The Role of Savings and Investment in Current Account Determination: The Case of the Federal Republic of Germany (1973 - 1979)*

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I. Introduction

In the years preceding the 1979/80 oil price increase the current account surpluses of Japan and Germany reached unprecedented levels and private capital movements were not sufficient to finance these imbalances. As a result international reserves and real exchange rates had to undergo considerable changes to facilitate the adjustment process. In addition, the current accounts themselves seem to have been slow to move in the right direction and to reduce thereby the extent of the adjustment problem. After the second oil crisis, the German current account moved into a deficit, which reached 1.9 per cent of *GDP* in 1980, 1.1 in 1981 and will probably move back into surplus only in 1982. The large depreciations of the mark in 1980 and 1981 seem thus to work very slowly towards the reduction of the deficit.

This paper developes a small macroeconomic model for Germany with the aim of studying the determination and the dynamics of the German current account. The hypothesis advanced in this paper is that German current account developments cannot be understood without reference to the "absorption approach" (*Alexander*, 1952). *Alexander* maintained that since the current account is identical to the difference between output and domestic absorption, defined as the demand for consumption and investment goods by the private sector plus government expenditure on goods and services, a devaluation or depreciation of the exchange rate cannot affect the current account unless it influences the level of output and/or of domestic absorption. By the *Keynes*ian income identity the difference between

* I would like to thank *J. Artus* and *A. Sommariva* for helpful suggestions. I am particularly indebted to *A. Steinherr*, whose help has been invaluable in all stages of the work from the setting up of the model and the preparation of the data bank to the interpretation of the results. Helpful research assistance was provided by *Gertrud Windsperger*, *Susana Sosa* and *Anthony Turner*. This paper was written in 1980 while I was at the International Monetary Fund. All views expressed in this paper are personal.

output and absorption (i.e. the current account) is also equal to the savings-investment gap plus the government budget surplus.[1] Thus fiscal policy is assumed in this model to influence directly the current account, while monetary policy affects it indirectly via two crucial functions in the model: the savings and the investment functions.

Savings are assumed to be a function of net real wealth, i.e. the stock of real capital plus the stock of private financial wealth deflated by the price level, net of financial liabilities of the private sector and of the real interest rate. Investment is a function of the discrepancy between the marginal product of capital and the real financial interest rate, and the terms of trade. Therefore the exchange rate appears directly in the investment function via the terms of trade. The model presented here departs from previous empirical work on the current account not only because the focus is on the savings and investment functions rather than import or export demand functions, but also because changes in the German price level, which are an important channel of current account adjustment both via their effect on relative prices and via their effect on the real value of financial wealth, are also endogenous. Given the central role played by real net wealth in the explanation of German savings behaviour and the current account, the demand for foreign financial assets by Germans and German financial assets by foreigners is also endogenous. Finally also the exchange rate is explained.

The main characteristic of the model presented here is that all markets are assumed to be in disequilibrium, i.e. actual and partial equilibrium (or desired) quantities of all endogenous variables are not assumed to be equal a priori.[2] The empirical test of the model will tell how long it takes for each market to return to equilibrium thus yielding useful insights into the actual working of the German economy in the seventies. Another important characteristic of the empirical estimates is that all equations are estimated simultaneously by a full information maximum likelyhood method developed by *Wymer* (1976, 1979).

The paper is structured as follows: Section 2 presents the quarterly model and Section 3 the empirical estimates. Section 4 contains concluding comments.

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[1] For a similar interpretation of the German current account behaviour see *Artus*, 1979.

[2] The discrepancy between actual and desired quantities at each point in time is assumed to be caused by transactions costs, information costs and real world frictions in general.

II. A Model of the German Current Account and of the DM-US Dollar Exchange Rate

Table 1 contains the list of the variables of the model and Table 2 the equations of the model. There are 16 endogenous variables and 16 equations (9 stochastic equations and 7 identities). All output and expenditure variables are defined in real terms, while financial variables are expressed in money terms. Real quantities are denoted by small letters and nominal ones by capital letters unless otherwise indicated. Behavioural equations are generally linear in the natural logarithms of the variables, so that elasticities are constant, but interest rates are introduced as natural numbers. Most identities are linear in the variables, so that the model is non linear in the natural logarithms. For economy of notation the error terms are omitted.

The model is specified in continuous time as a system of first order linear differential equations, and desired or partial equilibrium levels of the endogenous variables are allowed to be different from the actual ones in order to introduce disequilibrium into the system.

Adjustment parameters are denoted by α, long run elasticities by β and marginal or average propensities or equilibrium ratios by γ. Natural logarithms are denoted by "log" and capital D indicates a derivative with respect to time. A circumflex above a variable indicates a desired or partial equilibrium quantity, while an asterisk indicates that a variable is expressed in dollars. A number of a priori restrictions have been imposed upon the model. They will be mentioned when discussing the results of the empirical tests. A priori restrictions increase the number of degrees of freedom and the efficiency of the estimates of the remaining parameters, provided they are consistent with the data. The partial adjustment specification of most equations also allows to save degrees of freedom with respect to a specification in which all variables on the right hand side of an equation are allowed to affect with a different lag structure the variable on the left hand side.

The fact that the model presented below has some theoretical shortcomings arises mainly from the necessary compromises that must be made when trying to estimate models empirically. In the explanation of the theory underlying the various equations, the aspects of the model which are not completely satisfactory from a theoretical point of view will be discussed in greater detail. Suffice to mention here that generally the sophisticated econometric methods used in this paper provide much more stringent tests of the hypotheses embedded in the model than, for instance, ordinary least square (*OLS*) or two stage least square techniques. It is not infrequent that

Table 1

Germany: Variables of the Model[a)]

Endogenous Variables

BP^G	= Government bonds and bills held by households and banks
DA	= Domestic assets of Bundesbank
GFA	= Foreign assets owned by Germans abroad (including banks), in deutsche marks
GFL	= Assets owned by foreigners in Germany, in deutsche marks
i	= Real investment in machinery and equipment and construction
K	= Stock of physical capital, all sectors
l	= Wage rate
P	= Price level, *GDP* deflator
P_i	= Import prices in deutsche marks
P_x	= Export prices in deutsche marks
r	= 3-month deposit rate in Frankfurt
RN	= Net international reserves in deutsche marks
s_H	= Real savings of households
S	= DM-dollar exchange rate
w	= Stock of real net wealth of private sector
y	= Real gross national product

Exogenous Variables

A	= Claims of Bundesbank on commercial banks
b	= Real imports of goods and services
c	= Real private consumption
$CAus$	= U.S. current account, in dollars
DE	= Dummy for oil embargo in equation explaining *GFL*. Assumes the value of 1 in the third and fourth quarters of 1973 and zero otherwise
DW	= Dummy for wage explosion in 1969/70. Assumes the value of 1 in the last quarter of 1969 and the first of 1970
GFL^G	= Government bonds and bills held by foreigners, in deutsche marks
g	= real government expenditures
L	= Industrial employment
P^*_{oil}	= Price of oil, in U.S. dollars
P_i^*	= German import prices in dollars
pus	= U.S. *GDP* deflator
$P^*_{x,us}$	= U.S. export unit values in dollars
RCA	= Residual item in current account identity
RK	= Residual item in identity defining the stock of capital
r_{us}	= Three-month Euro-dollar deposit rate in London
s_c	= Corporate savings
T	= Government revenues in current prices
yp	= Potential output
y_w	= Real world income

[a)] A description of the sources of the data used is available from the author upon request. Suffice to mention here that most data are collected from the Bundesbank Bulletins and from *IFS* of the *IMF*.

Table 2

Germany: Equations of the Model

Household savings

(1) $D \log s_H = \alpha_1 (\log \hat{s}_H - \log s_H)$

(1 a) $\hat{s}_H = \gamma_1 w^{\beta_1} e^{\beta_2 (r - D \log p)} y^{\beta_3}$

Private investment

(2) $D \log i = \alpha_2 (\log \hat{\imath} - \log i) + \beta_4 \log (y/yp)$

(2 a) $\log \hat{\imath} = \gamma_2 + \left[0.35 \frac{y^e}{K} - (r - D \log p) \right] + \beta_5 \log (p_x/p_i)$

(2 b) $y^e = y$

GPD deflator

(3) $D \log p = \alpha_3 (\log \hat{p} - \log p) + \beta_6 \log \left(\frac{y}{yp} \right)$

(3 a) $\hat{p} = \gamma_3 \frac{l}{0.65\, y/L}$

Wage rate

(4) $D \log l = \alpha_4 (\log \hat{l} - \log l)$

(4 a) $\hat{l} = \gamma_4 \left(\frac{Pc}{0.65\, y/L} \right)$

(4 b) $Pc = P^{\beta_7} Pi^{1 - \beta_7}$

Demand for foreign assets by Germans

(5) $D \log GFA = \alpha_5 (\log g\hat{f}a - \log \frac{GFA}{p}) + D \log p$

(5 a) $g\hat{f}a = \gamma_5 w^{\beta_8} e^{\beta_9 (r_f + \log [S^e/S] - r)} (P^*_{OIL} \cdot S/p)^{\beta_{10}}$

(5 b) $\log (S^e/S) = \beta_{11} (D \log p - D \log pus)$

Demand for German assets by foreigners

(6) $D \log GFL = \alpha_6 \left(\log g\hat{f}l - \log \frac{GFL}{p} \right) + D \log p$

(6 a) $g\hat{f}l = \gamma_6 y_w^{\beta_{12}} e^{\beta_{13} (r - \log [S^e/S] - r_f)}$

(7) $Dr = \alpha_7 (\hat{r} - r)$

(7 a) $\beta_{15} \hat{r} = \alpha_{14} \log y - \log M/p - \beta_{16} D \log p$

(7 b) $M = Rn + DA$

Government reaction function

(8) $D \log DA = - \alpha_8 \log (y/yp)$

Exchange rate determination

(9) $D \log S = \beta_{17} (D \log p - D \log pus) + \beta_{18} (r_{us} - D \log pus) - \beta_{18} (r - D \log p) + \beta_{19} \log (CAus \cdot S/CA)$

National income identity

(10) $y = i + c + g + x - b$

(10a) $CA = p_x x - p_i b = (s_c + s_H - i)\, p\, (p_x/p_i) + (T - gp) + RCA$

(10b) $c = y - s_H$

Wealth identity

(11) $W = (BP^G + [M - A] + GFA - GFL)/p + K$

Definiton of stock of capital

(12) $\Delta K = i + RK$

Government budget constraint (determines BP^G)

(13) $g \cdot p - T = D\,(BP^G) + D\,(DA - A) + D\,(GFL^G)$

Balance of payments identity

(14) $DRn = CA + D\,(GFL) + D\,(GFL^G) - D\,(GFA/S)$

Import prices in deutsche mark

(15) $D \log p_i = D \log S + D \log p_{i^*}$

Export unit values in deutsche mark

(16) $D \log p_x = D \log S + D \log p_x^*$

an equation estimated by *OLS* once estimated in continuous time does not yield meaningful results, thus leading to doubts about the initial specification.

Equations (1) to (4) constitute the domestic demand price block, equations (5) to (8) the financial block, equation (9) explains the exchange rate of the DM with the dollar and equations (10) to (16) are identities. In equation (1) savings are assumed to depend on real wealth comprised of real financial outside wealth of the private sector and the stock of capital later defined in equations (11) and (12). Savings are also assumed to be affected by the real interest rate and by income. The rationale for the inclusion of wealth and the real rate of interest in the savings function can be found in *Metzler* (1951). Income was added alongside wealth in order to check whether the savings of households were constrained in Germany by the level of income also.

Corporate savings are assumed to be exogenous in the model despite their importance, because of difficulties in estimating a satisfactory equation. This is probably also related to the lack of satisfactory quarterly data.

Private investment in machinery, equipment and construction is assumed to depend on the discrepancy between the expected marginal product of capital derived from a *Cobb Douglas* production function and the real interest rate and on the terms of trade. The marginal product of capital derived from a *Cobb Douglas* production function is measured by the average product of capital times the share of capital in income. For lack of a better proxy the expected average product was approximated by the actual. A cyclical term also appears in the investment equation. The terms of trade are assumed to affect investment positively, contrary to *McKinnon* (1978). An improvement of the terms of trade can have two opposite effects on domestic investment: on the one hand it can be associated with a reduction in foreign demand and this can depress domestic investment and create an incentive for investment abroad. This is the effect considered by *McKinnon*. On the other hand, if Germany is viewed as an economy which transforms imported inputs into exportables, an improvement in the terms of trade improves the profit position and stimulates investment. Thus the higher the share of imported inputs in value added and the greater the degree of monopoly power of the German export industry, the more likely it is that the positive effect outweighs the negative one. *Steinherr* (1980) and *Steinherr* and *Morel* (1979) show that the German export industry has a high degree of monopoly power at least in the medium run, so that an appreciation of the DM will not reduce foreign demand prospects by much. To the extent that changes in the exchange rate have historically affected import prices faster than export prices, the effects of the appreciation on the terms of trade and on investment would be positive. This effect of the change in the exchange rate on investment is thus incorporated in the model at least in estimation. The terms of trade do not appear in the savings function, since it is believed that wealth as defined here (see equation 11) already incorporates at least part of the losses or gains connected with its changes.

In this model there is no equation for the foreign demand for German exports or domestic demand for imports. The current account balance results entirely from the Keynesian identity relating it to the private savings-investment gap and government savings (equation 10a). In theory, in a complete general equilibrium model it should make no difference to the explanation of the current account whether one specifies import and export functions or one follows the approach adopted here, since all variables appearing in the former would appear also in the savings and investment functions. In practice

it makes a difference. On the one hand, the standard theory of savings and investment has been largely developed for closed economies and the channels through which foreign variables affect the gap have not been satisfactorily explored. On the other hand, the impact of foreign variables on the savings and investment gap is probably less direct than on imports and exports. Since the aim of theorizing is to simplify and to make explicit only the most important direct links, there is a tendency to drop from the functions foreign variables which do not affect savings and investment directly. Despite these shortcomings, the approach adopted here has great appeal since it emphasizes other variables, mainly domestic ones, like real interest rates, real wealth and the productivity of capital, which the import and export functions approach to the current account has tended to neglect. The two approaches can therefore be considered as complementary. To clarify, let us take up the issue of the effects of exchange rate changes on the current account. The savings investment gap approach to the current account balance is not inconsistent with the idea that exchange rate changes play a role in the adjustment of the current account. It points out, however, that exchange rate changes can play a role in current account adjustment only to the extent that they affect domestic absorption or the savings-investment gap. This can occur through a number of channels: (i) via the inflationary effect of exchange rate depreciations on the real value of money and financial assets (*Alexander,* 1951) and wealth effects on consumption and savings, (ii) via income redistribution effects from lower income to higher income earners, from income earners to corporations and from the private sector to the government (*Alexander,* 1951), (iii) via the terms of trade effect on savings (*Laursen* and *Metzler,* 1951) and/or investment (*McKinnon,* 1978).

In the model presented here, effects (i) and (iii) above are explicitly incorporated. The view taken in this paper for the explanation of the current account departs therefore markedly from the view which was prevalent during most of the post-war period. which maintained that a depreciation of the exchange rate would increase the domestic price of imported goods in proportion to the devaluation and would leave the price of exported goods unchanged. These price changes would trigger equilibrating changes of demand for imports and exports if the sum of the demand elasticities is greater than one. The main shortcoming of this elasticity approach is that it is extremely partial equilibrium since it disregards the impact of exchange rate depreciation on macroeconomic aggregates (inflation, aggregate demand and the savings investment gap). This shortcoming has become evident as the experience with flexible exchange rates accumulated in the meantime (see *Artus* and *Young,* 1980) has shown that aggregate demand and cyclical

factors played an overwhelming role with respect to exchange rate changes in the determination of the current account.

The emphasis of the wedge between savings and investment (or between income and expenditure) for the analysis of the current account is not novel in the literature. It is central to the analysis of the current account or of the balance of payments in a number of relevant post World War II contributions (*Alexander* 1951, *Prais* 1961, *Metzler* 1968), but it has been also the central mechanism of adjustment in classical balance of payments theory for almost three hundred years.[3] It was incorporated into the monetary approach to the balance of payments and has been recently revived in the explanation of persistent deficits or surpluses in the current account after the advent of floating by *Kindleberger* (1976) and *Artus* (1979).

German inflation measured by the *GDP* deflator is simply assumed to adjust with a lag to unit labour costs, defined as the nominal wage rate divided by the marginal product of labour derived from a *Cobb-Douglas* production function. The speed of adjustment of inflation to its partial equilibrium term is assumed to be affected positively by the cycle (equation 3). The wage rate in turn adjusts with a lag to a cost of living index defined as a weighted average of the *GDP* deflator and import prices, deflated by the average product of labour (equation 4). One problem with the specification of the wage-price block is that expectations of inflation and monetary aggregates do not appear in the equations. They imply that the rate of inflation in the steady state would be equal to zero. However, this ist not a major drawback since this model is mainly intended to study cyclical fluctuations and short to medium run effects of policy changes.

Moving on to the financial block, equations (5) and (6) represent the demand functions for foreign assets by the German private sector, including banks, and for German assets by foreigners. The scale variables are respectively real private net wealth, and foreign income as a proxy for foreign wealth. Both functions are assumed to be homogenous of degree one in prices. Following the portfolio balance model of capital flows the level of the domestic interest rate and the level of the foreign interest rate appear in the demand functions. The interest rate differential has been corrected for the expected change in the exchange rate, where the latter is defined in equation (5b) by the inflation differential. The demand for foreign assets by Germans is also assumed to depend positively on the real price of oil as a proxy for the negative expectations which its increase entails for German

[3] For a review of classical balance of payments theory see *Frenkel* and *Johnson* 1976, Chapter 1 and *Tullio* 1981, Chapter 1.

inflation, the current account and the exchange rate. The demand for monetary base is assumed to be influenced negatively by the nominal interest rate and by the rate of inflation, the former reflecting substitutability of monetary base with financial assets and the latter with goods.

The interest rate is assumed to be determined in the market for the monetary base, but frictions in asset markets and possibly interventions by monetary authorities prevent the interest rate from clearing the market for monetary base (equation 7). The interest rate is assumed to change only by a fraction α_7, of the discrepancy between the partial equilibrium interest rate, i.e., the one which would instantaneously clear the market for the monetary base, and the actual interest rate. Equation (7) embodies the *Keynes*ian liquidity effect of an increase in the money supply. With the change in the inflationary environment after 1973 inflationary expectations might have become much more sensitive to changes in the money supply (or in the supply of monetary base) and the liquidity effect might have been weakened by a strengthening of an inflationary expectations effect on nominal interest rates. We shall take up the issue of the relative strength of these two effects on nominal interest and especially the increased importance of the expectations effect after 1973 when discussing the empirical evidence.

Equation (8) is a reaction function of German monetary authorities. The rate of change of domestic assets of the Bundesbank is assumed to depend negatively on the potential output gap, i.e., German monetary authorities are assumed to stabilize the cycle by changing domestic assets of the Bundesbank.

The exchange rate is assumed to adjust to the relative inflation differential between Germany and the United States, to the real interest rate differential and to the ratio of the current accounts (equation 9). In the long run the exchange rate is therefore assumed to adjust to purchasing power parity, but in the short run condition in asset markets and the relative cyclical position are allowed to cause deviations from purchasing power parity. Equation (9) can be interpreted as an intervention function of German monetary authorities in the foreign exchange market. They have been intervening very heavily at times to keep fluctuations of the exchange within reasonable proportions and are known to attribute great importance to the level of the exchange rate. The amount of interventions is assumed to be determined residually by the balance of payments identity (equation 14).

The model is completed by a number of identities: an income identity (equation 10), a government budget constraint (equation 13), which is assumed to determine the demand for government bonds by the private

sector and is very important in order to be able to simulate the effects on the model of a fiscal expansion, a balance of payments identity (equation 14), and two identities converting German import and export prices expressed in dollars into DM. Finally, the important identity (11) defines the stock of private net wealth as the sum of government bonds, the monetary base net of central bank advances to commercial banks and net foreign assets held by Germans abroad, all deflated by the price level and the stock of real capital.

III. Estimates of Parameters

The parameters of the model contained in Table 2 have been estimated from the first quarter of 1973 to the third quarter of 1979 with a full information maximum likelihood method developed by *Wymer* (1976, 1979).[4] The estimated parameters are contained in Table 3.

A number of a priori restrictions have been imposed upon the model. The wealth elasticity of demand for foreign assets by Germans (β_8) and the income elasticities of demand for German assets by foreigners (β_{12}) and for monetary base (β_{14}) have been constrained to be equal to one on a priori grounds. The semi-elasticity of investment with respect to the difference between the average product of capital and the real financial interest rate and the elasticity of the expected change in the exchange rate with respect to the inflation differential between Germany and the U.S. (β_{11}) have also been constrained to 1 after they were not found to be significantly different from it in the first estimation runs. Similarly, the share of capital in income and the share of the imported goods in the *GDP* deflator ($1-\beta_7$) have been constrained to 0.35. The elasticity of demand for monetary base with respect to the nominal interest rate has been constrained to 0.10 (β_{15}) and with respect to the rate of inflation to 0 (β_{16}). Finally, the elasticity of savings with respect to income (β_3) and the cyclical term in the investment function (β_4) were set equal to zero after they were found to be not significantly different from zero in the initial estimation runs. The number of a priori restrictions might seem somewhat high but given the relatively low number of observations it was found useful to impose restrictions upon the system whenever feasible.

One dummy has been included in the demand for German assets by foreigners reflecting the oil embargo of the last quarter of 1973 (*DE*).

The model of Table 2 has also been estimated from the first quarter of 1969 to the third quarter of 1979, with the exclusion of the reaction

[4] The name of the program used is RESIMUL.

Table 3

Germany: Estimated Parameters (Q1 1973 to Q3 1979)[a)]

Parameter	Entering equation	Number of equation	Estimate of parameter	*t*-value	Mean time lag (in years)
α_1	savings	(1)	0.856	3.58	0.29
α_2	investment	(2)	0.514	4.81	0.49
α_3	price level	(3)	0.045	3.16	5.56
α_4	wages	(4)	0.049	4.36	5.10
α_5	foreign assets	(5)	0.214	9.50	1.17
α_6	foreign liabilities	(6)	0.060	2.96	4.17
α_7	interest rate	(7)	0.125	–	–
α_8	reaction function	(8)	2.474	1.84	–
β_1	savings	(1)	1.048	3.04	–
β_2	savings	(1)	13.811 (0.068)	2.83	–
β_3	savings	(1)	0*	–	–
β_4	investment	(2)	0*	–	–
β_5	investment	(2)	1.121	4.81	–
β_6	price level	(3)	0.128	3.46	–
β_7	wage rate	(4)	0.65*	–	–
β_8	foreign assets	(5)	1*	–	–
β_9	foreign assets	(5)	9.343 (0.120)	2.25	–
β_{10}	foreign assets	(5)	0.803	13.16	–
β_{11}	exchange rate expectations	(5) (6)	1*[a]	–	–
β_{12}	foreign liabilities	(6)	1*	–	–
β_{13}	foreign liabilities	(6)	−28.668 (−0.481)	(2.78)	–
β_{14}	interest rate	(7)	1*	–	–
β_{15}	interest rate	(7)	5.950* (0.100)	–	–
β_{16}	interest rate	(7)	0*	–	–
β_{17}	exchange rate	(9)	1*	–	–
β_{18}	exchange rate	(9)	0.376	0.68	–
β_{19}	exchange rate	(9)	0*	–	–
–	Dummy *DE* in foreign liabilities	(6)	−0.030	2.65	–

[a)] Parameters marked by an asterisk have been constrained in estimation.

function of monetary authorities (equation 8) and the exchange rate equation (equation 9). The results are not reported here because of lack of space.[5] It is useful, however, to report here of significant changes which occurred in the value of some parameters after the advent of floating.

The speeds of adjustment in the real sector seem to have increased substantially after 1973. The mean adjustment lag of savings fell from about 6 months to about 4 months (i.e., 63 per cent of the discrepancy between actual and desired savings was eliminated in about 4 months during the flexible exchange rate period). The mean adjustment lag for investment fell from 13 to 6 months and for wages from about 8 years to about 5. The mean adjustment lag for the *GDP* deflator during the flexible exchange rate period is about 5 years. The strength of the cyclical term in the price equation more than doubled to about 0.13, which implies that a rise of 1 per cent of *GDP* above potential led to an increase of inflation of over 0.5 per cent. The increase of the speeds of adjustment in the real and wage-price sectors of the economy and the greater strength of the cyclical term in the price equation after 1973 are consistent with the more unstable and inflationary environment of the latter period. In the asset markets the speeds of adjustment did not change substantially and ranged from a little over a year for the demand for foreign assets by Germans to about 4 years for German liabilities to foreigners. The extensive controls by German monetary authorities on the accumulation of DM assets by foreigners might be responsible for the low speed of adjustment in the latter market.[6] Another indication of the change in the inflationary environment after 1973 can be found in the change in the value of the adjustment parameter in the interest rate equation (α_7). Although the latter has been constrained in both tables its values have been found by a search procedure which consisted in changing the value of α_7 from 0 to 1.50 in increments of 0.125 and selecting those which maximized the log-likelihood values. This yielded a value of 1.0 for the period 1969 to 1979 and a value of 0.125 for the flexible exchange rate period, implying that the strength of the *Keynes*ian liquidity effect of money supply changes on the nominal interst rate fell sharply. This finding might be a consequence of the greater importance which expectations of inflation have acquired in the latest period and suggests that a more complete model would have required explicit treatment of expectations.[7] This was beyond the scope of this paper, however.

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[5] They are available upon request from the editor of this journal or from the author.

[6] A similarly low speed of adjustment was found in the market for foreign assets demanded by Italian residents (*Tullio*, 1980 a). Italy has a rigid system of control on capital outflows.

The parameters which are semi-elasticities have been converted into elasticities evaluated at sample means (in brackets). During the flexible exchange rate period, the long-run elasticity of savings with respect to the real interest rate (β_2) was about 0.07 while the long-run elasticity of investment with respect to the terms of trade (β_5) was about 1.1. Since the effect of the terms of trade on investment is positive, exchange rate changes can affect the current account in the right direction to the extent that export prices react more slowly than import prices. The elasticity of savings with respect to wealth (β_1) was not found to be significantly different from one, while the elasticity of demand for foreign assets with respect to the interest rate differential (β_9) was 0.12 and with respect to the real price of oil (β_{10}) 0.80. In the demand for German assets by foreigners the elasticity with respect to the interest rate differential (β_{13}) is the only parameter which has the wrong sign. This may be related to the fact that we were unable to find an appropriate variable reflecting the degree of diversification of international portfolios away from the dollar towards the DM. Finally, the elasticity of the exchange rate with respect to the real interest rate differential (β_{18}) has the expected sign, and a plausible value, but is not highly significant. Out of 16 estimated parameters only one has the wrong sign and only two are not highly significant.

The results of the ex-post static and dynamic forecasts of the model and the stability analysis are presented in the Appendix. Suffice to mention here that the model is stable.

IV. Concluding Comments

This paper presents and estimates a small macroeconomic model of Germany with the aim of studying the determination and the dynamics of the current account and capital flows. A feature which is novel in empirical work is that the current account is explained in this model by the savings-investment gap. Therefore a savings and an investment function are specified in the model and play a crucial role. The interest rate has been assumed to be determined in the market for the monetary base. The *Keynes*ian liquidity effect of an increase in monetary base on the interest rate plays a crucial role in the model. One of the major shortcomings of the model is that expectational considerations have been neglected. So have some long-term laws like the quantity theory of money or the *Fisher* equation. It

[7] For a model of the German mark-U.S. dollar exchange rate which explicity takes into account anticipated and unanticipated changes in the money stock, see *J. Artus* (1980).

follows that this model is more suited to study short-run effects of policy disturbances than long-term effects. In principle it would have been preferable to specify the dynamics of the model consistently with those long-term laws and also to endogenize expectations of inflation. However, given the shortness of the flexible exchange rate period for which the model has been estimated (first quarter of 1973 to third quarter of 1979), it would have been difficult to obtain a satisfactory test of these laws form the data.

Despite these shortcomings, the model provides some useful insights. First, estimation results show that capital flows and the exchange rate are quite sensitive to real interest rate differentials and the current account to the fluctuations of the savings investment gap. Second, investment was found to be significantly affected by a terms of trade effect (in a positive direction) and by the real interest rate (in a negative one), and savings to be significantly and positively affected by wealth and the real interest rate. Third, the simulation results (not reported here) show a high responsiveness of the DM-exchange rate of capital flows and of the current account to fiscal and particularly monetary policy. The greater potency of monetary policy results from its strong impact on the interest rate, which plays a very crucial role in the transmission mechanism and in the dynamics of the exchange rate.

Appendix

Table 4 contains the root mean square errors of the ex-post static and dynamic forecasts of the model presented in Table 3. They have been computed using *Wymer*'s PREDIC program. In the static forecast only four variables have a root mean square error which is greater than 5 per cent: household saving, import prices, the exchange rate and domestic assets of the Bundesbank. In the dynamic forecasts in which the predetermined endogenous variables are the ones which are estimated by the model the root mean square errors are somewhat higher but only 4 exceed 20 per cent: household savings, the demand for foreign assets by Germans, domestic assets of the Bundesbank and net international reserves. Table 5 contains the eigenvalues of the model. The model is stable because the only positive eigenvalue is approximately equal to the rate of growth of the variables during the sample period.[8] *Wymer*'s CONTINEST program has been used to calculate the eigenvalues. The model converges in cycles. The stability of the model has also been checked by a fiscal and a monetary policy simulation, which is not presented here due to lack of space.

[8] The linearization of the model was done around sample means and not around the steady state.

Table 4
Germany: Ex post Root Mean Square Errors of Forecasts (1973 – Q1 to 1979 – Q3)

Variable	Model with exchange rate endogenous	
	Error of single period forecasts	Error of dynamic forecasts
s_H	0.058	0.103
i	0.033	0.049
p	0.005	0.010
l	0.007	0.023
GFA	0.048	0.111
GFL	0.015	0.042
DA	0.202	0.353
S	0.059	0.082
r	0.003	0.006
y	0.005	0.007
w	0.005	0.005
K	0.001	0.006
BP^G	0.011	0.026
Rn	0.043	0.209
p_i	0.054	0.083
p_x	0.042	0.074

Table 5
Germany: Results of Stability Analysis, Eigenvalues of Models[a)] (1973 – Q1 to 1979 Q2)

Version of model with exchange rate endogenous		
Eigenvalues	Damping period (in quarters)	Period of cycle
− 0.012	86.281	
− 0.856	1.169	
− 0.492	2.034	
− 0.111	8.997	
0.010	–	
− 0.021	47.706	
− 0.060	16.775	
− 0.039	25.575	
− 0.227 ± 0.016	4.402	378.767

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[a] The number of eigenvalues is less than the number of equations because a number of identities are of zero order and because some first order identities are linearly dependent thus yielding zero eigenvalues.

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Zusammenfassung

Die Bedeutung von Sparen und Investieren für die Entwicklung der Leistungsbilanz: Fall Bundesrepublik Deutschland (1973 - 1979)

Dieser Beitrag enthält ein kleines makroökonomisches Ungleichgewichtsmodell für die Bundesrepublik Deutschland, welches den Anpassungsmechanismus der deutschen Leistungsbilanz bei flexiblen Wechselkursen untersuchen soll. Das Modell arbeitet mit Vierteljahresdaten und zwar vom ersten Quartal 1973 zum dritten Quartal 1979 unter Anwendung von *Wymer*'s Programmen.

Die Haupthypothese, die diesem Modell zugrunde liegt, ist die Aussage, daß die Entwicklung der deutschen Leistungsbilanz ohne Einbeziehung des Spar- und Investitionsverhaltens nicht richtig verstanden werden kann; und zwar muß bei einem öffentlichen Defizit von Null ex post die Differenz zwischen Ersparnis und Investition dem Leistungsbilanzsaldo entsprechen. Insofern weicht dieses Modell von früheren empirischen Arbeiten über die Leistungsbilanz ab, indem es den Brennpunkt mehr auf Spar- und Investitionsfunktionen als auf Import- und Exportnachfragefunktionen richtet.

Die in dem Modell betrachteten Hauptwege, über die eine Abwertung der Wechselkurse die Leistungsbilanz beeinflußt wird, sind: erstens, der Realvermögenseffekt auf die Ersparnis. Es wird angenommen, daß die Abwertung das Preisniveau steigen läßt und dies wiederum den realen Vermögenswert reduziert und damit auch die Ersparnis. Wenn die Abwertung zu einer Zeit auftritt, in der die Leistungsbilanz sich im Defizit befindet, wie dies in den letzten Jahren der Fall war, tendiert dieser Effekt dazu, die Anpassung der Leistungsbilanz zu verzögern. Zweitens, der Realzinseffekt auf die Ersparnis. Dieser Effekt wirkt ausgleichend, wenn unter den oben angeführten Umständen (bei gleichzeitigem Leistungsbilanzdefizit) der Realzinssatz anzusteigen tendiert, als Resultat von Zahlungsbilanzdefiziten und Geldabflüssen aus dem Inland. Drittens, der Realzinseffekt auf die Investition; die ebenso unter den o.g. Annahmen ausgleichend wirkt. Viertens, der Effekt der Handelsbedingungen auf die Investition, welcher vermutlich die Investition positiv beeinflußt. Folglich tendieren die Investitionen dazu, zurückzugehen, wenn der Wechselkurs sinkt und die Importpreise schneller ansteigen als die Exportpreise in inländischer Währung. Die Investitionen tragen dann dazu bei, das Leistungsbilanzdefizit wieder auszugleichen.

Es wird gezeigt, daß alle vier Wege für Deutschland während der Periode flexibler Wechselkurse empirische Signifikanz besaßen. Das Modell enthält auch Nachfragefunktionen für Geldvermögen, die von Deutschen im Ausland und von Ausländern in Deutschland gehalten werden. Sie sind relevant in bezug auf die Endogenisierung der Zahlungsbilanz und Währungsreserveströme, die ein entscheidender Faktor für die Determinierung der Zinssätze sind.

Summary

The Role of Savings and Investment in Current Account Determination: The Case of the Federal Republic of Germany (1973 - 1979)

The paper contains a small disequilibrium macroeconomic model for Germany, which is intended to study the mechanism of adjustment of the German current account under flexible exchange rates. The model is also estimated on quarterly data from the first quarter of 1973 to the third quarter of 1979 using *Wymer*'s programs.

The main hypothesis underlying the model is that German current account developments cannot be properly understood without reference to the behaviour of savings and investment, the ex post difference in which must be equal to the current account, if the government budget deficit is equal to zero. Thus the model departs from previous empirical work on the current account in that its focus is on the savings and investment functions rather than import and export demand functions.

The main channels through which a depreciation of the exchange rate affects the current account that are considered in the model are (i) the real wealth effect on savings. The depreciation is assumed to increase the price level and this reduces the real value of wealth and hence savings. If the depreciation occurs at a time when the current account is in deficit, as has been the case in recent years, this effect tends to retard the adjustment of the current account. (ii) The real interest rate effect on savings. This effect is equilibrating if under the circumstances outlined above (depreciation occurring at a time of current account deficit) the real interest rate tends to increase as a result of balance of payments deficits and outflows of money from the country. (iii) The real interest rate effect on investment, which is also equilibrating under the above assumptions. (iv) The terms of trade effect on investment, which is assumed to affect investment positively. Hence, when the exchange rate depreciates, if import prices increase more rapidly than export prices in domestic currency investment tends to fall and to contribute towards reabsorption of the current account deficit.

All these four channels are shown to have been empirically significant for Germany during the flexible exchange rate period. The model also contains demand functions for financial assets held by Germans abroad and by foreigners in Germany. They are relevant in order to endogenize the balance of payments and reserve flows, which are an important factor in interest rate determination.

Résumé

La signification de l'épargne et des investissements pour le développement de la balance des paiements: cas de la République Fédérale d'Allemagne (1973 - 1979)

Cet article contient un petit modèle macroéconomique de déséquilibre pour la République Fédérale d'Allemagne. Celui-ci vise à analyser le mécanisme d'adaptation de la balance des paiements allemande lorsque les taux de change sont flexibles.

Le modèle utilise des données trimestrielles, à savoir du premier trimestre 1973 au troisième trimestre 1979 et il applique les programmes de *Wymer*.

L'hypothèse principale à la base de ce modèle est la suivante: on ne peut comprendre correctement le développement de la balance des paiements allemande sans y intégrer les comportements de l'épargne et des investissements. En effet, lorsque le déficit public est nul, la différence entre l'épargne et l'investissement doit correspondre ex-post au solde de la balance des paiements. Ce modèle diffère ainsi des travaux empiriques antérieurs sur la balance des paiements: en effet, il se centre plus sur les fonctions d'épargne et d'investissements que sur les fonctions de demande d'importations et d'exportations.

Le modèle considère les différentes possibilités de l'influence d'une dévaluation des taux de change sur la balance des paiements. Tout d'abord, l'effet du patrimoine réel sur l'épargne. On suppose que la dévaluation fait hausser les prix. A son tour, la valeur réelle du patrimoine diminue et par là aussi l'éspargne. Lorsque la dévaluation se produit au cours d'une période où la balance des paiements est déficitaire, comme ceci fut le cas ces dernières années, cet effet a tendance à retarder l'adaptation de la balance des paiements. Deuxièmement, l'effet des taux d'intérêt réels sur l'épargne. Lorsque, sous les conditions mentionnées ci-dessus (avec en même temps un déficit de la balance des paiements), les taux d'intérêt réels ont tendance à s'élever, ils exercent un effet compensateur. Ceci résulte du déficit de la balance des paiements et des sorties monétaires hors du pays. En troisième lieu, l'effet des taux d'intérêt réels sur les investissements. Ils ont le même effet compensateur en gardant les mêmes conditions metionées ci-dessus. En quatrième lieu, l'effet des conditions commerciales sur les investissements. Les conditions commerciales influencent probablement de manière positive les investissements. En conséquence, les investissements ont tendance à diminuer lorsque le taux de change baisse et lorsque les prix à l'importation augmentent plus rapidement que les prix à l'exportation en monnaie nationale. Les investissements contribuent alors à rééquilibrer le déficit de la balance des paiements.

Il est démontré ici que ces quatre possibilités d'influence ont une signification empririque pour l'Allemagne au cours de la période de taux de change flexibles. Le modèle contient également des fonctions de demande de patrimoine monétaire qui est détenu par des allemands à l'étranger et par des étrangers en Allemagne. Ces fonctions sont significatives pour l'endogénisation de la balance des paiements et des flux de réserves de devises, facteurs décisifs pour la détermination des taux d'intérêt.