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MACROECONOMIC FOUNDATIONS AND SIMULATION PROPERTIES OF THE BOF4 QUARTERLY MODEL OF THE FINNISH ECONOMY**

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ABSTRACT

This paper describes the structure and simulation properties of the Bank of Finland's macroeconometric model BOF4.

BOF4 is a quarterly, medium-sized macro model of the Finnish economy, consisting of about 70 behavioural equations. Including accounting identities and technical linkages of variables, the overall size of the model is about 270 equations. It replaced the previous (BOF3) model version in 1987, and has been used regularly thereafter for forecasting and policy analysis.

The macrotheoretical foundations of the model are in the conventional IS-LM-AS framework adapted for the analysis of an open economy. The relation of the BOF4 model to this analytical framework is discussed in the first part of the paper with the help of a simplified, theoretical "prototype" version of the model.

In the second part of the paper, the simulation properties of the actual model are described. The ability of the model to replicate actual economic developments are tested by means of historical (ex post) simulations. Finally, the responses of the model to international shocks and economic policy actions are examined with another set of simulation experiments.

The behaviour of the model in simulation experiments highlights the "neoclassical synthesis" properties of the model: the short-run results are strongly demand-determined, while the supply side influences dominate in the long run.

CONTENTS

1 INTRODUCTION AND SUMMARY

The BOF4 model of the Finnish economy is a quarterly econometric model developed and used at the Bank of Finland. The current BOF4 version has been operational since the beginning of 1987. It represents a fourth generation in the development of large scale, quarterly macroeconometric models in the Bank after the work on such models was initiated in the beginning of the 1970's. This paper presents an overview on the structure and properties of the BOF4, including some simulation results to illuminate the working of the model.[1]

The purpose of the model is to serve as an aid to short- and medium-term forecasting and policy analysis. As a research effort, the model provides a basis for accumulating applied econometric results, which otherwise might remain isolated and not appropriately utilized. Finally, the performance of the model is a kind of test for the mainstream macroeconomic paradigm which has been employed in the construction of BOF4. One of the outstanding features of the model is that its structure follows rather closely - notwithstanding certain extensions and attempts to disaggregate further - the standard open economy version of the "IS-LM-AS" model, widely used in applied economic analysis.

Technically, the model is a system of 272 equations. These may, somewhat arbitrarily, be classified in the following way:

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[1]The earlier versions, BOF1, BOF2 and BOF3 are documented in "A Quarterly Model of the Finnish Economy" (1972), "Suomen Pankin suhdannemalli" (1976), and in Tarkka and Willman (1985). Preliminary list of equations of the BOF4 model is published as Tarkka and Willman (1987). The following sectors of the present version of the model are reported in the Bank of Finland Discussion Papers: Exports and Imports (vol. 3/88), Production and Employment (14/88), Labour Supply, Wages and Prices (6/89), Consumption and Investment (9/89), and Financial Markets (1/90).

70	stochastic behavioural equations
30	stochastic technical linkages of variables
6	input-output equations determining production
9	input-output equations determining prices
157	definitions and accounting identities
272	total number of equations

The data of the model consists of 352 variables, excluding dummies. As the number of endogenous variables equals 272, the number of equations, there are 80 variables which remain exogenous in the system. The data are quarterly, seasonally adjusted where appropriate, and mostly from national accounts, balance of payments and banking statistics sources. A number of variables which do not exist on a quarterly basis in the official sources have been constructed specifically for the BOF model.

The most important differences of the present model from the previous and extensively documented BOF3 version are the following: (1) the disaggregation of fixed investment and stocks of fixed capital by sectors; (2) the use of the inverted production functions to solve for the required labour inputs; (3) the change in the technology assumption from Cobb-Douglas to CES technology in the production of value added on each sector; (4) the separation of public services form private services to a sector of its own; and (4) the use of market rates of interest to transmit monetary influences to the real side of the model, instead of the bank lending rate and credit rationing proxy which were used in the previous version.

The economic content of BOF4 may be briefly characterized as follows. The short-run determination of production, incomes and employment is governed by aggregate demand as in the Keynesian income-expenditure model. In BOF4, 16 different categories of aggregate demand and 5 categories of imports are distinguished. These determine the real value added on 5 production sectors by means of a compact input-output framework. In the course of time, however, the supply side comes to play an increasingly dominant role. Wages and prices respond to possible discrepancies between

demand and supply on the product and labour markets, and there is a gradual convergence towards a supply-determined long-run growth path of the economy. In this way, the model belongs to the "neoclassical synthesis" tradition of macroeconomics as defined, e.g., by Parkin (1982).

Consistent modelling of the supply side was emphasized in building the BOF4 model. The supply side of the labour market consists of a labour force participation equation (labour supply) and wage equations which include the Phillips curve effect. The modelling of the supply side of the goods market is based on an assumption of a CES value added production function for each of the five production sectors. Inverted production functions are used to solve for required labour inputs; the production functions are also used in calculating marginal costs of production and marginal products of fixed capital, which drive the price and investment equations of the model. Thus the model takes into account the supply-side effects of fixed investment on the stocks of fixed capital and on the development of productivity in the different sectors of the economy.

Expectations concerning future inflation, which are crucial for the wage-employment dynamics of the model, are assumed to be based on past inflation and on the deviation of the price of the Finnish exports of goods from the competitors' export prices. The inclusion of the latter term results from the fact that in the long-run the Finnish exporters are assumed to be price takers and, hence, domestic inflation can not permanently deviate from foreign inflation (both measured in a common currency). The long-run Phillips curve implied by the wage and price equations of the model is not constrained to be vertical. This means that inflation is allowed to have permanent effects on real wages in the model, contrary to the most extreme neoclassical position.

The modelling of the financial side of the economy follows the "monetary" tradition in the sense that the focus is on the supply of and demand for broad money. The market for other domestic financial assets is treated residually as is conventional in the IS-LM framework. Foreign assets are assumed to be imperfect substitutes to

domestic assets. Taken together with the "monetary" approach of modelling the domestic financial markets this leads to the model of partial monetary autonomy first developed by Kouri and Porter (1974). The market rate of interest is used to link the financial part of the model to the aggregate demand equations. The short-term market rate of interest can be treated either as a policy instrument or as endogenous. In the latter case, the domestic credit extended by the central bank is treated as exogenous. Exchange rates are assumed fixed in the model.

The simulation results reported in this paper reveal the existence of the "traditional" short-run tradeoffs between employment, inflation and external balance of the economy in the model. At least in the case of fiscal policy, the real effects are weaker than in the previous BOF model versions, however. In the long run, the scope for macroeconomic stabilization policy is much more limited than in the short run. In particular, even when fiscal expansion is implemented in the regime of accommodating monetary policy, there is full crowding out effect of fiscal expansion on domestic production in the long run. In this process the Finnish exports to the western market play a central role; they decrease until the cost pressures caused by fiscal expansion are fully neutralized. In the case of exchange rate policy, real effects are similarly reduced in the long run by price and wage flexibility. And, finally, the room for manoeuvre of monetary policy is narrowed in the long run by cumulative balance-of-payments effects of monetary expansion or contraction.

The rest of this paper is organized as follows. In chapter 2 the theoretical structure of the BOF4 is described by means of a simple and aggregative "prototype" model containing most of the outstanding features of the full empirical model. The simulation properties of the model are discussed in chapter 3.

2 A THEORETICAL PROTOTYPE MODEL

A frequently encountered problem in studying an econometric model is the difficulty of "seeing the forest for the trees": the amount of detail that has to be included in any model that is intended to be useful in practice makes it hard to locate the crucial parts and relationships. In this section we present a simplified "prototype" version of BOF4, which contains the essential features of the full model. This is hoped to enable the reader to recognize the basic genre of the BOF4 model.

2.1 The Simplified Structure

Our prototype model differs from the actual BOF4 in that the sectoral disaggregation of production has been entirely omitted. The composition of aggregate demand has been simplified by skipping the separate treatment of inventories, housing investment, bilateral exports and so on. Most of the institutional details in the government sector and in the distribution of the disposable income have also been excluded. For example, indirect taxes and interest payments by the Government have been disregarded. Government deficit is assumed to be financed exclusively by domestic bond issues. The supply of labour is treated as exogenous, although it is somewhat wage and income elastic in the actual model.

The functional forms and dynamics of the equations have been strongly simplified so that the model is for the most part linear or log-linear, and dynamics consist only of a Phillips curve, two partial adjustment mechanisms, two stock-flow identities connecting the balance of payments to the money supply and investment to the fixed capital stock, and, finally the definitional link from the rate of change of prices to the real rate of interest.

The symbols used in the exposition of the prototype model are mostly conventional enough to be self-explanatory. Nevertheless, a list of symbols is given after the model has been presented.

The model is a model of a small, open economy. We distinguish between three goods: (i) a domestic good which is produced in the country and both exported and used at home, (ii) an imported good which is used to satisfy a part of domestic investment and consumption demand, and (iii) a foreign good which competes with the domestic good in the export market. The domestic good is produced with a technology which uses labour, capital, and the imported good as inputs. The production function is CES for the value added and the input coefficient of the imported input is a constant.

Aggregate Demand:

(1) $$\log C = \mu_c \cdot \log Y_d + a \cdot \log[M/(P_c \cdot Y_d)] + (1-\mu_c) \cdot \log C_{-1}$$ (Consumption)

(2) $$I = \Delta K + d \cdot K_{-1}$$ (Investment)

(3) $$\Delta \log X = \Delta \log IM_f + b_0 \cdot \log(e \cdot P_f/P) + b_1 \cdot \Delta \log(IM \cdot e \cdot P_{im}/P)$$ (Exports)

(4) $$\log IM = c_0 \cdot \log Y - c_1 \cdot \log(e \cdot P_{im}/P)$$ (Imports)

(5) $$Y = C + I + G + X - IM$$ (Goods Market Equilibrium)

(6) $$Y_d = (P_y \cdot Y - T)/P_c$$ (Real Private Disposable Income)

Consumption (equation 1) is mainly determined by real disposable income and liquid financial wealth of the private non-bank sector. The equation includes lagged consumption as an argument, which makes the equation compatible with the permanent income model with adaptive expectations on real income. The effects of interest rates and inflation are weak enough in the model to be excluded in this simplified version.

The modelling of investment follows the neoclassical approach. This is discussed below in connection with the other supply side equations. Equation (2) above shows gross investment as a function of replacement investment and of the net change of the stock of fixed capital.

The change in the demand for exports (equation 3) depends with unitary elasticity on the change in the volume of the imports of Finland's trading partners as well as on the ratio of export prices to the prices of competitors' exports. Hence, the market shares of exports decrease (increase) as long as the export price is above (below) the competing world market price implying infinite price elasticity of the demand for the Finnish exports. The effects of Finland's bilateral trade with the Soviet Union are captured by the inclusion of the deflated value of imports in the export demand equation as an argument. In the full BOF4 model, a part of Finnish imports is satisfied by imports from the U.S.S.R. and bilateral exports adjust over time to achieve a balance in the bilateral trade.

Imports (equation 4) depend on the level of domestic activity as well as on the relative prices of imports and domestic goods.

Equation (5) is the usual goods market equilibrium condition. Real private disposable income is defined by equation (6).

Aggregate Supply: Productivity and Factor Demand

(7) $$\Delta \log N = \mu_n \{\log Q - \log[A \cdot \exp(\gamma \cdot TIME) \cdot (aK^{-\rho} + (1-a)N^{-\rho})^{-1/\rho}]\}$$

(Demand for Labour)

(8) $$MPN = h \cdot \exp(\gamma \cdot TIME) \cdot [a(K/N)^{-\rho} + (1-a)]^{-(\rho+1)/\rho}$$

(Marginal Product of Labour)

(9) $$MPK = j \cdot (Y/K_{-1})^{1+\rho} \cdot \exp(-\gamma\rho \cdot TIME)$$ (Marginal Product of Capital)

(10) $$\Delta \log K = \mu_k \cdot (MPK \cdot P_y/P_k - UC)$$ (Demand for Fixed Capital)

The supply side of the model consists of two parts. The first includes equations determining productivity and factor demand. The change in the actual labor demand is determined by the deviation of actual production from the level defined by aggregate CES production

function (equation 7). In the long run this partial adjustment mechanism adjusts the labor demand towards the level defined by the inverted CES function. The partial derivatives of the production function define marginal products of labour and capital (equations 8 and 9). Technical progress is captured by the inclusion of a time trend in the productivity functions. It is worth noting that the marginal product of labour (equation 8) is measured in terms of K/N instead of Y/N. This practice makes sure that also in the short run a positive demand shock decreases the marginal product of labour. We thus avoid the notorious problem of short-run increasing marginal productivity, which in many models leads to perverse reactions of prices to demand shocks.

The modelling of the demand for fixed capital can be seen as a result of the neoclassical profit-maximization approach with convex adjustment costs. Assuming static expectations on relative prices and the marginal product of capital, this yields a formulation in which the rate of change of the capital stock reacts to the gap between the marginal product and the user cost of capital - the so-called quasi-rent on fixed capital (equation 10).

Aggregate Supply: Price and Wage Behaviour

(11) $\Delta \log W = d_0 \cdot INF^e + \mu_u \cdot \log(N/NF) + \mu_w \cdot \log(MPN \cdot P_y/W) + q$

(Adjustment of Nominal Wages)

(12) $INF^e = (1 - \alpha_0) \cdot [\pi + \alpha_1 \cdot \log(e \cdot P_f/P)] + \alpha_0 \cdot \Delta \log P_c$

(Expected inflation rate)

(13) $P = (1-a_1) \cdot W/MPN + a_1 \cdot e \cdot P_{im}$ (Price of Domestic Output)

(14) $P_y = P/(1-a_2) - e \cdot P_{im} \cdot a_2/(1-a_2)$ (Value Added Deflator)

(15) $P_c = (1-a_3) \cdot P + a_3 \cdot e \cdot P_{im}$ (Consumption Deflator)

(16) $P_k = (1-a_4) \cdot P + a_4 \cdot e \cdot P_{im}$ (Investment Deflator)

(17) $UC = i + d - INF^e$ (Real User Cost of Capital)

The wage/price part of the supply side contains three behavioural equations and four definitions. The nominal wage adjustment equation (11) includes a Phillips curve effect augmented with an inflation term and a measure of the "real wage gap". Here the Phillips curve effect of employment on wages is entered through the ratio of employment to exogenous labour supply; in the actual BOF4 model, however, the Phillips curve is a function of the unemployment rate and labour force participation is endogenized. In addition, the effects of changes in personal taxation are included. The real wage gap is measured by the ratio of real product wages to the marginal product of labour (note that social security payments do not exist in this prototype model).

The relationship of the wage equation (11) of our model to the standard expectations-augmented Phillips curve may deserve a brief comment. If in (11) the coefficient of the expected inflation rate were equal to one, the equation would produce classical or "perfect foresight" dynamics for wages. However, the coefficient is actually smaller than one (about 0.7 as inferred from the parameters of the full BOF4 model).

In equation (12) the expected inflation rate is defined as a weighted average of the long-run core and the actual average inflation rates. The definition of the core inflation rate brings the aspect of forward-lookingness into the expectation formation; market participants know that the more the domestic price level is above the competing foreign price level the lower the inflation rate has to be in the future to reverse the long-run price parity.

The prices of output are proportional to marginal cost of production (equation 13). It is assumed that the production of the domestic good requires real value added and the imported good in fixed proportions $(1-a_2)$ and a_2. This implies also that equation (14) holds between the value added deflator and the prices of domestic and imported goods. Moreover, from (13) and (14) it can be seen that the value added deflator is proportional to W/MPN.

Private consumption and fixed investment are assumed to use the domestic good and the imported good in fixed proportions (equations 15 and 16). Note that although indirect taxes are not taken into account in this prototype model, they are included in the actual BOF4, where they considerably complicate the prices block of the model.

The equation (17) defines the real user cost of fixed capital as a function of the interest rate, the expected inflation rate and the depreciation coefficient of fixed capital. The actual formulas used in BOF4 are more complicated due to the inclusion of corporate tax parameters.

Government:

(18) $T = t \cdot P_y \cdot Y$ (Tax Function)

(19) $\Delta B = T - P_y \cdot G$ (Government Budget Constraint)

The tax function (equation 18) and the government budget constraint (equation 19) are shown here in an extremely simplified form. For example, the options of financing the government deficit by Central Bank credit or by foreign borrowing are here overlooked.

Financial Markets:

(20) $\Delta R = P \cdot X - e \cdot P_{im} \cdot IM + \Delta F$ (Balance of Payments)

(21) $F = f \cdot (i - i_f) \cdot Y \cdot P_y$ (Demand for Foreign Debt)

(22) $M = (m_0 - m_1 \cdot i) \cdot Y \cdot P_y + (1-\mu_m) \cdot M_{-1}$ (Demand for Broad Money)

(23) $S = s \cdot C \cdot P_c$ (Demand for Currency)

(24) $D = S + k \cdot (M - S) - R$ (Demand for Central Bank Credit)

(25) $M = R + D + L - CD$ (Money Supply by Credit Components)

In the simplified financial block, three types of assets are distinguished: net foreign assets, money, and domestic non-monetary assets. All domestic non-monetary assets are assumed to be perfect substitutes with each other. Accordingly, we need not deal with more than one domestic market rate of interest.

The balance-of-payments identity (equation 20) determines the change in the foreign reserves of the Central Bank as a sum of the trade balance and capital inflow.

The foreign capital movements - or, rather, the stock demand for foreign debt - are explained by a portfolio equation (21). Exogenous exchange rate expectations may be thought to be included in the foreign interest rate i_f. In the actual BOF4 model, the capital movement equation is estimated in the so-called Kouri-Porter form: in differences and with the domestic interest rate eliminated by inserting the inverted demand-for-money equation in its place.

The demand for broad money is given by equation (22). Here the inverse velocity depends linearly on the market rate of interest. In addition, a partial adjustment mechanism in a nominal form has been specified. The demand for currency (notes and coin) is a simple transactions relationship where the value of private consumption determines the need for transactions balances (equation 23).

The demand for domestic credit from the Central Bank is defined as the demand for currency plus the demand for required bank reserves (a fixed proportion k to deposit money M-S) minus foreign reserves (equation 24). Finally an identity (equation 25) decomposes the money supply into its "credit components". Domestic bank credit is here divided into central bank credit, credit from the deposit banks, and money market deposits at banks (which are treated as negative credit due to their exclusion from the definition of money). The identity (25) is capable only of determining the difference L - CD, a "net" bank credit concept. To determine separately both L and CD, an additional equation for the supply of gross bank credit L has been estimated in the complete BOF4 model. For the purposes of the present analysis that equation is not necessary, however.

The model may be solved with different assumptions on the monetary policy pursued by the Central Bank. In the version of the model presented here, the exchange rate is assumed to be fixed. However, as regards to the domestic side of monetary policy, the Central Bank may alternatively be assumed to peg the market rate of interest or fix its domestic credit. Under certain assumptions, the model can also be used to analyze monetary policy operating through quantitative control of bank lending (credit rationing).

List of Symbols:

B	the stock of government bonds outstanding
C	private consumption (real)
CD	money market deposits at banks
D	domestic credit of the central bank
d	depreciation rate of fixed capital
e	the exchange rate
F	the stock of net foreign debt
G	government consumption (real)
I	investment (real)
IM	imports (real)
IM_f	imports of foreign countries (real)
i	the rate of interest
i_f	the foreign rate of interest
K	the stock of fixed capital (real)
k	cash reserve requirement
L	bank credit (excl. central bank)
M	the supply of broad money
MPK	marginal product of capital
MPN	marginal product of labour
N	employment (=demand for labour)
NF	labour force (=supply of labour)
P	the price of domestic output
P_c	consumption deflator
P_f	the price of foreign goods in foreign currency
P_{im}	the price of imported goods in foreign currency
P_k	investment deflator
P_y	the value added deflator
R	foreign reserves (of the central bank)
S	currency
T	taxes
t	the tax rate
TIME	linear time trend
UC	real user cost of capital
W	the nominal wage rate
X	exports (real)
Y	production (real)
Y_d	private disposable income (real)

Negative subscripts denote lags.

2.2 The Short-Run Properties of the Model

A standard way to scrutinize the short-run properties of a model such as developed in equations (1) to (25) above is to derive the IS, LM, and AS schedules implicit in the model and to study the comparative statics of income, prices, and the interest rate when the model is subject to changes in its exogenous variables. The comparative statics analyzed below characterize the immediate impact effects of different exogenous changes on the model. In a longer perspective the properties of the model come to depend on the dynamics of the equation system, such as the accumulation of capital or the adjustment of real wages towards a labour market equilibrium. These processes are, however, so complicated that they are best studied by simulating the full model.

2.2.1 The IS Function

The IS schedule - or the aggregate demand for goods equation conditional on the rate of interest and the price level - may be derived by substituting the equations for the different demand components to equation (5), the goods market equilibrium condition. After using the equations for M, Y_d, T, B, ΔlogK, MPK, P^C, P_k and P_y to eliminate the respective variables, an IS curve of the following type is obtained:

$$(26) \qquad Y = IS(i,\ P,\ e{\cdot}P_f,\ e{\cdot}P_{im},\ G,\ t,\ IM_f,\ TIME,\ DLAGS)$$
$$\qquad\qquad\qquad - \ (-) \quad + \quad (+) \quad + \quad - \quad + \quad + \qquad\qquad (26)$$

The signs of the partial derivatives of the IS function - i.e. the partial derivatives of aggregate demand holding the rate of interest and the price level constant - are shown below the equation. If the sings are ambiguous, we report in parenthesis the results of simulations with the relevant equations of the BOF4 model. Since the interest here is on comparative statics, the presentation of dynamics is simplified by collecting all lagged variables in a composite variable DLAGS. This contains, for example, the lagged stocks of financial assets and fixed capital. For static analysis,

these are unimportant but they are of course crucial for the dynamics of the solution.

Mostly the interpretation of the signs of the partial derivatives of (26) is obvious. The rate of interest has a negative effect on aggregate demand because of the cost of capital effect on investment. The sign of the price level would be unambiguously negative, notwithstanding a positive effect of inflation on aggregate demand through the user cost of capital (17). In the actual BOF4 model, the negative effects of the price level on aggregate demand (i.e. the competetiveness effect on exports and imports and the real balance effect on consumption) by far dominate the cost of capital effect. It may be noted that the positive interest rate effect in the model is as such something of an artifact due only to the "backward-looking" inflation concept used in the cost of capital formula.

The partial effect of the exchange rate (defined as the price of the foreign currency in terms of the domestic currency) on aggregate demand (with a given rate of interest and a given price level) is also in principle ambiguous: There is a positive substitution effect through the price elasticities of imports and exports, and a negative income effect due to the reaction of the terms of trade. In the actual BOF4 model, the positive substitution effect dominates.

The effects of the fiscal policy variables (government consumption and the tax rate) and the growth of foreign markets are conventional. The time trend representing technical progress enters with a positive sign. This is because, with given prices, technical progress increases the marginal product of capital and hence boosts investment.

2.2.2 Aggregate Supply

The AS function - or the aggregate supply equation - may be derived by substituting the Phillips curve (11) and the expected inflation rate equation (12) to equation for the price level (14), and by

using the productivity equations (7) and (8) to eliminate employment from the equation. The aggregate supply function is of the following type:

$$(27) \qquad P = AS(Y,\ e{\cdot}P_f,\ e{\cdot}P_{im},\ NF,\ TIME,\ SLAGS)$$
$$\qquad\qquad\qquad\quad +\quad +\quad +\quad -\quad -$$

Again, the signs of the partial derivatives appear below the respective variables. The output variable Y has a positive sign so that an increase in the demand for goods pulls up the price level. This is partly because of the Phillips curve effect, and partly because of the less than infinite elasticity of substitution between labour and capital which implies decreasing marginal product of labour and, hence, increasing marginal costs of production when the stock of capital is predetermined.

The exchange rate and the price of imports have a positive effect on the prices of domestic goods because of the use of the imported goods as raw materials and also because of the effect of the cost of imports on consumer prices and hence on wages. The competitors' export price effect positively on the prices of domestic goods via expected inflation.

An increase in the supply of labour would cause a reduction in the price level through the Phillips curve effect. With a negative price elasticity of aggregate demand, this is a necessary part of the adjustment mechanism which works to equilibrate the labour market of the model in the long run.

Technical progress, represented by the time trend, increases productivity and lowers the marginal cost of production over time. This has a negative effect on the price level. Finally, all lagged variables in the aggregate supply function are represented by the composite variable SLAGS. Among these a particularly important one is the stock of fixed capital which links past invetment with current productivity and real wages.

2.2.3 The Monetary Equilibrium and the LM Function

The LM function indicates the equlibrium condition of the financial markets in the model. It may be derived from the demand for central bank credit equation (24) by substituting equations (20), (22) and (23) for foreign reserves, currency, and the broad money stock. After using the demand for foreign debt equation (21), this gives

$$(28) \qquad D = (1-k)\cdot s\cdot C\cdot P_c + k\cdot\left[(m_0 - m_1\cdot i)\cdot Y\cdot P_y + \mu_m\cdot M_{-1}\right] -$$

$$P\cdot X + e\cdot P_{im}\cdot IM - f\cdot(i - i_f)\cdot Y\cdot P_y + F_{-1} - R_{-1}$$

Using yet the equations for consumption (1), exports (3) and imports (4), the definitions of private disposable income, value added and consumption deflators and the government budget constraint, the demand for central bank credit may be written in the following way:

$$(29) \qquad D = D(Y,\ P,\ i,\ k,\ G,\ t,\ e\cdot P_{im},\ e\cdot P_f,\ IM_f,\ i_f,\ MLAGS)$$
$$\qquad\qquad + \ +\ -\ +\ +\ -\ \ (-)\ \ -\ \ -\ \ +$$

This is also the LM function in the case of exogenous (or pegged) domestic interest rate. In this case the central bank credit D adjusts freely to equilibrate the financial markets. In the other polar case of exogenous central bank credit and flexible interest rate it is useful to view the LM function in the following form, solved for the interest rate:

$$(30) \qquad i = LM(Y,\ P,\ D,\ k,\ G,\ t,\ e\cdot P_{im},\ e\cdot P_f,\ IM_f,\ i_f,\ ILAGS)$$
$$\qquad\qquad + \ +\ -\ +\ +\ -\ \ (-)\ \ -\ \ -\ \ +$$

In the two forms of the LM function the lagged variables, consisting of the "beginning-of-period" stocks of financial assets, are included in the portmanteau variables MLAGS and ILAGS.

From (29) and (30) it can be seen that an increase in either prices or real output tightens the money market, causing the central bank credit to expand - or, if monetary policy is not accommodating, rising the rate of interest.

The monetary policy instruments of the model consist of the cash reserve requirement and either the rate of interest or the quantity of central bank credit. As is natural to expect, an increase in the cash reserve requirement either rises the interest rate or increases central bank credit. An increase in central bank credit has a negative effect on the rate of interest, and an analogous negative relationship holds between these variables also when the rate of interest is treated as exogenous.

The monetary effects of fiscal policy in the model may deserve a comment: As is shown in (29) and (30), expansionary fiscal policy - an increase in government consumption G or a cut in the tax rate t - tightens the money market also directly, not only through its effects on output as is more conventional in IS-LM models. The reason is the dependence of the demand for currency on consumption rather than on output in (23). This implies that anything which increases the average propensity to consume C/Y will increase demand for currency and ultimately the demand for central bank credit at a given level of Y. For example, a tax cut increases the share of private disposable income in Y and hence also C/Y.

The foreign variables have monetary effects mostly through the balance of payments. An increase in the growth of foreign markets, for example, has a positive effect on the balance of payments and hence a negative effect either on the demand for central bank credit or on the rate of interest. This partial result hodls also with the actual BOF4 model, where the resulting increase in Y is taken into account. An increase in the prices of foreign competitors P_f has similar effects.

The effects of import prices are uncertain as to their direction in the theoretical model. Even the balance-of-payments effects may go to either direction, since an increase of import prices may either improve or worsen the trade balance, depending on the price elasticity of imports. In addition, changes in import prices have effects on relative prices in the economy so that with a given price of domestic output, an increase in import prices rises consumer prices but lowers the value added deflator. The consumer price

effect tightens the money market, while the value added deflator effect works in an opposite direction. Further, this ambiguity in the effects of import prices makes it impossible in priciple to ascertain the direction to which a change in the exchange rate would affect the money market. In the actual BOF4 model, however, the price elasticities of exports and imports are strong enough so that a devaluation improves the trade balance and has a loosening effect on money market.

As is natural to expect in a model with capital mobility, changes in the foreign rate of interest have effects on the domestic financial markets. If the domestic rate of interest is flexible, it follows partly the movements of the foreign rate. In the case of pegged domestic interest rate, an increase in the foreign rate has a positive effect on the demand for central bank credit.

2.2.4 Properties of the Short-Run General Equilibrium

Collecting the partial derivatives from the IS, AS and LM functions analyzed above (equations 26, 27, and 29 or 30) one can determine the total short-run impact effects of changes in exogenous variables on production, price level, and the interest rate (or on central bank credit, if the rate of interest is pegged).

The comparative statics of the model are presented in tables 1 and 2 for the cases of flexible and pegged interest rate, respectively.

TABLE 1. The Comparative Statics with a Flexible Interest Rate

	G	t	D	k	IM_f	$e \cdot P_f$	$e \cdot P_{im}$	i_f	NF
Y	+	-	+	-	+	+	(+)	-	+
P	+	-	+	-	+	+	(+)	-	-
i	+	-	-	+	(-)	(-)	(-)	+	(+)

TABLE 2. The Comparative Statics with a Pegged Interest Rate

	G	t	i	k	IM_f	$e \cdot P_f$	$e \cdot P_{im}$	i_f	NF
Y	+	-	-	0	+	+	(+)	0	+
P	+	-	-	0	+	+	(+)	0	-
D	+	-	-	+	(-)	(-)	(-)	+	(+)

A comprehensive discussion of the effects of economic policy or other exogenous impulses in the model is presented in chapter 3, where simulation properties of the full BOF4 model are described.

3 SIMULATION PROPERTIES

3.1 Ex Post Simulations

In this chapter the simulation properties of the BOF4 model are analyzed. This is done with two kinds of simulation experiments: ex post forecasts and multiplier analyses. The ability of the model to forecast economic development ex post is discussed first.

Ex post forecasts are a widely used method to evaluate the ability of macroeconomic models to replicate actual economic developments. These tests shed some light on the general reliability of the model, and may serve as diagnostic checks as well, revealing possible "weak spots" in the model structure. In ex post simulations, the model is simulated over a historical period so that the exogenous input of the model corresponds to the actual history of the exogenous variables. The resulting "forecast" is then compared to actual data of the endogenous variables.

In the following, we report results from two ex post simulation experiments. The first is a dynamic, within-sample simulation over the ten-year period from the beginning of 1976 to the end of 1985.

This simulation is "within sample" in the sense that the estimation period of most of the equations in the model extends from the 1960's up to 1985, and thus includes the simulation period in question. Furthermore, the constant terms of a number of equations were adjusted before the simulation to improve the overall tracking ability of the model. This calibration, which is also routine in actual forecasting work, compensates for outliers in the initial values of the endogenous variables of the model. It may also correct some of the simultaneous equations bias in the parameter estimates of the model, since the model has been estimated with the OLS method.

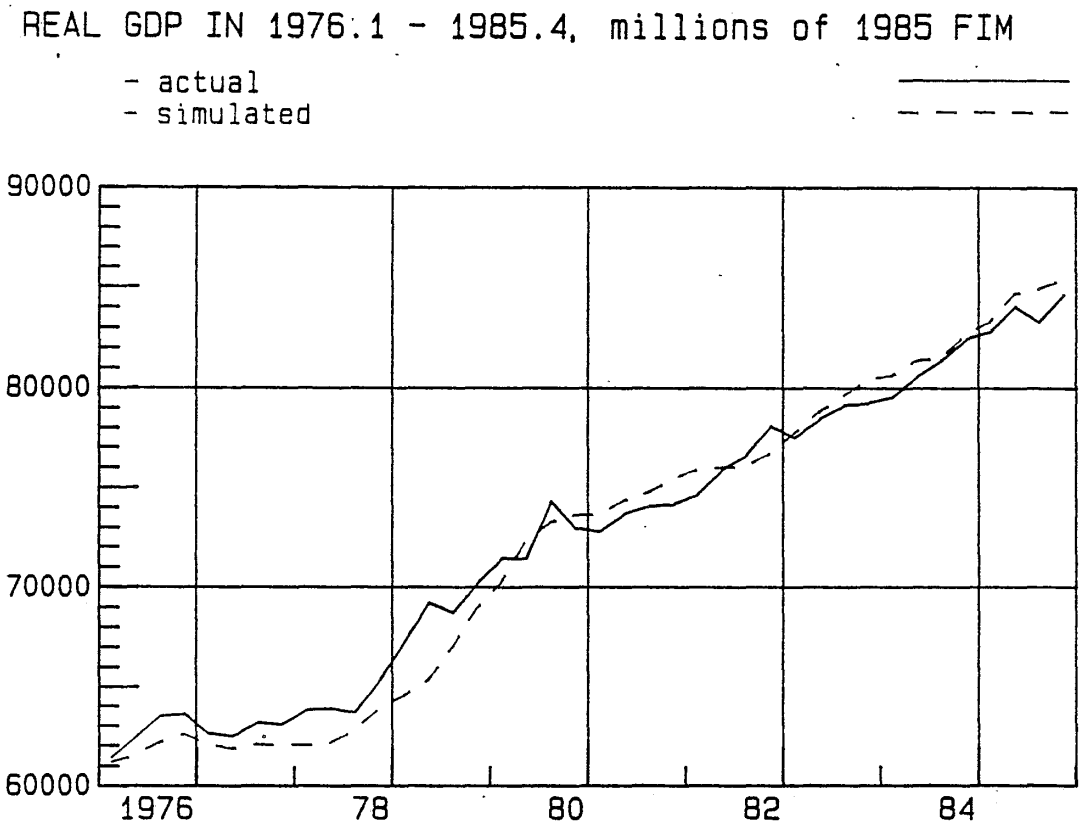
The simulation is "dynamic" in the sense that all lagged endogenous variables have their model-generated values for observations after the 1st quarter of 1976. This method allows possible forecast errors

to cumulate in the dynamic structure of the model, just as in the actual use of the model in multiperiod forecasting of the future.

The short-term interest rate and the inflation expectations variable were held exogenous in the simulation. The latter was given values corresponding to the inflation forecasts circulated by the Economics Department of the Bank of Finland for the relevant periods.

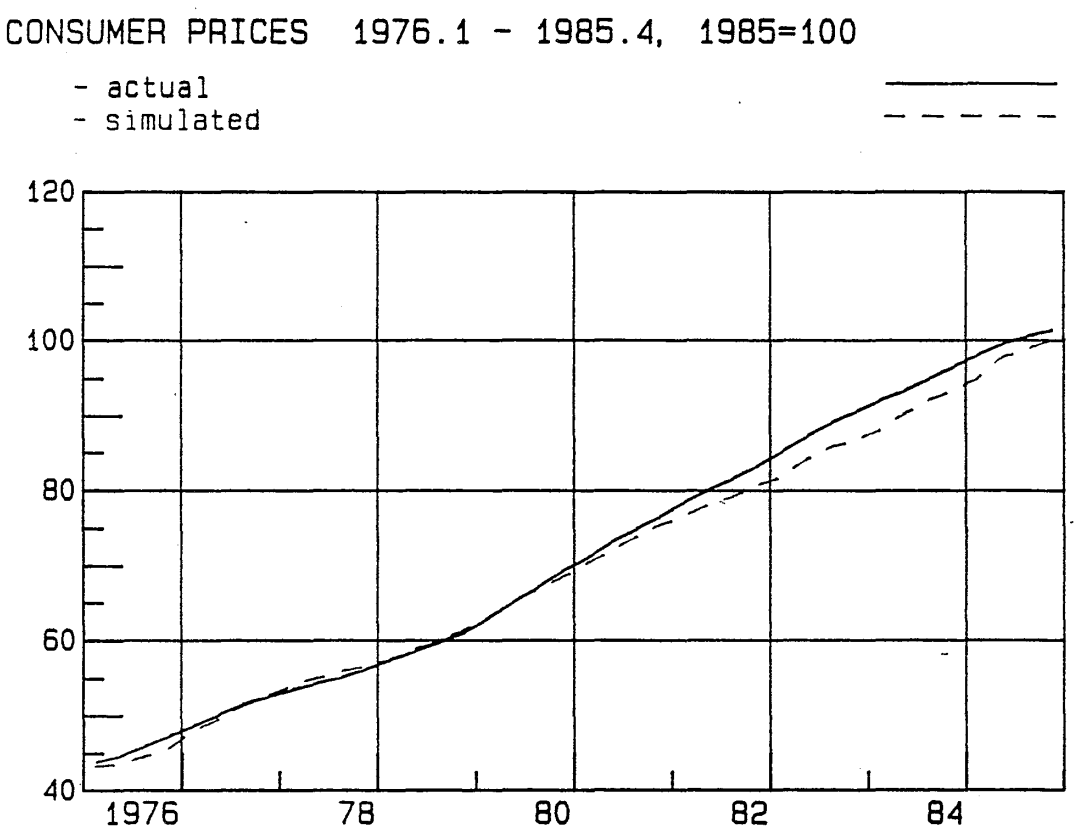
The ability of the model to replicate the actual development of real GDP is shown in fig. 1. It can be noted that the average growth rate of the ex post forecast of GDP is almost exactly right; the cyclical pattern seems to lag a couple quarters behind the actual cycle, at least in the major upswing of 1979 - 1980 which followed the "revitalization policies" adopted in 1977 and 1978.

FIGURE 1. Results from the Dynamic Ex Post Simulation:



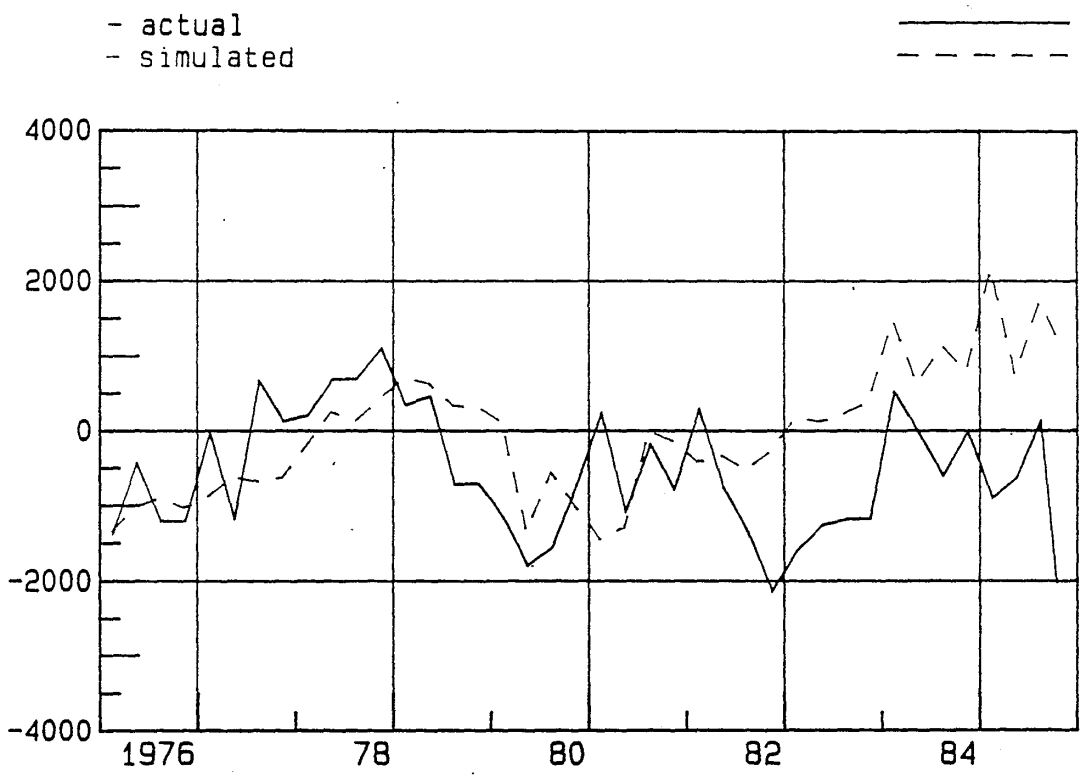
Inflation is a little slower in this ex post forecast than in actual history. Thus, by 1983 and 1984, the consumer price level is already underestimated by about 2 per cent. This is clearly visible in figure 2. Taking into account the length of the simulation, this discrepancy is not very serious, however.

FIGURE 2. Results from the Dynamic Ex Post Simulation:



Models often make relatively large errors in predicting trade deficits, budget deficits and other variables, which are determined as differences of larger aggregates. As figure 3 shows, the calibrated BOF4 version does quite well in predicting the Finnish current account deficit for the first six years of the simulation. Thereafter, the model produces a better external balance than actually occurred. This result is probably due to the underestimation of the domestic price level, which was discussed above. Lower domestic prices may improve the current account through overestimated competitiveness of domestic production in export and import markets.

FIGURE 3. Results from the Dynamic Ex Post Simulation.



A convenient way to summarize the forecast accuracy of a model over a given period of time is provided by error statistics such as the mean absolute errors made by the model. The mean absolute error MAE and mean absolute percentage error MAPE are defined as follows:

$$MAE = (1/T) \sum_{t=1}^{T} F_t - A_t$$

$$MAPE = (100/T) \sum_{t=1}^{T} (F_t - A_t)/A_t$$

where the period under scrutiny is from 1 to T, and F and A are the forecast and actual values, respectively, of a variable in period t.

MAPE's are often used to summarize forecast accuracy in the case of variables like production, expenditure, or price levels. For

variables which can take both positive and negative values, MAPE's are not appropriate, however. They are also not very informative for variables which are originally in percentage form. MAE statistics are commonly used for these kinds of variables.

The error statistics of the BOF4 model in the within-sample ex post simulation are as follows:

TABLE 3. Mean Absolute Percentage Errors (MAPE's) in Selected Variables in the Calibrated, Dynamic Simulation for 1976 - 1985

Variable	MAPE
Real GDP	1.3
Private consumption	1.7
Public consumption	3.1
Private fixed investment	1.9
Total exports	3.1
Total imports	2.6
GDP deflator	2.4
Consumption deflator	1.9
Real wage rate	1.8
Broad money (M3)	3.7
Employment	3.7

TABLE 4. Mean Absolute Errors (MAE's) in Selected Variables in the Calibrated, Dynamic Simulation for 1976 - 1985.

Variable	MAE
Unemployment rate	1.0
Current account, % of GDP	1.5
Inventory investment, % of GDP	1.3

As such, these results give an encouraging picture of the "fit" of the BOF4 model within the sample period. Notably, the errors seem to be smaller than in the previous BOF3 version of the model (see

Tarkka and Willman (1985)). It should be pointed out, however, that comparisons between models on the basis of ex post simulations are in most cases difficult, if not impossible. This is so because different models have different sets of exogenous variables. Since exogenous variables are given their true historical values in the ex post simulations, increasing the degree of exogeneity tends to improve the apparent performance of the model (see e.g. Mc Nees (1981)).

This point is illustrated by the case of public consumption in the BOF4 model. As can be seen in table 3 above, the mean absolute percentage error made by the model in forecasting public consumption is relatively large. This is because local government consumption is endogenous in BOF4. If it were exogenized, following the practice of most other macro models, the MAPE statistics would be improved, even though the usefulness of the model in ex ante forecasting or in policy analysis would probably decline.

The usefulness of the model outside the estimation period depends on the immunity or vulnerability of the model to structural changes which inevitably occur in the actual economy. This question may be assessed by comparing the performance of the model in out-of-sample simulations to the within-sample performance. This is the motivation of the second ex post simulation experiment which we report below.

The second ex post simulation is a dynamic simulation with the BOF4 model over the period 1986 (1st quarter) - 1988 (4th quarter). For most of the equations in the model, the data for this period has not been used in estimation. Exceptions can be found in the financial markets block of the model, where some equations have been estimated with more recent data. Consistent with the logic of simulating "post sample", the model has not been recalibrated, and the constant terms of the equations are thus as given by the OLS estimation.

The post sample simulation is run with endogenous interest rates. Correspondingly, the domestic credit of the Bank of Finland is exogenized. The resulting error statistics are as follows:

TABLE 5. Mean Absolute Percentage Errors (MAPE's) in Selected Variables in the Dynamic Post-Sample Simulation for 1986 - 1988

Variable	MAPE
Real GDP	1.2
Private consumption	0.8
Public consumption	4.2
Private fixed investment	2.7
Total exports	3.7
Total imports	1.8
GDP deflator	2.1
Consumption deflator	2.5
Real wage rate	1.1
Employment	0.5

TABLE 6. Mean Absolute Errors (MAE's) in Selected Variables in the Dynamic Post Sample Simulation for 1986 - 1988

Variable	MAE
Unemployment rate	0.8
Money mkt. interest rate	4.0
Current account, % of GDP	1.0
Inventory investment, % of GDP	0.5

The forecast performance of the model in this experiment is again quite satisfactory by general standards. Furthermore, the error statistics suggest that the performance of the model does not deteriorate much outside the period of estimation, although the period of three years (12 observations) is obviously much too short to allow any definite conclusions. The trouble spot seems to be the short-term interest rate, which is systematically underestimated by the model in this experiment. The error is, however, smaller in the bond rates of interest, which are the main links from financial conditions to the real economy in the model.

Detailed tables of the ex post forecast for 1986 - 1988 and the corresponding actual figures are presented for comparison in

appendix 2 of this paper. The evidence in the tables suggests that the model does not capture the effects of the oil price collapse of 1986 quite satisfactorily (the prices of energy imports fell by about 47 % that year). On the export markets, the model interprets the corresponding fall in trading partners' import prices as a sign of weakened competitive position, which leads to underestimation of export performance in the forecast. On the domestic side, the pass-through of the oil price drop to domestic prices is clearly too fast.

3.2 Multiplier Analysis

Some simulation experiments with the BOF4 model are reported in the following to illustrate the main properties of the model. We analyze the responses of the model to various foreign shocks and domestic policy measures. Special emphasis is on the analysis of the "small open country" properties of the economy. These include the supply side determination of exports and the adjustment of the price level to PPP in the long run. The simulations also focus on the scope for fiscal, monetary and exchange rate policy.[1]

All simulations reported here were run with the fixed exchange rate version of the model, and in all but one case the short-term interest rate was treated as exogenous. In one of the simulations the domestic credit extended by the central bank is fixed, and the short-term market rate of interest equilibriates the money market.

Effects of various exogenous shocks to the economy are reported as differences of the shock solution from a baseline solution for 1990 - 1999. To characterize the baseline, some average figures are compared to those of the 1980's in table 1 below.

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[1]Selected earlier reports on the simulation properties of the BOF model are listed separately at the end of the references section of this paper.

TABLE 7. Annual Averages of the Baseline Solution as Compared to Actual Data (1989 Forecast), Per Cent.

	ACTUAL 1980 - 1989	BASELINE 1990 - 1999
Volume of GDP, chg	3.5	2.0
Priv. cons. deflator, chg	7.2	4.4
Unemployment rate	5.0	5.8
Real rate of interest	5.0	6.3
Current account, % of GDP	-1.8	-3.1

In the baseline, growth of GDP slows down from the trend of the 1980's and averages 2 per cent annually. For the ten year period, the growth is rather stable (annual rates of GDP growth range from 1.5 % to 2.3 %). The underlying reason is a persistent current account deficit, requiring historically quite high interest rates. Unemployment rate increases accordingly from 4.2 % to 7.0 %.

All the simulations were run with exogenous nominal transfers from the central government to the other sectors of the economy. Income tax schedules, however, were endogenized to prevent bracket creep despite gradual inflation.

The following simulations are shortly described on the next pages. The detailed tables are presented in the appendix.

1. Sales tax rate increased by 1 percentage point.

2a. Public employment increased: Central government consumption and public value added increased by 1 billion 1985 FIM per quarter.

2b. As in 2a but with the flexible interest rate version of the model.

3. Export markets increased by 1 per cent.

4. World market prices increased by 1 per cent.

5. Short-term interest rate reduced by 2 percentage points.

6. Working-age population increased by 1000 persons.

3.3 Simulation 1: Sales Tax Rate Increased

The sales tax increase may be used to illustrate the effects of private domestic demand changes in the model. The tax is not quite neutral, however, since the Finnish sales (turnover) tax differs somewhat from a value-added tax. The tax base is modelled to consist of

93.3 % of the consumption of durables
74.3 % of the consumption of non- and semi-durables
6.3 % of the consumption of services
9.7 % of public consumption
29.1 % of fixed investment[2]
6.6 % of exports
32.0 % of value added, agriculture
28.6 % of value added, services etc.
15.4 % of value added, forestry, and
-9.3 % of value added, manufacturing.

It is worth noting that only a minor proportion of the consumption of services is included in the sales tax base.

In the baseline solution, the general sales tax is 16 % of the after-tax price, the average rate for industrial machinery and equipment 1.6 % and the rate for industrial buildings 0 %. In the shocked solution, the general sales tax rate is increased by one percentage point.

The main effects of the shock are reported as differences from baseline on page 1 in the appendix. The resulting price increases are, even in the short run, a little less than one per cent. In the long run, a marked decline takes place in the prices before tax. Thus consumer prices, for instance, rise only by 0.4 % in the long run. The induced inflationary impulse to wages is temporary and real wages actually decrease over time by 0.5 - 0.8 % due to decreasing demand.

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[2]Not including investment in manufacturing, for which there are two specific parameters in the model.

Domestic demand decreases somewhat; private consumption decreases by about half a per cent. A shift of domestic demand from the open sector and imports to the less comprehensively taxed closed sector (services) takes place.

Price competitiveness improves in the long run due to the Phillips curve mechanism and the loosening capacity constraints, and the temporary decrease in total exports turns into an increase. Bilateral exports follow the pattern of the decreasing imports. In net terms, however, increasing exports gradually compensate for the lost domestic demand.

Economic activity slows down during the first five years (the decrease in GDP is about half a per cent), and starts to recover towards the baseline level thereafter. This is reflected in a temporary decrease in employment by 13,000. The sensitivity of the unemployment rate to the level of GDP is in the short run pretty much in line with the so-called Okun's law, as is apparent from the following table.

TABLE 8. Effects of Demand-induced Growth of Real GDP on the Number of Employed (Per Cent/Per Cent) and on the Unemployment Rate (Percentage Point/Per Cent).

year	Effect of GDP growth on	
	Employment	Unemployment rate
1	0.19	-0.12
2	0.46	-0.20
3	0.59	-0.24
4	0.73	-0.28
5	0.91	-0.35

Central government revenue from sales tax increases in the first year by 3 FIM billion, reducing central government net borrowing by the same amount. Later on, government financial balance is further improved in the simulation because of the non-indexation of government transfers. As a result, the current account improves slightly.

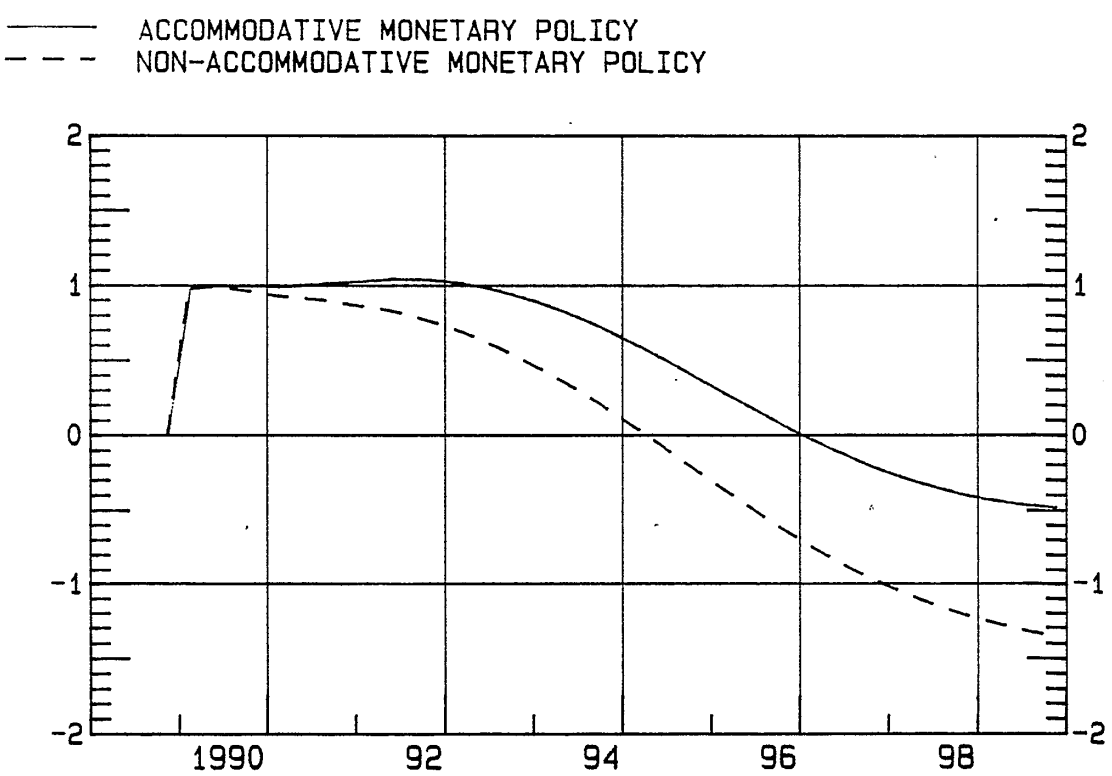
3.4 Simulations 2a and 2b: Public Employment Increased

Increase in public employment was implemented by increasing central government consumption and public sector value added 1 billion 1985 FIM per quarter equalling to 1 per cent of GDP in 1990. The fiscal stimulus was assumed to be financed by domestic bond issues.

Simulation 2a was run with accommodating monetary policy (fixed money market interest rate) and simulation 2b was run with non-accommodating monetary policy (fixed central bank credit).

According to the simulations, crowding-out effects from fiscal policy are strong especially with non-accommodative monetary policy. Dynamic multipliers are shown in tables 9 and 10 below. Note that the definition of multipliers is the effect in real terms divided by the fiscal stimulus, also measured in real terms. The concept of the multiplier is thus analogous to that of the derivative. By contrast, in the appendix tables 2 and 3 the effects of the fiscal policy measures are in percentage deviations from the baseline.

FIGURE 4. Dynamic Multiplier Effects on GDP of a Sustained Increase in Public Employment (Simulations 2a and 2b, Million Per Million in 1985 Prices).



Even with accommodative monetary policy, the multiplier effect on GDP is only slightly above one in the second and third year. Because of the shift of resources to the public sector with slow productivity, the GDP effect turns negative in the long run. Without this resource shift, the multiplier would converge to zero as is obvious from our stylized theoretical model. This is due to the small open economy assumption built in the model which leads to the supply-determination of open sector output in the long run.

TABLE 9. Fiscal policy multipliers with accommodating monetary policy: The effects of a bond-financed increase in public employment with interest rate fixed.

Year	1	2	3	4	5	10
GDP	0.99	1.01	1.04	0.97	0.78	-0.47
Imports, total	0.47	0.44	0.47	0.49	0.48	0.11
Exports, total	0.01	0.00	-0.04	-0.13	-0.26	-0.76
Multilateral (West)	-0.01	-0.02	-0.06	-0.15	-0.25	-0.67
Bilateral (East)	0.01	0.02	0.03	0.03	0.03	-0.01
Services	0.01	0.00	-0.01	-0.02	-0.04	-0.08
Private consumption	0.18	0.49	0.60	0.65	0.64	0.15
Public consumption	1.21	0.95	0.92	0.89	0.85	0.73
Private fixed investment	0.00	0.06	0.07	0.06	0.03	-0.33
Residential	0.02	0.06	0.06	0.07	0.07	-0.02
Non-residential	-0.01	0.00	0.01	-0.01	-0.04	-0.30
Domestic demand	1.45	1.45	1.54	1.59	1.51	0.40

An expansion in domestic demand increases domestic costs which, through losses in the competitiveness of Finnish goods on export markets, decreases the growth of exports until the original expansion in total production has been crowded out (this is called physical or labour market crowding-out). Hence, in the long-run fiscal stimulus produces a shift in resources from the open sectors of the economy to the closed sectors. After the completion of the adjustment process, which takes more than ten years, the magnitude of this resource shift equals the size of the original shock.

As exports are reduced by the fiscal expansion, the current account effect remains negative also in the long run. In the time horizon of

ten years, the increase in the current account deficit is about one third of the size of the increase in central government spending.

If monetary policy is non-accommodative, fiscal expansion causes the domestic interest rate to increase. As a result of the 1 billion 1985 FIM shock, the money market rate increases immediately by 0.3 percentage points. The current account deficit is widened with the fiscal stimulus. Thus further increases of the interest rate are needed to keep the foreign reserves of the central bank at the baseline level (see table 3 in the appendix).

TABLE 10. Fiscal policy multipliers with nonaccommodating monetary policy: The effects of a bond-financed increase in public employment with central bank credit fixed.

Year	1	2	3	4	5	10
GDP	0.98	0.90	0.81	0.61	0.29	-1.31
Imports, total	0.47	0.39	0.35	0.30	0.21	-0.40
Exports, total	0.01	0.00	-0.03	-0.11	-0.23	-0.68
Multilateral (West)	-0.01	-0.02	-0.05	-0.12	-0.21	-0.57
Bilateral (East)	0.01	0.02	0.03	0.03	0.02	-0.04
Services	0.01	0.00	-0.01	-0.02	-0.04	-0.07
Private consumption	0.17	0.44	0.46	0.42	0.32	-0.53
Public consumption	1.21	0.95	0.92	0.89	0.85	0.76
Private fixed investment	-0.01	0.01	-0.06	-0.17	-0.30	-1.01
Residential	0.01	0.03	0.02	0.00	-0.02	-0.19
Non-residential	-0.02	-0.03	-0.08	-0.17	-0.27	-0.82
Domestic demand	1.43	1.29	1.19	1.02	0.73	-1.03

As a result of the higher real interest rate, non-residential investment and the capital stock lag below their baseline level, turning the multiplier effect on GDP negative in the long run. Due to the reactions of imports to the lower activity, the negative current account effects are smaller than in the case with accommodating monetary policy. Equilibrium in the labour market requires that in the long run also real wages have to decrease as a result of fiscal expansion.

The scope for fiscal policy is limited by financial crowding out which is defined as the fraction of the increase in output which is

crowded out by the tightening of the financial market (see Wallis (1987)). In figure 4, the size of the effect is measured by the difference between the two curves, and the phenomena is also described in the following table. By the sixth year, the GDP multiplier turns negative in the non-accommodating monetary policy case, reflecting total crowding-out.

TABLE 11. The Financial Crowding-Out Effect, Per Cent.

Year	Crowding-out
1	1.6
2	10.1
3	22.0
4	37.3
5	62.1
6	>100

The small multiplier effect on GDP in the BOF4 model reflects the fact that production is modelled to be supply-side determined in the long run. The BOF4 model is more supply-oriented than its predecessor, BOF3. The price-output split measured as the ratio of consumer price effects to GDP effects of a demand shock (in simulation 2a) increases from 0.1 in the first year to 1.1 in the fifth year. By the sixth year, the original 1 per cent increase in GDP has caused the consumer prices to increase by 1 per cent (see the tables 2 and 3 in the appendix). In the long run, however, price level parity with foreign markets will be restored through the adjustment of exports as described above.

In absolute terms, the increase in employment in the public sector is at most about 30 000. As the ratio of public production to total production is in the baseline about 15 %, the policy measure taken in these simulations is substantial. It is worth noting that the immediate increase in central government net borrowing is less than the increase in outlays due to increase in income tax revenue.

In the following table, financing of the increase in central government consumption expenditure is analyzed. In the first year,

about one third of the fiscal policy expansion is financed "automatically" through induced increase in central government revenue, and only two-thirds remain to be entirely bond financed. In the long run, the fiscal expansion will be bond financed, since the positive activity effects are not permanent. Since non-accommodative monetary policy stabilizes the current account, it forces the government deficit to be financed from domestic sources.

TABLE 12. Deficit Consequences of the Bond Financed Fiscal Expansion. Increase in Central Government Deficit and Current Account Deficit as Percentage of the Increase in Central Government Consumption Expenditure.

	Monetary policy regime: Accommodative		Non-accommodative	
	Year: 1	10	1	10
Increase in central government deficit	68 %	97 %	69 %	130 %
Increase in current account deficit	37 %	41 %	36 %	10 %

3.5 Simulation 3: Export Markets Increased

In the previous simulation experiments, the responses of the model to different types of domestic demand impulses have been studied. Now we turn to export demand. In this simulation, export markets are increased by 1 per cent once and for all. Export markets are operationalized as the volume of imports of goods of Finland's 14 most important multilateral trading partners.

In the equation of multilateral exports, the elasticity of export demand with respect to market growth is constrained to unity for any time horizon. However, actual export growth is also influenced by prices. The one-year elasticity for multilateral exports with respect to relative export prices is -1.85 and the elasticity grows slowly to infinity in the very long run.

The response of export prices to demand depends, of course, on the exporters' supply behaviour. The price-volume split of the supply of exports, as inferred from the simulation, is almost zero in the short run and grows gradually to 0.53 towards the end of the 10-year horizon. So, the volume of (multilateral) exports (of goods) grows by about one per cent in the short run as a result of the increase in demand, but the effect diminishes over time, down to 0.16 per cent after ten years (see table 4 in the appendix).

In the short and medium run, the increase in exports has a positive effect on output and the domestic demand components. Both investment and consumption increase. The effect on investment is, however, quicker and also stronger in relative terms than the effect on consumption. Employment reacts with some lag: the effect on hours worked is about 0.3 per cent after three years, and starts to decrease thereafter.

Since imports react by less than exports, there is a positive effect on the external balance of the economy. This is further strengthened by an improvement in the terms of trade (this is about 0.2 per cent by the fifth year of the experiment).

The economy is, however, unable to sustain higher employment. Increased demand pulls up prices and costs, and market shares are lost in the export markets. This process continues until the economy has returned on the baseline path. Almost all of the adjustment to the original equilibrium seems to take place within the first ten years, which is an indication of the strength of the "supply side" in the model.

3.6 Simulation 4: World Market Prices Increased

In this simulation, all foreign currency prices are increased by 1 per cent. Note that inflation in foreign prices is not permanently accelerated; only the price level is permanently higher than in the baseline. This experiment reveals another aspect of the supply side influences in the model, namely the convergence towards PPP

(purchasing power parity of domestic and foreign currencies) in the long run.

World market prices in the BOF4 model include all import prices, competing foreign prices on export markets and world market prices of sawngoods (timber; this appears in the Prices in forestry equation). Notwithstanding the effects on the value of foreign interest payments, the interpretation of the present simulation could just as well be a 1 per cent devaluation of the Finnish markka. Whichever the interpretation, the real effects of this experiment depend crucially on the adjustment pattern of domestic prices.

The results from the experiment are summarized in table 5 in the appendix. In the short run, price competitiveness of both exports and imports improves as a result of the rise in foreign currency prices. Relative export prices drop by about 0.4 per cent, and the initial effect on the competitive position of imports is even higher, varying across the different import categories. In the first year, exports increase by 0.62 per cent, imports decrease by 0.1 per cent and the trade balance improves by 270 million FIM.

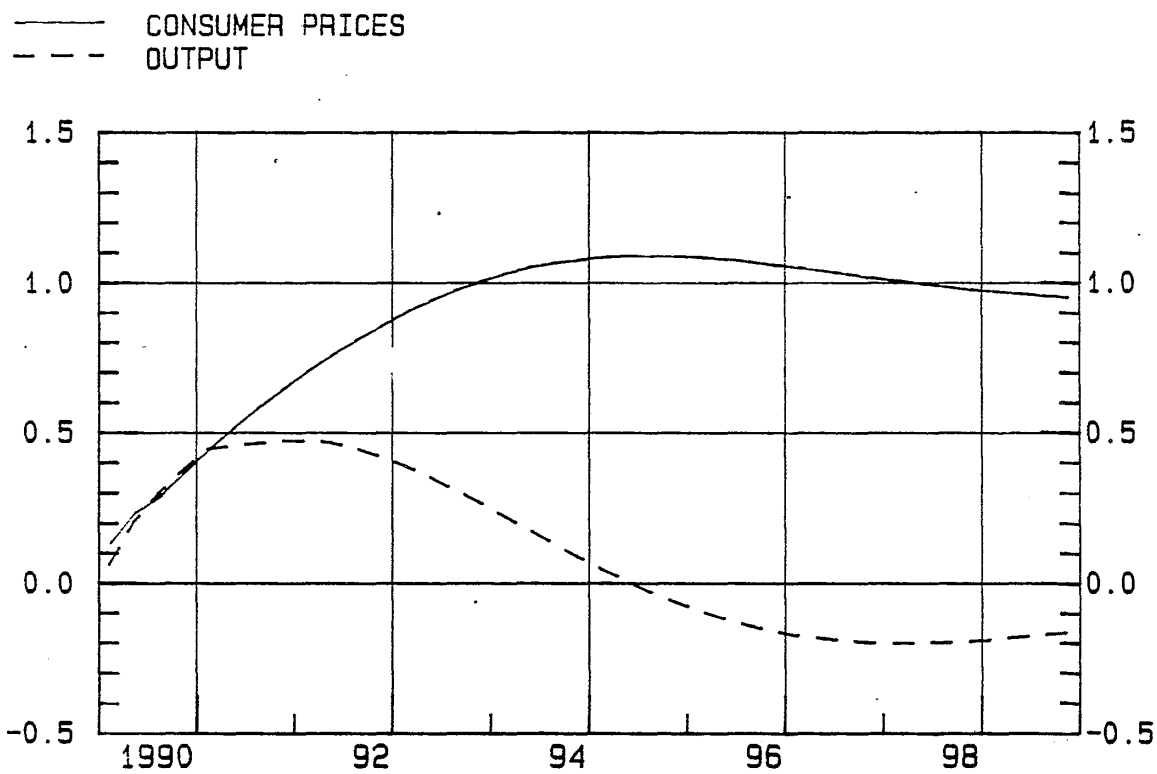
The shift of demand from foreign to Finnish goods increases output and employment in the short and medium run. The elasticity of real GDP with respect to the foreign currency prices reaches its maximum, 0.46, in the second year after the shock. The elasticity of hours worked is highest in the third year (0.41). These estimates of the short-run real effects of devaluations or foreign price increases are higher than in many other Finnish studies, e.g. in the previous BOF3 version of the Bank of Finland model (see Tarkka and Willman (1985), pp. 403-409). On the other hand, the real effects disappear quicker than in the BOF3 model. This is because domestic prices adjust faster.

The domestic price level starts to rise immediately after the increase in foreign currency prices. Export prices react fastest, followed by the investment deflator. Consumer prices and the wage rate rise almost pari passu, and the GDP deflator appears to be the most sluggish price index. All this means that, according to the

model, a devaluation or an increase in foreign prices does not lower the real consumption wage by much. However, real product wages fall in manufacturing and rise in services, increasing profit margins in the former sector and squeezing profits in the latter. The effects on relative prices are temporary, though. After five years, all prices have risen by the amount of the original foreign price shock, restoring old relative prices and the old purchasing power parity of the FIM.

The interaction of the real GDP effect and the price level effect is clearly visible in Figure 5.

FIGURE 5. Adjustment of Prices and Output to a Sustained Increase in World Market Prices by 1 per cent.



In considering the results from this experiment, one must note two qualifications: the money market interest rate and the nominal transfers distributed by the central government were exogenous in

the simulation. The assumption of a fixed rate of interest may not be too crucial, since the demand for central bank credit is not affected too much in the simulation. The assumption that central government transfers are not adjusted for the higher prices which emerge in the simulation is, however, an important one. It means that fiscal policy is automatically tightened by the rise in foreign currency prices, with the result that activity effects are weakened and the favourable effects on the balance of payments are strengthened compared to the case of "indexed" government transfers. The extent of these modifications is studied in Tarkka and Willman (1985, pp. 404 - 406) with the BOF3 model.

3.7 Simulation 5: Short-term Interest Rate Reduced

Effects of a permanent reduction of the money market rate by 2 percentage points can be seen in table 6 in the appendix. All interest rates do not move by the same amount in the experiment, however. In the BOF4 model, there are term structure equations for two long-term interest rates (market yield on taxable debentures, and tax-free bonds), which itransmit the changes of the monetary policy variables to the demand for goods equations.

Market yield on tax-free bonds appears in the sectoral user cost of capital equations as well as in the private consumption equation. Reduction of the short-term interest rate by 2 percentage points reduces the yield on tax-free bonds by .4 percentage points in the first year and by .7 percentage points in the long run.

The immediate reaction of investment, especially in the price-elastic open sector of the economy, is substantial. Later on investment is further increased by accelerator effects from boosted domestic production. The increase in private fixed investment is 0.4 %, 1.2 % , and 2.1 % in the first, second, and third year, respectively, and 2.9 % in the tenth year. The adjustment of residential investment takes place more quickly but the increase is somewhat less than the increase in non-residential investment. The permanent increase in the level of the capital stock is of the same magnitude as in the previous BOF3 model.

By contrast, the direct effect on private consumption is weak, the 0.9 % increase in private consumption being mainly due to increase in real income.

There is a slight worsening of the price competitiveness due to wage increases, and multilateral exports decrease. That is almost balanced by the bilateral mechanism: bilateral exports follow the pattern of the increasing bilateral imports of raw oil, fuels and lubricants. Thus, total exports is only slightly affected by the interest rate change.

Production and imports adjust quickly to the increased level of total demand. In the long run imports increase by 1.2 %, and, due to increased capital stock, production increases by 0.6 %. As a result, employment increases in spite of the shift in factor demand from labour to capital. Wages increase as a result of decreasing unemployment rate and slightly increasing labour productivity. In the long run real wages increase somewhat.

Reduction of the short-term interest rate decreases the demand for foreign capital immediately. A reduction of the short-term interest rate by two percentage points results in the outflow of short-term foreign capital by 6.9 FIM billion in the first quarter, and by 0.1 FIM billion in the second quarter. As, in addition, imports react strongly to the increase in economic activity, also the current account deteriorates and the foreign reserves of the central bank diminish substantially (by 7.4 FIM billion in the first year). Under such capital mobility, the scope for unilateral interest rate cuts is limited.

In an open economy with considerable capital mobility, the Central Bank may be unable to conduct monetary policy in terms of interest rate targets. Therefore, it might be more realistic to analyze Finnish monetary policy under the assumption of a flexible short-term interest rate. The macroeconomic effects of open market operations (central bank credit) are indeed described in Tarkka and Willman (1990), a report on the modelling of financial markets in BOF4.

3.8 An Increase in Labour Supply

In the last simulation experiment we consider the strength of the equilibrating mechanisms on the labour market. This is done by assuming that the working-age population is permanently increased by 1000 persons compared to the baseline. If the model has a strong tendency towards labour market equilibrium, an increase in the working-age population should cause a fall in wage rates, and quickly increase employment until the original unemployment rate and participation rate are restored. The speed of this mechanism is, of course, one of the central issues in macroeconomics.

The adjustment of the labour force, employment, real GDP and the wage rate after the population increase are described in the following table. The reactions of these key variables are measured as dynamic elasticities with respect to the working-age population.

TABLE 13. The Dynamic Elasticities of Key Variables With Respect to the Working-age Population.

Year	1	2	3	4	5	10
Labour force	0.4	0.4	0.4	0.5	0.5	1.0
Employment	0.0	0.0	0.1	0.1	0.2	1.1
Real GDP	0.0	0.1	0.1	0.2	0.4	1.1
Wage rate	-0.1	-0.2	-0.4	-0.6	-0.7	-0.7

Note that the elasticity of the labour force is less than one in the short run, since the initial increase in the unemployment rate causes some people to withdraw from the labour market (this is known as the discouraged worker effect). The reaction of employment and output to the growth of the working-age population is very sluggish in the first years of the experiment. The adjustment does ultimately happen, however, and after ten years the elasticities of output, employment, and the labour force with respect to the increase in population are all around unity. This means that the unemployment rate and the participation rate return to their original levels in about ten

years after the population shock. This shows how the BOF4 model combines short-run Keynesian dynamics with asymptotically classical properties.

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APPENDIX 1

SIMULATION RESULTS 1: INCREASE IN THE SALES TAX RATE

Sales tax rate increased permanently by one percentage point.
Interest rates fixed.

Difference from baseline case.

Year	1	2	3	4	5	10
GDP, %	-0.24	-0.38	-0.54	-0.62	-0.59	-0.08
Imports, total, %	-0.37	-0.45	-0.69	-0.88	-0.93	-0.50
Exports, total, %	-0.16	-0.35	-0.38	-0.28	-0.11	0.42
Private consumption, %	-0.53	-0.62	-0.82	-0.95	-1.00	-0.70
Public consumption, %	-0.22	-0.28	-0.27	-0.21	-0.16	0.06
Private fixed investment, %	0.03	-0.09	-0.58	-0.90	-0.95	-0.20
Domestic demand, %	-0.30	-0.41	-0.63	-0.80	-0.83	-0.36
GDP deflator, %	0.75	0.87	0.77	0.60	0.44	0.27
Private consumption deflator, %	0.81	0.94	0.85	0.71	0.57	0.45
Private investment deflator, %	0.45	0.56	0.48	0.35	0.23	0.13
Export goods deflator, %	0.08	0.14	0.11	0.01	-0.09	-0.18
Wage rate, %	0.32	0.34	0.19	0.00	-0.17	-0.36
Performed working hours, %	-0.12	-0.27	-0.44	-0.56	-0.61	-0.14
Employment, 1000 persons	-1.09	-4.32	-7.78	-11.04	-13.10	-5.15
Labour force, 1000 persons	-0.37	-2.50	-4.73	-6.90	-8.32	-3.11
Unemployment rate, percentage points	0.03	0.07	0.13	0.18	0.21	0.09
Balance of payments:						
Current account, FIM billion	0.41	0.37	0.64	0.97	1.20	1.68
Private capital imports, FIM billion	0.41	-0.09	-0.09	-0.08	-0.06	0.06
Foreign exchange reserves, FIM billion	0.82	1.10	1.64	2.53	3.67	11.25
Central bank domestic credit, FIM billion	-0.75	-0.96	-1.51	-2.45	-3.65	-11.18
Demand for money:						
Monetary base, per cent	0.18	0.35	0.32	0.18	0.05	0.12
Broad money, per cent	0.07	0.26	0.25	0.12	0.00	0.13

SIMULATION RESULTS 2: INCREASE IN PUBLIC EMPLOYMENT

Public production and central government consumption increased permanently by 4 billion 1985 FIM per annum (about 1 per cent of GDP in 1990). Interest rates fixed.

Difference from baseline case.

Year	1	2	3	4	5	10
GDP, %	1.00	0.99	1.01	0.92	0.72	-0.39
Imports, total, %	1.50	1.36	1.42	1.45	1.38	0.28
Exports, total, %	0.05	-0.01	-0.13	-0.43	-0.83	-2.17
Multilateral (West) %	-0.03	-0.11	-0.29	-0.64	-1.10	-2.58
Bilateral (East), %	0.20	0.60	0.88	0.99	0.95	-0.17
Services, %	0.30	-0.01	-0.16	-0.41	-0.80	-1.53
Private consumption, %	0.32	0.86	1.02	1.08	1.05	0.23
Public consumption, %	5.99	4.57	4.29	4.06	3.74	2.76
Private fixed investment, %	0.01	0.28	0.36	0.29	0.13	-1.46
Residential, %	0.26	1.05	1.21	1.31	1.22	-0.41
Non-residential, %	-0.08	0.01	0.07	-0.05	-0.24	-1.84
Domestic demand, %	1.40	1.37	1.45	1.47	1.36	0.33
GDP deflator, %	-0.13	0.53	0.70	0.95	1.24	1.45
Private consumption deflator, %	0.09	0.30	0.39	0.59	0.82	0.88
Private investment deflator, %	0.07	0.25	0.33	0.51	0.73	0.83
Export goods deflator, %	0.01	0.05	0.13	0.28	0.45	0.53
Wage rate, %	0.18	0.36	0.56	0.90	1.21	1.26
Performed working hours, %	0.91	1.40	1.40	1.36	1.23	0.07
Employment, 1000 persons	7.25	27.76	30.88	31.23	29.98	5.62
Labour force, 1000 persons	4.63	18.12	20.23	20.54	19.81	3.76
Unemployment rate, percentage points	-0.11	-0.40	-0.45	-0.46	-0.44	-0.08
Balance of payments:						
Current account, FIM billion	-1.84	-1.71	-1.94	-2.33	-2.72	-4.28
Private capital imports, FIM billion	0.25	0.23	0.25	0.35	0.35	0.18
Foreign exchange reserves, FIM billion	-1.59	-3.08	-4.77	-6.75	-9.13	-26.25
Central bank domestic credit, FIM billion	1.72	3.41	5.25	7.35	9.84	26.96
Demand for money:						
Monetary base, per cent	0.35	0.87	1.17	1.39	1.54	1.13
Broad money, per cent	0.43	1.04	1.40	1.61	1.74	1.20
Sectoral financial balances:						
Current account, % of GDP	-0.32	-0.25	-0.27	-0.31	-0.34	-0.42
Net lending, % of GDP						
Private sector	0.22	0.28	0.27	0.20	0.18	0.53
Public sector	-0.53	-0.53	-0.54	-0.51	-0.52	-0.95
of which Central government	-0.66	-0.70	-0.71	-0.70	-0.70	-1.03

SIMULATION RESULTS 3: INCREASE IN PUBLIC EMPLOYMENT

Public production and central government consumption increased permanently by 4 billion 1985 FIM per annum (roughly 1 per cent of GDP in 1990).

Money market rate endogenous, domestic credit extended by the central bank fixed.

Difference from baseline case.

Year	1	2	3	4	5	10
GDP, %	0.98	0.89	0.79	0.58	0.28	-1.12
Imports, total, %	1.47	1.20	1.07	0.89	0.63	-1.06
Exports, total, %	0.05	-0.01	-0.11	-0.37	-0.73	-1.94
Private consumption, %	0.31	0.77	0.80	0.71	0.52	-0.81
Public consumption, %	5.99	4.56	4.28	4.04	3.73	2.84
Private fixed investment, %	-0.02	0.02	-0.29	-0.83	-1.44	-4.71
Residential, %	0.19	0.62	0.33	-0.01	-0.44	-3.32
Non-residential, %	-0.10	-0.18	-0.50	-1.10	-1.78	-5.21
Domestic demand, %	1.38	1.23	1.12	0.95	0.67	-0.86
GDP deflator, %	-0.13	0.52	0.66	0.87	1.11	1.07
Private consumption deflator, %	0.09	0.29	0.36	0.51	0.69	0.55
Private investment deflator, %	0.07	0.24	0.30	0.43	0.61	0.53
Export goods deflator, %	0.01	0.04	0.11	0.24	0.38	0.46
Wage rate, %	0.18	0.35	0.51	0.80	1.05	0.66
Performed working hours, %	0.90	1.35	1.27	1.12	0.90	-0.48
Employment, 1000 persons	7.21	27.16	28.83	27.11	23.59	-7.05
Labour force, 1000 persons	4.61	17.78	19.02	18.04	15.86	-4.29
Unemployment rate, percentage points	-0.11	-0.39	-0.42	-0.39	-0.34	0.12
Interest rates, percentage points:						
Money market rate	0.31	0.73	1.07	1.33	1.57	2.40
Taxable bond rate	0.16	0.37	0.55	0.69	0.81	1.23
Taxfree bond rate	0.08	0.23	0.34	0.47	0.58	0.83
Balance of payments:						
Current account, FIM billion	-1.81	-1.49	-1.42	-1.43	-1.43	-1.00
Private capital imports, FIM billion	1.89	1.60	1.42	1.39	1.36	0.76
Foreign exchange reserves, FIM billion	0.08	0.19	0.19	0.15	0.08	-0.92
Central bank domestic credit, FIM billion	0.00	0.00	0.00	0.00	0.00	0.00
Demand for money:						
Monetary base, per cent	0.23	0.49	0.48	0.35	0.17	-1.52
Broad money, per cent	0.25	0.49	0.40	0.14	-0.18	-2.36
Sectoral financial balances:						
Current account, % of GDP	-0.31	-0.22	-0.19	-0.19	-0.17	-0.11
Net lending, % of GDP						
Private sector	0.23	0.34	0.41	0.44	0.52	1.27
Public sector	-0.54	-0.55	-0.60	-0.63	-0.69	-1.38
of which Central government	-0.67	-0.72	-0.76	-0.79	-0.84	-1.39

SIMULATION RESULTS 4: INCREASE IN EXPORT MARKETS

Volume of imports of goods of Finland's major western export countries increased permanently by one per cent. Interest rates fixed.

Difference from baseline case.

Year	1	2	3	4	5	10
GDP, %	0.17	0.28	0.29	0.24	0.15	-0.05
Imports, total, %	0.26	0.42	0.45	0.41	0.32	0.03
Goods, %	0.26	0.40	0.43	0.38	0.29	0.04
Services, %	0.23	0.48	0.59	0.58	0.47	0.02
Exports, total, %	0.81	0.73	0.61	0.48	0.36	0.19
Multilateral (West) %	0.95	0.83	0.67	0.51	0.37	0.16
Bilateral (East), %	0.03	0.11	0.18	0.20	0.17	-0.07
Services, %	0.79	0.75	0.65	0.54	0.46	0.50
Private consumption, %	0.07	0.19	0.24	0.23	0.17	-0.04
Public consumption, %	0.01	0.01	0.01	-0.01	-0.03	-0.06
Private fixed investment, %	0.14	0.27	0.33	0.29	0.17	-0.16
Domestic demand, %	0.03	0.20	0.25	0.22	0.14	-0.09
GDP deflator, %	0.02	0.09	0.16	0.23	0.26	0.12
Private consumption deflator, %	0.01	0.07	0.14	0.20	0.23	0.10
Private investment deflator, %	0.01	0.06	0.12	0.17	0.19	0.08
Export goods deflator, %	0.03	0.08	0.14	0.19	0.21	0.10
Wage rate, %	0.02	0.08	0.16	0.22	0.25	0.12
Performed working hours, %	0.10	0.21	0.28	0.29	0.25	-0.01
Employment, 1000 persons	0.86	3.39	5.46	6.44	6.19	0.27
Labour force, 1000 persons	0.53	2.16	3.54	4.24	4.13	0.22
Unemployment rate, percentage points	-0.01	-0.05	-0.08	-0.09	-0.09	0.00
Balance of payments:						
Current account, FIM billion	0.70	0.52	0.44	0.43	0.43	0.60
Private capital imports, FIM billion	0.05	0.08	0.08	0.07	0.05	0.01
Foreign exchange reserves, FIM billion	0.75	1.34	1.86	2.36	2.84	5.75
Central bank domestic credit, FIM billion	-0.72	-1.27	-1.74	-2.20	-2.68	-5.68
Demand for money:						
Monetary base, per cent	0.08	0.20	0.30	0.35	0.35	0.10
Broad money, per cent	0.10	0.24	0.35	0.40	0.39	0.11

SIMULATION RESULTS 5: INCREASE IN WORLD MARKET PRICES

World market prices (import prices and competitors'prices on export markets) increased permanently by one per cent. Interest rates fixed.

Difference from baseline case.

Year	1	2	3	4	5	10
GDP, %	0.24	0.46	0.45	0.33	0.16	-0.18
Imports, total, %	-0.10	0.29	0.38	0.33	0.21	-0.18
Goods, %	-0.06	0.30	0.35	0.30	0.18	-0.15
Services, %	-0.36	0.25	0.51	0.51	0.35	-0.33
Exports, total, %	0.62	0.74	0.61	0.44	0.30	0.25
Multilateral (West) %	0.66	0.77	0.63	0.46	0.32	0.33
Bilateral (East), %	0.17	0.45	0.61	0.60	0.50	-0.02
Services, %	0.80	0.81	0.51	0.25	0.07	0.07
Private consumption, %	0.01	0.26	0.34	0.29	0.18	-0.20
Public consumption, %	-0.11	-0.19	-0.24	-0.31	-0.38	-0.48
Private fixed investment, %	0.29	0.75	0.88	0.71	0.43	-0.25
Domestic demand, %	0.03	0.33	0.38	0.30	0.13	-0.30
GDP deflator, %	0.17	0.48	0.73	0.93	1.04	0.94
Private consumption deflator, %	0.25	0.54	0.78	0.95	1.05	0.95
Private investment deflator, %	0.34	0.61	0.81	0.95	1.04	0.95
Export goods deflator, %	0.59	0.67	0.82	0.96	1.04	0.98
Price competitiveness (relat. export prices), %	0.36	0.30	0.15	0.03	-0.05	0.02
Wage rate, %	0.24	0.54	0.79	0.98	1.09	1.01
Performed working hours, %	0.13	0.32	0.41	0.40	0.30	-0.20
Employment, 1000 persons	1.06	5.05	8.15	9.23	8.13	-3.81
Labour force, 1000 persons	0.70	3.22	5.30	6.10	5.46	-2.49
Unemployment rate, percentage points	-0.01	-0.08	-0.12	-0.13	-0.12	0.06
Balance of payments:						
Current account, FIM billion	0.34	0.15	0.14	0.21	0.31	1.07
Private capital imports, FIM billion	0.23	0.19	0.18	0.17	0.15	0.16
Foreign exchange reserves, FIM billion	0.57	0.90	1.22	1.61	2.06	6.86
Central bank domestic credit, FIM billion	-0.51	-0.70	-0.89	-1.17	-1.57	-6.35
Demand for money:						
Monetary base, per cent	0.16	0.52	0.82	1.00	1.07	0.81
Broad money, per cent	0.14	0.53	0.84	1.03	1.09	0.80

SIMULATION RESULTS 6: REDUCTION IN THE SHORT TERM INTEREST RATE

Money market rate permanently reduced by 2 percentage points.

Difference from baseline case.

Year	1	2	3	4	5	10
GDP, %	0.16	0.46	0.65	0.72	0.72	0.58
Imports, total, %	0.24	0.75	1.05	1.21	1.25	1.17
Exports, total, %	0.00	-0.03	-0.09	-0.17	-0.24	-0.24
Multilateral (West) %	-0.01	-0.09	-0.19	-0.31	-0.41	-0.37
Bilateral (East), %	0.02	0.15	0.36	0.56	0.70	0.86
Services, %	0.05	0.10	0.04	-0.05	-0.15	-0.36
Private consumption, %	0.12	0.46	0.72	0.87	0.93	0.92
Private fixed investment, %	0.35	1.22	2.05	2.52	2.73	2.94
Residential, %	0.69	1.79	2.30	2.52	2.52	2.37
Non-residential, %	0.23	1.03	1.97	2.52	2.81	3.13
Domestic demand, %	0.22	0.68	0.98	1.13	1.16	1.00
GDP deflator, %	0.01	0.07	0.16	0.25	0.32	0.45
Private consumption deflator, %	0.00	0.06	0.14	0.23	0.29	0.36
Private investment deflator, %	0.01	0.07	0.13	0.20	0.26	0.36
Export goods deflator, %	0.01	0.04	0.09	0.12	0.14	0.00
Wage rate, %	0.01	0.07	0.17	0.28	0.40	0.81
Performed working hours, %	0.07	0.28	0.47	0.60	0.64	0.34
Employment, 1000 persons	0.52	3.84	8.17	11.77	13.84	9.39
Labour force, 1000 persons	0.26	2.24	5.01	7.40	8.81	5.85
Unemployment rate, percentage points	-0.01	-0.07	-0.13	-0.19	-0.22	-0.15
Interest rates, percentage points:						
Money market rate	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00
Taxable bond rate	-1.03	-1.03	-1.03	-1.03	-1.03	-1.03
Taxfree bond rate	-0.35	-0.59	-0.66	-0.68	-0.69	-0.72
Balance of payments:						
Current account, FIM billion	-0.31	-1.03	-1.55	-1.93	-2.19	-3.04
Private capital imports, FIM billion	-8.82	-1.99	-1.85	-1.97	-2.23	-3.17
Foreign exchange reserves, FIM billion	-9.12	-12.14	-15.54	-19.44	-23.86	-51.43
Central bank domestic credit, FIM billion	9.40	12.68	16.28	20.33	24.88	52.94
Demand for money:						
Monetary base, per cent	0.77	1.37	1.78	2.05	2.21	2.41
Broad money, per cent	1.16	1.99	2.51	2.82	3.00	3.18

APPENDIX 2

EX POST FORECAST 1986 - 1988

Ex Post simulation 1986 - 1988: Forecast vs. actual figures.
Actual in parentheses after forecast.

Supply and Demand (volume changes, per cent):

Year	1986		1987		1988	
Real GDP	2.7	(2.1)	3.0	(4.0)	2.8	(5.0)
Private consumption	4.8	(4.1)	6.3	(5.7)	2.9	(5.0)
Private fixed investment	-1.6	(-0.4)	4.8	(5.0)	5.1	(11.7)
Total exports	1.8	(1.3)	-1.2	(2.6)	-0.6	(3.9)
Total imports	4.4	(3.1)	8.0	(9.0)	6.8	(11.5)

Other indicators:

Year	1986		1987		1988	
Inflation (CPI, per cent)	2.5	(3.1)	1.0	(3.8)	4.2	(4.6)
Real wage rate, per cent	2.5	(3.1)	5.9	(3.1)	3.4	(4.2)
Unemployment rate, per cent	5.5	(5.4)	5.8	(5.1)	6.0	(4.5)
Broad money (M3), per cent	18.3	(8.7)	9.2	(13.5)	8.2	(23.6)
Current account, FIM bill.	-0.4	(-3.8)	-5.1	(-7.9)	-5.8	(-12.6)
Money market rate, per cent	5.4	(11.8)	6.6	(10.0)	8.1	(10.0)

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