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DISCUSSION PAPERS

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Abstract

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 modelling approach for the US, Japan, Germany and the UK are compared with estimation results from the partial modelling 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.

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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.

Following Feldstein and Horioka (1980), several empirical studies have analysed 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 modelling approaches a disaggregate and full modelling 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 modelled 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 (i) public as well as private savings affect investment positively (ii) investment as well as government deficits affect current account balances negatively and (iii) government deficits affect future savings positively.

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. It is often argued that

[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), pp.31) and *...Results in full-scale, multi-equation macroeconomic models may prove more persuasive to some than the essentially reduced forms considered in this paper...* (Eisner (1994), pp.184).

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 analysed 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 modelling 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 concludes.

2 Savings, Investment and International Capital Mobility

From the national income identity

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

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

$$S^g + S^p - I = X - M \qquad \text{where} \qquad \begin{aligned} S^g &\equiv T - G \\ S^p &\equiv Y - C - T. \end{aligned} \tag{2}$$

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 since *'... 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, pp. 317). In this case fiscal policy is ineffective as a change in national savings will -probably- not be accompagnied by a change in domestic investment.

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

2.1 Partial Modelling 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

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

where α and β_s are parameters that can be estimated by simple regressions. They found that β_s is insignificantly different from one and interpreted this as evidence for low capital mobility, an interpretation which 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 even occur when capital is mobile since imports and exports can match perfectly.

An important criticism concerns the partial modelling approach. Two aggregate variables are modelled that are both known to be affected by important factors like GDP, technology shocks, etc. that are not modelled (see for instance Obstfeld (1986) and Baxter and Crucini (1993)).

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

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

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 ($S^g < 0$).

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. Firstly, Sachs (1981) specifies

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

where Y_{gap} is GDP in deviation from a deterministic trend. He 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).

Secondly, Feldstein and Bacchetta (1991) specify

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

and find $\beta_{gx} > 0$, though, not significantly different from zero in recent years. This result 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.

2.2 A Full Modelling Approach: The Global Econometric Model

In contrast to the partial modelling approaches the NiGEM is a full modelling approach. Most OECD countries are modelled in detail by about 30-40 equations. Other (blocks of) countries are represented by smaller equation sets. Data used in NiGEM are quarterly and seasonally adjusted. The model is new Keynesian since demand and supply sides, a monetary and financial sector are modelled, capacity utilization and unemployment rates are derived and price adjustments are sluggish.

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 NIGEM (1994).

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:

Investment

$$I \equiv I^b + I^h + I^v \quad \text{where} \quad \begin{aligned} I^b &= f(Y, r^l, p_{CED}) \\ I^h &= f(Y^d, r^s, p_{CED}) \\ I^v &= f(Y) \end{aligned} \tag{7}$$

Savings

$$S \equiv S^g + S^p \quad \text{where} \quad \begin{aligned} S^g &= T - G^c - G^i \\ S^p &= Y - C - T \end{aligned} \tag{8}$$

$$\text{and where} \quad \begin{aligned} C &= f(Y^d, W, p_{CED}) \\ T &= f(Y) \end{aligned}$$

Current account

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

Prices and interest rates

$$\begin{aligned} p &= f(p_M, CU) \\ p_Y &= f(p_C, p_X) \\ p_{CED} &= f(T, p_M, p, CU) \\ p_C &= f(p_{CED}) \\ r^l &= f(r^s(+1)) \qquad (10) \\ r^s &= f(p_{CED}, target) \qquad (11) \end{aligned}$$

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 (7)) is disaggregated into business, housing and inventory investment. Total savings (see (8)) comprise public and private savings, constructed from GDP, consumption and taxes. Except for the US, the government expenditures are disaggregated into consumption and investment.

The current account consists of exports and imports of goods and services where each component has its own (behavioural) equation. In addition to these goods and services (the exports and imports of) interests, profits and dividends (IPD) are taken into account in our analysis. Imports and exports of IPD are components of the capital account and are important because IPD-credits are a part of national savings. Similarly, 'unrequited transfers' are also important in savings studies. These transfers are also included in the calculations of $X - M$.

Simulations can be carried out with forward looking wages, exchange rates and long-run interest rates. In equation (10) this is indicated by the dependence on future ('+1') short term interest rates. In order 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 (10)) which in turn, depend on a target (indicated by *'target'* in (11)).

The behaviourial equations are log-linear with high autoregressive dynamics. Single-equation estimation methods are employed for almost all behavioural 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 1984.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 $\frac{S^g}{Y}$, $\frac{S^p}{Y}$, $\frac{I}{Y}$ and $\frac{X-M}{Y}$ (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].

The ratios show that, except for the forecast for Japan in 2004, the governments have deficits ranging from 0.2% to 5.6% of GDP. The US has a current account deficit of about 2.0%. 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%. 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.

In Table 2 OLS estimates of the $\beta-$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.

[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 for instance also Hakkio (1995).

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

$\frac{S^g}{Y}$, $\frac{S^p}{Y}$, $\frac{I}{Y}$ and $\frac{X-M}{Y}$ 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.

Table 2 Parameter estimates single-equation regressions

	β_s	$\overline{R}^2$	β_{sg}	β_{sp}	$\overline{R}^2$	β_i	$\overline{R}^2$	β_{gx}	$\overline{R}^2$
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 brackets are standard errors. * are significant coefficients. $\overline{R}^2$ is the adjusted R^2.
The regression equations are

(3) $\frac{I}{Y} = \alpha + \beta_s \frac{S}{Y}$

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

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

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

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* since 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' behaviour, shock (iii) a change in producers' behaviour 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 5 times greater than that for output (see NIGEM (1994)). A European union with Germany as leader is adopted. For all simulations a one 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 one percent increase in consumption is about twice its reaction to a two percent increase in consumption.

Table 3 presents the *instantaneous* responses (in 1994.I) of $\frac{S^g}{Y}$, $\frac{S^p}{Y}$, $\frac{I}{Y}$ and $\frac{X-M}{Y}$ to the different shocks, as deviations from base. Graphs 1-4 present the simulation results for the whole 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 (1)). This decrease in GDP depresses private savings. Private consumption depends positively and significantly on (disposable) income but private savings (see (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. Prices as well as interest rates decrease due to the fall in demand, and this, in contrast to the real effects, influences private savings and 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 response of S^p to the government shock turns out to be negative in the short run (i.e. 1994.I), see the first panel in Table 3. This holds for all countries and most strongly for the US. For this country the private savings decrease is -0.85%, thus largely offsetting the public savings increase. The increase in investment in this period could thus have been 0.15%, at most, but turns out to be about zero. It is the current account that increases by 0.15% (remember that $S^g + S^p - I = X - M$ always holds). The response of investment turns out to be -0.14% in Germany and positive in the other countries. In Germany the effect of the decrease in the interest rate on investment is stronger than the effect of the decrease in Y. The current account response is positive in the US, Japan and Germany, ranging from 0.03% to 0.47%, 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 modelled 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].

[4] For example, Lee (1995), considers the particular case of the US and argues that the reallocation of government

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.

spending from productive to consumption purchases in the 1980s has been a main cause of, among other things, the deterioration of the trade balance.

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 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%. 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

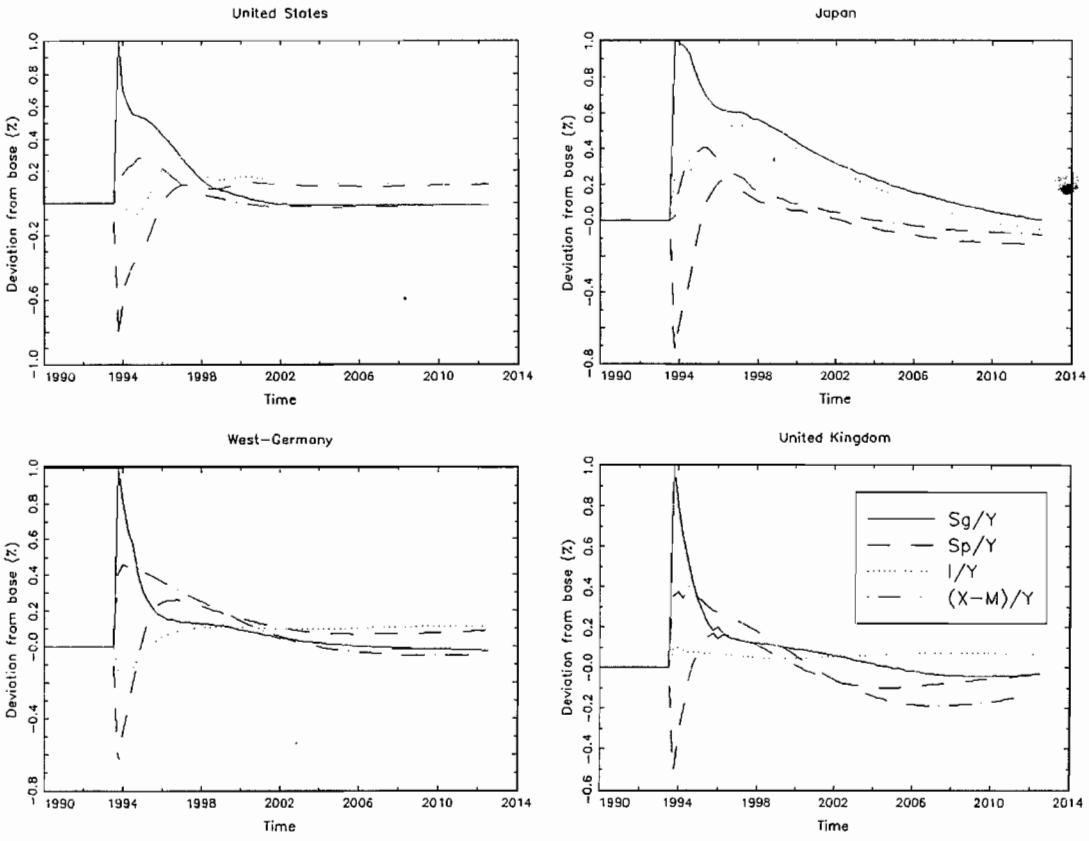
An increase in world trade, ceteris paribus, leads to a current account surplus because exports increase instantaneously. An increase in exports increases directly GDP. The increase in GDP increases private savings.

These short-run results presented in Table 3 differ a lot from the long-run results, as is clear from an inspection of graphs 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.

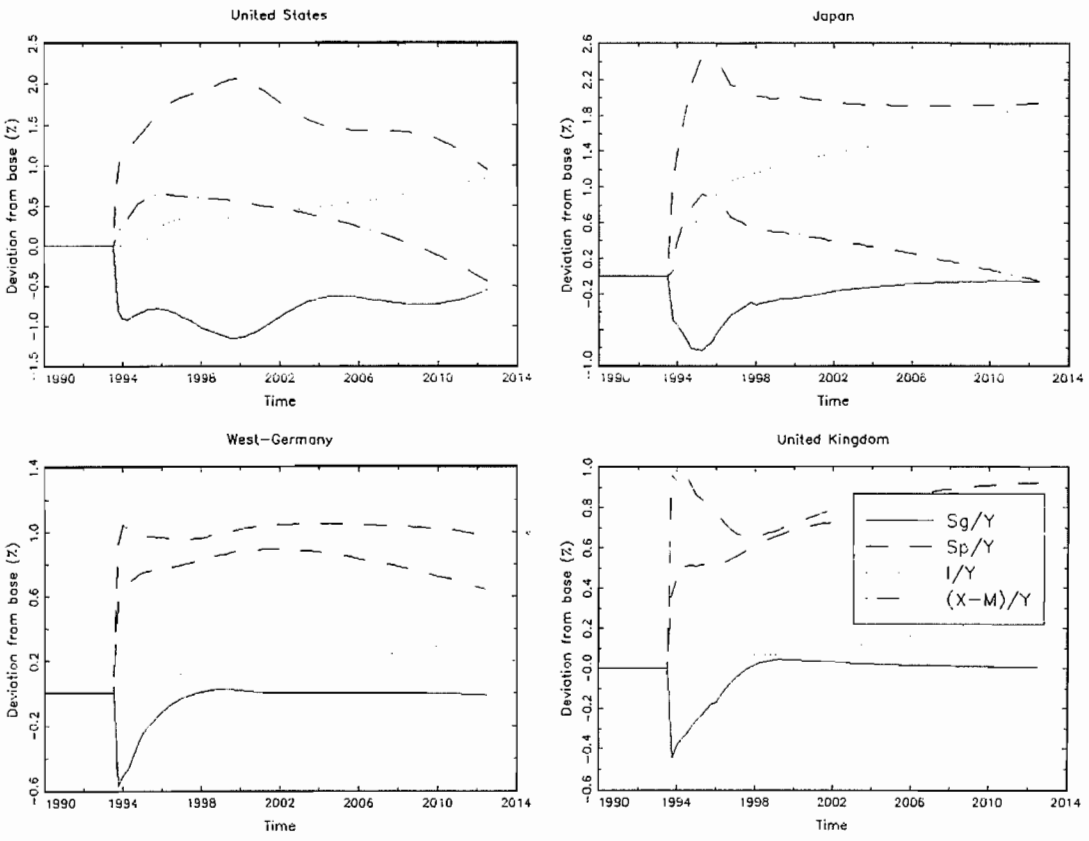
5 A Comparison of the Estimation and Simulation Results

In this section the estimation results of the partial models (see Table 2) are compared with the simulation results of NiGEM (graphs 1-4). In order to do this, the ratios $\frac{I}{S}$, $\frac{I}{S^g}$, $\frac{I}{S^p}$, $\frac{(X-M)}{I}$, $\frac{(X-M)}{S^g}$ are calculated from the simulation results in 1994.I and 2004.I and presented 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.

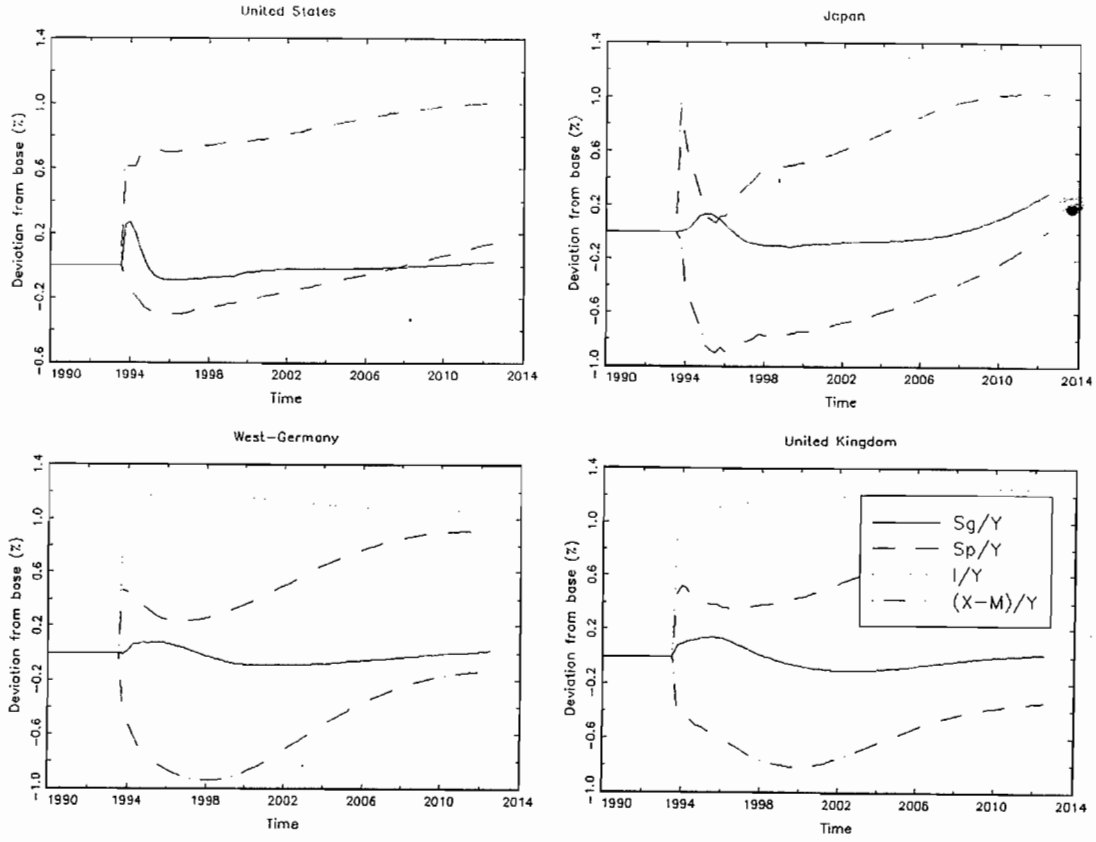
Graph 1 Negative shock to government consumption



Graph 2 Negative shock to private consumption



Graph 3 Positive shock to business investment



Graph 4 Positive shock to trade on the export markets

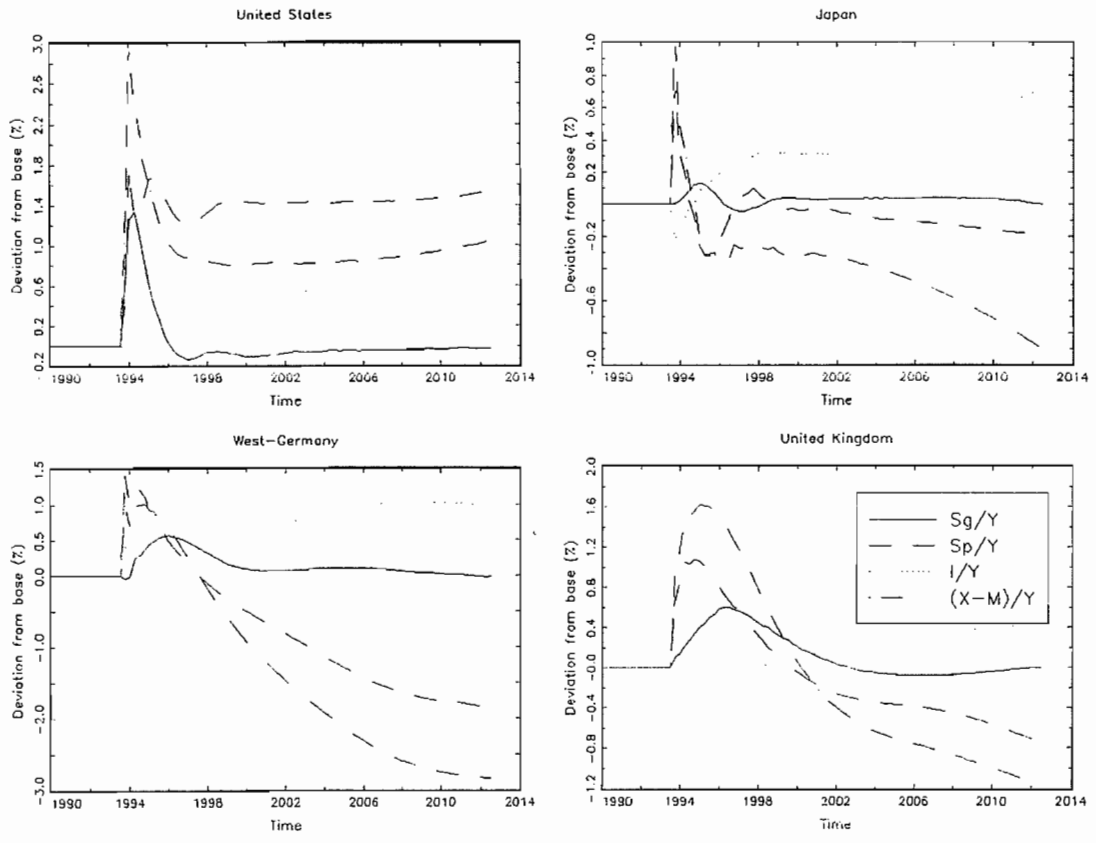


Table 4 Ratios of the simulation results 1994.I and 2004.I

	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 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. The ratios for 1994.I can be derived from Table 3. // "." indicates that the denominator of the ratio is very small.

5.1 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. 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% shock in public savings and 0.04 to a 1% shock in private savings. For Germany the response is even negative; -0.42% and -0.34% 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 finding 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 graphs 1 and 2 where investment is negative in the short run for the US and Germany. From these graphs 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 graph 1 for at least four years, i.e. during 1994-1998, and for the private savings shock in graph 2 for an even longer period for most countries. As a consequence of these public-private mirrors, the response of investment cannot be large since $S^g + S^p - I = X - M$ 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 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.

5.2 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. Graph 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 graph 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 graph 1, but the current account responses are very small.

5.3 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 modelling approach because of the behavioural 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 graphs, in particular graph 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 two years. Thus the short-run reponses 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 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 since 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 graph 1. Following these reasonings the savings mirror seems not to disappear, though, 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.

6.1 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, from both the definition of savings and it follows that current investment affects current private savings; investment increases GDP and private savings equals GDP minus consumption. In graph 3 private savings is therefore visibly affected by changes in business investment.

The relationships (3) and (4) seem thus 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

[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.

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 graph 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).

6.2 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 $X - M < 0$. In order 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 behaviour of private savers, in the sense that they save more. According to the simulation results in Table 2 this seems not appropriate since, 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 graph 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.

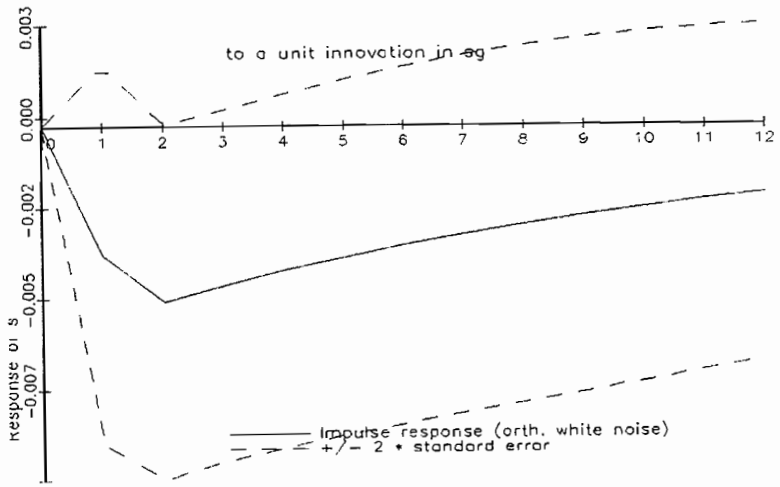
As Eisner (1995) argues, this negative effect on investment and thus on (future) growth -and savings- can be as important as the fall in deficit(s). His model is

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

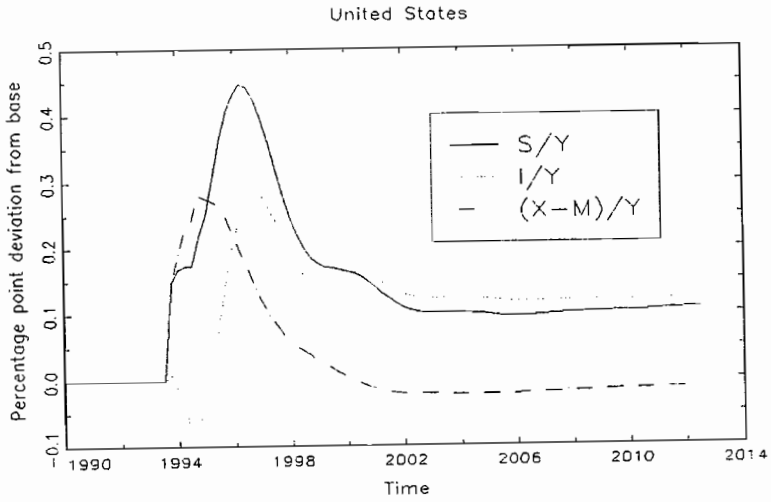
where S_t represents aggregate savings at time t, S^g_{t-1} public savings one period lagged, e_t the exchange rate and ΔM_t the (once differenced) money supply. Eisner estimates $\xi < 0$ for the US, by which current government deficits have the positive effect that they lead to future savings and, consequently, probably to future growth. A government deficit in this light is thus not a hindrance.

As the US is 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[11]

Graph 5 The reponse of savings to shock in public savings according to model (12)



Graph 6 S, I and X-M in the US in response to a government consumption shock (NiGEM, see graph 1)



Eisner (1995) yields the impulse response graph 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 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 since there is no 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 graph 6 that is similar to graph 1 but for *aggregate* savings, investment and the current account. Aggregate savings is here 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. The graphs 5-6 demonstrate this important difference in results that, once again, is only due to the different models that are used.

7 Conclusions

Simulations with the global macroeconomic model NiGEM show that rather different results are obtained from those given by the much simpler, partial models on savings-investment-current account that are often adopted in the literature. The simulation results are very similar for the four countries investigated.

In the short and long run the simulation effects of savings on investment are lower than the effects estimated by a simple investment-savings model. Also the effect of investment on the current account is weaker. The 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 in line with the NiGEM results.

These comparisons thus show that there are important differences between using a full macroeconomic model in which all relevant variables are modelled 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 modelling of capital flows.

Most striking is the result that changes in public (private) savings tend to be largely offset by reponses in private (public) savings. This in particular holds for the US, a country where a

[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.

solution needs to be found for the persistence of the twin deficits. 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 since 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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