8	1.0	0.6	0.1
Imports (consolidated)	0.0	-0.0	-0.2	-0.2	-0.1	-0.1	0.2	0.6	0.5	-0.1
Gross domestic product	0.1	0.1	-0.0	-0.1	-0.2	-0.1	0.2	0.2	0.1	0.0
Gross private sector output	0.1	0.0	-0.1	-0.2	-0.2	-0.1	0.2	0.4	0.3	-0.0
Deflators										
Gross domestic product	-0.0	0.0	-0.0	-0.0	-0.1	-0.2	-0.2	-0.1	0.0	-0.0
Private consumption	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.2	-0.1	0.0	0.2
Exports	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.1	-0.1	-0.0	-0.0
Imports	0.1	0.1	0.1	-0.0	-0.2	0.0	-0.4	-0.6	-0.2	0.4
Labour market										
Total employment	0.0	0.0	-0.0	-0.0	-0.0	-0.0	0.0	0.0	0.0	-0.0
of which private sector	0.0	0.0	-0.0	-0.0	-0.0	-0.0	0.0	0.1	0.0	-0.0
Unemployment rate (level, % of labour force)	-0.1	-0.1	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Nominal wage, private sector	0.1	0.1	-0.0	-0.1	-0.2	-0.2	-0.1	0.1	0.1	0.1
Take home real wage, private sector	0.0	0.0	-0.1	-0.1	-0.1	-0.1	0.1	0.2	0.1	-0.1
Producer real wage, private sector	0.0	0.0	-0.0	-0.1	-0.1	-0.0	0.2	0.3	0.2	0.1
Productivity (GDP per employee)	0.1	0.1	-0.0	-0.1	-0.2	-0.1	0.1	0.2	0.1	0.0
Financial sector										
Nominal short-term interest rate (level)	-0.2	0.1	0.4	0.6	0.6	0.6	0.1	-0.2	-0.3	-0.1
Nominal long-term interest rate (level)	-0.1	0.0	0.1	0.2	0.2	0.1	0.0	-0.0	-0.1	-0.0
Nominal effective exchange rate (-: apprec.)	0.4	0.8	1.5	1.8	1.9	2.6	1.8	0.4	-0.8	-0.9
Real effective exchange rate (-: apprec.)	0.4	0.8	1.5	1.8	1.9	2.6	1.8	0.3	-0.8	-0.9
Stock market indice	2.2	-0.5	-3.7	-6.8	-8.3	-6.6	-1.7	2.5	5.5	2.0
Deflator of residential buildings	0.4	-0.0	-0.5	-1.2	-1.4	-1.2	-0.7	0.2	0.9	0.6
Public finances										
Government net lending (% of GDP)	0.0	0.0	-0.0	-0.1	-0.1	-0.1	0.0	0.1	0.1	0.0
Government gross debt (% of GDP)	-0.1	-0.1	0.0	0.1	0.3	0.4	0.2	0.1	-0.0	0.0
Household sector										
Total available means	0.1	-0.0	-0.2	-0.4	-0.6	-0.6	-0.3	-0.0	0.2	0.0
of which real disposable income	0.0	0.0	-0.1	-0.1	-0.1	-0.1	0.1	0.2	0.1	-0.0
Net saving by households (level, % of dispos. income)	-0.1	0.0	0.1	0.3	0.4	0.3	0.2	0.1	0.0	0.1
International environment										
Foreign effective output	0.0	0.0	-0.2	-0.3	-0.3	-0.3	-0.0	0.4	0.5	0.3
Foreign effective price level	0.0	0.0	0.0	-0.0	-0.0	-0.1	-0.1	-0.1	-0.1	-0.0
Foreign effective interest rate (level)	-0.0	0.3	0.8	0.9	0.8	1.0	-0.2	-0.8	-0.8	-0.2
Current account (level, % of GDP)	-0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	-0.0

TABLE 12 - A counterfactual simulation for the United States: 1995-2004
(deviation from baseline level, in per cent or percentage-points)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Demand & supply (in constant prices)										
Private consumption	-0.1	-0.2	-0.4	-0.6	-0.7	-0.5	0.1	0.5	0.6	0.5
Public consumption	0.0	-0.0	-0.0	-0.1	-0.2	-0.3	-0.3	-0.3	-0.2	-0.1
Gross fixed capital formation	-0.1	-0.4	-0.9	-1.0	-1.0	-0.7	0.6	1.7	1.6	0.8
of which business sector	-0.1	-0.5	-1.1	-1.3	-1.3	-1.0	0.3	1.6	1.5	0.7
Exports	0.0	-0.0	-0.2	-0.6	-1.0	-1.2	-0.9	-0.1	0.3	0.3
Imports	-0.1	-0.2	-0.6	-0.8	-1.0	-1.0	-0.3	0.3	0.5	0.4
Gross domestic product	-0.0	-0.2	-0.4	-0.6	-0.7	-0.5	0.2	0.7	0.7	0.4
Gross private sector output	-0.1	-0.2	-0.5	-0.7	-0.8	-0.6	0.2	0.7	0.8	0.5
Deflators										
Gross domestic product	-0.0	-0.0	-0.2	-0.3	-0.6	-0.8	-0.8	-0.6	-0.3	-0.0
Private consumption	-0.0	-0.0	-0.1	-0.2	-0.3	-0.5	-0.6	-0.6	-0.4	-0.2
Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Imports	-0.0	-0.0	-0.1	-0.1	-0.2	-0.3	-0.3	-0.3	-0.2	-0.1
Labour market										
Total employment	-0.0	-0.1	-0.1	-0.2	-0.2	-0.1	0.2	0.4	0.3	0.2
of which private sector	-0.0	-0.1	-0.2	-0.2	-0.2	-0.1	0.2	0.4	0.4	0.2
Unemployment rate (level, % of labour force)	0.4	0.7	0.7	1.5	2.1	1.7	1.3	0.7	-0.1	0.1
Nominal wage, private sector	-0.0	-0.1	-0.3	-0.5	-0.8	-1.0	-0.9	-0.6	-0.2	0.1
Take home real wage, private sector	-0.0	-0.1	-0.2	-0.4	-0.5	-0.6	-0.3	-0.1	0.2	0.3
Producer real wage, private sector	-0.0	-0.1	-0.1	-0.2	-0.3	-0.3	-0.2	-0.0	0.0	0.1
Productivity (GDP per employee)	-0.0	-0.1	-0.3	-0.4	-0.5	-0.4	-0.0	0.3	0.4	0.3
Financial sector										
Nominal short-term interest rate (level)	0.1	0.5	1.0	1.2	1.4	1.0	-0.3	-0.8	-0.7	-0.3
Nominal long-term interest rate (level)	0.0	0.2	0.3	0.4	0.4	0.3	-0.1	-0.3	-0.2	-0.1
Nominal effective exchange rate (-: apprec.)	-0.0	0.0	-0.2	-0.8	-1.6	-1.7	-1.3	-0.7	-0.2	0.3
Real effective exchange rate (-: apprec.)	-0.0	0.0	-0.2	-0.8	-1.6	-1.6	-1.2	-0.7	-0.2	0.3
Stock market indice	-1.1	-4.5	-8.9	-11.4	-12.6	-8.7	3.5	15.3	17.5	4.9
Deflator of residential buildings	-0.3	-1.1	-2.4	-3.3	-3.9	-3.2	0.1	2.4	3.3	2.0
Public finances										
Government net lending (% of GDP)	-0.0	-0.1	-0.2	-0.3	-0.4	-0.3	-0.1	0.2	0.3	0.3
Government gross debt (% of GDP)	0.1	0.3	0.7	1.2	1.7	2.0	1.6	1.0	0.4	0.1
Household sector										
Total available means	-0.1	-0.3	-0.6	-0.9	-1.0	-0.7	0.3	0.9	1.1	0.5
of which real disposable income	-0.0	-0.0	-0.1	-0.1	-0.0	0.1	0.4	0.5	0.5	0.4
Net saving by households (level, % of dispos. income)	0.0	0.1	0.3	0.5	0.6	0.6	0.3	0.0	-0.1	-0.1
International environment										
Foreign effective output	0.0	-0.0	-0.1	-0.2	-0.2	-0.2	0.0	0.3	0.4	0.2
Foreign effective price level	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Foreign effective interest rate (level)	0.1	0.6	0.8	0.6	0.5	1.0	-0.1	-0.4	-0.6	-0.0
Current account (level, % of GDP)	0.0	0.0	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0

TABLE 13 - A counterfactual simulation for Japan: 1995-2004
(deviation from baseline level, in per cent or percentage-points)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Demand & supply (in constant prices)										
Private consumption	-0.0	-0.0	0.1	0.2	0.2	0.1	0.1	0.0	-0.1	-0.3
Public consumption	0.0	-0.0	-0.0	-0.0	-0.0	0.0	0.1	0.1	0.2	0.2
Gross fixed capital formation	-0.1	-0.3	-0.1	0.2	0.4	0.3	0.3	0.2	-0.1	-0.4
of which business sector	-0.1	-0.3	-0.3	-0.1	0.3	0.2	0.1	0.2	0.1	-0.0
Exports	-0.2	-0.7	-0.8	0.2	1.8	3.1	3.6	2.7	0.7	-1.4
Imports	-0.0	-0.0	0.0	0.1	0.0	-0.0	-0.0	-0.0	0.0	-0.0
Gross domestic product	-0.1	-0.2	-0.1	0.2	0.4	0.5	0.6	0.4	0.0	-0.4
Gross private sector output	-0.1	-0.2	-0.1	0.2	0.4	0.5	0.5	0.4	-0.0	-0.4
Deflators										
Gross domestic product	-0.0	-0.1	-0.1	-0.1	0.0	0.2	0.4	0.5	0.6	0.5
Private consumption	-0.0	-0.0	-0.1	-0.1	-0.0	0.1	0.3	0.5	0.6	0.6
Exports	-0.1	-0.3	-0.3	0.1	0.8	1.6	2.1	2.1	1.6	1.0
Imports	-0.1	-0.2	-0.0	0.3	0.7	0.9	0.8	0.5	0.2	0.0
Labour market										
Total employment	-0.0	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0	-0.0	-0.0
of which private sector	-0.0	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0	-0.0	-0.0
Unemployment rate (level, % of labour force)	0.1	0.1	0.0	0.0	-0.1	0.1	0.0	-0.1	-0.0	0.0
Nominal wage, private sector	-0.0	-0.1	-0.1	-0.0	0.2	0.4	0.7	0.7	0.6	0.3
Take home real wage, private sector	-0.0	-0.1	-0.1	0.1	0.2	0.3	0.3	0.2	-0.0	-0.3
Producer real wage, private sector	-0.0	-0.1	-0.0	0.1	0.2	0.2	0.2	0.2	0.0	-0.2
Productivity (GDP per employee)	-0.1	-0.2	-0.1	0.2	0.4	0.5	0.5	0.4	0.0	-0.4
Financial sector										
Nominal short-term interest rate (level)	0.4	0.6	0.3	-0.3	-0.1	0.3	0.1	0.4	0.4	0.4
Nominal long-term interest rate (level)	0.1	0.2	0.1	-0.1	-0.0	0.1	0.0	0.1	0.1	0.1
Nominal effective exchange rate (-: apprec.)	-1.0	-1.7	0.1	3.7	6.5	7.4	5.4	1.4	-2.3	-4.0
Real effective exchange rate (-: apprec.)	-0.9	-1.4	0.3	3.5	5.7	5.7	3.0	-1.0	-3.9	-4.9
Stock market indice	-3.9	-6.6	-3.0	3.6	1.3	-3.6	-1.4	-4.8	-4.8	-5.1
Deflator of residential buildings	-0.0	-0.0	-0.0	-0.0	0.0	0.1	0.2	0.2	0.3	0.2
Public finances										
Government net lending (% of GDP)	-0.0	-0.1	-0.1	0.0	0.1	0.1	0.1	0.1	0.0	-0.1
Government gross debt (% of GDP)	0.1	0.3	0.3	0.0	-0.5	-1.0	-1.4	-1.5	-1.1	-0.2
Household sector										
Total available means	-0.0	-0.0	-0.0	0.0	0.0	-0.0	-0.1	-0.1	-0.1	-0.2
of which real disposable income	-0.0	0.0	0.2	0.3	0.3	0.3	0.4	0.3	0.2	0.0
Net saving by households (level, % of dispos. income)	0.0	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.3
International environment										
Foreign effective output	0.0	-0.1	-0.3	-0.4	-0.4	-0.4	0.1	0.5	0.6	0.4
Foreign effective price level	-0.0	-0.0	-0.0	-0.1	-0.2	-0.3	-0.3	-0.3	-0.1	-0.0
Foreign effective interest rate (level)	0.0	0.3	0.9	1.1	1.1	1.0	-0.2	-0.8	-0.8	-0.3
Current account (level, % of GDP)	-0.0	-0.1	-0.1	0.0	0.2	0.5	0.6	0.5	0.3	-0.1

IV Appendix A: The NIME model

The NIME model is a macroeconometric world model developed by economists at the Belgian Federal Planning Bureau.

A. A macroeconometric world model

In the current version of the NIME model, the world is divided into six blocs, i.e. the euro area, the bloc consisting of the Western EU Member States that do not belong to the euro area[1], the Eastern non-euro EU Member States, the United States, Japan and a bloc representing the rest of the world. All these country blocs are linked together by trade and financial flows. Data for the euro area is aggregated using ECU/euro exchange rates. Data for the Western non-euro EU Member States and the Eastern non-euro EU Member States are aggregated in a common synthetic currency unit.

In all of these blocs but two, i.e. the Eastern non-euro EU Member States and the rest of the world, we distinguish a household sector, an enterprise sector, a government sector and a monetary sector. A similar set of behavioural equations and accounting identities is specified for each sector across blocs, while the parameter values of the equations are obtained using econometric techniques applied to the aggregated, annual data of the different blocs.

The household sector allocates its total available means over goods and services, real money balances, residential buildings and other assets as a function of the nominal interest rate, the real interest rate, the user cost of residential buildings and a scale variable. This scale variable consists of the household sector's assets (including bonds and residential buildings), its current income from assets, its current and expected future take-home labour income and its transfers. Error correction mechanisms and partial adjustment schemes are used to capture sluggish adjustment in the expenditure plans of the household sector. Moreover in the short-run the household sector is liquidity-constrained, implying that a fraction of its expenditures must be financed by disposable income.

The enterprise sector maximises its profits by hiring production factors and selling its output to final users. Gross output consists of goods for private consumption, investment and exports. There are three production factors: labour, fixed capital and intermediary imports. Error correction mechanisms and partial adjustment schemes are used to model the short-run demand for the production

1. I.e. Denmark, Sweden and the United Kingdom.

factors. In these demand schemes, the long-run factor demand equations are derived from a Cobb-Douglas production function with constant returns to scale.

Prices and wages are not fully flexible and clear the markets only in the long-run. Moreover, country blocs are engaged in multilateral trade where importers are price setters and exporters are price takers, except for the price of oil which is determined outside the model. The (equilibrium) real wage rate is a weighted average of labour productivity and the reservation wage, while the natural rate of unemployment is determined by the gap between the take-home wage and the reservation wage of the employees.

Government income is determined by endogenous tax bases and predetermined tax rates, while its expenditures are to a large extent determined by the business cycle and trend growth. The automatic fiscal stabilisers operate on the expenditure side mainly through unemployment benefits and interest payments on government gross debt and, on the revenue side, mainly through direct wage income taxes, profit taxes, social security contributions and indirect taxes.

In the default version of the model, the short-term interest rates are set according to the Taylor principle. This implies that the monetary authorities increase (decrease) the short-term nominal interest rate more than proportionally to increases (decreases) in inflation, thus increasing (decreasing) real interest rates when inflationary pressures arise (subside). It also implies that the monetary authorities keep the short-term interest rate below (above) the equilibrium interest rate if demand is below (above) potential output. Long-term interest rates are determined by the term structure theory of interest rates. Changes in an area's nominal effective exchange rate are determined by changes in the interest rate differential and the (expected) inflation differential. The risk premiums in the financial markets are kept constant.

B. Case studies, technical variants and economic outlooks for the world economy

Several studies have been made with the NIME model. Meyermans (2002.a and 2002.b) used the NIME model to investigate to what extent the working of the automatic fiscal stabilisers and monetary policy can contribute to the full realisation of potential output and price stability. Meyermans (2003) used the NIME model to assess the transmission of shocks from the United States to the euro area under alternative exchange rate policies. Meyermans (2004) studied with the NIME model how a cut in the social security contribution rate and an increase in the labour participation rate affect economic activity in the medium-term. Meyermans and Van Brusselen (2003) examined with the NIME model the impact on the Belgian international environment of a temporary worldwide autonomous drop in private consumption, a further monetary easing by the European Central Bank, a fiscal consolidation in the euro area and of a prolonged worldwide fall in stock markets, while Meyermans and Van Brusselen (2005.b) used the NIME model to describe the macroeconomic effects of an oil price rise. Finally, in addition to these variants, Meyermans and Van Brusselen (2004 and 2005.a) used the NIME model to prepare economic outlooks for the world economy for the periods ranging from 2004 to 2010 and from 2005 to 2011, respectively.

C. Asset prices in the NIME model

Here, we recall and extend some of the asset price equations of the NIME model, and we also describe briefly the sources of some of the data.

1. Asset price equations

We start with the specification of the price setting for the financial assets, next we discuss the price setting for residential buildings.

The household sector's portfolio of financial assets consists of equity and bonds (including financial instruments derived from equity and bonds), i.e.:

(A.1) $$CAOU = CAOEU + CAOBU$$

with CAOU the total stock of financial assets in current prices held by the household sector, CAOEU the stock of equity and CAOBU the stock of bonds.

The price of the total portfolio, PCAO, is defined as:

(A.2) $$PCAO = caob\ PCAOB + (1-caob)\ PCAOE$$

with PCAOB the unit price of the households' bond portfolio, PCAOE the unit price of the households' equity portfolio, and with caob the share of bonds in the portfolio satisfying the condition $0 \leq caob \leq 1$[1].

In equilibrium, the price of the households' bond portfolio, PCAOB, is determined by the price of the long-term bond, which is equal to 1/LI with LI the long-term interest rate, and the price of short-term bills, which is equal to 1, as:

(A.3) $$\begin{aligned} \ln(PCAOB) &= pcaob\_l0 + (1-pcaob\_l1)\ln(1) + pcaob\_l1\ln(1/LI) \\ &= pcaob\_l0 + pcaob\_l1\ln(1/LI) \end{aligned}$$

with pcaob_l1 the share of long-term bonds and $0 \leq pcaob\_l1 \leq 1$.

In equilibrium, the price of the households' equity portfolio, PCAOE, is proportional to the stock market index, i.e.:

(A.4) $$\ln(PCAOE) = pcaoe\_l0 + pcaoe\_l1\ln(STOCK)$$

with STOCK the stock market index.

In the NIME model, prices adjust only sluggishly to their equilibrium level due to menu and information costs, see for example Meyermans and Van Brusselen

1. In the NIME model, the parameter caob is a constant.

(2001). Hence, PCAOB and PCAOE are determined by the following error correction mechanism, i.e.[1]:

$$(A.5) \quad d\ln(PCAOB) = (1-pcaob\_sl)\,(pcaob\_sw-1)\,[\ln(PCAOB_{-1}) - \ln(PCAOBR)] + (1-pcaob\_sl)\,pcaob\_sw\,d\ln(UCAOB)$$

and

$$(A.6) \quad d\ln(PCAOE) = (1-pcaoe\_sl)\,(pcaoe\_sw-1)\,[\ln(PCAOE_{-1}) - \ln(PCAOER)] + (1-pcaoe\_sl)\,pcaoe\_sw\,d\ln(UCAOE)$$

with: $0 \leq pcaob\_sl, pcaob\_sw, pcaoe\_sl, pcaoe\_sw \leq 1$

The parameter px_sl is the fraction of the composite good x (x = CAOE, CAOB) for which the price is kept at its old price due to menu costs, and the parameter px_sw is the fraction of the prices that are revised according to a rule of thumb due to information costs.

The rational reset prices, PCAOBR and PCAOER, are defined in equations (A.3) and (A.4) respectively, and the rule of thumb price changes are set as ln(UCAOB) = d ln ($PCAOB_{-1}$) and d ln(UCAOE) = G_PCAOE with G_PCAOE the HP filtered trend.

Point estimates for equations (A.5) and (A.6) are shown in tables 15 and 16.

TABLE 14 - Price of bonds: point estimates[a]

	Euro area	Non-euro EU	United States	Japan
pcaob_sl	0.29	0.89	0.95	0.87
	(0.21)	(0.07)	(0.03)	(0.06)
pcaob_sw	0.50	0.42	0.27	0.40
	(0.16)	(0.14)	(0.11)	(0.14)

[a] Equation (A.5). Standard errors between brackets

TABLE 15 - Price of equity: point estimates[a]

	Euro area	Non-euro EU	United States	Japan
pcaoe_sl	0.29	0.64	0.27	0.67
	(0.30)	(0.10)	(0.15)	(-.-)
pcaoe_sw	0.33	0.11	0.01	0.17
	(0.28)	(-.-)	(0.17)	(0.23)

[a] Equation (A.6). Standard errors between brackets; if no standard error is given the parameter is fixed at its unrestricted estimate (with the wrong sign) plus one (or two) standard errors.

The price of residential buildings is set according to a similar price setting scheme, i.e.:

$$(A.7) \quad d\ln(PCIR) = (1-pcir\_sl)\,(pcir\_sw-1)\,[\ln(PCIR_{-1}) - \ln(PCIRR)] + (1-pcir\_sl)\,pcir\_sw\,d\ln(UCIR).$$

1. See equation (F.11) of Appendix F in Meyermans and Van Brusselen (2000.b).

Point estimation results for equation (A.7) are given in Table (19).

TABLE 16 - Price of residential buildings: point estimates[a]

	Euro area	Non-euro EU	United States	Japan
pcir_sl	0.06	0.20	0.04	0.18
	(0.17)	(-.-)	(0.52)	(0.10)
pcir_sw	0.99	0.85	0.91	0.47
	(0.12)	(0.10)	(0.05)	(0.11)

[a] Equation (A.7). Standard errors between brackets, if no standard error is given the parameter is fixed at its unrestricted estimate (with the wrong sign) plus one (or two) standard errors.

2. The data

In addition to the data descriptions presented in various other NIME Working Papers, we add here the following information.

The stock price indices for the various economic areas, STOCK, are measured as follows. For the euro area, we compute a composite euro area indice which is a GDP-weighted average of quotes for the German Dax, the French CAC40, the Italian MIBtel and the Belgian BEL20 indices; for the Western non-euro EU Member States, we use the UK's FT100 indice; for the United States, we use the S&P500 indice; and for Japan, we use the Nikkei225 indice.

The household sector's bond and equity holdings, CAOEU and CAOBU, are computed on the basis of data published in the household wealth and indebtedness tables, available in the statistical annexes of the OECD's economic outlooks (see for example OECD (2005), Annex Table 58. "Household wealth and indebtedness").

The price of equity, PCAOE, is calculated starting from:

$$\text{(A.8)} \qquad \text{CAOEU} = \frac{\text{CAOEU}_{-1}}{\text{PCAOE}_{-1}}\text{PCAOE} + \text{AOEU}$$

where AOEU is the acquisition of new equities.

Equation (A.8) states that the current value of the equity portfolio is equal to the portfolio inherited from the past and evaluated at current prices plus the net purchase of new equity. Equation (A.8) can be rewritten as:

$$\text{(A.9)} \qquad \text{PCAOE} = \frac{(\text{CAOEU} - \text{AOEU})}{\text{CAOEU}_{-1}}\ \text{PCAOE}_{-1}$$

Normalising the price of PCAOE to 1 in 1995, equation (A.9) can be used to calculate the rest of the series.

The variable AOEU is computed as follows:

$$\text{(A.10)} \qquad \text{AOEU} = \text{cear\_0}\ \text{AOU}$$

where cear_0 is the share of equities in household net equity and bond balances, also derived from OECD data. The variable AOU, measuring the total net acquisition of equities and bonds by households, is computed as the difference between the net saving of households (NSH) and household residential investment (IRU), the change in household inventories (DINVHU) and the change in household money balances (M):

(A.11) $$AOU = NSH - IRU - DINVHU - (M-M_{-1})$$

A series for PCAO is calculated in a similar way as we did for the PCAOE series. A series for PCAOB is calculated using equation (A.2) and the previously computed data for PCAO and PCAOE.

V Appendix B: A broad-based interest rate rule

In this appendix, we specify a broad-based interest rate rule. Under this new rule the short-term interest rate does not only respond to deviations of consumer price inflation from its target rate and the output gap, but also to deviations of asset price inflation from its target rate and changes in the output gap.

In the first section of this appendix, we define a broad price index for the household sector on the basis of the household sector's intertemporal utility optimization problem. There we show that the broad price index does not only include the traditional consumer price index but also the prices of liquidity services, residential buildings, and equities. In the second section, we specify an interest rate rule based on the broad price index and a functional form similar to the Taylor rule. We conclude the second section by calculating values for the parameters of the new interest rate rule.

A. A broad price index for the household sector

1. A quantity and price vector for the household sector

In the NIME model, the household sector allocates its total available means over goods and services, money balances (which provide monetary services), residential buildings (which provide housing services) and financial assets (other than money, which provide future purchasing power) in such a way that it maximises its intertemporal utility subject to its intertemporal budget constraint.

In Appendix A of Meyermans and Van Brusselen (2000.a) it is shown that the intertemporal optimization problem of the household sector can be characterised in terms of the goods vector Y and price vector Π, which read as[1]:

(B.1.a) $$Y' = (CPO, \frac{M}{PCH}, CIRO, Z)$$

1. For an interpretation of these results, see Chapter III of the main text or Meyermans and Van Brusselen (2000.a).

and

$$(B.1.b) \quad \Pi' = (PCH, \frac{LIC}{(1+LIC)} PCH, \frac{LIC + \rho_{iro} - \left(\frac{PCIR_{+1}}{PCIR} - 1\right)(1-\rho_{iro})}{1+LIC} PCIR, \frac{PCH_{+1}}{1+LIC})$$

with CPO private consumption, M nominal money balances, PCH the consumer price, CIRO the stock of residential buildings, Z assets generating purchasing power in the future, LIC the interest rate[1], PCIR the price of residential buildings, and ρ_{iro} the rate of depreciation of the residential buildings.

The price vector reads in short-hand notation also as[2]:

$$(B.1.f) \quad \Pi' = (PCH, PM, USERIR, PZ).$$

The variable Z is defined as:

$$(B.2) \quad Z = (M+CIRO(1-\rho_{iro}) PCIR_{+1} + INVHO\ (1-\rho_{invh}) PINVH_{+1} + CAOU\ (1+LIC) + ZY_{+1})/PCH_{+1}$$

with INVHO inventories held by households, PINVH the price of inventories, CAOU the stock of financial assets (equity plus bonds) and ZY expected future non-asset income.

Let w_cpo, w_m, w_ciro and w_z be the shares of the goods CPO, M, CIRO and Z in total household outlays[3], then we define the household sector's overall price index P as:

$$(B.3.a) \quad \ln(P) = w\_cpo \ln(PCH) + w\_m \ln(PM) + w\_ciro \ln(USERIR) + w\_z \ln(PZ)$$

---

1. LIC is a weighted average of the short-term and long-term interest rate.
2. We define:
   $$(B.1.c) \quad PM = \frac{LIC}{(1+LIC)} PCH,$$
   $$(B.1.d) \quad USERIR = \frac{LI + \rho_{iro} - \left(\frac{PCIR_{+1}}{PCIR} - 1\right)(1-\rho_{iro})}{1+LIC} PCIR$$
   $$(B.1.e) \quad PZ = \frac{PCH_{+1}}{1+LIC}$$
   See also Meyermans and Van Brusselen (2000.b).
3. Let:
   TOTMEANS = CPO PCH + (M/PCH) PM + CIRO USERIR + Z PZ,

   then we define:
   w_cpo = CPO * PCH / TOTMEANS
   w_m = (M/PCH) * PM / TOTMEANS
   w_ciro = CIRO * USERIR / TOTMEANS
   w_z = Z * PZ / TOTMEANS

   so that:
   w_cpo + w_m + w_ciro + w_z = 1.

with:

(B.3.b) 0<w_cpo, w_m, w_ciro, w_z <1

and

(B.3.c) w_cpo+ w_m + w_ciro + w_z = 1.

2. Equity, real estate and bonds imperfect substitutes

In the NIME model, the household sector's total financial wealth (other than money) consists of equities and bonds, i.e.:

(B.4.a) CAOU = CAOBU + CAOEU

with

(B.4.b) CAOBU = CAOBO PCAOB

(B.4.c) CAOEU = CAOEO PCAOE

where CAOU is total household financial assets in current prices, CAOBU the stock of interest yielding bonds in current prices, CAOEU the stock of equity in current prices, CAOBO the stock of bonds in constant prices, PCAOB the price of equity, CAOEO the stock of equity in constant prices and PCAOE the price of equity.

Previously it was assumed in the NIME model that bonds and equity are perfect substitutes yielding an (expected) return equal to LIC (LIC=$PCAOE_{+1}/PCOE-1$). Here, we assume that bonds and equity are no longer perfect substitutes, implying that their expected returns may differ. A similar assumption applies for the substitutability between bonds and real estate. Hence, to reflect the new assumptions regarding substitutability, we re-define the vector Z, previously defined in equation (B.2) for the case of perfect substitutability, as:

(B.5.a) $Z' = [(M+INVHO(1-\rho_{invh})\,PINVH_{+1}+CAOBU\,(1+LIC)+ZY_{+1})/PCH_{+1},$

$$CIRO(1-\rho_{iro})\,PCIR_{+1}/PCH_{+1},\quad CAOEO\,PCAOE_{+1}/PCH_{+1}]$$

with corresponding price vector:

(B.5.b) $$\Pi_z' = [\frac{PCH_{+1}}{1+LIC},\quad \frac{PCH_{+1}\,PCIR}{PCIR_{+1}(1-\rho_{iro})},\quad \frac{PCH_{+1}\,PCAOE}{PCAOE_{+1}}]$$

The interpretation of these prices is as follows. Let us first consider the case of bonds (and its substitutes). Holding bonds for one period yields an interest LIC.

Hence, the expected purchasing power of carrying one unit of bonds to the next period is equal to $\frac{1 + LIC}{PCH_{+1}}$. In other words, if one wants to obtain one real unit of purchasing power in the next period by holding bonds, one has to pay today the unit price $\frac{PCH_{+1}}{1 + LIC}$.

Furthermore, in order to obtain one unit of purchasing power in the next period by holding one unit of residential buildings, one has to buy today residential buildings at the price $\frac{PCH_{+1}\ PCIR}{PCIR_{+1}(1 - \rho_{iro})}$.

Similarly, in order to obtain one unit of purchasing power in the next period by holding one unit of equities, one has to buy today a unit of equity at the price $\frac{PCH_{+1}\ PCAOE}{PCAOE_{+1}}$.

Using equation (B.5.b), the price of the aggregate Z is then defined as[1]:

$$\text{(B.6.a)}\quad \ln(PZ) = wz\_zy \ln\left(\frac{PCH_{+1}}{1 + LIC}\right) + wz\_ciro \ln\left(\frac{PCH_{+1}\ PCIR}{PCIR_{+1}(1 - \rho_{iro})}\right) + wz\_cooe \ln\left(\frac{PCH_{+1}\ PCAOE}{PCAOE_{+1}}\right)$$

with

$$\text{(B.6.b)}\quad 0 < wz\_zy, wz\_ciro, wz\_cooe < 1$$

and

$$\text{(B.6.c)}\quad wz\_zy + wz\_ciro + wz\_cooe = 1.$$

Using condition (B.6.c), equation (B.6.a) can be rewritten as:

$$\text{(B.7)}\quad \ln(PZ) = \ln(PCH_{+1}) - wz\_zy \ln(1+LIC) + wz\_ciro \ln\left(\frac{PCIR}{PCIR_{+1}(1 - \rho_{iro})}\right) + wz\_cooe \ln\left(\frac{PCAOE}{PCAOE_{+1}}\right)$$

1. With the shares defined as:

$$wz\_zy = [(M+INVHO(1 - \rho_{invh})\ PINVH_{+1}+CAOBU\ (1+LIC)+ZY_{+1})/PCH_{+1}]\ \left(\frac{PCH_{+1}}{1 + LIC}\right)\ \frac{1}{Q}$$

$$wz\_ciro = [CIRO(1 - \rho_{iro})\ PCIR_{+1}/PCH_{+1}]\left(\frac{PCH_{+1}\ PCIR}{PCIR_{+1}(1 - \rho_{iro})}\right)\ \frac{1}{Q} = \frac{CIRO\ PCIR}{Q}$$

$$wz\_cooe = \left(\frac{CAOOE\ \ PCAOE_{+1}}{PCH_{+1}}\right)\left(\frac{PCH_{+1}\ PCAOE}{PCAOE_{+1}}\right)\ \frac{1}{Q} = \frac{CAOOE\ \ PCAOE}{Q}$$

The variable Q is defined as:
$Q = Z' \Pi_Z$.

3. A broad price index in levels

Using equations (B.1.c)-(B.1.e) and (B.7), we rewrite equation (B.3.a) as:

(B.8) $\ln(P) = w\_cpo \ln(PCH)$

$$+ w\_m \ln\left(\frac{LIC}{1+LIC}\ PCH\right)$$

$$+ w\_ciro \ln\left(\frac{LIC + \rho_{iro} - \left(\frac{PCIR_{+1}}{PCIR} - 1\right)(1-\rho_{iro})}{1+LIC}\ PCIR\right)$$

$$+ w\_z \left[\ln(PCH_{+1}) - wz\_zy \ln(1+LIC) + wz\_ciro \ln\left(\frac{PCIR}{PCIR_{+1}(1-\rho_{iro})}\right)\right.$$

$$\left. + wz\_cooe \ln\left(\frac{PCAOE}{PCAOE_{+1}}\right)\right]$$

so that on collecting terms and using equation (B.3.c):

(B.9) $\ln(P) = \ln(PCH)$

$$+ w\_m \ln(LIC) - (w\_m + w\_ciro + w\_z\ wz\_zy) \ln(1+LIC)$$

$$+ w\_ciro \ln\left(LIC + \rho_{iro} - \left(\frac{PCIR_{+1}}{PCIR} - 1\right)(1-\rho_{iro})\right)$$

$$+ w\_ciro \ln\left(\frac{PCIR}{PCH}\right)$$

$$+ w\_z \ln\left(\frac{PCH_{+1}}{PCH}\right)$$

$$- w\_z \left[wz\_ciro \ln\left(\frac{PCIR_{+1}(1-\rho_{iro})}{PCIR}\right) + wz\_cooe \ln\left(\frac{PCAOE_{+1}}{PCAOE}\right)\right].$$

Equation (B.9) shows how the broad price index of the household sector augments the traditional consumer price index, PCH, by interest rate charges, the real price of residential buildings, the expected change in consumer prices, and the expected change in the prices of houses and assets.

4. A broad price index in first differences

Taking first differences of (B.9) yields:

(B.10) $d \ln(P) = d \ln(PCH)$

$$+ w\_m \, d \ln(LIC) - (w\_m + w\_ciro + w\_z \, wz\_zy) \, d \ln(1+LIC)$$

$$+ w\_ciro \, d \ln \left(LIC + \rho_{iro} - \left(\frac{PCIR_{+1}}{PCIR} - 1 \right) (1-\rho_{iro}) \right)$$

$$+ w\_ciro \, d \ln \left(\frac{PCIR}{PCH} \right)$$

$$+ w\_z \, d \ln \left(\frac{PCH_{+1}}{PCH} \right)$$

$$- w\_z \, wz\_ciro \, d \ln \left(\frac{PCIR_{+1}(1-\rho_{iro})}{PCIR} \right)$$

$$- w\_z \, wz\_cooe \, d \ln \left(\frac{PCAOE_{+1}}{PCAOE} \right)$$

so that, on keeping the rate of depreciation ρ_{iro} constant, we can simplify the change in the broad price index as[1]:

(B.11.a) $d \ln(P) = d \ln(PCH) + p\_1 \, d \, LIC + p\_2 \, d \ln \left(\frac{PCIR}{PCH} \right)$

$$+ p\_3 \, d \ln \left(\frac{PCH_{+1}}{PCH} \right) + p\_4 \, d \ln \left(\frac{PCIR_{+1}}{PCIR} \right) + p\_5 \, d \ln \left(\frac{PCAOE_{+1}}{PCAOE} \right)$$

with:

(B.11.b) $p\_1 = w\_m \, / \, LIC - (w\_m + w\_ciro + w\_z \, wz\_zy) \, / \, (1+LIC)$

$$+ w\_ciro \, / \, [LIC + \rho_{iro} - \left(\frac{PCIR_{+1}}{PCIR} - 1 \right) (1-\rho_{iro})] \lessgtr 0$$

(B.11.c) $p\_2 = w\_ciro > 0$

(B.11.d) $p\_3 = w\_z > 0$

---

1. Here we made use of:

$$d \ln(1+LIC) = \frac{1}{1+LIC} \, d(1+LIC) = \frac{1}{1+LIC} \, d \, LIC$$

$$d \ln(LIC) = \frac{1}{LIC} \, d \, LIC$$

$$d \ln [LIC + \rho_{iro} - \left(\frac{PCIR_{+1}}{PCIR} - 1 \right) (1-\rho_{iro})]$$

$$= 1/[LIC + \rho_{iro} - \left(\frac{PCIR_{+1}}{PCIR} - 1 \right) (1-\rho_{iro})] \, d (LIC + \rho_{iro} - \left(\frac{PCIR_{+1}}{PCIR} - 1 \right) (1-\rho_{iro})]$$

and:

$$d \left(\frac{PCIR_{+1}}{PCIR} - 1 \right) = \left(\frac{PCIR_{+1}}{PCIR} \right) d \ln \left(\frac{PCIR_{+1}}{PCIR} \right).$$

(B.11.e) $p\_4 = -w\_z\ wz\_ciro - w\_ciro / [LIC + \rho_{iro} - \left(\frac{PCIR_{+1}}{PCIR} - 1\right)(1-\rho_{iro})]$

$$\left(\frac{PCIR_{+1}}{PCIR} - 1\right)(1-\rho_{iro}) \begin{matrix} < \\ > \end{matrix} 0$$

(B.11.f) $p\_5 = -w\_z\ wz\_cooe < 0$.

B. The broad price index and the interest rate rule

Now that we have defined a broad-based price index, we will integrate this index into an interest rate rule.

1. The Taylor rule

Consider the interest rate rule:

(B.12) $SI = si\_sl \{HP\_LI + si\_1 [INFL - TARGETINFL] + si\_2\ OUTPUTGAP\}$

$$- (1-si\_sl)\ SI_{-1} + SI\_V$$

with INFL some measure of inflation, TARGETINFL the corresponding target inflation rate and OUTPUTGAP the output gap.

Equation (B.12) reads as a traditional Taylor rule augmented by a lagged short-term interest rate and a stochastic component SI_V. The lagged short-term interest rate reflects the importance that the monetary authorities may attach to interest rate smoothing, while the stochastic component captures randomness in human behaviour.

2. The change in the broad price index and the targeted overall inflation rate

Usually, the contemporaneous consumer price inflation rate is used as the relevant inflation measure in equation (B.12)[1]. In this Working Paper, we propose to measure the inflation rate (INFL) by the rate at which the broad price index changes[2]. By doing so we are able to derive a new interest rate rule. However, before we can do this we first have to define the targeted overall inflation rate.

Here, we assume that in equilibrium, prices grow at a steady rate, i.e.:

(B.13.a) $d \ln(PCH) = G\_PCH$

(B.13.b) $d\ LIC = d\ HP\_LI$

1. I.e. INFL = d ln(PCH).
2. As defined in equation (B.11).

(B.13.c) d ln(PCIR) = G_PCH + GQ_PCIR

(B.13.d) d ln(PCAOE) = G_PCAOE

where G_PCH is trend (or targeted) inflation, GQ_PCIR trend (or targeted) increase in the real price of residential buildings, G_PCAOE the trend (or targeted) increase in the price of equities, and HP_LI the equilibrium nominal interest rate.

In order to obtain the targeted increase in the overall price index, we evaluate equation (B.11.a) for the targets spelled out in equation (B.13.a)-(B.13.d). This yields:

(B.14) TARGETINFL = G_PCH + p_1 d HP_LI + p_2 GQ_PCIR

+ p_3 d G_PCH + p_4 d (G_PCH + GQ_PCIR) + p_5 d G_PCAOE.

3. The augmented interest rate rule

Inserting equations (B.11) and (B.14) into equation (B.12) yields, on rearranging terms:

(B.15) SI =

$$
\begin{aligned}
&si\_sl\,\{HP\_LI + si\_1\,[d\ln(PCH) - G\_PCH] + si\_2\,OUTPUTGAP\} - (1 - si\_sl)\,SI_{-1} \\
&+ si\_sl\,si\_s1\,\{p\_1\,[d\,LI - d\,HP\_LI] \\
&+ p\_2\,[d\ln(\frac{PCIR}{PCH}) - GQ\_PCIR] \\
&+ p\_3\,[d\ln\left(\frac{PCH_{+1}}{PCH}\right) - d\,G\_PCH\,] \\
&+ p\_4\,[d\ln\left(\frac{PCIR_{+1}}{PCIR}\right) - d\,(G\_PCH + GQ\_PCIR)] \\
&+ p\_5\,[d\ln\left(\frac{PCAOE_{+1}}{PCAOE}\right) - d\,G\_PCAOE]\} \\
&+ SI\_V\,.
\end{aligned}
$$

The first line on the right hand-side of equation (B.15) describes a traditional interest rate rule, see for example equation (2) of the main text. The terms in the following lines indicate by how much the traditional interest rate rule has to be augmented if one wants to take into account all the welfare implications of contemporaneous and future price changes. However, before we proceed with the discussion of this result we note here that some of the right-hand side variables of equation (B.15) are not directly observed[1]. Therefore, we make the following assumptions.

1. Not observable are the variables with a lead +1.

First, in the NIME model, the expected consumer price inflation is determined by the contemporaneous output gap and trend inflation[1]:

$$\text{(B.16) } \ln\left(\frac{PCH_{+1}}{PCH}\right) = \text{(1-pch\_sl) (pch\_sw-1) pch\_s1 OUTPUTGAP}$$

$$+ \text{(1-pch\_sl) } G\_PCH_{+1}$$

where the parameters 0<pch_sl, pch_sw<1, and pch_s1<0 are obtained from the equation determining contemporaneous inflation.

Second, real estate prices change according to equation (A.7) of Appendix A. Mutatis mutandis, the latter equation holds also for the future changes in equity prices, so that:

$$\text{(B.17) } \ln\left(\frac{PCIR_{+1}}{PCIR}\right) = \text{(1-pcir\_sl) (pcir\_sw-1) [ln(PCIR) - ln(PCIRR}_{+1}\text{)]}$$

$$+ \text{(1-pcir\_sl) pcir\_sw [G\_PCIR}_{+1}\text{].}$$

Third, equation (A.6) of Appendix A describes the change in the price of equity. Mutatis mutandis, the latter equation holds also for the future changes in equity prices, so that:

$$\text{(B.18) } \ln\left(\frac{PCAOE_{+1}}{PCAOE}\right) = \text{(1-pcaoe\_sl) (pcaoe\_sw-1) [ln(PCAOE)-ln(PCAOER}_{+1}\text{)]}$$

$$+ \text{(1-pcaoe\_sl) pcaoe\_sw [G\_PCAOE]}$$

Fourth, the trend growth rates in the different prices, i.e. G_PCH, GQ_PCIR, and GQ_PCAOE are exogenous and they are equal to the value obtained applying a Hodrick-Prescott to the corresponding historical price series. We assume here that:

$$\text{(B.19.a) } G\_PCH_{+1} = G\_PCH$$

$$\text{(B.19.b) } GQ\_PCIR_{+1} = GQ\_PCIR$$

$$\text{(B.19.c) } G\_PCAOE_{+1} = G\_PCAOE.$$

Inserting equations (B.16), (B.17), (B.18) and (B.19.a)-(B.19.c) into equation (B.15) and rearranging terms, yields:

1. See equation (F.14.a) of Appendix F of Meyermans and Van Brusselen (2000.b). Here, we assume d ln(UCH) = G_PCH_{+1}.

(B.20) SI =

$$
\begin{aligned}
&si\_sl\ \{HP\_LI + si\_1\ [d\ \ln(PCH) - G\_PCH] + si\_2\ OUTPUTGAP\} - (1 - si\_sl)\ SI_{-1} \\
&+ si\_sl\ si\_s1\ \{p\_1\ [d\ LIC - d\ HP\_LI] \\
&+ p\_2\ [d\ \ln\left(\frac{PCIR}{PCH}\right) - GQ\_PCIR] \\
&+ p\_3\ (1 - pch\_sl)\ (pch\_sw - 1)\ pch\_s1\ d\ OUTPUTGAP \\
&+ p\_4\ (1 - pcir\_sl)\ (pcir\_sw - 1)\ [d\ \ln(PCIR) - (G\_PCH + GQ\_PCIR)] \\
&+ p\_5\ \{(1 - pcaoe\_sl)\ (pcaoe\_sw - 1)\ [d\ \ln(PCAOE) - G\_PCAOE] \\
&- p\_3\ pch\_sl\ d\ G\_PCH \\
&+ p\_4\ [(1 - pcir\_sl)\ pcir\_sw - 1]\ d\ (G\_PCH + GQ\_PCIR) \\
&+ p\_5\ [(1 - pcaoe\_sl)\ pcaoe\_sw - 1]\ d\ G\_PCAOE \\
&+ SI\_V
\end{aligned}
$$

Equation (B.20) augments the "traditional" interest rate rule (which only considers the deviation of consumer price inflation from targeted inflation and the output gap) with the deviation of the long-term interest rate from the equilibrium interest rate, the change in the real price of residential buildings vis-à-vis a target, the change in the output gap, the change in the nominal price of residential buildings vis-à-vis a target, the change in the price of equity vis-à-vis a target, and the changes in the targets.

4. Parameter values

The parameters of the augmented interest rate rule (B.20) are determined by the parameters of the original Taylor rule (i.e. si_s1, si_s2 and si_sl), the budget shares of the various expenditure items in the household budget (i.e. p1, ..., p5) and the parameters of the price equations (i.e. px_sl and px_sw with x = ch, cir, caoe). These parameter values are summarised in Table 17.

TABLE 17 - Parameter values for the augmented Taylor rule (equation 20)

	Euro area	Non-euro EU	United States	Japan
si_s1	1.5	1.5	1.5	1.5
si_s2	0.5	0.5	0.5	0.5
si_sl	0.4	0.3	0.3	0.5
p1	0.0	-0.4	-0.2	-0.9
p2	0.0	0.0	0.0	0.0
p3	0.9	0.9	0.9	1.0
p4	-0.4	-0.2	-0.3	-0.0
p5	-0.2	-0.1	-0.3	-0.0
pch_sl	0.0	0.0	0.1	0.0
pch_sw	0.5	0.5	0.9	0.3
pch_s1	-0.3	-0.7	-2.6	-0.5
pcir_sl	0.1	0.2	0.0	0.2
pcir_sw	1.0	0.9	0.9	0.5
pcaoe_sl	0.3	0.3	0.0	0.5
pcaoe_sw	0.3	0.6	0.2	0.2

Source: the NIME model

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