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1. Background*

The main purpose of the financial model KOFI (i.e. KOSMOS FINANS) is to serve as a financial block in KOSMOS. The latter is a model used for forecasting by the National Institute of Economic Research. KOFI can, however, also be used - mainly for simulations - as a selfcontained model. The simulations are then focused on financial markets i.e. on the markets for money, credit, securities and foreign exchange.

As main prototype for KOFI has served the Swedish model MINIMAC[1.] The core of MINIMAC consisted of a number of financial sector balances. Interest rates and the exchange rate were exogenous in line with the regulated markets of the time. In KOFI a farreaching disaggregation is combined with endogenous interest and exchange rates. As other prototypes have served well established models of the Netherlands[2] and Denmark[3].

The portfolio balance approach on which KOFI is based, as well as its formal structure, has been described in an earlier Working Paper[4]. The purpose of the present paper is to place the model in its institutional context and to illustrate its properties by simulations. Furthermore, previous work with Swedish and foreign financial models have shown that the statistical input has been a bottleneck hampering full exploitation of the portfolio balance approach. In order to widen the bottleneck as far as possible, extensive work has been undertaken in order to supply KOFI with relevant unpublished statistics.

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[1] Markowski, A. [1989]. *Minimac – an econometric model of the Swedish Economy from a Central Bank's perspective*.Occasional Paper 6, Central Bank of Sweden. Also Kragh, B and Markowski, A [1988], *Effects of interest-rate policy in the short and medium term – a simulation study*. Quarterly Review of the Central Bank of Sweden, no 4.

[2] *Morkmon, A quarterly model of the Netherlands economy for macroeconomic policy analysis*, Monetary Monograph No 2. De Nederlansche Bank [1985].

[3] Pedersen, N.L. [1989], *Findan – finansiell sektor till "ADAM"*. Danmarks Statistik; Arbejdsnotat No 26.

[4] Markowski, A [1996]. *The financial block in the econometric model KOSMOS*. Working Paper No 53, National Institute of Econocmic Research.

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The number of sectors in KOFI is less than in the Swedish financial accounts, but larger than in similar foreign models, and thus requires a relatively large volume of statistics. That volume is manifolded as data are collected on a yearly as well as a halfyearly and quarterly basis. To link up with KOSMOS - which is a halfyearly model - yearly statistics had to be transformed into halfyearly data. Another complication has been frequent incompatability between the data from Statistics Sweden and from other sources. The statistical work has focused on capital markets and foreign exchange markets i.e. on the areas which represent the core of a financial model.

The selection of sectors and of the variables in the sector portfolios has been made with regard to their importance in simulations of financial macroprocesses. In practice the handling of the model has required that - compared to the financial accounts - a number of items are excluded because they are relatively small, relatively constant or difficult to interpret. To the latter category belong the residuals (”other assets and liabilities”) that appear on both the debit and the credit side of the balance sheets of the portfolios.

The accounting framework of the model is shown in *section 2. Section 3.1* contains an overview of the development in the Swedish financial markets. As a starting point is used a table of the changes of the portfolio of the *total* economy distributed between the various components: money, certificates, bonds and loans. This gives an idea about the structural changes in later years caused particularly by deregulation. Long run changes in supply are otherwise not so easily revealed in an analysis which centers on the demand behaviour of individual sectors. As further background material, the section contains tables of historical changes of demand and supply in the markets for bonds and certificates. These tables are derived from KOFI sector balances. Such tables are of vital importance for the interpretation of the simulations.

Section 3.2-5 deals with various institutional aspects of KOFI’s sectors that are relevant for their modelling. *Subsections 3.2 and 3.3* give brief accounts of the borrowing behaviour of

mortgage institutions and of Central Government. *Subsection 3.4* raises the question whether the model should distinguish or not between private insurance companies and the National Pension Fund. It appears there are good reasons for aggregating the two subsectors.

The design of the ”residual sector” of the model is described in *subsection 3.5*. The residual sector contains households, non-financial enterprises, local authorities, investment companies and finance companies. Also in this case questions are raised concerning the level of aggregation. There are arguments both for and against having households and non-financial enterprises in a common sector. Some problems concerning the modelling of the foreign sector are treated in *subsection 3.6*.

In *section 4* certain formal aspects of KOFI are dicussed as well as the econometric properties of the model. The latter concerns the determination of the long and the short term rates of interest, the exchange rate and the portfolio choice of the various actors. (These relationships are updated versions of those which have been more extensively described in the report referred to in footnote 1).

Section 5 contains four simulations undertaken with KOFI. They concern the effects of respectively, a change of the strategy of government borrowing, an increase of the domestic short term rate, an increase of the foreign interest rate and, finally, an increase of the budget deficit. The simulations are described in the form of deviations from a given basic scenario and limited to developments within the financial markets. The developments are registered as changes of the balance sheets of the various sectors. The emphasis is mainly on the processes generated by the interaction between the sectors and not so much on the decision making by each actor. A typical outcome of a simulation is the volume of open market operations required by the Central Bank to defend a targeted short term rate of interest. Other outcomes concern e.g. the paths followed over a number of periods by lending and borrowing by various sectors.

Section 6 gives some indications of the future development and use of KOFI.

2. The accounting framework

The model's data base consists of a flow-of-funds matrix (or its stock-value counterpart) derived from the Financial Accounts published by Statistics Sweden. Annual Financial Accounts time series for 1986-94 were distributed by half-years (and in some instances quarters) using other sources, in particular the data compiled by the Central Bank.

The model includes seven sectors, defined in terms of the Financial Accounts. They are listed below with their definitions and abbreviated names.

Central Bank (CB)
Central Government (Gov)
Banks - commercial, savings and co-operative banks,
Insurance sector (Ins) - social security funds, insurance companies and pension funds,
Mortgage institutions (Mor) - mortgage institutions and credit companies,

Residual sector (Res) - local government, non-financial enterprises, finance companies, investment companies and funds, households,
Foreign sector (For).

The model includes nine asset categories: certificates, bonds, (bank deposit) money, net foreign assets, loans, equity, notes and coin, insurance savings and claims on the National Savings Scheme (*allemansparande*). Government and mortgage bonds are treated as perfect substitutes; the same applies to certificates. As the model is presently designed, there is no need to distinguish between demand for bonds (or certificates) issued by the government and for those issued by mortgage institutions. This distinction is, however, upheld on the supply side.

Certificates of deposit and non-bank holdings of Central Bank certificates are reckoned as certificates, but their supply is not modelled. While they are present in the model for reasons of realism, they hardly affect anything. The scope for simulations is, however, hereby widened.

Banks' holdings of Central Bank certificates are included in "banks' net borrowing from the Central Bank", which - being a net item - thus differs from other loan variables.

Bonds and certificates are issued by two sectors: central government and mortgage institutions. These two sectors are assumed not to invest in these assets (i.e. not to have any holdings of bonds and certificates). The remaining sectors invest in bonds and certificates but do not issue any securities with the above mentioned exception of Central Bank certificates and certificates of deposit issued by the banking sector.

The stylized balance sheets of the sectors of the model are shown below. The sectors are referred to by the abbreveations given in parentheses after the sector name.

Central Bank *(CB)*

Assets	**Liabilities**
Net loans to *Banks*	Notes and coin
Bonds	*CB* certificates
Certificates	Net wealth
Foreign reserves	

Central Government *(Gov)*

Assets	**Liabilities**
Loans to *Res*	SEK certificates
Foreign loans	SEK bonds
Domestic equity	Foreign currency liabilities
	National Savings Scheme
	Net wealth

Banks

Assets	**Liabilities**
Bonds	Deposits of *Res*
Certificates	Net foreign currency liabilities

Advances and loans to Res	Net borrowing from Cb
Domestic equity	Certificates of deposit
	Net wealth

Mortgage Institutions (*Mor*)

Assets	**Liabilities**
Loans to *Res*	SEK certificates
	SEK bonds

Insurance Sector (*Ins*)

Bonds	Insurance savings of *Res*
Certificates	Net waelth
Foreign assets	
Loans to *Res*	
Domestic equity	

Residual sector (*Res*)

Assets	**Liabilities**
Notes and coin	Loans from *Banks*
Bank deposits	Loans from *Gov*
Certificates	Loans from *Mor*
Bonds	Loans from *Ins*
Insurance savings	Net foreign currency liabilities
National Savings Scheme	Equity debt to *Banks*, *Gov*, *Ins*
	Net equity debt to *For*
	Net wealth

Foreign Sector (*For*)

Assets	**Liabilities**
Foreign currency liabilities of *Gov*	Foreign reserves of *CB*
Net foreign currency liabilities of *Banks*	Foreign assets of *Ins*

Foreign currency liabilities of *Mor*

Loans from *Gov*

Net foreign currency liabilities of *Res*

National net foreign debt

SEK bonds

SEK certificates

Net equity claim on *Res*

The assets and liabilities of the model form a double entry system. This means that each asset is a liability of some other sector and that the sum of the net wealth of all sectors is zero. Furthermore, in each sector's balance sheet the sum of all assets is equal to the sum of all liabilities. Equality of the asset and liability sides in a sector's balance sheet is ensured by determining one balance sheet item as a residual. This means that in model simulations e.g. one asset is computed as the sum of all liabilities minus the sum of all the remaining assets in the sector.

The variables computed as a residual are:

certificate holdings in the *Central Bank*'s balance sheet,
net borrowing from the Central Bank in the *banking sector*'s balance sheet,
bank deposits in the *residual sector*'s balance sheet,
bond holdings in the *insurance sector*'s balance sheet,
supply of certificates in the *mortgage institutions*' balance sheet and
supply of bonds in the *central government'*s balance sheet.

Furthermore, the net wealth in the residual sector is computed as the sum of the other sectors' net wealth variables with reversed sign, making sure that the net wealth variables sum to zero.

In a stylized form the connections between the sector balances can be illustrated by the following table where "F" denotes a variable which is determined by a portfolio choice within the sector, "O" a variable that is determined outside the sector (enters via another sector), "R" a residual in the balance sheet of the sector. The table represents the core of KOFI.

	Bonds	Certificates	Bank	Deposits	Central Bank

			lending		lending
Residual sector	F	F	F	R	-
Banks	O	F	O	O	R
Central Bank		R			O

The *residual* sector's holdings of bonds and certificates and its bank borrowing are determined by estimated equations. In the *bank* balance only certificates are determined by equation. *Central bank* borrowing is a residual. The other variables are determined within the residual sector. The Central Bank's holding of certificates is residual but indirectly determined by the net demand from the other sectors. In the Central Bank's balance the counterpart to certificates is the net lending to banks.

The mortgage institutions choose between borrowing by bonds or by certificates. The choice of the insurance sector is mainly between investing in bonds or certificates. The total borrowing of the Central Government as well as its forms of financing is exogenous to KOFI.

3. The credit market 1985-1995

As a background to the simulations this section describes the main developments in the credit market 1985-95. i.e. the period which has been used as a basis for the estimates of portfolio behaving. It should be noted that since then there have been some important changes in the institutional setup such as mergers between credit institututes.

Subsection 3.1 gives an overview; the following subsections give a more detailed analysis of the portfolio behaviour of the sectors of the model: the mortgage institutions, central government, the insurance sector, the residual sector and the foreign sector. Banks are modelled as financial intermediators - these functions are discussed in connections with the simulations.

3.1 An overview

Table 1 A pictures the development of the "total portfolio" of the economy. According to the last column the total credit market volume increased continously from 1985 to 1993. (The yearly rate of increase was about 5 per cent). The year 1994 signifies a break in the trend; for

some components the break occurs already in 1993. The break can be seen as the effects of the finance crises started in 1992. The shrinking of the financial basis of the economy continued in 1995.

Table 1 A. Financial markets 1985-1995

Stocks in per cent of GNP

	Currency and deposits	Certi-ficates	Bonds	Corporate shares	Loans	Total
1985	54	15	96	38	174	377
1990	52	19	92	49	267	479
1992	68	33	109	45	269	524
1993	63	35	138	72	256	564
1994	62	42	135	73	242	554
1995	72	37	129	79	218	535

Source: Financial Accounts 1985-95.

Table 1B shows the percentage distribution of financial stocks corresponding to the figures given in table 1A. According to the relationship used in KOFI - see section 4 - changes of the share of bonds in relation to certificates should, ceteris paribus, go together with corresponding changes of their yields.The semi-annual variability of these shares in the sector portfolios is one of the main features of the simulations which are on a half-year basis.

Table 1 B. Financial markets 1985-1995

Percentage distribution

	Currency and deposits	Certi-ficates	Bonds	Corporate shares	Loans	Total
1985	14	4	26	10	46	100
1990	11	4	19	10	56	100
1992	13	6	21	9	51	100
1993	11	6	25	13	45	100
1994	11	8	24	13	44	100

1995	13	7	24	15	41	100

Source: Financial Accounts 1985-95.

Table 2 A shows the percentage distribution of the *holders (lenders)* in the certificate market. During later years the private and the foreign sector together had about two thirds of total certificate holdings.

Table 2 A. The certificate market: lenders

Percentage distribution of stocks

	Central Bank	Banks	Insurance Sector	Private sector	Foreign sector	Total
1985	31	7	5	41	16	100
1990	9	9	10	61	11	100
1992	12	4	7	37	40	100
1993	14	10	14	23	39	100
1994	10	13	11	38	28	100

Source: KOFI sector balances. The basic statistics differ slightly from the material used for table 1. The private sector concerns households and non-financial enterprises.

Table 2 B shows the percentage distribution of the *borrowers* in the certificate market. The government has been the main borrower.Its share declined in 1993 when the Central Bank issued certificates for enterprises and insurance companies. In 1994 mortgage institutes increased their share as the government's share decreased. In the next section there is a description of the borrowing strategies of these sectors.

Table 2 B. The certificate market: borrowers

Percentage distribution of stocks

	Central Bank	Government	Banks	Mortgage institutions	Total
1985	0	95	4	1	100
1990	0	68	3	29	100
1992	0	84	1	15	100
1993	5	80	2	13	100

1994	10	72	1	17	100

Source: KOFI sector balances.

Table 3 A shows the percentage distribution of government and mortgage bonds by lender. (The government and mortgage bonds constitute about 90 per cent of the total stock of bonds). During the periods of restrictions on lending, banks were forced to absorb a large part of the stock of bonds. This is reflected in their high market share in 1985. The holding was subsequently reduced, but started to rise in 1993 in connexion with a weakening demand for bank loans. The share of the insurance companies varied inversely to that of the banks. The foreign sector has since 1990 almost continously increased its share.

Table 3 A. The bond market: lenders

Percentage distribution of stocks

	Central Bank	Banks	Insurance Sector	Private sector	Foreign sector	Total
1985	4	22	41	15	18	100
1990	2	14	49	19	16	100
1992	5	7	52	16	20	100
1993	2	9	46	13	30	100
1994	2	11	41	17	29	100

Source: KOFI sector balances.

Table 3 B shows the percentage distribution of *borrowers* in the bond market. The development up to 1990 reflects the improvement in central government finance and the boom in residential building. Thereafter the situation is reversed in both respects. In 1995 the distribution was about the same as ten years earlier.

Table 3 B. The bond market: borrowers

Percentage distribution of stocks

	Central government	Mortgage institutions	Total
1985	58	42	100
1990	34	66	100
1992	36	64	100
1993	45	55	100
1994	50	50	100

1995	55	45	100

Source: KOFI sector balances.

Table 4 shows the percentage distribution of lending to the private sector from other sectors. Mortgage institutions have been the largest lender. Their share has increased at the cost of the banks.

Table 4. Lending to the private sector

Percentage distribution of stocks

	Banks	Mortgage institutions	Insurance sector	Central government	Total
1985	31	45	4	20	100
1990	32	53	4	11	100
1992	33	54	4	9	100
1993	27	58	4	11	100
1994	25	61	4	10	100

Source: KOFI sector balances.

3.2 The mortgage institutions

As shown in tables 3B and 4 the mortgage institutions have been the main lender to the private sector and mostly also the main borrower in the bond market. In KOFI the main determinant of the borrowing strategy of this sector is the variation of the spread between the long and short term rates of interest on government bonds and certificates. The use of one single bond rate simplifies considerably the modelling. The presumption is, that there is a reasonably stable relationship between the government bond rate and the mortgage bond rate.

The margin between 5 years mortgage and central government bond rates (per cent)

July 1986-December 1986	0.7-0.9
January 1987-December 1987	0.5-0.6
January 1988-September 1989	0.2-0.3
October 1989-August 1990	0.4-0.6
September 1990-November 1990	0.6-0.9
December 1990-December 1993	>1.0
Januari 1994-June 1994	0.8-1.0
July 1994-December 1994	0.6-0.8
January 1995-March 1997	0.4-0.6

Source: Swedish Central Bank: Quaterly Review and Statistical Yearbook.

In reality, the margin between the government and mortgage bond rates varied considerably in the years following the deregulation of interest rates. In the years 1988-89 the margin was as small as 0.2 %-0.3 %. Then followed a gradual increase, with a maximum of two per cent in connection with the turbulence in September 1992. Then there was a gradual decline and a stabilization. In the years 1995 and 1996 the margin stayed between 0.4 % and 0.6 %.

Long-run trends in the spread can probably to a large extent be explained by changes in *credit* risks (these are practically nil for the government). Credit risks were high in the years 1990-1994 but have since diminished. This is reflected in the narrowing and stabilization of the margin in recent years. Another long run effect on the margin has been relative trends in the borrowing requirements of the two sectors. Budget deficits increased in the 90's whereas housing construction stagnated. There has been a corresponding increase in the share of government bonds in the bond market (Table 3B). This change result in a tendency to diminish the spread. Generally speaking mortgage bonds have become accepted substitutes for government bonds as shown by their pricing. (Standard and Poor's rating for Stadshypotek's long term debt was A+ in 1996[5].) Furthermore, the interest rate on mortgage certificates has in later years been only some 20 basis points above that of the treasury bill rate.

[5] Stadshypotek, Annual Report 1996. P.18

There is, however, a specific *financial* risk involved in the funding of mortgage debt. This risk in principle prevents the full exploitation of market conditions and represents another disadvantage compared with government bonds[6]. Morgage institutions are namely strictly bound to match the term structure of their borrowing with that of their lending. Thus in 1995 as well as in 1996 (year-ends) the average interest rate adjustment period remaining for all lending as well as for borrowing was 1.8 years[7]. This restriction hampers the management of bond issues and thereby can cause unwanted effects on borrowing costs.

Bonds intended for large investors in the Swedish market are sold within the framework of a benchmark loan system. This means fewer new bond issues and a larger volume for each individual loan. The aim of the system is to improve the performance of the market and the liquidity of the bonds i.e. by making better price quotations possible. It becomes, on the other side, more difficult to match lending and borrowing e.g. when a large number of borrowers at the same time want to switch from floating to fixed rates or vice versa.Various methods are used in order to obtain flexibility of the funding operations. Thus funds are raised from the savings market and from foreign markets in order to match the lending with maturities furthest from those of the benchmark loans. The currency exposure of the foreign borrowing is completely neutralized through swap agreements.[8]

Actually, the border line between long- and short-term borrowing is vague. The benchmark loans, having an initial maturity of about 5 years, are open for sale on a continuous basis. Short-term borrowing can normally be obtained through the sale of bonds from earlier five-year loans with suitable remaining maturities. Trading in the futures market improves the liquidity of the bonds from the benchmark loans and facilitates the large issues required for loan rollovers. It is thus possible to lower the cost of redemption of large volume of loans which mature at the same time.

Through the various strategies mentioned above mortgage bonds can be kept almost as liquid

[6] The following description is taken from the annual reports of the dominating mortgage institute i.e. Stadshypotek.
[7] Stadshypotek, annual reports 1995 (p. 25) and 1996 (Table 40).
[8] Stadshypotek, Annual Report 1996, pp 16-17.

as government bonds, although government borrowing does not have to take into account any matching rule. There is, furthermore, nowadays hardly any credit risk involved in holding bonds of the large mortgage institutions which are backed by commercial banks. There are therefore good reasons to assume that the interest margin between mortgage and government bonds should remain small and stable.

Certificates (commercial paper) are used for the financing of short-term lending and to redeem bonds from the benchmark loans. As a rule, this occurs about one year before the maturity date. Part of the outstanding certificate stock thus can be said to belong to the long-term part of the debt since it has replaced bonds with short remaining maturities. The short-term part of the borrowing of the mortgage institutes thus can be made to correspond to the preferences of the customers.

According to the guidelines of Stadshypotek about 10 % of funding should be raised on the savings market (retail market bonds), 20 % from issues abroad and the remaining 70 % from the market for traditionally large investors. At year-end 1996 the institutional market accounted for 86 % of the entire volume while the savings market accounted for 8 % and forreign borrowing for 6 %[9]. In KOFI, the share of foreign borrowing has, at the margin, been pre-set at the 1995 level for the mortgage sector as a whole i.e. at 7 %.

3.3 Central government

In contrast to the mortgage institutions, the government needs not match borrowing against any lending. In principle the long term borrowing rerequirement is financed by long-term debt, i.e. by bond issues, while fluctuations in the requirement is managed by treasury bills[10]. The Swedish National Debt Office has, however, also a responsibility for the liquidity and the predictability of the market for government bonds.This helps to satisfy the overall objective to minimise the cost of borrowing. Cost minimization is also served by adjustments to the demand in the market.

The tender procedure employed by the Debt Office for its funding also serves to make the

[9] Stadshypotek, Annual Report 1996, p 14.
[10] The Swedish National Debt Office (Riksgäldskontoret), Annual Report 1995/96, p. 12.

market transparent. Another means to increase transparency is - as Stadshypotek does - to concentrate the long-term borrowing to large and standardized benchmark loans. This strategy also reduces the refinancing risk. It can, however, disturb market pricing at the time of redemption. Therefore, a new strategy has been applied, according to which new issues of benchmark loans have been divided between four segements: 2-3 years, 5 years, 10 years and over 10 years. Thus, there will be a more evenly distributed maturing profile and consequently a reduced refinancing risk[11]. This strategy implies a lengthening of the average term to maturity which, for domestic debt, has increased from 3 years at end 1992, to 4,4 years in 1994/95 and 5.6 in 1995/96[12]

The lengthening of the term of the SEK debt is mainly a consequence of the fact that bond loans now account for a larger proportion of total borrowing. This borrowing has also become more long-term particularly because of an increase of index-linked treasury bonds. In 1995/96 the stock of these loans increased by SEK 62 bn while nominal bond loans increased by 45 bn. In spring 1997 index loans amounted to 6 % of total borrowing.

The Debt Office has examined to what extent its bond issues have affected interest rates. One effect concerns the mark-up i.e. the difference between the average yield at the time of the auction and the market yield. A widening mark-up may be an effect of uncertainty of the market. The uncertainty is also reflected in a wide spread between bids and in a poor tender ratio - i.e. the volume bid for is small in relation to the volume offered. Thus, in the beginning of the fiscal year 1994/95, the tender ratio was low and the yield spread wide in the case both of Treasury Bills and Treasury Bonds. The average auction yield also exceeded the market yield (For Treasury Bills the mark-up was on average 6-8 basis points.) Later in the year the tender rate increased and the mark-up on Treasury Bills became insignificant.[13]

Another rate of interest effect of the funding concerns the premium required to persuade an investor to buy government securities prior to the issue when the yield tends to rise in the secondary market. If the outcome of the auction turns out as expected, the yield in the

[11] Annual Report 1995/96, p. 15.
[12] Annual Report 1995/96 p. 8.
[13] Annual Report 1994/95 pp 17-20.

secondary market will fall back again. It is, however, difficult to establish statistically whether any systematic yield movements occur around the time of an auction. An exception was the development in the autumn of 1994 when the interest rate increased by about 10 basis points before each issue and thereafter fell back as much to the previous level.[14]

The Debt Office borrows *from households* through lottery bonds, index-linked Treasury Bonds, National Debt Account (”Riksgäldskonto”) and National Savings Account (”Allemansspar”). There is a large number of lenders (2-3 million) and numerous dealers. The aim is that the costs for these loans should be below the cost of equivalent loans on the money and bond markets.

The borrowing from households has experienced strong competition from private bonds issued by Stadshypotek and banks. The banks have considerably increased their sales by diverting low-yielding bank deposits to their own bonds. The willingness of households to invest in private bonds indicates increased sensitivity to yield differences. Thus the money stock as measured by M0 and M3 may in the future become increasingly interest elastic.

The objective of *foreign currency borrowing* is - as of other borrowing - to obtain the lowest possible long-term cost and also to spread the maturities of the loans to reduce the refinancing risk. In order to achieve this objective, the borrowing must be diversified by markets both geographically and in terms of instrument. The Debt Office uses all market segments, i.e. short-term borrowing (mostly in central banks), bank credits and major international capital markets. Flexibility is made possible by extensive use of derivatives to manage the currency and interest rate risks.

The government stipulates a borrowing limit for the Debt Office’s currency borrowing. For calendar year 1995 the limit was set at a minimum borrowing of 30 billion SEK. For the calendar year 1996, net foreign currency debt was foreseen to increase by 20 billion SEK. Actually, however, the increase amounted to 30 billion since the Debt Office choose to take

[14] Annual Yearly Report 1994/95, tables 2.5 and 2.6.

advantage of the considerable declines of the interest rates in some European countries[15]. The short term debt has during later years on average amounted to about 15 per cent of total foreign borrowing[16].

3.4 The insurance sector

The development of the portfolio of the insurance sector as a whole roughly follows that of the total economy as described in subsection 3.1 above. Bonds and certificates increased their shares of the sector's total financial assets from about 55 % to about 65 % during the period 1986-95. The holdings of money market instruments were small during the 80's but thereafter increased in line with the bond holdings. During the first half of the 90's the share was 6-7 %.

The distribution between the holdings of mortgage bonds and central government bonds reflect the variation of the supply. The share of mortgage bonds increased gradually to 74 % in 1991 but then started to fall. In 1995 the share was considerably lower (45 %) than at the beginning of the period. There are, however, considerable differences between the portfolios of the two subsectors of the insurance sector - the National Swedish Pension Fund and the insurance companies. These differences can to a large extent be explained by differences in regulations.

Table 5 compares the percentage distribution of assets in 1996 (Total assets of the insurance companies are about twice as large as those of the Pension Fund).

Table 5 Assets of the National Swedish Pension Fund and of the insurance companies, end 1996

Percentage distribution (Market values)

	Pension Fund	**Insurance companies**
Bonds	76.4	44.0
Money market instruments	12.3	4.4
Lending	6.8	3.9
Real estate and shares	4.5	47.7
	100.0	100.0

[15] Annual Report 1995/96 pp 23-24, 32.
[16] Annual Report 1995/96 p.26.

of which in foreign currency	1.0	4.8

Source: Central Bank Quarterly Review 1997:1, tables 11 and 12.

The share of bonds and money market instruments in the portfolio of the insurance companies has been around 50 % since mid 80's. Investments denominated in foreign currency increased continuously from 6% to 15 % of total assets in 1995 - a share which is rather typical internationally. In 1996, howewer, its share declined to about 5 %.This decline was mainly offset by an increase in stockholding.

The National Swedish Pension Fund has a comparatively high (and stable) share of its assets placed in bonds and money market instruments (around 90 %). It has, on the other hand, only about 1 % of its assets denominated in foreign currency. The allowed share is 10 % of the market value of total assets. Another main difference between the portfolio structures of the two subsectors concerns the investments in shares and property. The scope for the Pension Fund to invest in shares is limited to the shares of real estate companies. These investments must, furthermore, fall within the real estate quota which is 5 %. At end 1996 the Fund's property portfolio had a market value of about SEK 21 billion i.e. about 4 % of total assets. In 1996 the Fund increased its holdings of index-
linked interest-bearing Government bonds to about 7 % of assets (1½ % in 1995)[17].
In spite of the differences in their asset structures, there are good reasons for treating the Pension Fund and the insurance companies as one single sector. They exhibit similar trends in the holdings of various assets and the short term variations have been comparatively synchronized. The two sectors have similar long-term investment horizons and in the short-term they pursue the same risk- and yield-evaluation strategies. This is particularly true for their activities in the security markets on which the modelling in KOFI is concentrated.

3.5 The residual sector

The residual sector contains local government, non-financial enterprises, households, finance companies, investment companies and funds. The financial behaviour of local government has in recent years become increasingly similar of that of the non-financial enterprises. Finance

[17] The National Swedish Pension Fund. Annual Report 1996, p. 8.

companies, investment companies and funds play - because of their smallness - a relatively insignificant role in the credit market. The most important demarcation problem is therefore whether households should be seperated out from the residual sector.

Foreign models usually choose to aggregate households and non-financial enterprises. In the Danish model Findan there is no choice since the Danish National Accounts do not distinguish between enterprises and households. In the Swedish National Accounts the two sectors are separated but the demarcation is blurred.This is indicated by the large unclassified accounts which appear in the two sector balances and are difficult to interpret. To a large extent these items are made up of transactions between households and non-financial enterprises - items which are not identifiable. In the account of the non-financial enterprises the non-specified item ”other liabilities” is considerably larger than ”other assets”. In the household’s account there are no ”other liabilities” but the item ”other assets” is about as large as the difference between ”other liabilities” and ”other assets” in the enterprise sector account. Aggregation reduces and stabilizes the remaining ”net other accounts” of the residual sector.

An operational argument for aggregating households and non-financial enterprises is that a single expression for the stock of liquid assets is obtained in that way. It has been judged important to include ”money stock” as a separate variable - it plays a role as a transmission channel from KOFI to KOSMOS and introduces a ”monetaristic” element in the model. Consequently the private banking sector has been separated from other credit institutes. The liquid assets of the residual sector thus have a counterpart among the liabilities of the banking sector.

The accounts used by KOFI are compressed compared with the Financial Accounts, in an effort to limit the number of items modelled. The slimming in particular concerns the residual sector. The total of retained assets and liabilities of the sector amounts to about 50 % of those in the Financial Accounts. This percentage was relatively stable during the whole period 1980-95 for which the KOFI balance sheets have been compiled. The explanation of this stability is that some of the excluded items are large and appear on both sides of the account. The behaviour of the ”unclassified accounts” was mentioned above. Futhermore, assets and liabilities of inter-group companies are almost identical. They amount each to about ten per cent

of the total financial assets (liabilities) of the residual sector. The same stability is shown by the item ”trade credits” which also enters on both sides of the account with almost identical values. The exclusion of the above mentioned items thus does not hamper the analysis of the residual sector but facilitates the handling of its balance sheet.

As an illustrationTable 6 shows the balance sheet of the residual sector in KOFI for the years 1988-95. Below total assets and liabilities there are rows giving their respective share of the corresponding totals of Financial Accounts. The coverage amounts to around fifty per cent. The stability of the shares indicates that the KOFI accounts can be utilized independently of the figures excluded from the Financial Accounts.This is even more true of the other sectors.

TABLE 6. THE BALANCE SHEET OF THE RESIDUAL SECTOR

	1998	1989	1990	1991	1992	1993	1994	1995
NOTES AND COINS	54788	60281	61545	64317	64052	67050	68803	68542
BANK DEPOSITS	450727	497242	551189	580160	611197	631910	665534	687409
GOVERNMENT CERTIFICATES	63178	71026	132442	179588	131824	69S27	126940	88572
BANK CERTIFICATES	5185	7176	7294	5033	7348	6166	4704	9044
CENTRAL BANK CERTIFICATES	0	0	0	0	0	12738	31750	11134
BONDS	210479	197875	193693	193800	196877	226888	307855	310367
INSURANCE SAVINGS	104903	127823	150033	169093	197602	206930	223732	245648
NATIONAL SAVINGS SCHEME	57098	66734	58634	65707	71526	67825	53932	49865
LENDING (incl. corrections)	338686	358827	389858	308197	316613	321163	249190	267793
TOTAL ASSETS	**1285044**	**1396984**	**1544678**	**1564895**	**1637039**	**1610197**	**1732440**	**1737374**
(coverage)1)	0,462	0,433	0,471	0,480	0.489	0,428	0,435	0,426
LOANS FROM GOVERNMENT	165938	172179	179978	177663	171832	189054	1656SS	146957
LOANS FROM MORTGAGE INSTITUTIONS 621898	748216	889327	998580	1020814	1071757	1059263	1075393	
LOANS FROM BANKS	418229	481190	525848	563145	633463	497476	436627	563445
LOANS FROM INSURANCE	60802	64238	67637	62592	71232	70999	69735	70495
NET DOMESTIC EQUITY DEBT	145087	185365	122179	130733	117524	180817	196968	238357
NET FOREIGN EQUITY DEBT	-35390	-77935	-99321	-116501	-126494	-69502	3236	40317
NET FOREIGN CURRENCY LIABILITIES	211968	305673	387184	287991	274636	230743	245602	108929
TOTAL LIABILITIES	**1588431**	**1878926**	**2072732**	**2104203**	**2163007**	**2171344**	**2167086**	**2243892**
(coverage)1)	0,554	0.557	0.542	0,548	0,546	0,529	0,534	0,555

1) In comparison with the total assets of the Financial Accounts

3.6 The foreign sector

The foreign sector in KOFI is rather rudimentary. Its demand equations for certificates and bonds should be regarded as convenient assumptions rather than regression estimates since the availale data period (1991-95) was too short and too turbulent.

One particular difficulty with the formulation of the demand equations for the foreign sector has been to find adequate variables for the total of foreign portfolio assets. In the actual estimations, these assets were represented by alternatively, the domestic supply of SEK cerificates and domestic wealth. Such a construction may cause unreasonable effects in simulation e.g. when the domestic financial market expands. This is the case in simulation 4 (cf. Section 5) below which illustrates the effects of a permanent budget expansion. This expansion is reflected in an increase in the foreign demand for Swedish securities – an effect that dominates the opposite effect of a simultaneously narrowing gap between the Swedish and foreign rates of interest. An alternative would be to relate foreign demand to a trend for international borrowing in securities markets, assuming that a fixed share of this borrowing is directed towards the Swedish market. The international securities market expanded at a yearly rate of 6-9 per cent in 1991-95 (depending on the choice of markets)[18]. Included in the demand function such a trend would not blurr the effects of variation in the interest rate gap. On the other hand, such a solution would imply that foreign demand is not affected by the size of the Swedish market.

Foreign demand for SEK bonds at times seems to have been strongly affected by expectations about changes of Swedish interest rates. These were thus expected to decline after the unsuccessful defense of SEK in november 1992. Foreign actors started to invest in Swedish government bonds. These speculative purchases were to a large extent financed by repurchase agrements. Between November 1992 and February 1994 foreign investors increased their holdings by SEK 90 à 100 Bn – a doubling of earlier acquisitions. Over the period the five-year bond rate actually declined by about 4 percent. Thereafter the interest rates started to climb and the foreign holdings to decline. At the beginning of 1995 foreign actors were in a negative (short) position of SEK by 40 à 50 Bn[19]. Because of the short observation period it has not,

[18] Bank for International Settlement, 66th Annual Report; Basle 10th June 1996, p. 149.
[19] Ragnartz, C. and Östberg, J.: *The Swedish Repurchase Market*. Quarterly Review of the Central Bank of Sweden 1997:3/4.

however, been possible to derive from these data a viable relationship.

Foreign investments in the Swedish bond market can, in its turn, affect prices in the Swedish bond market. According to estimates concerning the period January 1993-June 1996 foreign net purchases (sales) of Swedish long term bonds of SEK 10 Bn were associated with a change of the rate of interest of between 4 and 8 basic points.[20]

4. Main aspects of the formal model

Despite the relatively large number of assets the model is rather simple, any refinements having been left to subsequent model versions. The approach is eclectic. At the core lies the portfolio balance model, but the portfolio in question is defined narrowly to include only net foreign assets, certificates, bonds and (bank deposit) money. The remaining assets are assumed to be acquired for other reasons than pure portfolio investment and their purchase is assumed to be effected before any portfolio decision is taken.

The portfolio choice is assumed to take place in two steps. The first decision refers to the choice between foreign and domestic assets. In the second step, domestic assets are distributed between bonds, certificates and bank deposits. The latter asset is held only by the residual sector. In the case of the issuing sectors, the portfolio consists only of liabilities.

A common long-run demand relation for a domestic portfolio asset has the form:

$$\frac{C^i}{W^i} = a_{ci}(r^l - r^s) + b_{ci}$$

where

C^i – i-th sector's holdings of assets C,
W^i - the i-th sector's total domestic portfolio assets,
r^l - domestic bond interest rate,
r^s - domestic certificate interest rate,
a_{ci}, b_{ci} - constant coefficients

Loans, notes and coin, insurance savings and equity are not involved in the portfolio choice.

[20] Säfvenblad, Patrik: *Efterfrågeeffekter på den Svenska penningmarknaden*. I "Från optionsprissättning till konkurslagstiftning". Red. Bergström C. och Björk T. EFI 1997.

Bank loans are assumed to finance mainly the real economic activity; notes and coin to be demanded for transactions purposes. Insurance savings are here seen solely as a means to get pension and life insurance. Equity is considered to be a financial investment but its importance in sector analysis is limited, since most of the shareholding takes place *within* the corporate-and-household sector rather than *between* sectors.

In the model, the Central Bank conducts monetary policy by controlling *the short term interest rate.* This is achieved through operations in the certificate market. Technically, the short term rate is exogenous to the model and represents the monetary policy instrument (the long rate being endogenous). The Central Bank's holdings of certificates are computed as a residual from the Bank's financial balance sheet. The banking sector's borrowing from the Central Bank, another variable of importance for monetary policy, is computed as a residual from the banking sector's balance sheet. This set-up gives results that can readily be interpreted in terms of certificate supply control.

The long-term interest rate is derived from an aggregate equilibrium condition for the bond market. The short-term rate is one of the determining factors in the equation for the long-term rate r^l. The latter depends, furthermore, on the difference between the foreign and domestic short rates, (r^{fl} - r^s), adjusted for the expected rate of currency depreciation, e. The supply condition is represented by the quotient between the supply of bonds, ?, and the domestic financial wealth W^d. The long-term rate increases when an increased bond supply is to be absorbed in a given portfolio. The supply of bonds ? concerns SEK bonds (exclusive of Central Bank holdings) issued by Central Government and mortgage institutions. The domestic portfolio , W^d, contains bonds, certificates and bank deposits.

The difference between the long and short rate is strategic for the portfolio decisions of most sectors. The stylized version of the equation for (r^l - r^s) used in the simulation is[21]:

$$?(r^l - r^s) = f_1 ? (B/W^d) + f_2 ? (r^{fl} + e - r^s) + f_3 (r^l - r^s)_{-1} + f_4 (B/W^d)_{-1} + K$$

[21] The estimated relationship is described in Markowski (1996) pp. 40-51.

Bond demand of four out of the five investing sectors is modelled, the holdings of the banking sector being determined as a residual from the market equilibrium identity. This procedure corresponds to the assumption that banks primarily act as market makers in the bond market.

Changes in the interest rates give rise to variation of the portfolio composition. Table 7 summarises the reactions of asset shares in the portfolio of the residual sector to isolated changes in interest rates.

Table 7. Reactions of asset shares in the residual sector's portfolio to changes in the long and short interest rates

	Short run effect		Long run effect	
	1% increase in r^l	1% decrease in r^s	1% increase in r^l	1% decrease in r^s
B	0.4%	0.8%	2.1%	2.1%
C	-0.2%	-1.8%	-2.1%	-2.1%
M	-0.2%	1.0%	0	0

r^l - long-term interest rate,

r^s - short-term interest rate.

B - Bonds, C - Certificates, M - Money

According to the results in the table, money is in the short run but hardly in the long run affected by portfolio redistribution due to yield changes. This is fully compatible with the role of money as a short-term buffer stock and the assumption that in the long run money is held for other reasons than its yield, such as for liquidity, transactions, precaution.

The short-term sensitivity of certificate holdings in respect of r^s is only slightly lower than the long run one. In the case of bond holdings this difference is much larger. It thus appears that bond holdings are rather stable and only slowly adjust to interest rate variations while certificate holdings react more strongly.

Sector demand for foreign assets/liabilities is determined in a simplified way for mortgage institutions, the insurance and banking sectors. The supply is determined by the balance of payments identity. The net foreign assets of the residual sector are computed as a residual.

According to the estimated relationship *the rate of change of the exchange rate* depends on:
a) exchange rate expectations
b) the difference between the domestic and foreign short interest rates,
c) the private capital balance (scaled by the money stock).

Exchange rate expectations depend on the deviation of the current exchange rate from the sustainable exchange rate. The latter is determined by the purchasing power parity (i.e. constant real exchange rate principle) corrected for the difference between the domestic and foreign interest rates[22] .

5. Simulations

The structure and functioning of KOFI will be illustrated by some simple simulations. These are enacted exclusively within the framework of financial markets i.e. the markets for bonds and certificates, for loans, shares and foreign investments. The exclusiveness causes some processes to take a seemingly unexpected course because of the implicit ceteris paribus assumption about the non-financial variables (GNP, private consumption, foreign trade etc.) The results should be more recognizable e.g. when changes of the rate of interest or the exchange rate are allowed to affect commodity demand, balance of trade and prices with reaction back to the financial sector. The KOFI thus concern only partial adjustments e.g. to economic policy measures or impacts from abroad. (In some cases the responses can be seen as short-term effects as compared with those in the non-financial part of the model i.e. in KOSMOS.)

Four KOFI simulations are described below:

[22] The derivation of the exchange rate is described in Markowski (1996) pp 33-39. Because of the short estimation period - 24 monthly observations - the equation can be considered as no more than a qualified guess.

1. A permanent change in the pattern of government borrowing.
2. A permanent increase of the domestic short-term interest rate.
3. A permanent increase of the foreign short term interest rate.
4. A permanent increase of the Central Government's budget deficit.

The simulations are compared with a basic scenario, "Base", referring to a fictitious development during the eight half-years 1991-1994. The simulated deviations from Base are shown as changes on the balance sheets of the various sectors. It should thus be born in mind that "incrase" and "decrease" mean in comparison with the base run, rather than "over time".

The first simulation (Sim 1) is rather simple. It concerns an autonomous shift in the distribution between long- and short-term government borrowing. The sectors gradually adjust to changes in the margin between the endogenously determined long-term rate and a pegged short-term rate. The Central Bank is required to intervene in order to secure the target for the short-term rate. Sim 1 is illustrated by balances of demand and supply in the bond and certificate markets. It turns out that through the market mechanisms the original borrowing pattern is considerably modified.

The processes of Sim 1 form part of simulation 2 (Sim 2). In the latter there is an authonomous change in the domestic short-term rate of interest. Sim 2 thereby becomes more complex than Sim 1 since there are endogenous changes not only of the long-term rate but of the exchange rate also. The portfolio decisions will be influenced by expectations of both these rates. Sim 2 is illustrated by diagrams which trace the half-yearly changes in market rates and sector portfolios.

The third simulations (Sim 3) is mainly the reverse of Sim 2 since the interest margins ($r^l - r^s$ and $r^s - r^{fs}$) and thereby also the portfolio decisions shift symmetrically in opposite directions. The main difference is that the interest revenues and expenditures - which are modelled within KOFI - turn out to be asymmetric.

The fourth simulation (Sim 4) is generated by a permanent decrease in the Government's

financial saving. Since the ensuing processes - as in all four simulations - are contained within KOFI, the negative financial saving of the Government will have a counterpart in a positive financial saving of the private sector. Sim 4 shows how this transformation is reflected in the portfolios of the various sectors. A so called credit market matrix is used to illustrate the process.

5.1 A change of the borrowing pattern of Central Government

In the reference scenario (Base) certificates amount to *30 %* of the accruels to Government domestic net borrowing. In this simulation the share of certificates is permanently lowered to *25 %*. Compared to Base, an increase in borrowing through bonds corresponds to a redemption of certificates. The simulation highlights the rôles of the Central Bank and the private banks as market makers in certificates and bonds respectively. It also illustrates the ability of KOFI to trace supply and demand reactions caused by an autonomous disturbance within the financial market.

An obvious effect of the shift in the borrowing strategy is that the long term rate rises because of the continuous increases in the supply of bonds. Along with the increases of the long rate there will be a small offsetting supply effect as mortgage institutions shift their borrowing from bonds to certificates.

The stock of bonds is built up gradually. These changes determine, according to the bond rate equation, each period's long-term rate. The rate also increases gradually and at the end of the simulation (1994:2) is about one half per cent above Base. The exchange rate is not affected in this simulation since r^s is assumed to be kept stable.

The decrease of the net supply of certificates maintains a downward pressure on the short-term rate as investors only slowly adjust their portfolios to the rather small increases of r^l. The Central Bank pegs, however, the initial level of the short rate through
open market operations. In the first half-year its sales of certificates actually amount to not much less than the reduction of the supply caused by the shift in the borrowing
pattern of the Central Government.

Table 8 gives a summary view of the bond and certificate markets in 1991:1 and 1994:2 The total increase in Central Government's borrowing through bonds (+) and the corresponding decrease in borrowing through certificates (-) is set at 100.The other figures in the table have been recalculated proportionally. The underlying figures (in SEK bn) have been extracted from the simulated sector balances.

In the first period the reaction of the mortgage institutions is negligible since the long rate has risen only one basis point compared to Base. Because of the only small increase in the long rate in 1991:1 there is not much shift from certificates to bonds in the holdings of other sectors than banks. The banks thus have to clear the excess supply in the bond market by buying the larger part of the additional issue of Government bonds. The Central Bank clears the certificate market by replacing larger part of the reduction of the government issue.

Table 8. The markets for certificates and bonds in the first and last period of Sim 1

	1991:1		1994:2	
	Bonds	Certificates	Bonds	Certificates
Central Government	100	-100	100	-100
Mortgage institutions	-2	2	-28	28
	98	-98	72	-72
Banks	82	0	24	-13
Central Bank	0	-82	0	-24
Other sectors[1]	16	-16	48	-35
	98	-98	72	-72

[1] Incl. The insurane sector.

In the end period r^l has increased about one half per cent. The mortgage institutions by then have shifted a considerable part of their (accumulated) borrowing from bonds to certificates. The transactions of the mortgage institutions have thus to some extent offset the changes in the borrowing pattern of the Government. This has a dampening effect on the

increases of the long rate caused by the shift in government borrowing.[23]

At the end of the simulation (1994:2) the market outside the banking system has absorbed almost half (48 %) of the additional issue of government bonds. The market clearing through bond purchases by the banks and certificate sales by the Central Bank has been very much reduced compared with the initial period.The table illustrates the way in which KOFI is modelling the interaction between supply and demand in the finance market.

5.2 An increase in the domestic short-term rate of interest

The simulation concerns an increase of one per cent of the domestic treasury bills rate r^s, initiated by the Central Bank. (Chart 1.) When r^s is increased in relation to the long-term rate r^l, investors will sell bonds and buy bills. Borrowers exchange certificate debt for bond debt. Demand for bonds decreases and supply increases. Thus r^l will also increase. According to the equation used r^l should, ceteris paribus, increase as much as r^s in order to reestablish any initial difference $r^l - r^s$. This process is, however, also influenced by the change of the difference between the interest rates at home and abroad.

When r^s is increased in 1991:1 the margin between the domestic and the foreign (German) rate r^{fs} increases correspondingly. As a consequence the exchange rate appreciates (Chart 2)[24]. There are also expectations of further appreciation caused by the shift (appreciation) of the long-run equilibrium of the exchange rate. The actual exchange rate is adjusting towards that position but has in 1991:1 additional way to go. The expectations of exchange rate appreciation dampen the increase of r^l which therefore does not increase in line with r^s.(Chart1.) Inflation and price expectations are outside the model and thus do not affect neither interest rates nor the exchange rate.

In the second period the exchange rate overshoots its long run equilibrium which causes expectations of depreciation in 1992:1. There are still expectations of an appreciation in 1991:2

[23] Säfvenblad (1997) estimates the effect on the difference r^d-r^s caused by a shift of 100 SEK bn from long-term to short-term government borrowing. The effect would, if recalculated by Sim 1, be reached after about five periods. (Säfvenblad's result is based on a non-periodized single equation.)

[24] The foreign exchange rate is shown as absolute deviation from Base in percentage units (negative sign for appreciation).

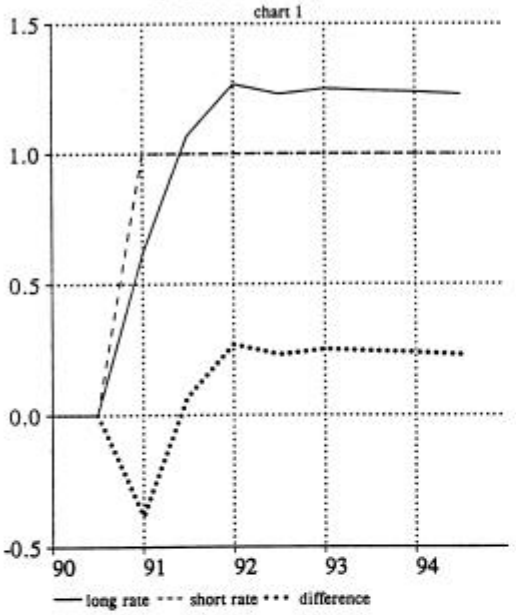
- expectations being determined by the development in 1991:1 when the actual exchange rate still was weaker than the sustainable rate. The expected appreciation is smaller than it was in the previous period (Chart 2); but r^1 will still be below its long run position (Chart 1). The expectation of depreciation in 1992:1 is reflected in the peaking

An Increase in the Domestic Short-Term Rate of Interest (Sim 2)

Deviations from base

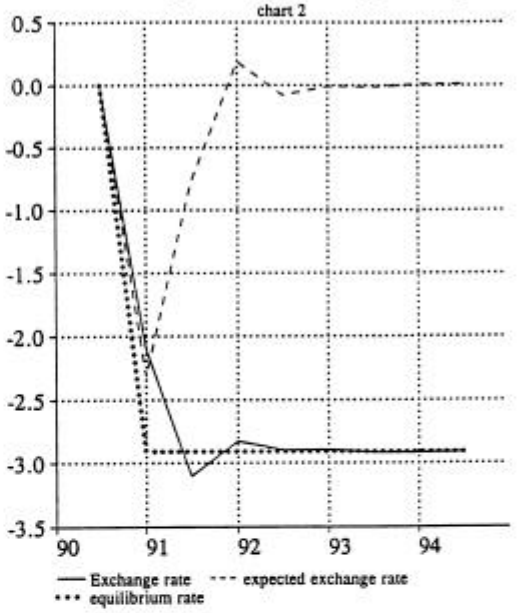
Interest rate, percent

chart 1



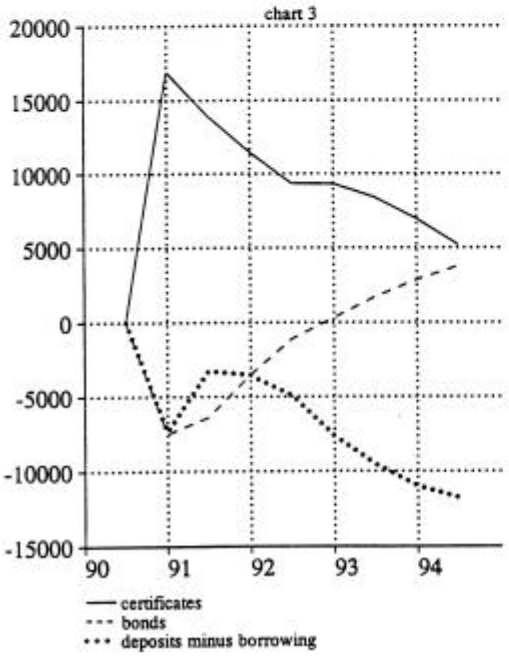
Exchange rate, percentage change

chart 2



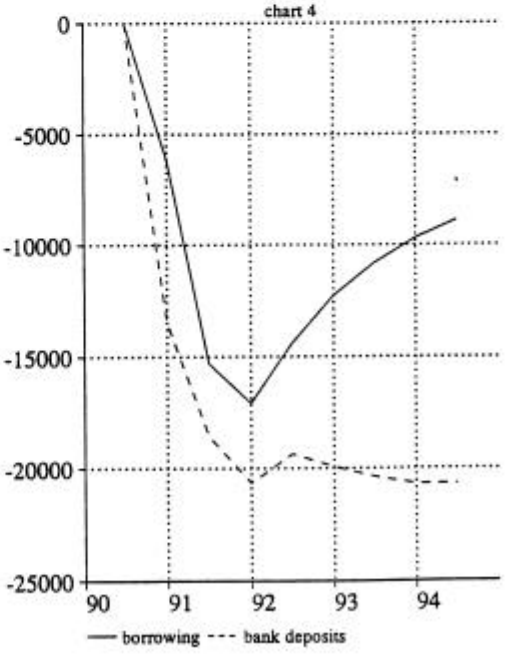
Residual sector, SEK millions

chart 3



Residual sector, SEK millions

chart 4



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of r^l in the same period. From 1992:2 on, both the exchange rate and the long-term interest rate are close to their new equilibrium levels.

The long-term equilibrium of the exchange rate is determined by the differece between the domestic and the foreign rate of interest and also by changes in the purchasing power parity. (The latter variable is outside the scope of the simulation.) One factor in the determination of the long-term equilibrium of r^l is - in line with the portfolio balance approach - the share of bonds in the portfolio of total domestic investments. This share increases because the total portfolio diminishes considerably (see below). For the bonds to be absorbed into the portfolio, the long-term interest rate will have to increase in relation to other yields. There is thus a permanent increase in the margin between the long and the short term interest rates (Chart 1). This gap will in the long run be a determining factor for the portfolio choice of the various sectors.

The *residual sector* is the sector most articulated one with regard to the endogeneity of the portfolio composition. The shares of the *holdings of certificates and of bonds* are affected in opposite directions by changes in the interest margin $r^l - r^s$. The short-run effect is larger for certificates than for bonds (Chart 3)[25]. In the long-run the effects are symmetric. The variables adjust, however, only slowly to their long-run equilibrium positions which, besides the interest margin, also depend upon changes in the size of the total portfolio of the sector.

The SEK *bank borrowing* of the residual sector is affected by changes in the relative costs of alternative borrowing. Since the domestic bank lending rate is assumed to increase as much as the short-term rate, borrowing abroad will become relatively cheaper (The foreign bank lending rate is assumed constant.) The incentives for the residual sector to shift borrowing abroad is reinforced by expectations about appreciation during the first two periods of the simulation. This factor is assumed to take effect with a one period lag. The decline of domestic borrowing therefore culminates in 1992:1 (Chart 4). The change of the interest margin determines the new long-term equilibrium. This equilibrium is not defined as a portfolio share but in relation to the

[25] Charts 3-8 show, by half-years, differences between stock values of the simulation and the underlying base scenario.

- here unchanged - total domestic demand. Domestic borrowing does not reach its equilibrium level during the simulation - the adjustment coefficient in the equation is rather small. The increase in foreign borrowing does not appear explicitly in the balance sheet of the residual sector. Only the net foreign debt is shown there. This item is not affected when borrowing abroad is balanced by the foreign exchange that has been obtained thereby. (According to the model the foreign exchange stays inside the residual sector.) Table 8 shows the residual sector balance at the end of the simulation period.

Table 9 Residual sector balance 1994:2

Deviation from Base: SEK bn

Bank deposits[1]	-23	Bank borrowing	-9
Certificates	5	Shares; net debt	2
Bonds	4	Net financial assets	-7
	-14		-14

[1] Incl. coin and notes.

Bank deposits constitute a residual in the balance - they play the role of a buffer. Part of the large decrease of deposits has a counterpart in the decrease of domestic bank lending. The remaining decrease of deposits has its counterpart in net purchases of certificates and bonds (Chart 3) as determined by the demand functions for these variables. During the last periods of the simulation there is a decrease of the net financial assets of the residual sector - these changes have their counterpart in the insurance sector which receives increased revenues from the higher interest rates. The whole sector balance is downsized - i.e. the portfolio reduced - compared to Base which explains the stabilization of the long-term rate at a higher level.

From Sim 2 as well as from Sim 1 can be derived the traditional Keynesian liquidity function. In Sim1 a successive decline of bank depsits (M) goes togheter with successive increases of r^l. In Sim 2 a permanently lower level of deposits goes together with a permanently higher level of r^l. In a way the simulations give a portfolio interpretation of the dynamics implicit in the liquidity function.

The changes in the portfolio of the *mortgage institutions* are limited to symmetric shifts between borrowing through bonds and certificates. Lending and total borrowing are not

affected since investment in housing is outside the simulation. Borrowing abroad also remains unchanged since it is a fixed share of the total assets (liabilities) of the sector.

The distribution between the sector's borrowing through bonds and certificates reacts with one period's lag upon changes in the interest margin ($r^l - r^s$). Compared to Base, bond borrowing thus culminates in 1991:2. In the long run, bonds are gradually exchanged for certificates as the latter become relatively cheaper.

Central Government is only indirectly affected by the simulation. Borrowing through certificates is assumed to be inelastic with regard to interest rate changes. The interpretation of this assumption is that the Debt Office strives to maintain a minimum size of the market for its certificates. Deposits with the National Savings Account - which is handled by the banks - decrease in line with the ordinary deposits of the residual sector. The decrease is reflected in an increase of the stock of certificates issued by Central Government. Its bond debt is not affected in this simulation.

The *insurance sector* inreases its holding of certificates in 1991:1 as the short-term rate has increased more than the long rate. This development is reversed in the following period. Thereafter the holding of certificates increases slowly. Its long-term share of the portfolio is assumed to be constant, but the increase of financial assets makes place for absolute increases of both certificates and bonds (Chart 5). This is also true of the holding of foreign assets which constitute a given proportion of total financial assets. As the latter increase with net interest income, foreign assets show a slight trend upwards.

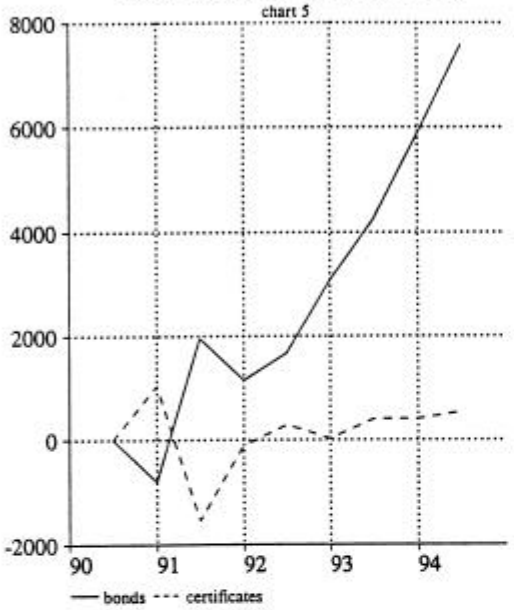
The sector's holding of shares (as a percentage of total assets) is depending on the difference between the (given) yield on fixed capital and the long-term rate of interest. The holding is negatively affected by the increase of the long-term rate. The increase in interest revenues implies, however, a scope for a continuous net increase of share holding. There is a corresponding increase in the share debt of the residual sector (Table 9).

An Increase in the Domestic Short-Term Rate of Interest (Sim 2)

Deviations from base

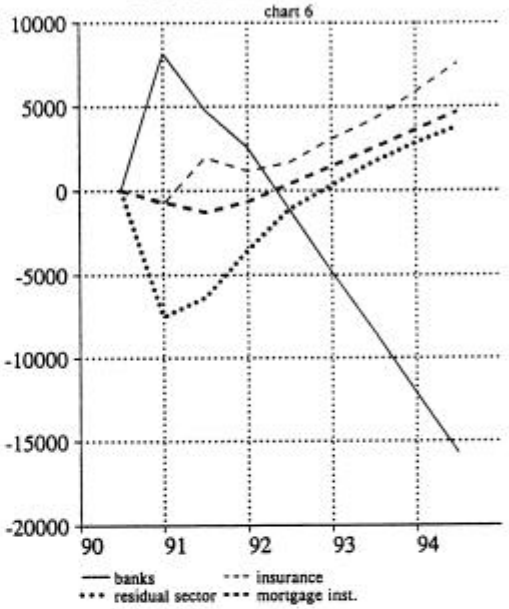
Insurance sector SEK millions

chart 5



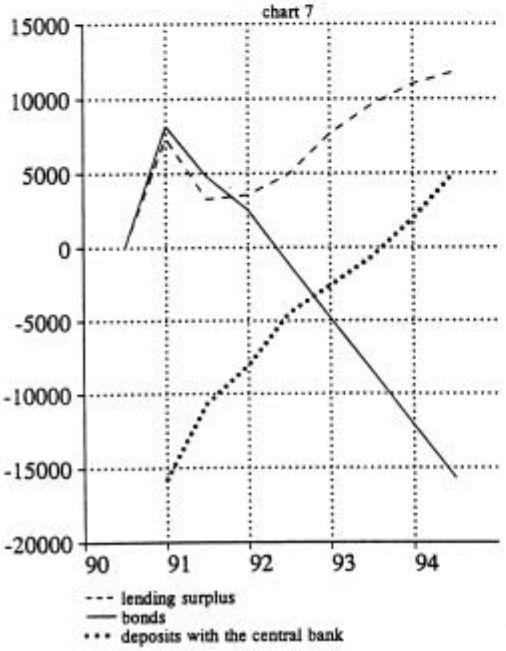
Bond market, SEK millions

chart 6



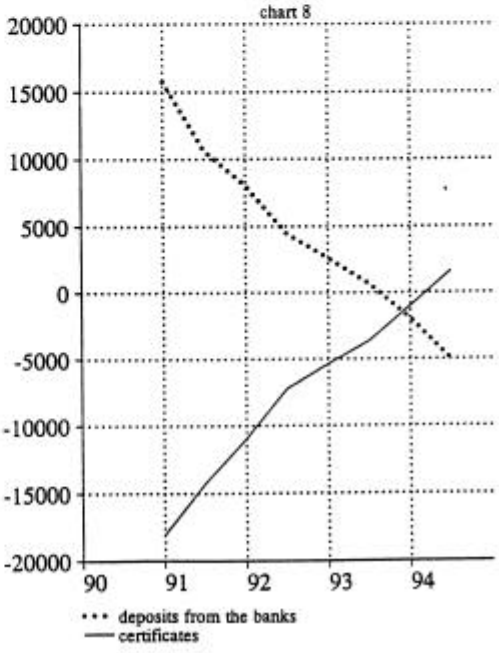
Banks, SEK millions

chart 7



Central bank, SEK millions

chart 8



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The holding of bonds is residual in the balance sheet of the insurance sector. The variable behaves as could be expected in view of the initial variations in relative yields and the continous increase of financial assets. (Chart 5).

The *foreign sector* increases its holding of SEK securities. Both r^l and r^s have increased in relation to r^{fs}. During the first two periods there are, furthermore, expectations of appreciation. Later on the holding of certificates is stabilized and that of bonds decreases slightly. The foreign sector's holding of shares is determined in the same way as that of the insurance sector.

The changes in the balance sheet of *the banks* reflect the rôle of these institutions as intermediators in the credit market. Their lending and deposits are determined by the residual sector. In the simulation, bank lending decreases and deposits decrease even more. It is assumed that the banks are market makers in the bond market and thus accomodate the net demand or net surplus resulting from the trading of other sectors. Thus the banks to begin with take up the bonds which are offered for sale by the residual sector and the mortgage institutions. This holding is then gradually wound up. At the end of the simulation period the banks have diminished their holdings considerably through sales to the insurance sector, mortgage institutions and the residual sector. The development in the *bond market* is shown in Chart 6. (For the mortgage institutions a positive figure indicates debt redemption.)

Net borrowing from the Central Bank is a residual in the banks' balance sheet. To begin with this borrowing covers both net lending to the public and bond purchases (Chart 7). Towards the end of the simulation there is a shift from borrowing to deposits with the Central Bank. The decrease in the banks' bond holding has by then become larger than the increase in their net lending.

The development in the *certificate* market is shown in Table 10. The situation in the first and the last half-year of the simulation period are there compared with each other.

The residual sector is the main buyer of certificates.The certificate market is cleared by the Central Bank which initially sells a large amount of (government) certificates. This amount

corresponds to the net demand caused by the increase in the short term interest rate. The sales of certificates by the Central Bank represent the amount of *open market operations* required to stabilize the short-term rate at its higher level. In the following half-years the Central Bank gradually buys back certificates as the demand in the market declines. The decline in its borrowing through certificates roughly corresponds to the decline in its lending to the banks (Chart 8).

Table 10. The certificate market in the first and last period of the simulation

Deviation from Base, SEK bn

	1991:1	1994:2
Buyers		
Banks	-1	-3
Insurance sector	1	1
Foreign sector	1	2
Residual sector	17	5
	18	5
Sellers		
Central Bank	18	-1
Mortgage institutions	-1	5
Central Government	1	1
	18	5

In KOFI the Central Bank balance contains a number of variables which play only a minor rôle in the simulation described here. Their changes are determined by other sectors than by the Central Bank. Thus e.g. the demand for currency is affected negatively by the increase of the short-term rate. There is an increase of the bank deposits of the residual sector and, consequently, a decline of the banks' borrowing in the Central Bank. This decline corresponds to the initial decline of currency.

Excursus

In the simulation described first (Sim 1), the long rate increases because of a change of the Government's borrowing strategy. In the simulation where the short rate is increased (Sim 2), an increase in the long rate is obtained through a change of monetary policy. In Sim 2 the long rate increases fast. Already after three half-years it is stabilized at about 1 1/4 % above Base. In Sim 1 the long rate increases gradually but at the end of the simulation period it is not more

than 1/2 % above Base.

To the extent that KOFI is approximately linear the effects on the long rate of the two simulations could be compared directly. If e.g. r^s in Sim 2 is raised by only 0.3 % - 0.4 % (instead of 1 %) , r^l in 1994:2 would have increased by about as much as in Sim 1. Similarly, the shift of the debt policy has to be made 2 á 3 times larger than in Sim 1, if the effect on r^l should be as large as in Sim 2.

In Sim 2 there are several contractionary effects which are absent in Sim 1. Thus in Sim 2 the increase in r^s leads to an appreciation of the currency. In Sim 2 there is, furthermore, a contraction of the balance sheets of the banks and of the residual sector. In Sim 1 the changes in the sector balances are dominated by substitutions between certificates and bonds. Measured by M3 the contraction in Sim 2 is eventually four times as large as in Sim 1.

5.3 An increase of the foreign short-term rate of interest

The foreign short-term rate is increased by one percentage point while the domestic rate is assumed unchanged. This simulation is mainly the reverse of the one described above. In both cases the interest margin $r^s - r^{fs}$ changes by 1 % but with opposite signs. Exchange rates and exchange rate expectations then change symmetrically. When the foreign interest rate increases unilaterally, the exchange rate depreciates while it appreciates correspondingly when the domestic rate increases. Exchange rate expectations likewise assume the same values but with reverse signs. These changes determine the domestic interest margin $r^l - r^s$ as described in the previous simulation. Since the interest margins $r^l - r^s$ largely determine the portfolio choices the development of the sector balances becomes much the same in the two simulations. There is, however, an important difference caused by the way in which interest payments are modelled in KOFI.

When in Sim 1 the domestic short rate is increased by 1 % the long rate increases by 1 1/4 %. When in Sim 2 the foreign short rate is increased and the domestic short rate is kept unchanged, the domestic long rate falls by about 1/4 %. Because of the difference between the numerical values of the changes of the long rates, the flows of interest income also differ - they are larger

in the first case (r^l increases 1 1/4 %) than in the latter (r^l decreases by 1/4 %). The insurance sector and the residual sector are the main sectors concerned.

The financial assets of the insurance sector largely consist of bonds and certificates. When the domestic rates increase the sector's interest income and net financial assets increase compared with Base. These increases have their counterparts mainly in the bank sector and the residual sector. This is one of the factors which explains the decrease of deposits of the residual sector in Sim 2. In Sim 3 the result is an increase of deposits. Because of the assymmetry in interest flows, the decreases of deposits in Sim 2 become considerably larger than the increases in Sim 3. Thus the transmission to KOSMOS both via r^l and M3 differ between the two simulations.

5.4 A permanent increase of the budget deficit of the government

The budget deficit is assumed to be increased permanently by SEK 20 bn per half-year. (The change can be thought of as an increase of expenditure, the impact of which is contained within the financial sector). The short rate is assumed to be kept unchanged through open market operations. 30 % of the increase in government debt is assumed to be financed by borrowing abroad. Domestic borrowing consists of 30 % certificates (incl. National Savings Scheme) and 70 % bonds. The deficit financing implies a liquidisation of the market and causes a gradual lowering of the long term rate. At the end of the simulation r^l has fallen about one percentage point.

Table 11. Credit market matrix for 1994:2

SEK bn

	Certi-ficates	Bonds	Borrow-ing abroad	Central Bank deposits	Bank-deposits	Total
Central Government	-25	-78	-48		-9	-160
Central Bank	-52		+59	-7		0
Banks and in-surance sector	+16	+88		+7	-111	0
Mortgage institutions	+22	-22				0
Foreign sector		+18	-18			0

Residual sector	+39	-6	+7		+120	+160
Total	**0**	**0**	**0**	**0**	**0**	**0**

The negative financial saving of Central Government corresponds to a positive financial saving of the residual sector (enterprises, households and local authorities), which receive the additional money spent by the Government. The residual sector gradually adds to its financial assets, mainly in the form of certificates and deposits. The holdings of bonds increase initially but at the end of the simulation period is smaller than in Base. Since the short rate and thus also the bank lending rate are assumed unchanged, the borrowing of the residual sector is not affected.

Table 11 shows how the initial pattern of Government borrowing is transformed on its way through the financial markets to the final lender i.e. the residual sector. The table concerns the situation in the last period of the simulation (1994:2) and shows the stocks as deviations from Base. The columns show borrowing and lending in the various financial markets. The rows show the sector balances. They sum to zero except for Central Government and the residual sector. In these two sectors net financial assets change, decreasing respectively increasing by the amount of the cumulated budget deficits (8x20 bn = 160 bn). A plus sign in the table denotes an augmentation to, a minus sign a diminution of the net financial assets of the sector. The figures are rounded. Some insignificant items have been excluded.

The first row shows the distribution of Central Government borrowing beetween various lenders. Deposits (-9 bn) concern borrowing through the The National Savings Scheme (”Allemanssparande”). The second row shows that the Central Bank has sterilized the larger part of the increase of the exchange reserve (59 bn) through sales of certificates (-52 bn). The increase of the foreign reserves emanates partly from direct government borrowing abroad, partly from government SEK bonds purchased by the foreign sector. The liquidisation which is the counterpart of the increase in foreign reserves is partly offset by Central Bank sales of government certificates purchased by the residual sector and the banks. The open market operations are required to prevent the short term rate from falling.

The first column of table 11 shows that in the certificate market sales from the Central Bank and the government to some extent have been offset by a reduction of the debt of the mortgage institutions (+22 bn). The balance corresponds to increased demand from the banks and insurance (+16 bn) and from the residual sector (+39 bn). In the bond market (the second column) there are sales not only by the Government but also by the residual sector and mortgage institutions. The latter substitute bonds for certificates. (the long rate is falling). The supply of bonds is to a minor part absorbed abroad; the rest is taken up by the banks. The bond purchases of the banks are ”financed” by a large increase of deposits. The residual sector has only to a minor extent placed the increase of its financial assets in the securities issued by the Debt Office. This is due to the fact that there is a continous flow of Government money to which the sector balances adjust only gradually.

The foreign sector increases its bond holding although the long rate is falling. The demand has namely - according to the function used - a very low interest elasticity. The dominating effect is that of the long run increase of the total bond holdings. (see section 3.6). The increase of the foreign sector’s bond holdings is assumed to be constituted of 60 % government bonds and 40 % mortgage bonds. The purchase of Government bonds corresponds to that part of the increase in the foreign exchange reserve which does not originate from government borrowing abroad (0.6 x 18 = 59 - 48). The foreign sector’s purchase of bonds has as its counterpart a liability towards the foreign reserve owners
(-18).

The table illustrates the rather complex reactions an initial government borrowing might have. The borrowing abroad causes a liquidisation of the market and a downward pressure on both the short and long rates. The open market operations result - compared to Base - in a trebling of the initial increase of the borrowing through government certificates. The bond sale is taken up by the banks and largely corresponds to an increase of deposits. Three quarters of the government borrowing end up as an increase of the volume of money. The outcome of this ongoing process thus has not much in common with the initial distribution of government borrowing between various markets and instruments.

6. Further work

The next step will be to link KOFI with KOSMOS. The application of the fullfledged model e.g. to the simulations described above will show the interaction between the financial sector and the real sector of the economy. The application can, in principle, also be extended to forecasts. In that case the statistical basis for KOFI needs regular updating. One difficulty is the time-lag in the appearance of the Financial Accounts.

Exercises of the kind, that was illustrated above by a credit market matrix (Table 11), have been used in the Medium-Term Surveys of the Ministry of Finance (e.g. LU 84). The approach then was comparative statistics. The comparison concerned only the initial and the final year of the scenario and were based on assumption about the financial savings of various sectors.The consistency of the scenario from the point of view of credit market developements could then be achieved only by trial and error. KOFI now makes it possible to account for complex dynamic processes in the financial markets in a systematic and fully consistent manner.

7. Literature

1. Bank for International Settlement, 66th Annual report 1996.
2. Kragh, B. and Markowski, A. [1988]. *Effects of interest-rate policy in the short and medium term – a simulation study*. Quarterly Review of the Central Bank of Sweden.
3. Markowski, A. [1989]. *Minimac – an econometric model of the Swedish economy from a Central Bank´s perspective*. Occasional Paper 6, Central Bank of Sweden.
4. Markowski, A. [1996]. *The financial block in the econometric model KOSMOS*. Working Paper No 53, National Institute of Economic Research.
5. *Morkmon, A quarterly model of the Netherlands economy for macroeconomic policy analysis,* Monetary Monograph No 2. De Nederlansche Bank [1985].
6. The National Swedish Pension Fund, annual report 1996.
7. Pedersen, N.L. [1989]. *Findan – finansiell sektor till "ADAM"*. Danmarks Statistik; Arbejdsnotat No 26.
8. Ragnartz, C. and Östberg, J. *The Swedish Repurchase Market*. Quarterly Review of the Central Bank of Sweden 1997:3/4.
9. Stadshypotek, annual reports 1995 and 1996.
10. The Swedish National Debt Office, annual reports 1994/95 and 1995/96.
11. Säfvenblad, Patrik. *Efterfrågeeffekter på den svenska penningmarknaden*. I "Från optionsprissättning till konkurslagstiftning". Red. Bergström C. och Björk T. EFI 1997.