A LONG-RUN SIMULATION MODEL FOR THE SWEDISH ECONOMY

- THE LRS-MODEL -

By Tomas Restad[1]

1. INTRODUCTION.

Different versions of the LRS-model have for some years been used in my teaching at Stockholm University. Conceptually the LRS-model is built on the Solowian growth model (Solow 1956), the Keynesian consumption function and the Scandinavian price model (the EFO-model 1970 and Aukrust 1977). The principal aim of the LRS-model is to enhance the understanding of basic macro- economics in an empirical context and to offer an experimental station for analysis of macro- economic policy problems. The LRS-model is based on empirical data. However, it is still a very simplified text-book model with primarily educational purposes. The ambition is to connect basic macro-economic theory to real world data. The framing of the model between the Scylla of economic theory and the Charybdis of reality has been guided by the principle of Occam's razor.

The purpose of this paper is to present the LRS-model and the concept of an open interactive simulation model without entering either into a discussion of macro-economic theory as such or the problems of a full-fledged empirical model. Part two of the paper gives a verbal presentation of the LRS-model. The principal equations of the model are presented in an annex to the paper. The interactive computer program is presented in part three. Finally, in part four the working of the model is explained by way of a projection for the development of the Swedish economy during the period 1996-2000.

The LRS-model is based on the Swedish national accounts. It has a similar - albeit a much simpler - scope than the model used in preparing the report on economic development, which is published in conjunction with the budget statement of the Swedish government. The LRS-model comprises two sectors: The private sector and the public sector. The public sector differs from the rest of the economy in (at least) six respects.

1. Production is by definition not marketed.
2. Therefore changes in productivity can not be measured.
3. Production is extremely labour intensive.
4. The possibilities for factor-substitution are small.
5. Import substitutes are non-existing.
6. Production in itself uses very little imports.

In an earlier version the housing sector was singled out from the private sector because - like the public sector - it is a substantial part of the economy with special characteristics. The housing sector shares points (4)-(6) with the public sector. Point (3) is reversed: Production is extremely capital intensive. There is no doubt that the model would have given a sharper picture of reality

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had this three sector base been retained. In order to keep the model simple this set-up was abandoned when the model developed in other directions. Obviously the picture would be even sharper with a further disaggregation beyond three sectors. This, however, would require an input-output structure as the base for the model and we would be on our way to a full-fledged empirical planning model in the multi-sectoral growth tradition (Johansen 1974).[2]

2. THE MODEL.

The LRS-model is built around a version of the traditional Solowian neo-classical growth model, which includes foreign direct investments. The centre of gravity in the LRS-model is savings and investments , but unlike the Keynesian IS-LM model the LRS-model does not include a monetary side. However, the Keynesian consumption function is included and unlike most growth models the LRS-model does not rely upon an assumption of full employment.

Dynamically most variables in the LRS-model - with the notable exception of those representing cumulative stocks - are depicted as trends, chiefly in terms of annual rates of change. Thus, the model is not equipped to predict cyclical change. A STEP function is however included in the computer program. This makes it possible to analyse exogenously specified cyclical change in, for example, export market growth and the propensity to save or invest.

In the private sector a traditional Cobb-Douglas production function is assumed. Technological change is treated as neutral and exogenous.[3] The production function for the public sector is built on the assumption of proportionality between production and the input of labour. No substitution between capital and labour is assumed and the rate of change in productivity is zero by definition. The common rate of growth in public employment, public production and public consumption is exogenously determined. Also the rate of growth in public investment is exogenous. In the private sector the investment ratio is exogenous and investments are determined by the rate of growth in production. Net direct investments as well as investments in stocks are specified in terms of an exogenously specified GNP ratio.

Prices are cost related. The price model for the private sector is based on the definition of the share of wage-cost in value added (at factor cost).[4] Exogenous assumptions are made for the development of the wage/profit share, nominal wages and the rate of pay-roll taxes, indirect taxes and subsidies. The mechanism of the price model can be described as follows. Nominal wages can grow at the same pace as productivity with Swedish production prices remaining unchanged if the profit share is constant along with the rate of taxation and subsidies. Nominal wages can grow faster than productivity at constant production prices if that increase in nominal wages, which exceeds productivity growth, is compensated by a decrease in the profit share and/or an increase in subsidies and/or a decrease in the rate of taxation.

The development of international prices and the exchange-rate are exogenously determined. Domestic prices are calculated as a weighted average of import prices (denominated in Swedish currency) and Swedish production prices. Swedish export prices are calculated excluding indirect

[2] Swedish versions of the MSG-model have been presented by (Restad 1984) and (Bergman 1980).
[3] The author is not unaware of the theory of endogenous growth. I do not think, however, that it would be easily adapted to any long run-simulation or planning model.
[4] The share of wage-cost and the profit share add to one.

taxes. Relative import prices in Swedish denomination and relative export prices in international denomination are also calculated.

Export and import functions link the development of foreign trade to the development of foreign and domestic market growth on the one hand and to the development of Swedish relative prices on the other. The rate of growth in the foreign market is exogenously determined. The rate of growth in the market for imports is endogenous and equal to the growth in private domestic demand. Changes in relative prices regulate gains and losses in market shares by way of price-elasticities.

The public sector is treated in consolidated terms. The consolidated public sector is the net aggregate of central government, local government and the social security sector. The implicit price of public production is assumed to follow the development of wage-cost.

Public sector incomes are disaggregated into direct taxes, indirect taxes, pay-roll taxes and a residual. Public expenditures are divided between consumption, investments, transfers abroad, transfers to domestic households and subsidies to private production. Interest rate payments as well as assets and liabilities are treated net. Liabilities are predominantly central government debt and assets are those of the buffer funds in the social security system.

It ought to be stressed that the netting of interest rate payments and assets/liabilities are rather strong simplifications. Another simplification worth mentioning is that in the real world there are a lot of miscellaneous items in the consolidated public budget ranging from financial transactions, income from public enterprises and last but not least income from privatisation. In the LRS-model we include all this in a residual income, which we assume to be a fixed fraction of GNP equal to the value in the base year; presently about 6%. [5]

A Keynesian consumption function relates the development of private consumption to the development of disposable income and the savings ratio. Gross income is subdivided into wages generated in the two sectors of production, transfers from the public sector and a residual. The development of the savings ratio and the development of transfers are determined exogenously. Residual household income is linked to GNP.

In the final analysis employment in the private sector is determined - in a Keynesian way - by the level of aggregate demand in the economy. Labour supply is exogenously determined as well as employment in the public sector. Thereby unemployment is also determined. For all employment variables the LRS-model comprises measurements both in numbers and hours. The latter measure being relevant when labour is looked upon as a factor of production.

In most of its parts the LRS-model is solved recursively. The exception being the determination of private investments and production and the determination of private consumption and employment. At these points numerical iteration has been used. The model is stable because of the convexity of the Cobb-Douglas production function.

The LRS-model is an open model with a large number of exogenous variables. It is primarily an instrument for making exogenous assumptions and model results consistent . The model results

[5] It should be noted that it is within this sphere that governments are now manoeuvring to meet the Maastricht criteria. The LRS projections for the PSBR and the public debt must be interpreted as "normalised" values excluding , for example, large privatisation programs.

are simulations rather than forecasts. They illustrate different conceivable paths of development for the Swedish economy based on assumptions for the international environment, domestic development and assumptions for economic policy. The projections are conditioned by the assumptions made and can also be labelled as conditioned forecasts. Not least are the results conditioned by the assumptions made for the controllable policy variables. These can be set to achieve certain goals for the level of unemployment, for the current account and for the public sector borrowing requirement. The projections thereby get a normative status. Given a set of probable assumptions for exogenous non-controllable variables the LRS-model can be used to find values for the set of exogenous controllable policy variables in order to explore an optical development path in terms of the central goals for economic policy.

It must be stressed that there are numerous implicit relations between the variables of the model both within the set of exogenous variables and between exogenous variables on the one hand and endogenous variables on the other. For example, the private investment ratio, the rate of interest and the profit share are all exogenous although clearly not independent. By the same token the rate of increase in nominal wages is exogenous and the rate of unemployment is endogenous. It would have been possible to introduce an investment function and a Phillips-curve type of relation into the model. The reason why this has not been done is the enormous complexities of these relations in a real world context.

It is therefore of paramount importance that all assumptions are made withn the framework of a coherent scenario and that this scenario is checked against the consequent model results. The whole point with an open model is that complicated and unstable relations - such as that between the investment ratio, the rate of interest and the profit share - are left to be analysed outside the model using the human brain and adjacent sub-models. Simple mechanical calculations and stable econometric relations, on the other hand, are left to the computer where the program can be run over and over again in an iterative process linking sub-models and common sense to the computerised model. This is the essence of an open interactive simulation model. [6]

3. THE COMPUTER PROGRAM.

The program is DOS-oriented and requires an exe-file (lrs.exe) and two data files. One of these files is the database for predetermined values (dat) and the other is a starting file for change in the exogenous variables (ex).

A copy of the compiled program and the data bases can be obtained from the author at request.

The program starts with a demand to state data files. The first of these is the database for predetermined values (dat). The second is the starting file for values of change in the exogenous variables (ex). The third file is a file for storing new values for changes in the exogenous variables. If this file is given the same name as the starting file, new values will replace old values in the editing process. Therefore, this file should initially be given a new name. A copy of the original ex-file should always be retained.

[6] Obviously an open interactive simulation model is also well suited for educational purposes as the students must use knowledge in economic theory to construct a coherent projection.

When data files have been stated, current values in the ex-file are printed on the screen and the user is able to make changes. The development of exogenous variables is formulated in three different ways:

(a) As an annual rate of change.
(b) As an average constant value throughout the period.
(c) As a given value in the final year of the calculation, often in terms of a share-value.

In the last case values from the predetermined starting value to the exogenously specified value for the final year are interpolated linearly.

On the screen the ex-file is organised as follows:

1. NUMBER OF YEARS FOR THE PROJECTION

2. THE INTERNATIONAL ENVIRONMENT.
   Real rate of international interest (average)
   Swedish interest premium (average)
   Rate of growth of the Swedish export market
   Rate of international inflation
   Rate of change in the currency rate
   International transfers (Share in GDP year in the final year)
   Residual in the current account (Share in GDP in the final year)

3. WAGES, PROFITS, SAVINGS AND INVESTMENTS.
   Rate of change in nominal wages
   Wage-share (Share in value added in the final year)
   Household savings ratio in the final year
   Private sector investment ratio in the final year
   Rate of capital depreciation
   Investment in stock (Share in GDP in the final year)
   Net direct investments (Share in GDP in the final year)

4. THE CONSOLIDATED PUBLIC SECTOR.
   Rate of change in the volume of public consumption
   Rate of change in the volume of public investments
   Rate of change in the volume of transfers to households.
   Subsidies to private production (Share in value added in the final year)
   Rate of direct tax in the final year
   Rate of indirect tax in the final year
   Rate of pay-roll tax in the final year

5. LABOUR FORCE AND TECHNOLOGICAL CHANGE.
   Rate of change in the supply of labour.
   Rate of change in the average working time.
   Rate of technological change.

6. ELASTICITIES.

The output elasticity of capital
The output elasticity of labour
The price elasticity of import
The price elasticity of export
The income elasticity of import

These exogenous values cover two pages on the screen and are edited in the standard way. Every change of a value must be confirmed by <enter>. When editing is finished, the model is solved by pressing the function key F2. By pressing <esc> instead, the editor is left without any of the changes taking effect.

When the solution is ready, the balance of resources and some key indicators are printed on the screen. The user is also required to give the next command. There are two types of commands in the LRS-model: commands handling the presentation of results on the screen and commands of an operative character.

-exo1 Prints some exogenous assumptions on the screen. -exo2 Prints more exogenous assumptions. -bop Prints the balance of payments. -psbr Prints public sector borrowing requirement. -psi Prints public sector income. -emp Prints employment and unemployment. -bal Prints the balance of resources. -con Prints household income, consumption and savings. -int Prints the components in the nominal rate of interest. -prc1 Prints rates of change for some key variables. -prc2 Prints percentage shares for other key variables.

-save Saves results to file (You will be prompted for a name). -start Starts a new calculation from the present database. -new Starts a new calculation from a new database. -step Creates a database with values for year T. -dos Shells to DOS. (exit returns to LRS) -exit Back to system.

The point in making a difference between "start" and "new" is the following. With "start" the user can keep playing the same ex-file on the original dat-file in an iterative process. With "new" the user can start a new process with a new set of data. This is, for example, necessary if "step" is used. "Step" is a command which makes it possible to subdivide the projection period into parts with different exogenous assumptions. "Step" creates a new database for predetermined values based on the latest projection. This database has the same format as the initial dat-file. The user is prompted for a name.

4. AN EXAMPLE OF A LRS-PROJECTION.

4.1 Introduction.

The purpose of this exercise is to explore one of several conceivable paths of development for the Swedish economy up to the turn of the century and at the same time to shed some light on the working of the LRS-model.

The projection is to some extent normative. Given plausible assumptions for the development of the international economy the following questions can be raised. Can the high rate of unemployment in Sweden be lowered without endangering the sanitation of the finances of the public sector? What would be required of Swedish policy and domestic development in respect to taxation, public expenditures, household savings, private investments? Last but not least, what is a permissible rate of increase in nominal wages?

An important delimitation of the study is that only data available in March 1996 are used. The study does not take any later revisions into account.

4.2 Assumptions.

4.2.1 The international development.

The market for Swedish exports is mainly in the advanced industrial nations within the OECD area. Many of these nations have slow growing economies and face similar macro- economic problems as Sweden. The growth rate in the GNP of the OECD area (series 2) and the growth rate of Swedish exports (series 1) are depicted together in diagram 1 for the period 1974-1996. This gives a picture of a fairly good correlation, exempting periods when Swedish relative costs got out of hand or the Swedish currency was devalued. A simple regression was made using the logarithm value of Swedish exports as the dependent variable and the logarithm value for GNP in the OECD area as the independent variable. This resulted in an elasticity of 1.49 (R^2=0.94). The period 1974-1996 covers both subperiods when Swedish relative costs got out of hand and sub-periods when the Swedish currency was devalued. Therefore, this elasticity is a measure of the relation between Swedish exports and the international market growth, if and only if, we assume that cost crisis and adjustment of the currency rate evened out in the long run. This, however, seems to be a fair assumption. The relation between Swedish prices and import prices in SEK was the same 1996 as 1974. The mean value for this relation during the whole period was 0.9 with a standard deviation of 0.1.

The rate of growth in the OECD is now turning upwards. It was reckoned to be 2.6% in 1994-1995 and 2.9% in 1995-1996 (OECD Economic Outlook June 1995). Let us assume that the average growth for OECD will be 3.4% for the period 1996-2000. This is the average reached during the period 1987-1990, which was the previous peak. Assuming a Swedish market elasticity of 1.5 this would imply an average market growth for Swedish exports of 5.1% per annum up to the turn of the century.

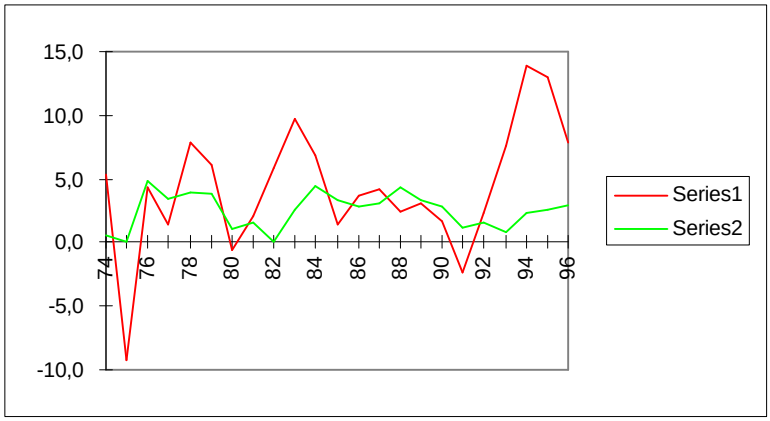

Fig 1. GNP growth within the OECD and
Swedish export growth 1974-1996

We further assume that the rate of inflation in the OECD area will be an average of 2% per year during the projection period; that the international real rate of interest will be 4%; that the Swedish interest premium will be 1.5 per cent points and that the rate of exchange will be constant ex post (Although it is implied that the Swedish currency is *expected* to depreciate). Foreign transfers in the form of development aid and contribution to the EU budget are assumed to be an average 2% of GNP. The residual in the current account was 0.3% of GNP in 1996. We assume this share unchanged for the projection period.

4.2.2 Labour force, investments and the Solow residual.

Figure 2 below depicts for the period 1971- 1989 the Solow residual in the production function (the rate of technological change) and the rate of growth in productivity. Productivity change represents the upper curve and technological change represents the lower. The difference between the two curves represents the contribution to productivity growth from an increase in capital intensity.

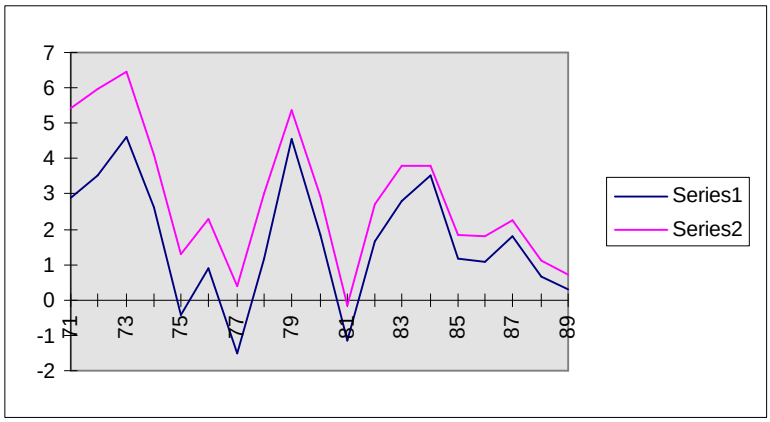

Fig2. Technological change and productivity

There are two fairly recent studies of the residual in the production function for the private sector carried out on Swedish data. In 1991 a government commission showed a decline in the residual

from 2.6% for the period 1970-1975 to 1.3% for the period 1980-1989. Another commission - within the 1995 Medium Term Survey (MTS 95) - calculated an average value of 1.2% for the period 1970-1992. We shall adopt this value as our assumption for the period 1996-2000.

In the MTS 95 the number of persons in the supply of labour is calculated to increase by 1% per year for the period 1995-2000. At the same time the active population is calculated to grow by only 0.3% per year for the same period. The survey assumes an increase in the participation rate. Between 1990 and 1994 the participation rate in the Swedish labour market fell from 84% to 77.6%. The survey assumes an increase to 82% at the turn of the century. As our projection will indicate a continued high level of unemployment, this assumption seems rather dubious. We therefore assume that the growth in supply of labour will be 0.5% per year for the period 1996-2000. This implies a more limited increase in the participation rate.

In the MTS 95 the average working time is assumed to decline by 0.2% per year up to the turn of the century. No new legislation is presupposed. The decline is explained by an increase in the share of part-timers in the labour force. We adopt this assumption of a decline in the average working time.

The development of the investment ratio and the profit share in the private sector is shown in figure 3. The profit share is the upper curve. We can see that the investment ratio has fallen from 26.5% in 1990 down to 15.1% in 1994. Since then the development is in reverse and the investment ratio has climbed to 18.2% in 1996. We shall assume a further increase during the projection period so that the investment ratio reaches 21.5% in the year 2000. The profit share has increased from 35.5% in 1990 to 44.9% in 1995. It has started to decline and was 40.7% in 1996. We shall assume a further decline down to 38% in the year 2000.

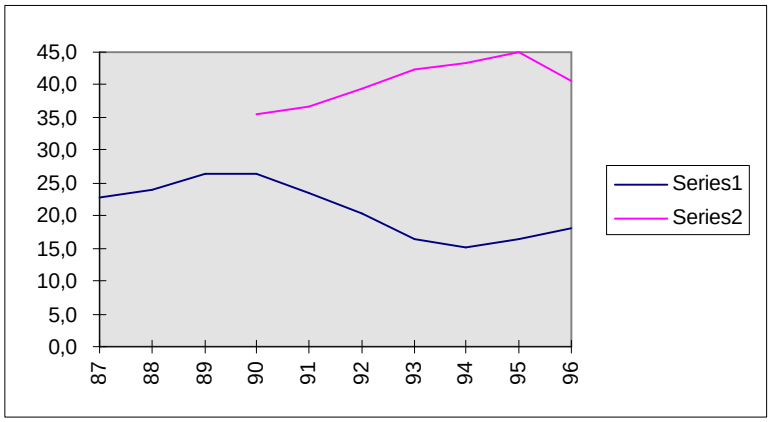

Fig 4. Investment ratio and profit share

Net direct investments have been highly volatile since the deregulation in the mid 1980s. At the moment there seems to be an approximate balance. We shall assume an increase in the net (foreign investments in Sweden minus Swedish investments abroad) to 1% of GNP at the turn of the century. Investments in stocks are assumed to go down from -0.2% of GNP in 1996 to -1.5% in the year 2000. In other words, we assume an increasing rate of selling from stocks during the projection period.

4.2.3 The consolidated public sector.

Public consumption amounted to 25% of GNP in 1996. The share of local government was about 2/3. Public investments amounted to about 2.5% of GNP with a local government share of 2/3. For the projection period 1996-2000 we shall assume that the volume of public consumption decreases by 0.5% per year while public investments are assumed to increase by 1.5% per year.

In 1996 public transfers to the household sector were 37% of total public expenditures or nearly 25% of GNP. This huge redistributing machine is an important feature of the "Swedish model". These transfers are dominated by: Pensions (50%); Unemployment benefits and the cost for labour market policies (15%); Costs for so-called “family policies” including housing benefits and costs for parental leave (15%). It should be pointed out that the Swedish system for social security and compulsory pension schemes is not based on funding but is a "pay as you go system". Such a system relies heavily on continuous growth.

For the projection period we assume that the volume of household transfers decreases by 0.5% per year, brought about by reductions in both pension rights and other social security benefits. Subsidies to the private sector are assumed to decrease from 7.8% of value added in 1996 to 6% in the year 2000. This decrease is supposed to be achieved mainly by a reduction in government grants to the private housing sector.

Incomes for the consolidated public sector stem 1/3 from direct taxes, 1/3 from indirect taxes and 1/3 from pay-roll taxes. During the projection period direct taxation is assumed to increase by one percentage point. The rate of indirect taxes and pay-roll taxes are assumed to be unchanged.

4.2.4 Nominal wages and the savings ratio.

The projection is based on the assumption that the rate of growth in nominal wages is limited to an average of 4.4% per year. It should be stressed that a persistent lowering of the rate of increase in the nominal wage to this level would be a radical change of previous Swedish records. During the period 1982-1991 negotiated wage increases amounted to 4.6% per year. Wage drift added as much on top. In total, nominal wages in Sweden increased by about 9% per year during this nine year period. We might now spot a change. During the period 1992-1995 the rate of increase in nominal wages was only 3% per year. However, this restraint might be only temporary. For 1996 and 1997 an average rate of increase in the nominal wage of 4.9% per year is forecasted. If this forecast materializes, the scope for wage increases for 1998 and 1999 is limited to 3.9% for each of these two years in order for the average of the projection period as a whole to be limited to 4.4% per year.

The development in the household savings ratio for the period 1963-1996 is depicted in figure 5 below. The mean value for the entire period is 6.3% showing marked deviations during the period 1982-1996. The mean value for the relatively stable period 1963-1981 is 4.4%.

Private consumption has been growing at a slow pace for a number of years. The volume of private consumption is to-day below the level of 1988. The savings ratio in 1996 is significantly above its mean value for the period 1963-1996. We therefore assume that the savings ratio will fall from 7.5% in 1996 to 6% at the end of the century. It should, however, be pointed out that

predicting the development of the household savings ratio is especially hazardous in the wake of a projection which implies profound changes in social welfare and in the pension system.

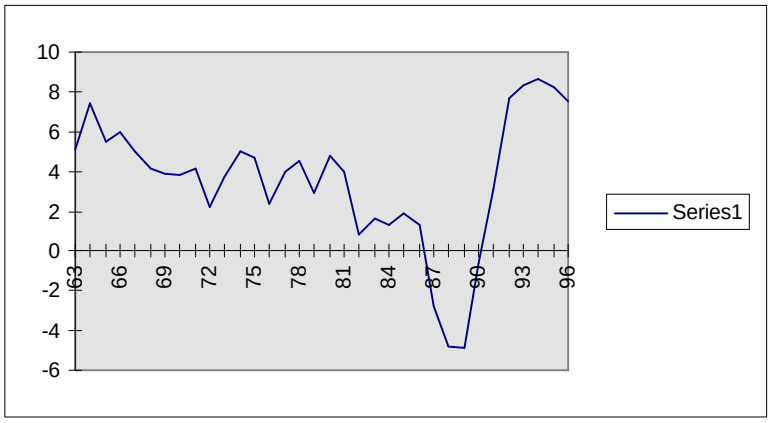

Fig.5 The household savings ratio 1974-1996

4.3 Results.

The assumed increase in the private sector investment ratio in conjunction with other assumptions implies that private investments will grow by 6.9% per year during the projection period. Net direct investments are also assumed to increase. These two factors together make possible an increase in capital intensity, notwithstanding a fairly rapid growth in private employment. As a consequence growth in productivity exceeds the assumed rate of technological change and reaches an annual growth rate of 1.7%. This is just a little less than the average productivity growth registered for the period 1975-1995 at 1.9% per annum. Production in the private sector is projected to increase by 2.6% per year and employment by 1.1%. This is equivalent to about 120,000 new jobs in the private sector at the turn of the century.

Table 1. The private sector 1996-2000.
Annual percentage growth

Investment	**6.7**
Capital stock	**2.2**
Employment	**1.1**
Number of hours worked	**0.9**
Productivity	**1.7**
Production	**2.6**

Open unemployment is projected to fall from 7.5% in 1996 to 7% in the year 2000. Reduced public consumption will decrease the share of public employment from 31.2 % in 1996 to 30.1% in the year 2000 at which time the number of jobs in the public sector is projected to have decreased by 15,000 compared to 1996.

The rate of inflation is projected to be in line with what is assumed internationally, which is 2% per annum. This tallies with the assumption of a stable rate of exchange. Nominal wages are

assumed to increase by 4.4% per year and productivity is projected to increase by 1.7%. A two per cent rate of inflation therefore implies that the assumed decrease in the profit share absorbs both the assumed decline in government subsidies and some part of the assumed increase in nominal wages.

The real wage rate is projected to increase by 2.4% per annum. Disposable income still grows by just 1.3%. The reason for this discrepancy is the assumed increase in direct taxes and the assumed decrease in government transfers to the household sector.

The international nominal rate of interest is determined by two exogenous assumptions: Real rate of interest and the international rate of inflation. The Swedish nominal rate of interest is in turn determined by way of two further assumptions: A Swedish interest rate premium and the rate of change in the Swedish currency value. From the assumptions made in section 3.2.1 it follows that the Swedish nominal rate of interest is an average 7.5% during the projection period while the average real rate is 5.5%.

Table 2. Wages, prices and rates of interest 1996-2000
Annual percentage change

Nominal wages	**4.4**
Rate of inflation	**2.0**
Real wages	**2.4**
Real disposable income	**1.3**
Nom. rate of interest	**7.5**
Real rate of interest	**5.5**

The balance of resources for the period 1974-2000 is presented in table 3 below. During the historic period 1974-1996 - which covers a whole generation - the economic development in Sweden has been weak. In the beginning of the 70s the United States, Switzerland and Sweden were amongst the most prosperous nations in the world. This is still true for the United States and Switzerland while Sweden has plunged to a 20th position in the OECD prosperity league. The average rate of annual growth in the Swedish GNP during the period 1974-1996 was 1.6% compared to an OECD average of 2.5%. Until the 90s it was a point of advantage that Sweden had a lower rate of unemployment and a better social security system than most other countries. This, unfortunately, is no longer the case.

The Swedish growth during the period 1974-1996 rested heavily on exports, public consumption and public investments. The relatively high rate of growth in exports was achieved at the cost of a steady decline in the value of the Swedish Crown. Between 1974 and 1996 the value of the Deutch Mark, measured in SEK, has increased by more than 175%. The expansion of the public sector, on the other hand, has been achieved at the cost of a net public debt which 1996 amounted to 30% of GNP in spite of a high rate of taxation. Private consumption and private investments, on the other hand, showed a very modest rate of growth during the period 1974-1996. The growth in private consumption was 1% per annum and the average growth in private investments was a mere 0.7%.

Table 3. Balance of resources 1974-2000

	1974-1996	1996-2000 LRS	1996-2000 NIER
Gnp	**1.6**	**1.8**	**2.0**
Imports	**3.3**	**5.0**	**5.8**
Public Consumption	**1.7**	**-0.5**	**-0.4**
Private Consumption	**1.0**	**1.7**	**2.2**
Private Investment	**0.7**	**6.9**	**-**
Public Investment	**1.1**	**1.5**	**-**
Total Investment	**0.8**	**6.2**	**5.8**
Exports	**4.3**	**5.1**	**5.4**

The LRS projection for the period 1996-2000 rests on an assumption of a favourable international development in combination with a continued increase in domestic investments and a moderate increase in Swedish nominal wages. GNP is projected to grow at an average annual rate of 1.8%. Exports are projected to grow in pace with the international market as a consequence of a Swedish inflation rate in harmony with international inflation. Public consumption is assumed to decline. Private consumption is projected to grow at 1.7% per year - just a little slower than GNP but faster than disposable income. One quarter of private consumption growth stems from a decline in the household savings ratio. The comparably fast growth in private investments and consumption reduces private sector financial savings from 6.4% of GNP in 1996 to 2% of GNP in the year 2000.

A brief comparison is made with a projection from the National Institute for Economic Research (NIER) published in March 1996. The projection for exports is somewhat less optimistic in the LRS projection than in the NIER projection while the projection for total investments is more optimistic. Furthermore, the projection for private consumption is lower in the LRS projection than in the NIER projection. This can be explained by the fact that behind the NIER projection is an assumption that the household savings ratio declines to 4.6% in the year 2000 while it is assumed in the LRS projection that the decline stops at 6%.

An alternative projection has been made where the NIER values for the savings ratio, the export market growth and the decline in public consumption were inserted in the LRS-model while all other assumptions were left unchanged. On these assumptions the LRS-model generated the same growth rates for GNP and private consumption as the NIER projection. Import growth, however, turned out a little lower (5.6% in LRS as compared to 5.8% in NIER). Furthermore, a higher rate of unemployment in the year 2000 was calculated in LRS (5.7% in LRS compared to 5.2% in NIER).

In table 4 below the outcome for the current account (CA) is presented. The projection points at a growing surplus amounting to 2.8% of GNP at the turn of the century. As a consequence the net foreign debt decreases from 45% of GNP in 1996 to 35% in the year 2000.

Table 4. The balance of payments 1996-2000
Current prices billion sek.

	1996	2000
Exports	671.4	886.4
Imports	-574.9	-756.5
Capital	-46.0	-40.5
Fo.aid + EU	-31.9	-39.9
Residual	5.3	6.0
CA	24	55.4
GNP Share	1.4	2.8

The budget of the consolidated public sector is presented in table 5 below. The deficit of 4.9% of GNP in 1996 is turned into a small surplus of 0.8% of GNP in the year 2000. In answer to the initial query we can conclude that it does seem possible to bring unemployment down and at the same time continue the sanitation of public sector finances. The consolidated net public debt, however, increases from 30% of GNP in 1996 to 35% of GNP at the turn of the century.

Table 5. The consolidated public sector 1996-2000.
Current prices billion sek.

	1996	2000
Direct taxes	377.8	452.9
Indirect taxes	270.4	324.6
Pay-roll taxes	218.4	262.9
Residual income	105.6	125.8
Consumption	-441.9	-514.5
Investment	-39.4	-45.3
Fo.Aid + EU	-31.9	-39.9
Transfers	-391.5	-415.7
Subsidies	-96.2	-82.0
Capital (net)	-54.0	-53.0
PSBR	-82.8	15.6
GNP-share	-4.9	+0.8

4.4 Alternative paths of development.

The projection which has been presented above (MAIN) is based on a lot of uncertain assumptions. To illustrate the magnitude of the effects of changes in some of these assumptions three sensitivity tests (ST) have been carried out. All three are going in a negative direction.

ST1 - The export market growth is one percentage point lower than in the projection above (MAIN). That is 4.1% p.a instead of 5.1%.

ST2 - The savings ratio remains at the 1996 level (7.5%) instead of falling to 6% at the turn of the century as in MAIN.

ST3 - The investment ratio in the private sector remains at the 1996 level (18.2%) instead of increasing to 21% at the turn of the century as in MAIN.

These changes are ceteris paribus and all other assumptions are unchanged. Some key results from these exercises are presented in table 6.

The public sector would get into fiscal balance by the end of the century in ST1, ST2 and ST3 but not quite in ST4. Unemployment, however, would be higher than MAIN in all cases and even higher than in 1996.

Table 6. Sensitivity analysis.

	MAIN	ST1	ST2	ST3
Annual growth:				
GNP	1.8	1.6	1.7	1.4
Private consumption	1.7	1.6	1.3	1.5
Percentage shares in 2000:				
Unemployment	7.0	8.2	7.6	8.5
PSBR	0.8	0.2	0.5	-0.1
Current account	1.4	2.2	3.4	4.6

The sensitivity tests have been mechanical in their ceteris paribus construction. As was pointed out earlier in the paper, there are complicated implicit relations between the variables. To take these into account is the whole point with an open simulation model. In relation to the sensitivity tests above some of these mechanisms should be mentioned.

Should, for example, ST1 be the case then the development of the investment ratio in the private sector would probably be affected in a negative direction. We would have a scenario where the negative effects of ST1 are magnified and where unemployment rises and the PSBR is still significant. We might then consider a further increase in taxes and/or a further decrease in public expenditure. An increase in taxes might have an effect on the assumed rate of the increase in nominal wages. A further reduction in transfers to the household sector might have an effect on the savings ratio. We might at this stage find that the Swedish rate of inflation no longer harmonises with the international. This might give reasons to change the assumption for the rate of exchange. Etc. etc.

4.5 Concluding remarks.

The primary aim of this paper has been to present and explain the LRS-model. The method used has been to do this by way of an example. In this example of usage a secondary aim was embedded; To use the model to try to answer the following question:

Can the high rate of unemployment in Sweden be lowered without endangering the sanitation of the finances of the public sector?

The main projection points at such a path of development - Albeit an uncertain one. The key to a positive development for the Swedish economy is restrained increases in nominal wages in order to secure the competitiveness of Swedish enterprise. The growth engine can no longer be the public sector, which in this projection gives a negative contribution. Growth must instead come from exports, investments and private consumption and a large part of the growth in private consumption must come from a reduction in the household savings-ratio.

It is far more difficult to reduce the rate of unemployment in a situation of investment led growth than in one with an expansion of the public sector. Growth in investment does create demand but it also boosts productivity. This in turn has a negative effect on the demand for labour.

The projection rests on the assumption of a positive international development. Domestically, the investment ratio is assumed to increase in the face of a diminishing profit share and the household savings ratio is assumed to decrease in spite of a marked reduction in social welfare. Is this a viable scenario? That is the question.

ANNEX.

Sector 1 = The private sector.
Sector 2 = The public sector.

<u>THE PRODUCTION MODEL.</u>

Private production:

$$X_1(t) = A_1*(1+tech)^{t}*K_1(t)^{alfa}*N_1(t)^{beta}$$

K_1 = Capital stock; N_1 = Number of hours worked

tech = 1.2 ; alfa = 0.4 ; beta = 0.6

Public production = Public consumption:

$X_2(t) = A_2 * N_2(t)$

Public employment:

$N_2(t) = N_2(0)*(1+n_2)^t$; n_2 = exogenous

GNP:

$X(t) = X_1(t)+X_2(t)$

Labour supply:

$NS(t) = NS(0)*(1+ns)^t$; ns = exogenous

Average working time:

$AW(t) = AW(0)*(1+aw)^t$; aw = exogenous

Unemployment:

$\{NS(t) - N_1(t) - N_2(t)\}/AW(t)$

INVESTMENTS AND CAPITAL FORMATION.

Gross investments:

$I_j(t) = I_j(0)*(1+i_j)^t$

i_2 = exogenous

i_1 determined so that $I_1(T)/X_1(T) = invk_T$ = exogenous

Net direct investments:

$DI(t) = di*X(t)$ för $t>0$; di = exogenous

Investments in Stocks:

$SI(t) = si*X(t)$; si =exogenous

Total investments:

$I = SI+I_1+ I_2$

Capital formation:

$K_1(t+1) = (1-dep_1)*K_1(t)+I_1(t)+DI(t)$

$dep_1 = 0.03$; $K_1(0)/X_1(0) = 4.0$

THE PRICE MODEL.

lkp = rate of pay-roll tax
txi = rate of indirect tax
sub = Subsidies (Value added share)

All three determined exogenously by a value in the final year.

Wage share:

$lna = \{W_1*N_1*(1+lkp\}/\{P_1*X_1*(1-txi+sub\}$

Productivity:

$PI = X_1/N_1$

From the above two definitions follows:

$P_1 = \{W_1*(1+lkp)\}/\{lna*PI*(1-txi+sub\}$

Wages in the private sector:

$W_1(t) = W_1(0)*(1+w)^t$; w = exogenous

The implicit price index for the public sector:

$P_2 = A*W_2*(1+lkp)$

Wages in the public sector:

$W_2(t) = W_2(0)*(1+w)^t$; w = exogenous

The GNP deflator:

$P = \{P_1*X_1+P_2*X_2\}/X$

q = Rate of depreciation/appreciation of SEK

v = International rate of inflation

ima = import share in the private sector = 0.32

International prices in foreign denomination:

$P_v(t) = P_v(0)*(1+v)^t$

International prices in SEK:

$P_m(t) = P_m(0)*(1+v-q)^t$

Swedish domestic prices in SEK:

$P_h = (1-ima)*P_1+ima*P_m$

Export prices in SEK:

$P_e = P_h*(1-txi)$

Swedish rate of inflation:

$inf_i = [P_h(T)/P_h(0)]^{(1/T)} - 1$

Swedish rate of inflation excluding indirect taxes:

$inf_e = [P_e(T)/P_e(0)]^{(1/T)} - 1$

Swedish export prices in foreign denomination:

$P_{eu}(t)=P_{eu}(0)*(1+inf_e+q)^t$

Relative export price:

$RP_e = P_{eu}/P_v$

Relative import price:

$RP_v = P_h/P_m$

THE EXPORT FUNCTION.

m = market growth for Swedish exports

$lamda_2$ = price elastisity of exports = -1.4

$EX(t) = EX_0*(1+m)^t*RP_e(t)^{lamda_2}$

THE IMPORT FUNCTION.

gamma = income elasticity of imports = 1.9

$lamda_1$ = price elasticity of imports = 1.3

$IM(t) = IM_0*X_1(t)^{gamma}*RP_v(t)^{lamda_1}$

DISPOSABLE INCOME.

Real wage income:

$RINC = \{W_1*N_1+W_2*N_2\}/P_h$

Public transfers:

$TRF(t) = TRF(0)*(1+trf)^t$;trf = exogenous

Gross income:

fia = constant to determine residual gross income

fia = {GI(0)-RINC(0)-TRF(0)}/X(0)

GI = RINC+TRF+fia*X

Rate of indirect tax:

$taxd = taxd_T$ = taxd exogenous

Real disposable income:

DISP = {1-taxd}*GI

PRIVATE CONSUMPTION (PC).

Savings ratio:

SPK(T) = spk_T = exogenous

PC determined by the consumption function:

CON(t)={1-spk(t)}*DISP(t)

PC determined by the balance of resources:

C(t)=X_1(t)+IM(t)-I(t)-EX(t)

EQUILIBRIUM CONDITION.

CON(t) = C(t)

This condition closes the model and determines employment in the private sector.

BALANCE OF PAYMENT.

Trade and service balance:

VTB = P_e*EX - P_m*IM

Transfers:

TRB = utr*X*P + R_i*S_i + rest*X

utr = exogenous constant (average)

Current account:

CA = VTB + TRB

Capital balance:

S_i(t+1) = S_i(t)*(1-q) + CA(t) - DIC(t)

DIC = Net direct investments in current prices = exogenous.
S_i = Net foreign debt ; R_i = Nominal international rate of interest

THE CONSOLIDATED PUBLIC SECTOR.

Public income

Direct taxes:

$TAXD = txd*GI*P_h$

Indirect taxes:

$TAXI = txi*X_1*P_1$

Pay-roll taxes:

$LKP = lkp*\{W_1*N_1+W_2*N_2\}$

Residual income:

$ROI = roi*P*X$; $roi=ROI(0)/\{P(0)*X(0)\}$

Public expenditure

Consumption:

$OC = P_2*X_2$

Investments:

$OI = P_h*I_2$

Foreign transfers (Development aid and EU budget):

$EUU = utr*P*X$

utr = exogenous constant

Household transfers:

$TRFC = P_h * TRF(t)$

Subsidies:

$SUBC(t)=P_1*sub*X_1$

Interest payments net:

$ORN = R_o * S_o$

Interest rate:

R_o = rent + rdf + v - q

rent = international real rate of interest = exogenous

rdf = Swedish interest premium = exogenous

Public sector borrowing requirement/
Public sector fiscal savings:

PSBR = TAXD+TAXI+LKP+R0I-OC-OI-EUU-ORN-TRFC-SUBC

Public debt accumulation:

S_o = Net public debt

$S_o(t+1) = S_o(t) + PSBR(t)$

Private sector fiscal savings:

PSFS = CA - PSBR

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