The public-private savings mirror and causality relations among private savings, investment and (twin) deficits: A full modeling approach

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The Public–Private Savings Mirror and Causality Relations Among Private Savings, Investment, and (twin) Deficits: A Full Modeling Approach

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Relations between national public and private savings, domestic investment, and the current account are analyzed with the Global Econometric Model (National Institute, London). Simulation results obtained with this full modeling approach for the US, Japan, Germany, and the UK are compared with estimation results from the partial modeling approaches adopted in the literature. The results from the two approaches are rather different. The simulation results indicate that private savings largely offset public savings (and vice versa) in the short run. In contrast with findings in partial models, a smaller effect of aggregate savings on investment is found and government deficits tend to increase current account imbalances. © 1999 Society for Policy Modeling. Published by Elsevier Science Inc.

1. INTRODUCTION

In a closed economy fiscal and monetary policy have a full effect on private consumption and private investment. In an open economy the effectiveness of these policies depends upon the degree of capital mobility. In order to investigate the effectiveness of government policies many studies have drawn attention to international capital mobility in recent decades.

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Following Feldstein and Horioka (1980), several empirical studies have analyzed national savings and investment, either with time series or cross-sections of countries. A main conclusion of these studies is that national savings, consisting of public and private savings, affect investment positively, and the effect is rather high because of a relatively low international capital mobility. According to these models government deficits thus hinder investment and, therefore, economic growth. Others have indicated that government deficits are (also) a nuisance because they may lead to current account deficits (see Obstfeld and Rogoff, 1995). Eisner (1994), on the other hand, investigates the role of public savings on future national savings in a dynamic model and finds a positive effect of government deficits on future savings and, hence, potential economic growth.

In all these studies the models used can be called partial models. They focus only on two or three variables instead of the whole set of variables needed to describe an interdependent economic system.[1]

In contrast to these partial and rather aggregate modeling approaches a disaggregate and full modeling approach is considered in this paper. The Global Econometric Model (NiGEM, for short), which is developed and estimated by the National Institute of Economic and Social Research, is used to carry out simulations, and the relations between public and private savings, investment, and the current account in the short and long run are analyzed. A main advantage of NiGEM is that all relevant variables as well as their (trade) linkages are modeled explicitly. So no important channels are neglected.

The main aim of this study is to verify whether this full model corroborates the results of the partial studies, being basically that (1) public as well as private savings affect investment positively (2) investment as well as government deficits affect current account balances negatively, and (3) government deficits affect future savings positively.

[1] In many of the partial studies the neglect of important parts of the economic system is mentioned as a major shortcoming in the analyses: ... Beware: these simple correlations are merely suggestive and have no structural interpretation ... (Obstfeld and Rogoff, 1995, p. 31) and ... Results in full-scale, multiequation macroeconomic models may prove more persuasive to some than the essentially reduced forms considered in this paper ... (Eisner, 1994, p. 184).

Knowing about these (causal) relations is of particular importance for those countries having twin deficits, i.e., a government and a current account deficit, like the US had. It is often argued that in order to tame one of the two deficits the government should either cut government expenditure, increase taxes, and/or stimulate private savings (see, for instance, Feldstein, 1995, Nixon, 1995, or Hakkio, 1995). In the different scenarios analyzed with NiGEM attention is paid to this issue.

The outline is as follows. Section 2 reviews the relations between savings, investment, and international capital mobility as derived from national accounting identities. Empirical modeling approaches are presented, both partial approaches and the full approach of NiGEM. In Section 3 estimation results obtained with data from NiGEM are given for the partial models under investigation. In Section 4 NiGEM simulation results are presented. In Section 5 the results from partial models and NiGEM are compared. Section 6 gives some reflections on related issues. Section 7 concludes.

2. SAVINGS, INVESTMENT, AND INTERNATIONAL CAPITAL MOBILITY

From the national income identity (Eq. 1)

$$Y = C + I + G + X - M, \tag{1}$$

where Y represents domestic income (GDP), C private consumption, I domestic investment, G government expenditure, X exports, and M imports, it follows that (Eq. 2)

$$S^g + S^p - I = X - M, \tag{2}$$

where

$$S^g \equiv T - G$$
$$S^p \equiv Y - C - T.$$

Public savings and private savings, S^g and S^p, respectively, form total savings (S), and T are taxes.

In a closed economy, $X = M = 0$, and consequently $S^g + S^p = I$. In such an economy the correlation between public savings and the private savings gap, i.e., $S^p - I$, is perfect and equals minus one. The correlation between total savings and investment equals one. Fiscal policy is thus fully effective as a change in (total) savings is matched by the equivalent change in investment.

In an open economy, X and M differ from zero and probably do not balance. A savings surplus (deficit) is accompanied by a surplus (deficit) of the current account $X - M$. In this case, the correlation between total savings and investment and the correlation between public savings and the private savings gap are not determined.

The opposite extreme of a closed economy is an open economy, where capital is perfectly mobile. If perfect international capital mobility (ICM, for short) holds, there is no relation between savings and investment because "... saving in each country responds to the worldwide opportunities to investment while investment in that country is financed by the worldwide pool of capital ..." (Feldstein and Horioka, 1980, p. 317). In this case, fiscal policy is ineffective, as a change in national savings will probably not be accompanied by a change in domestic investment.

Some empirical studies that focus on relations between savings, investment, and/or the current account are considered below.

2A. Partial Modeling Approaches

In many studies *the degree of ICM* has been investigated by savings–investment relations. Studies with cross-sections of countries have been followed by time series analyses, regional analyses, short- and long-run analyses, etc. These studies followed Feldstein and Horioka (1980), who adopted the model (Eq. 3)

$$\frac{I}{Y} = \alpha + \beta_s \frac{S}{Y}, \tag{3}$$

where α and β_s are parameters that can be estimated by simple regressions. For a cross-section of 21 countries during the period 1960–74, they found that β_s is insignificantly different from one, and interpreted this as evidence for low capital mobility, an interpretation that prompted a lot of discussion. As follows from the last subsection, the estimate for β_s is insignificantly different from one in case of no ICM. The value of β_s is, though, not sufficient to draw a conclusion on capital (im)perfectness; $\beta_s \approx 1$ can occur when capital is mobile because imports and exports can match perfectly.

An important criticism concerns the partial modeling approach. Two aggregate variables are modeled that are both known to be affected by important factors like *GDP*, technology shocks, etc., that are not modeled. See, for instance, also Obstfeld (1986) and Baxter and Crucini (1993), who adopt a two-country life-cycle model. Obstfeld (1986) studies international capital mobility theoretically (and in partial time-series models) whereas Baxter and Crucini (1993) look at results obtained with the calibrated general equilibrium model.

Nevertheless, numerous studies on *only* national savings and domestic investment relations have appeared. Most empirical studies on savings-investment relations that followed were concerned with the question why the estimate of β_s obtained by Feldstein and Horioka (1980) was so high. A further example is Feldstein and Bacchetta (1991), who disaggregate savings, to obtain (Eq. 4)

$$\frac{I}{Y} = \alpha + \beta_{sg} \frac{S^g}{Y} + \beta_{sp} \frac{S^p}{Y}, \tag{4}$$

and find significant parameter estimates with $\beta_{sg} \approx \beta_{sp}$ and, moreover, close to one. Elaborating on these results, they draw the conclusion that private investment is crowded out by government deficits (i.e., the case where $S^g < 0$).

Many other empirical studies on investment, savings, and/or the current account have been performed by single-equation regressions with one or two explanatory variables. We take two examples that do not consider ICM but investigate effects on the current account balance. First, Sachs (1981) specifies (Eq. 5)

$$\frac{X - M}{Y} = \alpha + \tau Y_{\text{gap}} + \beta_i \frac{I}{Y}, \tag{5}$$

where Y_{gap} is *GDP* in deviation from a deterministic trend. For 14 industrialized countries he estimates a current-account equation covering the period 1960–79 and for the large majority finds $\beta_i < 0$ and significantly different from zero. This result is interpreted as an association between current account deficits (surpluses) with investment booms (slumps).

Second, Obstfeld and Rogoff (1995) specify (Eq. 6)

$$\frac{X - M}{Y} = \alpha + \beta_{gx} \frac{S^g}{Y}, \tag{6}$$

and find $\beta_{gx} > 0$ for several industrial countries in the seventies, though, not significantly different from zero in the eighties. This is interpreted as government deficits deteriorating current account balances, but in more recent years, current accounts being determined by other factors than government deficits alone.

2B. A Full Modeling Approach: The Global Econometric Model

In contrast to the partial modeling approaches the NiGEM is a full modeling approach. Data used in NiGEM are quarterly and seasonally adjusted. In comparison with dynamic general equilibrium models like in, for example, Backus, Kehoe, and Kydland (1993) and Baxter and Crucini (1993), the NiGEM describes reduced-form equations only, estimates instead of calibrates parameters, includes dynamics where significant, and takes intertemporal decisions into account less explicitly.

The model has separate models for each of the Group of Seven countries of about 30–40 equations. Spain, The Netherlands, and Belgium also have their own model. Other (blocks of) countries are represented by smaller equation sets. The model is new Keynesian, because demand and supply sides, a monetary and financial sector are modeled, capacity utilization, and unemployment rates are derived and price adjustments are sluggish. In fact, it extends the simple Mundell-Fleming model, by adding dynamics, incorporating forward-looking behavior, and takes asset and debt stocks into account.

The model differs across countries in functional form and in the (dis)aggregation of variables. For this reason it is not possible to present the model specification in much detail, and only the main relations are presented here. For a detailed information on specifications and parameter estimates, we refer to the description of the model equations in NIGEM (1994), and studies in which the model is analyzed also, like Mitchell, Sault, Smith, and Wallis (1996) or Bini-Smaghi and Del-Giovane (1996).

We focus on the relations between investment, savings, and the current account and let f represent a log-linear functional form. A stylized model per country is then given by (Eq. 7 & 8):

Investment

$$I \equiv I^b + I^h + I^v \tag{7}$$

where

$$I^b = f(Y, r^l, p_{CED})$$
$$I^h = f(Y^d, r^s, p_{CED})$$
$$I^v = f(Y)$$

Savings

$$S \equiv S^g + S^p \tag{8}$$

where

$$S^g = T - G^c - G^i$$
$$S^p = Y - C - T$$

and where

$$C = f(Y^d, W, p_{CED})$$
$$T = f(Y)$$

Current account (Eq. 9)

$$X = f(WT, p_X)$$
$$M = f(Y, p_M) \tag{9}$$

Prices and interest rates (Eq. 10 & 11)

$$p = f(p_M, CU)$$
$$p_Y = f(p_C, p_X)$$
$$p_{CED} = f(T, p_M, p, CU)$$
$$p_C = f(p_{CED})$$
$$r^l = f(r^s(+1)) \tag{10}$$
$$r^s = f(p_{CED}, \text{target}) \tag{11}$$

where I = total investment; I^b = business investment; I^h = housing investment; I^v = inventories; S = total savings; S^g = government surplus; S^p = private savings; Y = national income; Y^d = disposable income; CU = capacity utilization rate; G^c = government consumption; G^i = government investment; T = taxes; C = consumption; W = wealth; X = exports; M = imports; WT = import demand in the country's export markets based on 1987 trade weights; p = wholesale price index; p_C = consumer price index; p_Y = GDP deflator; p_{CED} = consumer expenditure deflator; p_X = export prices; p_M = Import prices; r^l = long-term interest rate; r^s = short-term interest rate.

In this study results will be presented for the US, Japan, Germany (i.e., West Germany) and the UK. For these countries total investment (see Equation 7) is disaggregated into business, housing, and inventory investment. Total savings (see Equation 8) comprise public and private savings, constructed from GDP, consumption, and taxes. Except of the US, the government expenditures are disaggregated into consumption and investment.

The dynamic structure is apparent in most of the model equations (where dynamics were empirically found to be significant). The accumulation of physical capital stock, government debt

stock, and wealth also occurs. So increases in investment, government deficits, and personal income lead to accumulations in the stock variables. A direct feedback from these stock variables does not occur, but indirect channels exist. For instance, increasing government deficits and, hence, debt stocks will increase interest rates through the channel of private consumption, investment, and increasing prices. Consumption is related to current and past financial wealth (see Equation 8) but future labor income is not included. The intertemporal constraint on current account deficits is controlled by, among others, the fiscal solvency rule.

The current account consists of exports and imports of goods and services where each component has its own (behavioral) equation. In addition to these goods and services (the exports and imports of) *i*nterests, *p*rofits and *d*ividents (IPD) are taken into account in our analysis. Imports and exports of IPD are important because IPD credits are a part of national savings. Similarly, "unrequited transfers" are important in savings studies. These transfers are also included in the calculations of $X - M$.

Stimulations can be carried out with forward-looking wages, exchange rates and long-run interest rates. In Equation 10 this is indicated by the dependence of future ("+1") short-term interest rates. To solve for the rational expectations a terminal condition is needed. In NiGEM, this is the fiscal solvency rule that prevents the stock of government debt from exploding (see, for instance, Barrell, 1994). This is achieved by manipulating the direct tax rates in such a way that the government deficit returns back to base at the end of the horizon (i.e., 2013.I in NiGEM).

The interest rates in the model are endogenous. The long rates depend on the short rates (as follows from Equation 10), which in turn, depend on a target (indicated by "target" in Equation 11).

The behavioral equations are log-linear with high autoregressive dynamics. Single-equation estimation methods are employed for almost all behavioral equations, and for most equations the overall fit is, probably thanks to the high dynamics, good. The parameter estimates and residuals are then used to forecast. The period over which the historical data and forecasts are provided in NiGEM is 1985.I–1994.IV and 1995.I–2013.I, respectively. In our simulations the last period is neglected because of the solvency rule imposed.

3. SAVINGS, INVESTMENT, AND THE CURRENT ACCOUNT 1984–2004

In Table 1 historical data for 1984, 1994, and forecasts for 2004 from NiGEM are used to calculate S^g/Y, S^p/Y, I/Y, and $(X - M)/Y$ (in percentages).* All variables are measured in real terms. The government budget, the IPD flows, and the unrequited transfers are deflated by the *GDP* deflator. Private savings are calculated as the current account $X - M$ (including IPD flows and unrequited transfers) plus investment minus the government budget.[2]

Table 1: Public Savings, Private Savings, Investment, and the Current Account

	Year	$\frac{S^g}{Y}$	$\frac{S^p}{Y}$	$\frac{I}{Y}$	$\frac{X-M}{Y}$
US	1984	−2.9	18.2	18.3	−2.9
	1994	−1.8	17.5	18.0	−2.3
	2004	−1.7	19.9	19.4	−1.3
Japan	1984	−2.1	24.8	20.1	2.6
	1994	−2.2	24.9	22.8	−0.0
	2004	0.1	23.0	24.8	−1.8
Germany	1984	−1.9	24.7	18.0	4.7
	1994	−3.0	26.7	17.9	5.8
	2004	−0.2	28.5	18.5	9.8
UK	1984	−3.0	16.6	13.7	−0.0
	1994	−5.6	19.1	14.8	−1.3
	2004	−0.9	17.3	15.6	0.8

S^g/Y, S^p/Y, I/Y, and $X - M/Y$ are public savings, private savings, investment, and the current account as a percentage of *GDP*, respectively. Data used come from NiGEM, are yearly averages, and are historical for 1984, 1994, and forecasts for 2004.

The ratios show that, except for the forecast for Japan in 2004, the governments have deficits ranging from 0.2 to 5.6 percent of *GDP*. The US has a current account deficit of about 2.0 percent. In the US these twin deficits persist over the whole sample and forecast period. Japan and the UK have, like the US, in some years also twin deficits; Japan in 1994, for instance, and the UK in 1984 and 1994. During the whole period Germany has a relatively high current account surplus of about 5.0 percent. Also of note is that the US and the UK have lower private savings rates than Japan and Germany.[3] We now turn to an investigation of the relationships between the four variables for each country.

* Notice that these forecasts were made in 1997.

[2] Statistics presented here differ from NiGEM statistics because of differences in the measurement of variables.

[3] For a comparison of savings rates on disposable income for the US, Japan, and Germany, see Artus (1995), and for analyses on the low savings rates of the US, see also Hakkio (1995).

Table 2: Parameter Estimates Single-Equation Regressions

	β_s	$\bar{R}^2$	β_{sg}	β_{sp}	$\bar{R}^2$	β_i	$\bar{R}^2$	β_{gx}	$\bar{R}^2$
US	0.87*	0.29	1.00*	0.74*	0.30	−0.51*	0.75	−0.16	0.02
	(0.20)		(0.23)	(0.23)		(0.08)		(−0.84)	
Japan	1.37*	0.76	1.39*	0.28	0.87	−0.95*	0.87	−0.51*	0.42
	(0.12)		(0.09)	(0.21)		(0.09)		(0.09)	
Germany	0.57*	0.51	0.69*	0.59*	0.51	−0.66*	0.43	−0.21	0.05
	(0.09)		(0.15)	(0.09)		(0.15)		(0.11)	
UK	0.68*	0.25	0.44*	0.10	0.47	−0.79*	0.74	0.06	0.52
	(0.17)		(0.16)	(0.20)		(0.15)		(0.06)	

Figures in parentheses are standard errors.

* are significant coefficients. $\bar{R}^2$ is the adjusted R^2. The regression equations are:

(3) $I/Y = \alpha + \beta_s S/Y$

(4) $I/Y = \alpha + \beta_{sg} S^g/Y + \beta_{sp} S^p/Y$

(5) $\frac{X - M}{Y} = \alpha + \tau Y_{gap} + \beta_i I/Y$

(6) $\frac{X - M}{Y} = \alpha + \beta_{gx} S^g/Y$

In Table 2 OLS estimates of the β-coefficients of the models 3–6 using the NiGEM historical database (1984.I–1994.IV) are presented. These allow comparisons with the existing partial studies discussed in Section 2.1, and with the full-model simulations presented in the next section.

Except for the estimate for β_{gx} for Japan, the results corroborate the main findings in the literature. First, β_s is highly significant in all countries. This, in particular, holds for the US and Japan, being large countries that are said to have a highly integrated financial market within the country. Second, β_{sg} and β_{sp} are both highly significant and do not differ very much from each other in the US, Germany, and the UK. So deficits indeed seem to depress investment. Third, for all four countries β_i is highly significant and negative, suggesting that investment booms do seem to depress the current account balance. Finally, the estimate for β_{gx} is not significant for the US, Germany, and the UK. This confirms that government deficits do not seem to depress the current account in this (recent) period, as the literature suggests.

To conclude, apart from one parameter estimate for Japan, the results here are similar to those obtained in previous studies. They will be compared with the NiGEM simulation results *in the short and long run*, because some authors interpret the equations of Section 2.1 as long-run relationships (see Feldstein, 1983), whereas others interpret them as short-run relationships and estimate the equations in first differences (see Obstfeld, 1986). As the four models 3–6 are static and the variables stationary, though, the difference between estimating in levels or first differences does not change much. Exceptions are the estimate for β_{sp} and β_{gx} for Japan, which are 0.31 (standard error 0.15) and 0.03 (standard error 0.20), and the estimate for β_{sp} for the UK, which is 0.88 (standard error 0.19), in case of estimation in first differences.

4. SIMULATION RESULTS

In this section the results from four NiGEM simulations are presented. The aim of these simulations is to analyze the effect of (public and private) savings on investment, and investment as well as public savings on the current account balance.

Shocks carried out are (i) a negative shock to government consumption or government investment (ii) a negative shock to private consumption (iii) a positive shock to business investment, and (iv) a positive shock to "world trade" (i.e., the variable with the trade weights called USS that directly increases US exports in NiGEM for the US, etc.). So shock (i) concerns fiscal policy, shock (ii) a change in consumers' behavior, shock (iii) a change in producers' behavior, and shock (iv) an external shock. All are permanent shocks, beginning in 1994.I. The reason for choosing the four shocks mentioned above is that they are basically shocks in public savings S^g [shock (i)], private savings S^p [shock (ii)], investment I [shock (iii)], and the current account $X - M$ [shock (iv)].

In carrying out the simulations, rational expectations are assumed for wages, exchange rates, and long-term interest rates. The interest rate targets real *GDP* and inflation with a weight allocated to inflation five times greater than that for output (see NIGEM, 1994). A European union with Germany as leader is adopted. For all simulations a 1 percentage change is given but the results presented are normalized. As the model is basically log-linear, this normalization does not influence the main conclusions; for instance, the reaction of investment to a 1 percent increase in consumption is about twice its reaction to a 2 percent increase in consumption.

Table 3 presents the *instantaneous* responses (in 1994.I) of S^g/Y, S^p/Y, I/Y, and $(X - M)/Y$ to the different shocks, as deviations from base. Figures 1–4 present the simulation results for the whole

Table 3: Simulation Results 1994.I

	$\frac{S^g}{Y}$	$\frac{S^p}{Y}$	$\frac{I}{Y}$	$\frac{X-M}{Y}$
Shock (i): A negative shock to government consumption				
US	1.00	−0.85	0.00	0.15
Japan	1.00	−0.73	0.24	0.03
Germany	1.00	−0.67	−0.14	0.47
UK	1.00	−0.51	0.10	0.39
Shock (ii): A negative shock to private consumption				
US	−0.80	1.00	0.00	0.19
Japan	−0.49	1.00	0.45	0.06
Germany	−0.58	1.00	−0.15	0.57
UK	−0.45	1.00	0.11	0.44
Shock (iii): A positive shock to business investment				
US	0.25	0.63	1.00	−0.11
Japan	0.00	0.93	1.00	−0.06
Germany	−0.01	0.54	1.00	−0.47
UK	0.08	0.52	1.00	−0.40
Shock (iv): A positive shock to trade on the exports markets				
US	0.60	0.40	−0.00	1.00
Japan	0.00	0.75	−0.24	1.00
Germany	−0.04	1.45	0.40	1.00
UK	0.11	0.74	−0.14	1.00

The figures are simulated responses in 1994.1 to shocks that take place in the same period. The values are deviations from base, normalized by the responses in S^g/Y, S^p/Y, I/Y, and $(X - M)/Y$ for the four shocks, respectively.

period, i.e., 1994.I–2012.IV. The short-run responses of Table 3 are discussed first.

Shock (i): A Decrease in Government Consumption or Government Investment. A decrease in government consumption, ceteris paribus, is an increase in public savings. The shock decreases *GDP* (see Equation 1). This decrease in *GDP* depresses private savings. Private consumption depends positively and significantly on (disposable) income but private savings (see Equation 8), being income minus consumption, is more affected by the income decrease than the consumption decrease. Gross investment depends positively on *GDP* and consequently decreases. But the shock leads to nominal effects that affect savings and investment also. The simulation results show that prices decrease due to the fall in

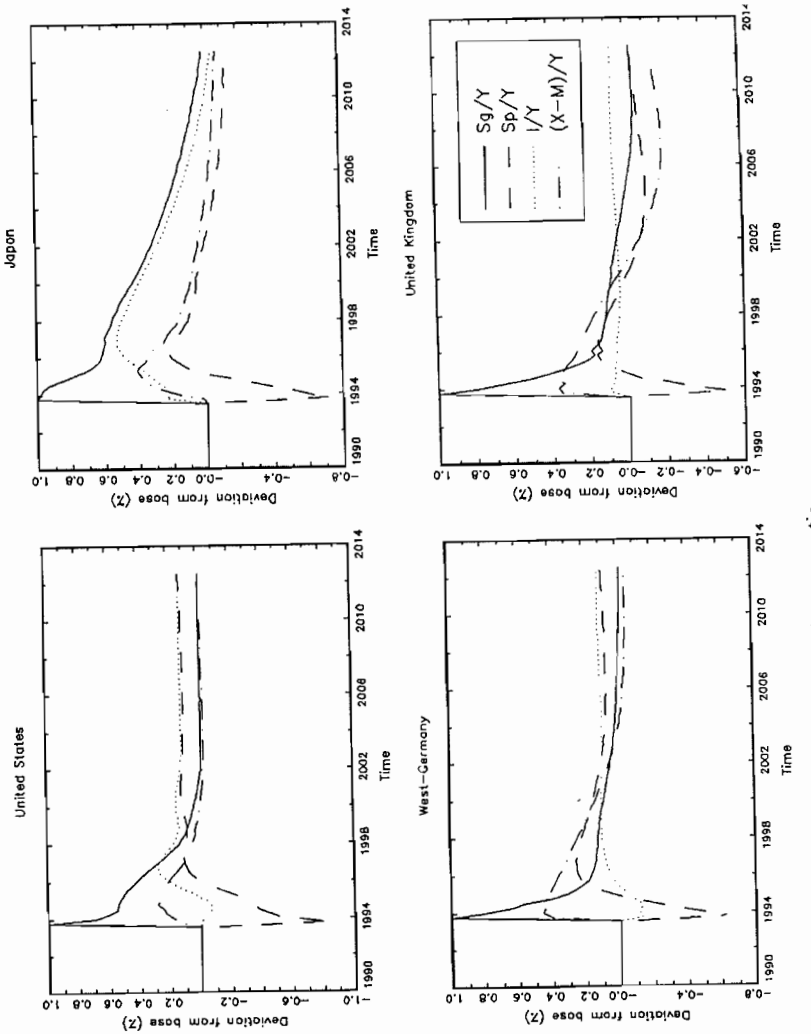

Figure 1. Negative shock to government consumption.

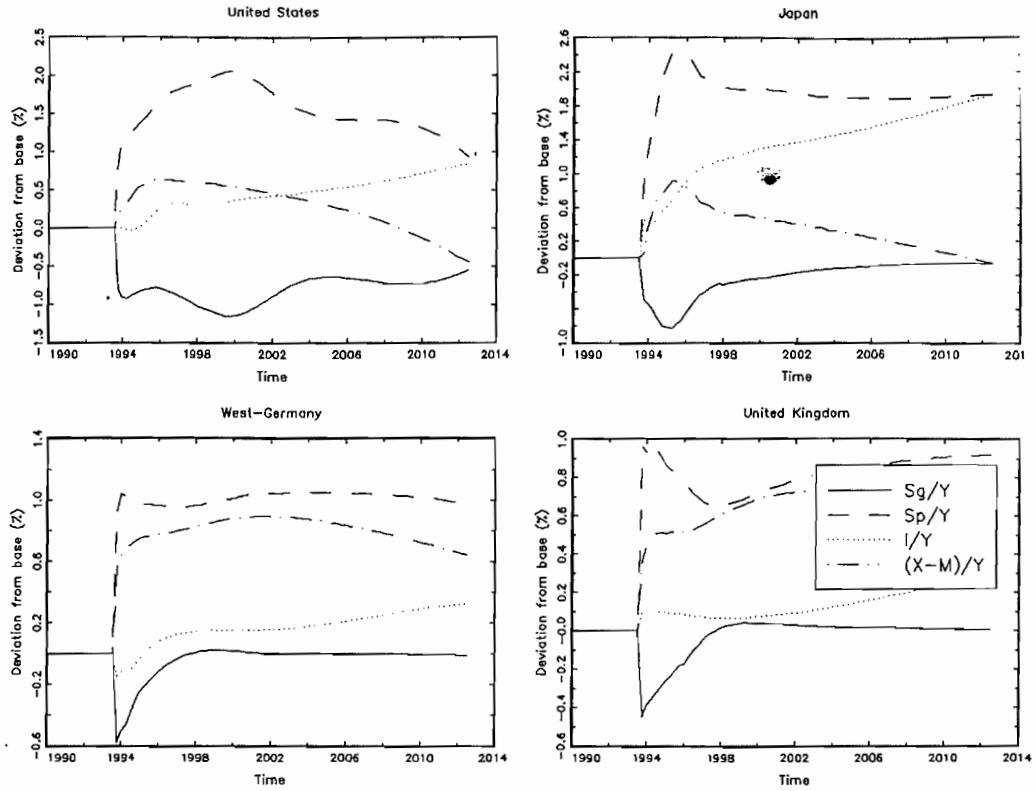

Figure 2. Negative shock to private consumption.

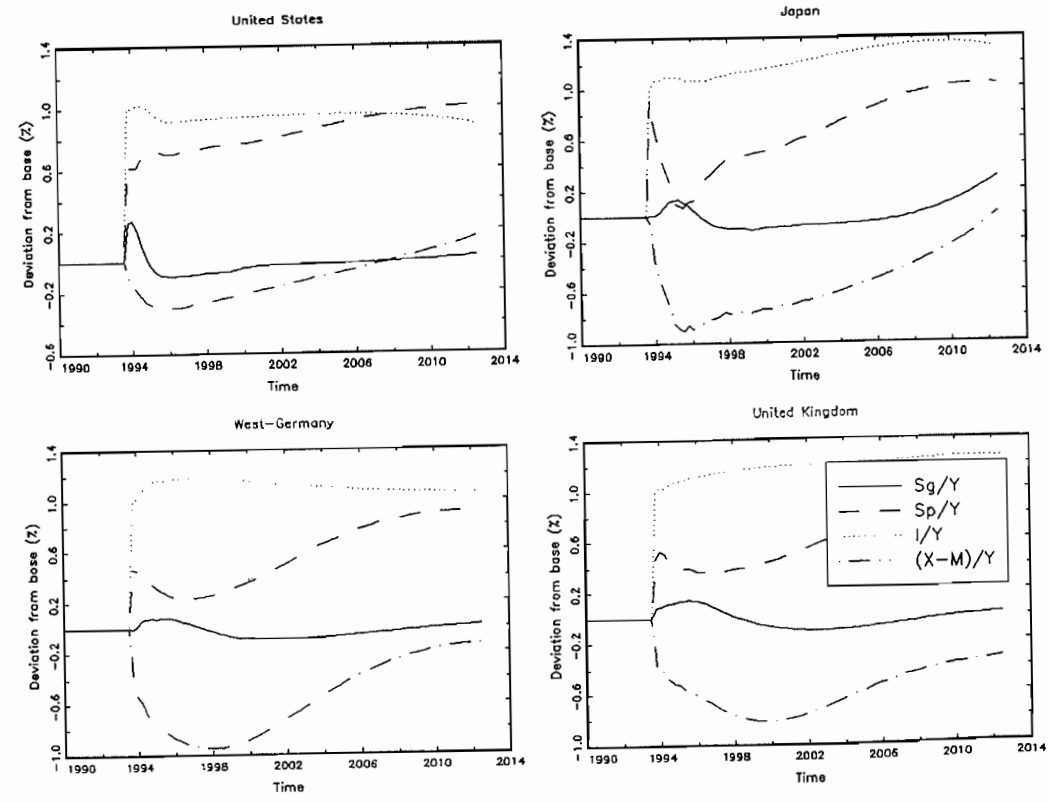

Figure 3. Positive shock to business investment.

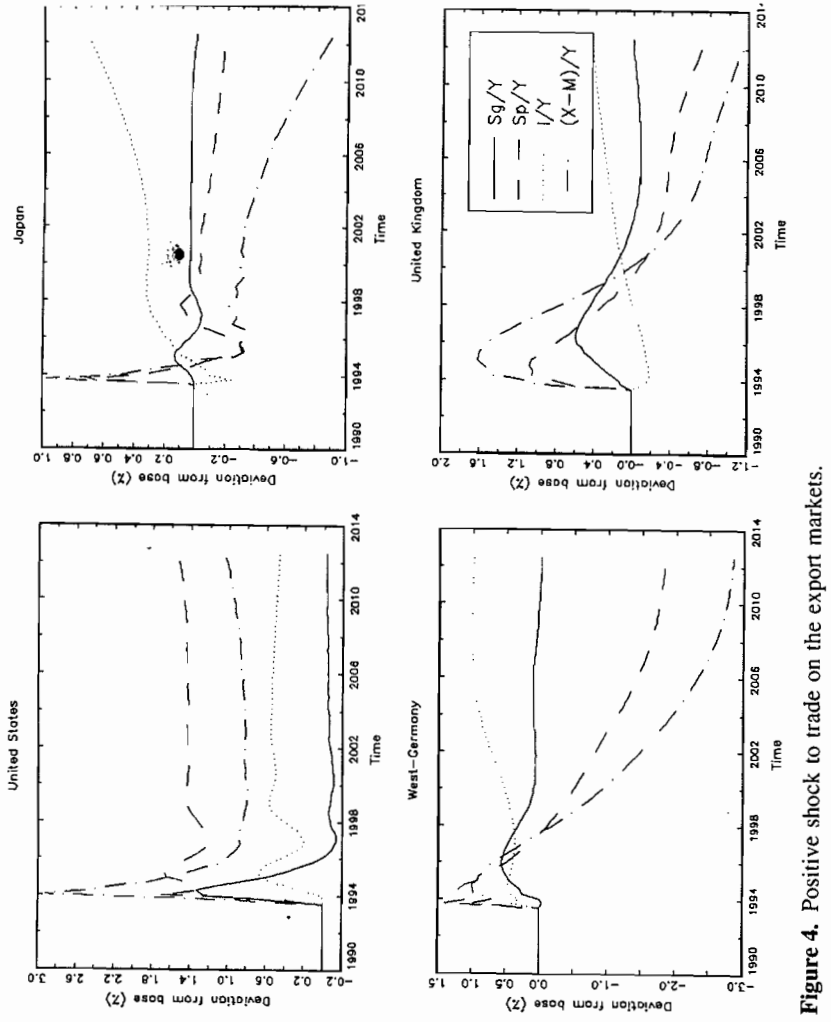

Figure 4. Positive shock to trade on the export markets.

demand and this, in contrast to the real effects depresses consumption strongly and, hence, influences private savings positively. Interest rates decrease, which influences investment positively. The price and interest changes are rather sluggish, however. In addition to this, private savings and investment depend in most countries, significantly but less weakly, on these nominal factors than on *GDP*. For these reasons the real effects can be expected to be stronger than the nominal effects.

The first panel in Table 3 shows that the response of S^p to the government shock is negative in the short run (i.e., 1994.I) indeed. This holds for all countries and most strongly for the US. For this country the private savings decrease is -0.85 percent, thus largely offsetting the public savings increase. The increase in investment in this period could thus have been 0.15 percent, at most, but turns out to be about zero. It is the current account that increases by 0.15 percent (remember that $S^g + S^p - I = X - M$ always holds). The response of investment turns out to be negative (-0.14%) in Germany indeed. In the other countries, however, the response is positive. This results from the fact that investment is more influenced by the interest decrease than the *GDP* decrease. The current account response is positive in all countries, ranging form 0.03 to 0.47 percent, mainly because the demand for imports decreases.

A decrease in government investment basically leads to the same responses as a decrease in government consumption in NiGEM. This results from the fact that government consumption and government investment are modeled in a similar way; they are both explained by their past and are not influenced by other variables. Unfortunately, therefore, the model does not allow a distinction between the effects of productive purchases, like investment in infrastructure, etc., that lead to growth in the long term, and consumption purchases that have only temporary effects.[4]

Shock (ii): A Decrease in Private Consumption. A decrease in private consumption, ceteris paribus, is an increase in private savings. Also, this shock decreases *GDP*. As taxes depend on *GDP*, public savings decrease. Basically the same mechanism is then at work as under the previous shock. The results in the second panel of Table 3 show that the responses of investment and the

[4] For example, Lee (1995), considers the particular case of the US, and argues that the reallocation of government spending from productive to consumption purchases in the 1980s has been a main cause of, among other things, the deterioration of the trade balance.

current account to the two savings shocks are very similar; investment decreases in Germany and the current account increases in all four countries.

Shock (iii): An Increase in Business Investment. An increase in business investment, ceteris paribus, increases *GDP*. In most countries public savings increase because of increasing taxes. As shown in the third panel of Table 3, an exception is Germany. In all countries private savings seem to benefit most; increases are between 0.52 and 0.93 percent. The increase in current *GDP* obviously exceeds the increase in current consumption. The current account shows a deficit because of increasing imports.

Shock (iv): An Increase in Trade on the Export Markets. An increase in world trade, ceteris paribus, leads to a current account surplus because exports increase instantaneously. An increase in exports increases directly *GDP*. The increase in *GDP* increases private savings.

These short-run results presented in Table 3 differ a lot from the long-run results, as is clear from an inspection of Figures 1–4. As the long-run results are more affected by the fiscal solvency rule imposed than the short-run results, only the relations between (public and private) savings, investment, and the current account to each shock will be considered in the next section.

5. A COMPARISON OF THE ESTIMATION AND SIMULATION RESULTS

In this section the estimation results of the partial models (see Table 2) are compared with the simulation results of NiGEM (Figures 1–4). To do this, the ratios I/S, I/S^g, I/S^p, $(X - M)/I$, and $(X - M)/S^g$ are calculated from the simulation results in 1994.I and 2004.I and represented in Table 4. The ratios for 1994.I will be interpreted as short-run and the ratios for 2004.I as long-run relations. These ratios can be compared with the estimation results of Table 2. The investment–savings relations of the models 3–4 are discussed first, the investment–current account (5), and savings–current account (6) next, and finally some possible limitations of NiGEM are considered.

5A. The Public–Private Savings Mirror

In model 3 the effect of national savings on domestic investment, β_s depends, according to the theory, on the extent of savings that flows abroad. The estimate for β_s, as given in Table 1, is 0.87 for the US, 1.37 for Japan, 0.57 for Germany, and 0.68 for the UK.

Table 4: Ratios of the Simulation Results 1994.I and 2004.I

	1994.I					2004.I				
	(1) $\frac{I}{S}$	(2) $\frac{I}{S^g}$	(3) $\frac{I}{S^p}$	(4) $\frac{X-M}{I}$	(5) $\frac{X-M}{S^g}$	(6) $\frac{I}{S}$	(7) $\frac{I}{S^g}$	(8) $\frac{I}{S^p}$	(9) $\frac{X-M}{I}$	(10) $\frac{X-M}{S^g}$
Shock (i): A positive shock to public savings										
US	0.06	0.00	−0.01	—	0.14	1.23	—	1.13	−0.18	2.68
Japan	0.91	0.24	−0.33	0.10	0.03	0.97	0.81	−5.12	0.04	0.03
WG	−0.42	−0.14	0.21	−3.37	0.47	0.99	4.82	1.25	0.01	0.05
UK	0.20	0.10	−0.19	3.98	0.39	−0.87	2.66	−0.66	−2.14	−5.71
Shock (ii): A positive shock to private savings										
US	0.04	−0.01	0.00	—	−0.23	0.56	−0.70	0.31	0.79	−0.56
Japan	0.89	−0.91	0.45	0.13	−0.12	0.81	—	0.76	0.23	−2.68
WG	−0.34	0.25	−0.15	−3.92	−0.99	0.16	—	0.16	5.13	—
UK	0.20	−0.25	0.11	3.95	−0.98	0.14	5.43	0.15	6.05	—
Shock (iii): A positive shock to investment										
US	1.12	3.93	1.58	−0.11	−0.44	1.14	—	1.11	−0.12	—
Japan	1.06	—	1.07	−0.06	−7.27	1.92	—	1.75	−0.48	—
WG	1.90	—	1.86	−0.47	—	2.01	—	1.75	−0.50	—
UK	1.66	—	1.92	−0.40	−4.86	2.21	—	1.87	−0.55	—
Shock (iv): A positive shock to the current account										
US	−0.00	−0.01	−0.02	—	1.68	0.40	—	0.38	1.52	—
Japan	−0.32	—	−0.33	−4.10	—	—	—	−4.34	−1.12	—
WG	0.29	−9.64	0.28	2.48	—	−0.87	—	−0.80	−2.15	—
UK	−0.17	−1.24	−0.19	−7.05	−8.73	−0.61	—	−0.69	−2.65	—

The left and right part present ratios of the simulated values of 1994.I and 2004.I, respectively, to shocks that begin in 1994.I. All ratios are ratios of deviations from base (instead of deviations from base). The ratios for 1994.I can be derived from Table 3. — indicates that the denominator of the ratio is very small.

These estimation results suggest that national savings are mainly invested domestically. According to the simulation results obtained with NiGEM in column 1 in Table 4, the instantaneous response to an impulse in savings [see shock (i)–(ii)] is smaller than these results suggest. For the US, for instance, the investment response is 0.06 to a 1 percent shock in public savings and 0.04 to a 1 percent shock in private savings. For Germany, the response is even negative; −0.42 and −0.34 percent to both savings shocks. The long-run NiGEM responses are more in line with the estimates. From column 6 in Table 4 it follows that they range from −0.87 to 1.23 for both savings shocks.

In model 4 the effect of public savings and private savings on investment is represented by β_{sg} and β_{sp}, respectively. The estimates for these parameters, as given in Table 2, are positive and each close to one for most countries. Like the responses of national investment to aggregate savings, the columns 2–3 in Table 4 show that these estimates are not corroborated by the NiGEM simulation results. The most remarkable findings here is that the public response is always close to a mirror image of the private savings response. Also in the long run, see columns 7–8 in Table 4, negative responses appear.

Increasing savings by increasing public savings and/or private savings thus does not instantaneously lead to economic growth, according to NiGEM. This follows clearly from Figures 1 and 2, where investment is negative in the short run for the US and Germany. From these figures it follows that the major impact of a shock to public savings is reflected in private savings, and vice versa. This holds for the public savings shock in Figure 1 for at least 4 years, i.e., during 1994–98, and for the private savings shock in Figure 2 for an even longer period for most countries. As a consequence of these public–private mirrors, the response of investment cannot be large because $S^g + S^p - I = X - M$ must hold. As the mirror is not perfect but a bit smaller than the impulse, i.e., $S^g > S^p$, and $S^g < S^p$ in the case of the public and private savings shock, respectively, aggregate savings increase in all countries for both savings shocks. In the short run the current account seems to benefit from the total savings impulse, whereas in the long run investment grows. But also in the long run, the investment increase in most countries does not match the whole savings shock. Thus, the parameters β_s, β_{sg}, and β_{sp} seem to be overestimated in the partial models in comparison with the NiGEM results.

5B. Effects on the Current Account

In model 5 the effect of investment on the current account is represented by β_i. The estimates for this parameter, as given in Table 2, are negative, ranging from -0.51 to -0.95, and highly significant. The NiGEM simulation results presented in columns 4 and 9 in Table 4 show that the negative effects are confirmed for the investment shock in both the short and long run; in 1994.I they range from -0.06 to -0.47 and in 2004.I from -0.12 to -0.55. Figure 3 shows that the current account is even negative for the whole simulation period. For each country, though, the simulation results are less negative than the estimation results.

In model 6 the effect of public savings on the current account is β_{sg}. This parameter is only estimated significantly for Japan, and is for this country, in contrast to expectations, negative. In column 5 in Table 4 the public savings shock [shock (i)] is relevant here. The results show positive effects ranging from 0.03 for Japan to 0.47 for Germany in 1994.I and 0.03 for Japan and 2.68 in the US 2004.I. As discussed in the previous subsection, the current account increases, in particular, in the short run in response to the public savings shock. According to NiGEM, the current account thus clearly benefits from government surpluses (see Figure 1). These simulation results are thus more in line with the theory put forward, by Obstfeld and Rogoff (1995), among others, that government deficits depress current account balances. An exception is the UK in the long run (see Figure 1), but the current account responses are very small.

5C. Characteristics of NiGEM

NiGEM thus renders rather different results than the partial models in the literature; the effect of savings on investment is lower because of the public–private savings mirror, the effect of investment on the current account is weaker, and the effect of government savings on the current account is stronger (for most countries). Although NiGEM is a more complete modeling approach because of the behavioral equations of different economic agents and interdependency between countries, it is appropriate at this stage to raise the question as to what extent the results depend on specific characteristics of the model.

Simulation results obtained with NiGEM are influenced by the fiscal solvency rule that forces public savings to return to base in 2013.I. Public savings, investment, and the current account are thus also affected by the rule in the long run as follows from identity 2. This can be seen from the figures, in particular Figure 1, where public savings as well as the other three variables go back to base rather quickly. Experiments with NiGEM show that there is no difference between imposing the rule and not imposing the rule (in which case government debt could explode) in the short run, i.e., about 2 years. Thus, the short-run responses do not seem to be affected by the rule, whereas the long-run responses are clearly affected. But because of the fact that public savings, private savings, investment, and the current account are tied together, there does not seem to be a reason for the relations between these variables to be affected, neither in the short run, *nor*

in the long run. For this reason the results in Table 4 uphold, irrespective of the solvency rule.

Another criticism of the use of NiGEM could be that the model is new Keynesian, with sluggish adjustment of prices and interest rates. How would the results differ with a more neo-classical model? In the case of the public savings shock, for instance, it still holds that if government consumption decreases, *GDP* decreases by which private consumption and investment fall. If prices and interest rates adjust immediately and because of the decrease, consumption and investment could increase indeed. The decrease in private savings in the short run, though, will remain because *GDP* falls and consumption falls less than the fall in *GDP*. Because of the price and interest adjustments, investment will start increasing at an earlier stage than under the NiGEM, as shown in Figure 1. Following these reasonings the savings mirror seems not to disappear, although they may exist over a shorter period than the NiGEM results show.[5]

6. FURTHER CONSIDERATIONS

In this section some attention is paid to causality issues.

6A. Arrows of Causality

The models 3–6 suggest that the causality between current savings, current investment, and the current account only runs from savings to investment and savings *as well as* investment to the current account.

It follows from the specification of NiGEM, however, and is illustrated by the simulation results that public and private savings affect each other instantaneously. For this reason savings should not be treated as exogenous for investment. The OLS results of model 4 have a positive bias in comparison with the NiGEM results (see Section 5.1). Moreover, it follows that current investment affects current private savings, investment increases *GDP* and private savings equals *GDP* minus consumption. In Figure 3

[5] Simulation results with the world model MSG (see McKibbin and Sachs, 1991; see Table B-1 to B-3, pp. 222–227), where a fiscal expansion of 1% leads to a private consumption increase of about 0.20%, as well as the original data also show the public–private savings mirror. See also, Marrinan and Wincoop (1993), who mention the mirror between the private savings gap and public savings in original data.

private savings is, therefore, visibly affected by changes in business investment.

The relationships 3 and 4 thus seem not appropriate. To model the relationship between savings and investment correctly, all factors influencing the economic system are to be involved and their relationship is to run in both directions. As investigated in Eisner (1994) and also argued in Eisner (1995), the effect of current investment (for instance, government expenditure) on future savings, and thus potential economic growth, should not be neglected. To take these aspects into account dynamic instead of static models are needed.

The current account is often seen as the outcome of forward-looking dynamic savings and investment decisions (Obstfeld and Rogoff, 1995) in the "intertemporal approach" to the current account). Although this might be true, changes in the current account, like changes in world trade (see Figure 4), influence domestic savings and investment in turn. The criticism of the models 3–4 could then, strictly speaking, also be applied to the models 5–6.

6B. Twin Deficits

Finally, we focus on the issue of countries that have both a government deficit and a current account deficit. We recall the equality $S^g + S^p - I = X - M$, where in case of twin deficits $S^g < 0$ and $X - M < 0$. To reduce (at least one of) the twin deficits, it is often suggested that either public or private savings should be increased. Reducing investment is not desirable, and reducing the current account is not fully within a government's reach.

Let us first consider a change in the behavior of private savers, in the sense that they save more. According to the simulation results in Table 3 this seems not appropriate because, although it increases the value of the current account, it further increases the government deficit. After all, it will always go at the cost of current consumption, and thus be a loss of economic growth. If instead of increasing private savings, public savings are increased by decreasing government expenditures, the current account is increased, as follows from Figure 1. According to the NiGEM simulation results, the twin deficits are thus decreased simultaneously. A drawback for the US and Germany is, though, that investment decreases in the short run.

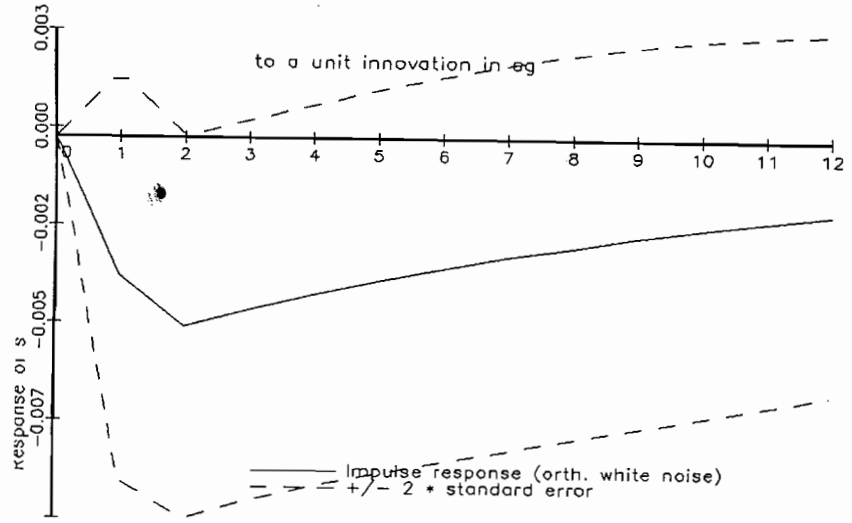

Figure 5. The response of savings to shock in public savings according to model (12).

As Eisner (1995) argues, this negative effect on investment and thus on (future) growth—and savings—can be as important as the fall in deficit(s). His model is (Eq. 12)

$$S_t = \alpha_0 + \alpha_1 S_{t-1} + \xi S^g_{t-1} + \gamma_1 \Delta M_{t-1} + \gamma_2 \Delta M_{t-2} + \gamma_3 e_{t-2}, \qquad (12)$$

where S_t represents aggregate savings at time t, S^g_{t-1} public savings one period lagged, e_t the exchange rate, and ΔM_t the (once differenced) money supply. With annual data covering the period 1972–91 for the US, Eisner finds an estimate for ξ of -0.757 that is significant (standard error 0.334). According to this result current government deficits have the positive effect that they lead to future savings and, consequently, probably to future growth. A government deficit in this light is thus not a hindrance.

As the US was the only one of our four countries with twin deficits over the whole sample period, we look at it in more depth. For the US sample period in NiGEM replicating the results of Eisner (1995), yields the impulse response Figure 5. As in Eisner (1995), the response of current public savings to future savings is negative, though insignificant. According to this partial (dynamic) model, reducing the public deficit in the US affects future savings

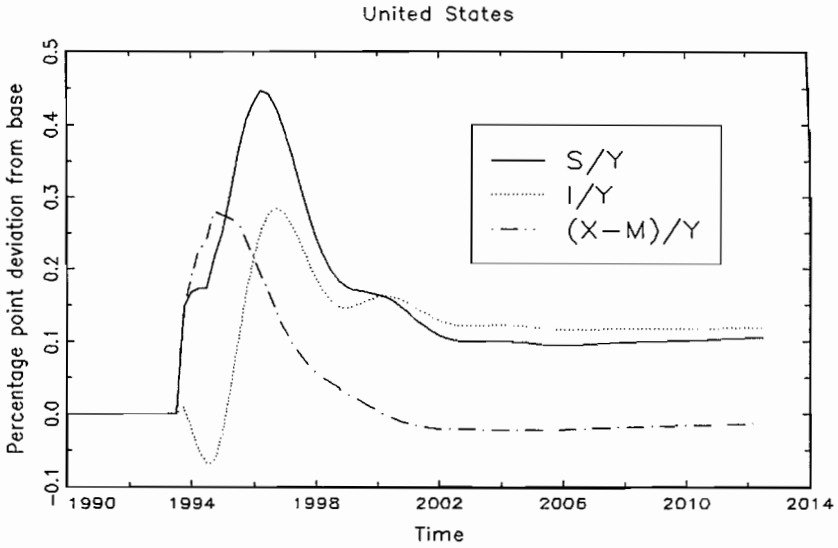

Figure 6. S, I, and $X - M$ in the US in response to a government consumption shock.

thus negatively, indeed. Consequently, future investment and future economic growth will certainly not increase because of this fall in savings.

This result is, however, not confirmed by NiGEM, because there is not a negative effect on aggregate savings. This follows from the fact that the mirror image of private savings is smaller than the shock in public savings in NiGEM. This is shown for NiGEM in Figure 6 that is similar to Figure 1 but for *aggregate* savings, investment, and the current account. Aggregate savings here is positive over the whole period. In Eisner's model the (mirror) image of private savings to public savings is to be larger, otherwise ξ would not be negative.[6]

Although reducing the government deficit thus leads to a fall of investment in the short run, it does not confirm Eisner's result that aggregate savings (also) fall. Figures 5–6 demonstrate this

[6] Eisner (1994) experiments with different measurements of national savings. The effect ξS^g (in the long run) can be interpreted as Keynesian if $\xi < 0$, Ricardian equivalence if $\xi = 0$, and neo-classical (crowding out) if $\xi = 1$, see footnote 4 and 5 in Eisner (1994). The NiGEM results here thus tend to be neo-classical rather than Keynesian.

important difference in results that, once again, are only due to the different models that are used.

7. CONCLUSIONS

Several studies have presented evidence against the view that high savings–investment correlations are inconsistent with a high international capital mobility, see, for example, Baxter and Crucini (1993). This study shows that most studies dealing with this capital mobility issue report correlations that might be overestimated. Simulations with the global macroeconomic model NiGEM render lower parameter estimates than those obtained by the much simpler, partial models on savings–investment usually adopted. The simulation results are similar for the four countries investigated, being the US, Japan, West Germany, and the UK, both in the short as well as the long run.

In the same line, NiGEM simulations differ from other partial studies on investment–savings–current account. In partial studies a strong effect from investment on the current account and a weak effect of public savings on the current account is found. NiGEM shows an effect of investment on the current account that is weaker. The NiGEM effect of public savings on the current account seems much stronger. The results of a dynamic partial model concerning the public savings effect on aggregate savings are also not according to the NiGEM results.

These comparisons thus show that there are important differences between using a full macroeconomic model in which all relevant variables are modeled and models that only relate the variables of interest: Except for the inclusion of relevant variables, the differences come from included dynamics (multivariate) causal relationships and, among others, the structural modeling of capital flows.

Most striking in the analyses here is the result that changes in public (private) savings tend to be largely offset by responses in private (public) savings. This in particular holds for the US. Because of the almost perfect public–private savings mirror in the short run, an increase in private savings—as often proposed as a solution—would almost fully be translated in an increase of the government deficit. According to NiGEM, decreasing the government deficit by fiscal policy is a better approach because it also decreases the current account deficit. It is, however, at the cost of investment in the short run. In the longer run both deficits decrease, and investment recovers.

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