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PENTTI L. I. VARTIA

AN ECONOMETRIC MODEL FOR ANALYZING AND FORECASTING SHORT-TERM FLUCTUATIONS IN THE FINNISH ECONOMY

Helsinki 1974

ERRATA

Page 17, line 10. For: of cource, read: of course

Page 22, table 2.1. For: total output, read: total resources

Page 50, line 8. For: $\sum_{i=m+1}^{n} b_i(x_{i,t} - \lambda x_{it-1})$,

read: $\sum_{i=m+1}^{n} b_i(x_{it} - \lambda x_{i,t-1})$

Page 66, line 3. For: accelerator-type investment,

read: accelerator-type terms in investment

Page 82, line 20. For: $(p_{xg} - p'_x)_{-1}$, read: $(p_{xg} - p'_x)_{-i}$

Page 83. For: X_{gw}, read: x_{gw}

Page 84. For x_{g1}, read: x_{gw}

Page 119, line 1. For: Figl, read: Fig.

Page 144, line 7. For: 0 = 100, read: 0 = 100

Page 160, line 3. For $\hat{A}y_t$, read: $\hat{A}\hat{y}_t$

Page 160, line 22. For: $(y+\Delta y)$, read: $(\hat{y}+\Delta y)$

Page 188, line 19. For: bahavioural, read: behavioural

Page 209, line 18. For: that, read: than

Page 219, line 1. For: $(I-A)^{-1}$, read: $(I-\hat{A})^{-1}$

Page 219, line 4. For: $(I-A)^{-1}B$, read: $(I-\hat{A})^{-1}\hat{B}$

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PREFACE

It has been a valuable experience working on the short-term forecasting project of the Research Institute of the Finnish Economy, and I would like to express my sincere gratitude to the other members of the group: Mr Heikki Hämäläinen and Mr Yrjö Vartia. Without their co-operation and help, this study would not have been completed. Mr Hämäläinen, the leader of the group, is constructing a more extensive forecasting framework of which this model will be only a part. Mr Y.Vartia is studying the stochastic specification and estimation of the model.

The Research Institute of the Finnish Economy has provided a stimulating atmosphere and also the practical facilities for this work. I wish to express my thanks to the successive directors of the Institute for the support they have given during the execution of the work. Special thanks are due to Prof. Meinander who sired short-term forecasting in RIFE and who suggested the construction of an econometric model. Prof. Molander gave useful advice when first experiments in actual forecasting situations with the model were carried out.

Dr Larna's encouragement and interest decisively furthered the completion of the report. Many other persons have given me valuable help. Of them I should particularly mention Mr Pekka Hemmilä, Mr Heikki Lehtimäki, Mrs Sinikka Salo, Mr Heikki Vajanne, Mr Seppo Wallenius, Mr Martti Verho and Mrs Arja Väisänen-Veilahti who have been connected for shorter or longer periods with the project and who have done much of the concrete work and made numerous valuable comments. Mr Vajanne has been responsible for most of the programming work which is so essential for a project of this kind.

My stay of three months at the Dutch Central Planning Bureau in the Hague was an important step forward in the construction of the model and I owe a debt of gratitude to all the members of the Bureau, especially Mr Jan Hoogland, Mr Jan Kooyman, Mr J.J. Post and Mr Antoine Schwartz who guided me through the wonderlands of model construction and gave me good advice on the specification of a number of different equations. The visits which Mr Kooyman and Mr Schwartz paid to our institute were also very valuable.

I also want to thank all the persons at the Bank of Finland and the University of Helsinki with whom I have discussed both general and specific aspects of model construction. Dr Pertti Kukkonen and Prof. Pentti Pöyhönen have acted as official examiners of the work and provided constructive criticism and valuable advice. I am particularly greatful to Prof. Pöyhönen whose encouragement has helped me to complete this study.

Discussions with Prof. Leo Törnqvist and with participants in his seminars have also been of great help. Mr Gavin Bingham, whose advice was most valuable on a number of points, read through the study and removed some of the infelicities in my phrasing. Mr Juhani Hirvonen, Mr Heikki Loikkanen and Dr Timo Teräsvirta read the manuscript and suggested several valuable improvements and corrections.

I am also extremely grateful to my wife and friends who have been kind and wise enough to provide me with much needed distraction and who have tolerated my one-sided interests.

Miss Ann-Christine Ekebohm, Mrs Leena Konttinen and Mrs Arja Selvinen typed the text skillfully and rapidly and put their practised hands to drawing the figures.

None of those who have helped me bear any of the responsibility for the remaining errors and shortcomings of this study.

Finally, I wish to thank the Yrjö Jahnsson Foundation for the financial support which it granted me in the course of work on this project.

Vaajakoski, August 1974

TABLE OF CONTENTS

LIST OF FIGURES

page

page

LIST OF TABLES

1. INTRODUCTION

It seems to be generally accepted that an econometric model, suitably applied, is an important tool in analyzing and forecasting economic phenomena. When the Research Institute of the Finnish Economy (RIFE) decided to start preparing short-term forecasts in the autumn of 1970, it was thus thought advisable to construct a short-term econometric model[1]. This study presents some of the results of the work done since spring 1971. The model is by no means finished. Models never are. However, since its different versions have already been used for some time to help forecast events and analyze economic policy, a report seems necessary.

Actually, it is impossible to avoid using a model. All sound economic reasoning must be based on models in the wide sense, explicit or implicit. It is well known that explicitly formulated models have significant advantages over implicit models. Most of these are connected with the fact that empirical data and statistical methods can be used more efficiently. Moreover, because both good and bad decisions are made, every effort should be made to improve not merely the decisions themselves, but also the decision making process.

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1) The framework for forecasting and the model were outlined in Hämäläinen [1971].

Explicit models allow us to investigate the activities of decision makers. Use of implicit models gives the decision maker a chance to escape responsibility since no one can analyze just for what reasons a particular decision was taken. Basically erroneous models are often patched up with ad hoc explanations and in this way many of the inadequacies of the model can be overcome.

On the other hand, there is no reason to help spread some of the myths about model building. The chain of "better" and more sophisticated models may be seen as consecutive approximations of reality. Even though an empirical model is a simplification of reality, it may be sufficient for certain purposes. Whether it is or not, depends on the relationship between the model, the purpose and reality. As far as I know, the theory of relativity was not needed to fly man to the moon, for Newtonian mechanics was an adequate approximation.

The differences between intuitive reasoning and formalized models are often exaggerated. This may be due to fact that some economists, who are afraid of mathematical methods and some econometricians who have been educated in the "Fisherian" tradition of mathematical statistics, find it difficult to combine personal judgment and an econometric model. But if we consider our model as a "play process" mirroring the "real process", it is only common sense to modify an approximate first attempt if some better alternative is found. Flexible use of different kinds of information - expert opinions, knowledge of changes in relationships, monthly data, investment inquiries, intuitive allowance for some unusual developments, etc. - is also possible with explicit models. We are never strictly bound to the results given by the first run of some mechanical procedure, for there are many methods for manipulating the model solutions towards the desired values. Use of these methods, of course, makes models less "objective" and requires clear explanation and justification. Special attention to these questions is given in Chapter 6. which deals with methods of solution.

A model can be seen as a tool. The choice of the appropriate tool allows us to get at the most interesting aspects of a particular problem. In table 1.1. I have reproduced the aggregate balance of resources and expenditure as it appeared in "Economic Prospects in Finland" published by RIFE in May 1974. The focus of the present study is the short-run development of the variables making up this balance, and some other variables closely related to these. When linked together, they form one possible complete set of equations for the demand oriented analysis of business cycles on a macro level.

The model is thus essentially of a macro character and can be classified as a "small model". This is, of course, partly due to limited resources, but can also be taken to express our views on the relative merits of models of different sizes. Different problems require different models, but it would seem more reasonable to start with a few behavioural equations and then enlarge the model as needed than to start directly with a complicated system of interdependencies.

Table 1.1. Aggregate balance of resources and expenditure 1973-1975

	1973* Mrd. mk 1 000 Mill. mk	Ennuste vuodelle 1974 Forecast for 1974				Ennuste vuodelle 1975 Forecast for 1975			
		Vuosimuutos, % Annual change, %			Mrd. mk 1 000 Mill. mk	Vuosimuutos, % Annual change, %			Mrd. mk 1 000 Mill. mk
		Volyymi Volume	Hinta Price	Arvo Value		Volyymi Volume	Hinta Price	Arvo Value	
Bruttokansantuote markkinahintaan Gross domestic product at market prices	66.1	3	15	18.5	78.4	2.5	8	10.5	86.6
Tavaroiden ja palvelusten tuonti Imports of goods and services	19.0	6	28	35.5	25.7	5	6	11.5	28.7
Kokonaistarjonta Total resources	85.1	3.5	18	22	104.1	3	7.5	10.5	115.3
Tavaroiden ja palvelusten vienti Imports of goods and services	18.2	8.5	26	36.5	24.8	4.5	4	8.5	26.9
Investoinnit Investment	18.2	4.5	15	20	21.9	2.5	9	11.5	24.4
— **yksityiset** private	15.1	4.5	15	20	18.2	2	9	11	20.2
— **julkiset** public	3.1	4	16	20.5	3.7	6	8	14.5	4.2
Kulutusmenot Consumption	44.4	2.5	15.5	18.5	52.6	2.5	8.5	11.5	58.6
— **yksityiset** private	33.4	1.5	15.5	17.5	39.2	2	8	10	43.2
— **julkiset** public	11.0	5	15	21	13.4	5	10	15.5	15.4
Varastojen muutos Inventory changes	4.3			0.6[1])	4.8			0.6[1])	5.4
Kokonaiskysyntä Total demand	85.1	3.5	18	22	104.1	3	7.5	10.5	115.3

[1]) Varastojen muutoksen vaikutus kokonaiskysynnän muutokseen, prosenttiyksikköä
Contribution of inventory changes to growth of total demand, per cent

The semi-annual forecasts published by RIFE are much more disaggregated than the ones produced by the model. The present model is thus a kind of master model for separate formal and informal satellite models used to forecast events in various sectors.

It is only natural that in constructing a model there will be different and inconsistent ideas about the form of the equations. Economic theory is often of little help since several competing explanations of the same phenomena may be supported by the same evidence. This does not, of cource, mean that all explanations are equally good in all circumstances. Statistical methods often help us to discard some explanations as inadequate, but it is extremely difficult to choose the best or the most "objective" by relying only on them. This is particularly the case in non-experimental work. The methods used should be so robust that small specification errors do not distort the main interdependencies postulated for the phenomena under study. Detailed and refined analysis which makes use of a great number of free parameters and restrictive assumptions is important in the development of the theory, but as it often operates on a different, "unidentifiable" level, it can not always be applied directly in practical work.

It can also be claimed that the choice of a particular relation, e.g., the investment equation, affects economic policy. We may have profits or changes in production as rival explanatory variables, and the different equations will lead to different policy proposals, e.g., the reduction in direct corporate taxes or the increases in public expenditure. In questions like this, explicitly stated models may help to clear up the discussion, even if they do not necessarily resolve the debate.

Models are based on some postulates about the invariance in the phenomena and this restricts the use of models in qualitatively new situations, when the relationships are not the same as in the past. In these cases personal judgment is essential. I would be inclined to defend the view that even in these cases, the problems should be handled within explicitly stated, if not statistically estimated models. The desire to forecast after structural changes have taken place, and the inclusion of extra information make knowledge of the structural form of the model necessary. A more fruitful approach to analyzing economic phenomena is thus introduced in a natural way and cannot be separated from forecasting.

This present model is based on simple behavioural equations which describe those relationships in the Finnish economy which are thought to hold with some certainty. I have also experimented with more complicated equations for several of the relationships and obtained a better fit. Variables other than the present ones could also have been included. This is especially true for monetary variables which could have been introduced, for example, in the consumption and investment equations. The public sector could also be handled in a more disaggregated way. However, the introduction of these and other refinements has been left for later versions. So many of the "loose ends" have been tied together that a total model results. The desire to construct a workable model in a short time has led to using rather standard relationships which give the model an empiricist touch, even if the relationships have a theoretical background. At earlier stages of constructing an empirical model it is particularly important to deal with the basic methodological problems and to see, e.g., what possibilities the data available gives to formulation of more refined hypothesis.

Perhaps it is also worthwhile mentioning other attempts to construct macro-models for Finland. Recently a considerable part of the scarce research resources in Finland have been used to analyze short-term problems. The pioneer effort was Grönlund's [1965] semi-annual model. This model has not been used for actual policy analysis or forecasting. Its purpose was rather to test the feasibility of constructing economic models for this purpose in Finland. The properties of the model will be further investigated in Konttinen [1974].

In 1970 work was started on the construction of a short-term model at the Bank of Finland. This quarterly model is the largest econometric model of the Finnish economy and is used in connection with Project Link. This sectoral model includes large foreign trade, monetary and production-employment-incomes blocks and has been used to help forecasting and policy analysis since 1974[1].

The short-term annual model of Koivisto [1972] should also be mentioned, though the explanatory power and other properties of the model have not been examined. It has been used to support business cycle analysis at the Economic Research Department of Kansallis-Osake-Pankki (Finland's largest commercial bank).

A medium term planning model MEPLAMO, has been constructed at the Economic Planning Centre. Although this model, which is based on the input-output system, has also been used to study short-term fluctuations, it cannot be regarded as a cyclical model[2]. The Ministry of Finance has recently assumed responsibility for MEPLAMO and a new long-term allocation model for the Finnish economy, AMFE, is being constructed at the Economic Planning Centre.

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1) Cf., Bank of Finland Institute for Economic Research [1972], Aurikko [1973] , Halttunen [1972] , Koskenkylä [1972] and Lahtinen [1973].

2) Cf., Economic Planning Centre [1970].

2. NOTATION AND SYMBOLS

In the following we denote absolute variables by the symbol (~); e.g., the level of consumption during year t is $\tilde{C}_t$. Where no confusion is expected to arise, the subscript t (denoting time) is dropped for the sake of simplicity. Similarly $\tilde{C}_{t-1}$ is abbreviated $\tilde{C}_{-1}$.

Since the model is constructed for yearly percentage changes (= 100 x relative changes), we use the following simple notation

$$c_t = 100 \cdot \frac{\Delta \tilde{C}_t}{\tilde{C}_{t-1}} = 100 \cdot \frac{\tilde{C}_t - \tilde{C}_{t-1}}{\tilde{C}_{t-1}} .$$

Here the Δ-operator indicates a change from the preceding period. This is usual in economics but contrary to the customary usage in mathematics.

In general capital letters are used to denote the values and small letters the volumes of the variables. Price indices are indicated by the letter p with the symbol of the corresponding variable as a subscript; e.g., p_c denotes the consumption prices. The Δ-operator can also be applied to percentage changes, e.g.,

$$\Delta C_t = 100 \cdot \frac{\Delta \tilde{C}_t}{\tilde{C}_{t-1}} - 100 \cdot \frac{\Delta \tilde{C}_{t-1}}{\tilde{C}_{t-2}} .$$

In the following list of the variables of the model, exogenous variables are underlined. The other symbols used in this study are defined in the context where they appear.

Table 2.1. List of variables and symbols used in the model

Symbol	Explanation
a	labour input in the private sector
c	private consumption, volume
C	private consumption, value
d	total demand (=total output), volume
D	total demand (=total output), value
d'	total output less inventory changes, volume
D'	total output less inventory changes, value
$\underline{F}$	depreciation
$\underline{g}$	public expenditure, volume
G	public expenditure, value
GAP	difference between potential and actual gross domestic product expressed as a percentage of the potential
H	unit labour costs
i	private fixed investment, volume

Table 2.1. continued

Symbol	Explanation
$\widetilde{fC}$	curvilinear transformation of unused capacity
I	private fixed investment, value
K	gross profits per total sales
m	imports, volume
M	imports, value
m_g	commodity imports, volume
M_g	commodity imports, value
$\underline{m}_s$	imports of services, volume
$\underline{M}_s$	imports of services, value
$\underline{m}_w$	weighted growth of industrial production in 10 OECD countries, export demand variable
n	inventory changes, volume
N	inventory changes, value
$\underline{O}$	income transfers
p_c	consumption prices
p_d	prices of total demand (output)
$p_{d'}$	prices of total output less inventory changes
p_g	prices of public expenditure
p_i	investment prices
$\underline{p}_m$	import prices
$\underline{p}_{mg}$	prices of commodity imports
$\underline{p}_{ms}$	prices of imports of services
p_x	export prices
p_{xg}	prices of commodity exports
$\underline{p}_{xs}$	prices of exports of services

Table 2.1. continued

Symbol	Explanation
$\underline{p}'_x$	prices of competing exports
T_i	indirect taxes minus subsidies
$\underline{T}'_i$	incidence of indirect taxes minus subsidies
$\tilde{U}$	unemployment rate
$\widetilde{UC}$	unused capacity
w	wage rate
W	wage bill in the private sector
$(W+Z)^D$	disposable income of households
x	exports, volume
X	exports, value
x_e	bilateral commodity exports, volume
$\underline{X}_e$	bilateral commodity exports, value
x_g	exports of goods, volume
X_g	exports of goods, value
x_{gw}	multilateral commodity exports, volume
X_{gw}	multilateral commodity exports, value
$\underline{x}_s$	exports of services, volume
$\underline{X}_s$	exports of services, value
y	gross domestic product at market prices
y'	gross domestic product less inventories
Z	non-labour income

3. SHORT DESCRIPTION OF THE MODEL

The model, which is similar to most of the existing short-term models for western economies, has its roots in the Dutch tradition of model construction. Since the path-breaking work of Tinbergen[1], the Dutch have built a number of models for the Netherlands and other countries. The short-term annual model of Verdoorn and Eijk [1958], Verdoorn [1967] and Verdoorn, Post and Goslinga [1970], the cyclical growth model of Van den Beld [1968] and the quarterly model of Driehuis [1972] are particularly worthy of note. The foundation for our work was the Dutch short term annual model. The same prototype has also been used in construction of models for the Federal Republic of Germany[2], Austria and several other countries included in the present Meteor Project of the Dutch Central Planning Bureau. Being able to learn from the Dutch experience certainly has saved time, but its effect should not be over-estimated. Countries are far too different to allow the mechanical re-estimation of the same specification with

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1) Tinbergen has built models for the Netherlands, Tinbergen [1937], the U.S., Tinbergen [1939] and the U.K., Tinbergen [1951].

2) See Van der Werf [1971].

domestic data. Instead different specifications must be worked out to take account of individual features of the economies.

As is usual with short term models, the emphasis has clearly been on the demand side. The main expenditure categories all have their own behavioural equations, and no explicit production function is present. In a demand oriented model a production function could be used to derive the demand for factors of production and to calculate full capacity output. As actual output is determined by demand this would give us a measure of capacity utilization. However, there are difficulties associated with estimating the production function and the interrelated factor demand functions and for this reason we have estimated separate input demand functions in an unsophisticated manner[1]. Furthermore, because of its dual nature the production side is reflected in the price equations. Imports are also tied to the expenditure categories by a relationship which may be given a technical interpretation.

In the present version of the model capacity variables are not used as explanatory variable in the behavioural equations. On macro level rather strong assumptions are needed to arrive at a suitable measure of capacity utilization. We have experimented with difference between actual and potential production and

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1) See the chapter on investment function.

under-utilization of the total labour force as a proxy for unused capacity. In future versions, unused capacity should enter the behavioural equations to allow for the fact that economic systems behave in a different way under different degrees of capacity utilization. Since the impact of capacity utilization increases nonlinearly when approaching the capacity ceiling, a curvilinear function of under-utilization can be used[1].

With a system of simultaneous relationships, one could of course start explaining the interdependencies of the income-demand - production - triangle in many places, but since the model can be seen as an attempt to forecast the balance of resources and expenditure, we choose to start with basic definitions.

Total demand is broken down into private consumption (C), private investment (I), stock formation (N) and exports (X), and separate behavioural equations are formulated for these components. Together with exogenous autonomous demand (G) they are definitionally equal to total resources (D). As there is an equation for imports (M), gross domestic product (Y) is obtained as residual on the resources' side. GDP is used to derive demand for labour in man-years (a) and labour productivity (y-a). Demand for labour determines unemployment $\Delta\tilde{U}$. This is used together with labour productivity, exogenous import prices (p_m) and direct taxes (T_i') to determine

1) See section 4.2.3.4.

wages and prices (w, p_c, p_i, p_g and p_x), and thus the functional distribution of income (Z, W). After taking into account income transfers (O), we return to the main determinant of private consumption and our triangle is closed. In analyzing demand we of course also use information gathered earlier in this "causal chain", e.g., changes in GDP affect investment, prices are accounted for, etc.

As all the components on the expenditure side have behavioural equations, the residual has to be on the resources' side. In this model the residual is non-labour income, which is equal to total demand minus imports, depreciation, wages and indirect taxes less subsidies. Treating this term as a residual is justified by the way non-labour income is determined in some sectors of a market economy. Due to interaction between wages, prices and profits this technical relationship does not of course tell the whole story about the formation of profits[1)].

In forecasting we know realized figures for the balance of resources and expenditure in past years and use this information together with a model to predict the balance for the coming year. The present model which is constructed in percentage changes, is further analyzed in table 3.1. The model can be used to determine the impact of exogenous and lagged variables on the percentage changes, most of which are endogenous (exogenous variables are underlined). The decomposition of indirect taxes (T_i) into the tax base (D')

1) See e.g. Evans [1969] p. 274-280, see also 4.2.2.4.

and tax incidence (T_i') is not strictly a value-volume-price breakdown but formally it is analogous. The weights used in identities are calculated on the basis of lagged absolute variables in constant prices for volume changes and in current prices for value changes. After solving for the percentage changes, the balance of resources and expenditure in absolute values can be calculated for the next year. Table 3.1. also presents the skeleton of horizontal and vertical identities that must be satisfied in the model.

Fig. 3.1. Block diagram of the main interdependencies of the model. Endogenous variables are in squares and exogenous ones in circles.

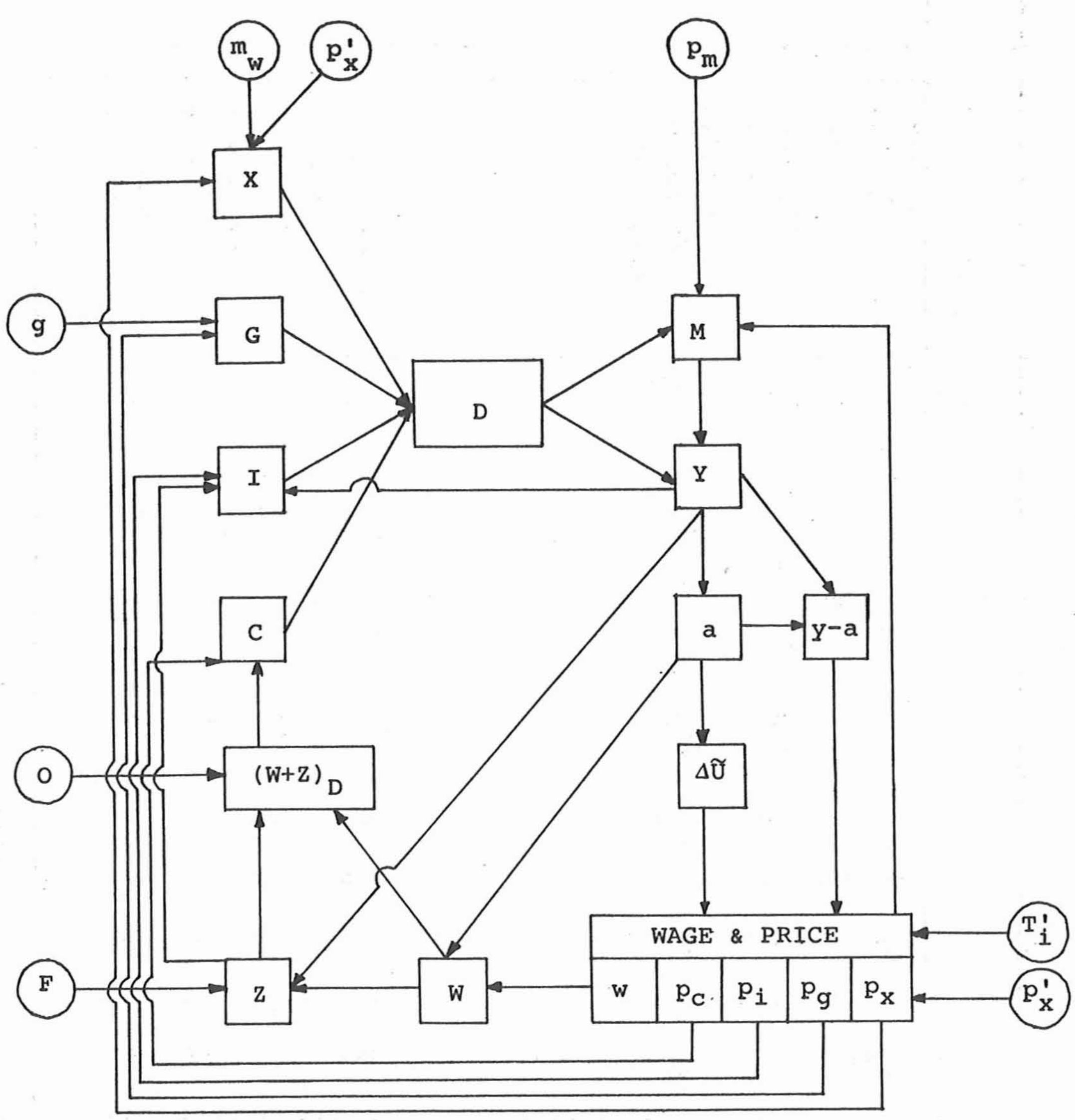


Table 3.1. Balance of resources and expenditure and the variables of the model

Resources	Absolutes for year t-1		%-changes			Absolutes for year t	
			vol.	price	value		
Wage sum in the private sector	$\tilde{W}_{-1}$		a	w	W	$\tilde{W}$	
Other income	$\tilde{Z}_{-1}$				Z	$\tilde{Z}$	
Indirect taxes - subsidies	$\tilde{T}_{i,-1}$		D'	$\underline{T'_i}$	T_i	$\tilde{T}_i$	
Depreciation	$\tilde{F}_{-1}$				$\underline{F}$	$\tilde{F}$	
Gross domestic product at market prices	$\tilde{Y}_{-1}$	$\tilde{y}_{-1}$	y	p_y	Y	$\tilde{Y}$	$\tilde{y}$
Commodity imports	$\tilde{M}_{g,-1}$	$\tilde{m}_{g,-1}$	m_g	$\underline{p_{mg}}$	M_g	$\tilde{M}_g$	$\tilde{m}_g$
Imports of services	$\tilde{M}_{s,-1}$	$\tilde{m}_{s,-1}$	$\underline{m_s}$	$\underline{p_{ms}}$	M_s	$\tilde{M}_s$	$\tilde{m}_s$
Total imports	$\tilde{M}_{-1}$	$\tilde{m}_{-1}$	m	p_m	M	$\tilde{M}$	$\tilde{m}$
Total resources	$\tilde{D}_{-1}$	$\tilde{d}_{-1}$	d	p_d	D	$\tilde{D}$	$\tilde{d}$

Expenditure	Absolutes for year t-1		%-changes			Absolutes for year t	
			vol.	price	value		
Private consumption	$\tilde{C}_{-1}$	$\tilde{c}_{-1}$	c	p_c	C	$\tilde{C}$	$\tilde{c}$
Private investment	$\tilde{I}_{-1}$	$\tilde{i}_{-1}$	i	p_i	I	$\tilde{I}$	$\tilde{i}$
Change in stocks	$\tilde{N}_{-1}$	$\tilde{n}_{-1}$	n	..	N	$\tilde{N}$	$\tilde{n}$
Public demand	$\tilde{G}_{-1}$	$\tilde{g}_{-1}$	$\underline{g}$	p_g	G	$\tilde{G}$	$\tilde{g}$
Multilateral commodity exports	$\tilde{X}_{gw,-1}$	$\tilde{x}_{gw,-1}$	x_{gw}	p_{xg}	X_{gw}	$\tilde{X}_{gw}$	$\tilde{x}_{gw}$
Bilateral commodity exports	$\tilde{X}_{e,-1}$	$\tilde{x}_{e,-1}$	x_{ge}	p_{xg}	$\underline{X_e}$	$\tilde{X}_e$	$\tilde{x}_e$
Exports of services	$\tilde{X}_{s,-1}$	$\tilde{x}_{s,-1}$	$\underline{x_s}$	$\underline{p_{xs}}$	X_s	$\tilde{X}_s$	$\tilde{x}_s$
Total exports	$\tilde{X}_{-1}$	$\tilde{x}_{-1}$	x	p_x	X	$\tilde{X}$	$\tilde{x}$
Total demand	$\tilde{D}_{-1}$	$\tilde{d}_{-1}$	d	p_d	D	$\tilde{D}$	$\tilde{d}$

Note: Exogenous variables are underlined.

Unlike a number of other econometric models, the present model is not used to make public economic plans, but rather to forecast and analyze the policy measures implemented by the government. The model contains the usual policy variables: incidence of indirect taxes, income transfers, volume of public expenditure and changes in the exchange rate. Monetary policy instruments are not present in this version of the model.

On the other hand the target variables are, in one way or another, endogenous. For example the growth rates of the volumes and prices of all the main categories of expenditure, changes in the balance of payments situation, the unemployment rate and the functional distribution of income into labour and non-labour components are included.

Analytical use of the model is by no means limited to the assessment of public economic policy. All the endogenous variables can be exogenized or "corrected" to any desired degree, and their cumulative effects over one or several periods can be obtained. Thus the model can be used to simulate wage negotiations, the effects of a price freeze, the effects of additional investment in the private sector, changes in consumption habits, etc. (see Chapter 6. and 8.).

The choice of endogenous variables depends on how the model is to be used and especially on the information available outside the model. The version that is presented here is one where all the "traditional" variables such as investment, exports and export prices are endogenous. Of course, this does not mean that we have to let the values of the variables be determined by the model when we are making forecasts. For example, valuable information on planned investment can be gathered from the investment survey of the Bank of Finland[1). The inventory inquiry of RIFE, the barometer of the Federation of the Finnish Industries[2), etc. may be useful, even if the data cannot be used directly in the model. The use of this kind of specialized information in forecasting national accounting variables is a challenging area of research[3). Similarly information is available on expectations of export performance in several sectors of the economy. When exogenizing an endogenous variable in a model we should, however, remember that we are actually dealing with a different model, and that e.g. the remaining parameters of the model should (because of the simultaneous character of the model) be re-estimated. If we use parameters estimated by simultaneous equation techniques, we face the problem of potential inconsistencies, similar to those encountered when we estimate the structural parameters using the ordinary least squares method. However, theoretical considerations of this kind are rarely taken into account. The consequences of the stochastic specification of simultaneous models is a delicate methodological question, for discussion of which we refer to Mosbaek and Wold [1970].

1) See Nordberg-Koskenkylä [1970].

2) See Jalas [1968].

3) H. Hämäläinen will treat this problem of extraneous information in a forthcoming study.

4. SPECIFICATION OF THE MODEL

4.1. General

4.1.1. Relative first differences

Most of the equations are linear relations between yearly percentage changes (= relative changes multiplied by one hundred) in the absolute values of the variables.

Actually the best transformation in this connection would be logarithmic differences of the absolute variables. However, for small relative differences[1)]

$$\Delta \ln \tilde{x} = \ln(\frac{\tilde{x}}{\tilde{x}_{-1}}) = \ln(1 + \frac{\Delta \tilde{x}}{\tilde{x}_{-1}}) \approx \frac{\Delta \tilde{x}}{\tilde{x}_{-1}} . \qquad (4.1.1.)$$

Use of relative differences can thus be justified by the fact that they approximate logarithmic differences and have (for small relative changes) the same advantages. We have also estimated behavioural equations using logarithmic differences and the results do not differ substantially. A model based on logarithmic rather than relative differences is more appealing to a theoretically oriented econometrian, but as normal

1) We may also write $\Delta\ln \tilde{x} = \ln(\frac{\tilde{x}}{\tilde{x}_{-1}}) = \frac{\Delta \tilde{x}}{L(\tilde{x},\tilde{x}_{-1})}$, where $L(y,x) = \frac{y-x}{\log y - \log x} \approx \sqrt[3]{xy(\frac{x+y}{2})}$ is the logarithmic average of y and x as defined by Y. Vartia [1974]. Approximation of L(y,x) above is from Törnqvist [1936]. We have thus used the arithmetic average to approximate the logarithmic average and further $\tilde{x}$ to approximate $\tilde{x}_{-1}$: $\Delta\ln \tilde{x} \approx \Delta\tilde{x}/(\frac{\tilde{x}+\tilde{x}_{-1}}{2}) \approx \frac{\Delta \tilde{x}}{\tilde{x}_{-1}}$.

percentage changes are still used extensively the introduction of "log-percents" is left to a later date.

Logarithmic and relative differences are compared in table 4.1. and fig 4.1. We see that percentage changes approximate logarithmic differences quite well when the changes are small. However for large changes it is clear that logarithmic differences are to be preferred. Because of their symmetry logarithmic differences clearly correspond more closely to our intuitive idea of the impact of various relative changes on economic behaviour. For example it is hard to believe that a rise of 100 per cent in some explanatory variable would have the same impact as a fall of 100 per cent, as must be supposed if we are using asymmetrical percentage changes. These two changes are qualitatively different: if a variable can be doubled it often can be also tripled or increased tenfold, but a variable which is measured on ratio scale cannot fall by more than 100 per cent. On the other hand, as the ratio $\tilde{x}_j/\tilde{x}_i$ approaches 0 the change in "log-percents" approaches $-\infty$. For logarithmic changes we have

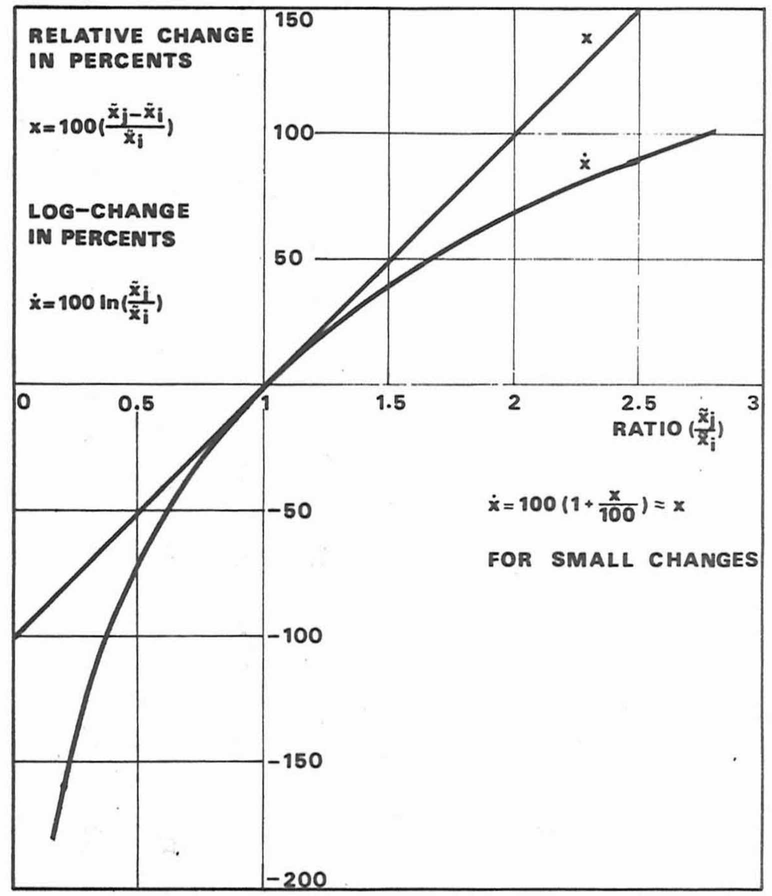
$$\ln (\tilde{x}_j/\tilde{x}_i) = -\ln (\tilde{x}_i/\tilde{x}_j). \qquad (4.1.2.)$$

Thus a consecutive rise and decline of same "log-magnitude" will lead to a return to the original value. This, however, does not happen with usual percentage changes. Similarly log-changes are additive, i.e. the sum of a sequence of log-changes is equal to the total log-change. Because of these and

Table 4.1. Comparison of percents and log-percents as indicators of relative change

$\tilde{x}_j/\tilde{x}_i$	$100\,\dfrac{\tilde{x}_j-\tilde{x}_i}{\tilde{x}_i}$	$100\ln\left(\dfrac{\tilde{x}_j}{\tilde{x}_i}\right)$
0	-100	- ∞
.01	- 99	-460.517
.1	- 90	-230.259
.2	- 80	-160.944
.5	- 50	- 69.315
.9	- 10	- 10.536
.95	- 5	- 5.129
.99	- 1	- 1.005
1.0	0	0.000
1.01	1	0.995
1.05	5	4.879
1.1	10	9.531
1.5	50	40.547
2.0	100	69.315
3	200	109.861
4	300	138.629
5	400	179.176
10	900	230.259

Fig. 4.1. Comparison of precents and log-percents as indicators of relative change



other methodologically attractive properties, logarithmic differences have proved to be suitable for constructing index numbers[1].

The choice of the transformation used depends, of course, on our ideas about how economic agents behave. As a model which is linear in logarithmic differences (or logarithms) corresponds to a multiplicative power function of the absolute values (see(4.1.6.) and(4.1.7.)), the parameters of the model can be interpreted as partial elasticities. Some of the reasons for using constant elasticities rather than constant propensities are discussed by Verdoorn and Eijk [1958].

The logarithmic transformation allows us to use techniques developed for estimation and manipulation of linear systems. The difference transformation is particularly suitable for treating short-run reactions. To quote F.M. Fisher [1966]:

> The primary device for the estimation of short-run reactions is the use of first differences of the data. Aside from the fact that such use often (but by no means always) has the convenience of reducing or eliminating autocorrelation in the residuals, or reducing multicollinearity, it seems analytically the correct form for the estimation of short-run functions. The use of absolutes for estimation purposes must necessarily involve a complete specification of the time structure of the model, and of the variables thereof, including long-run as well as short-run elements. The use of first differences, however, enables us approximately to

1) See, for example, Törnqvist [1936], Törnqvist [1970], Theil [1973] and Y. Vartia [1974].

> isolate the short-run elements since we may assume the long-run components of the reaction to be relatively constant during the interval over which first differences are taken. This is frequently of considerable advantage since we need not specify the precise form that the long-run elements take. It is thus often possible to use first differences to obtain estimates of short-run influences that are not dependent on the precise form of our long-run assumptions. Since the quantitative analysis of long-run economic behaviour is yet in its infancy, it seems highly desirable to break the problem in this way, despite the theoretical loss of information.

The use of differences (linear or relative) usually implies the introduction of an extra time element in the equation for absolute values, for it is only in this way that the same behaviour can be described. Going to absolutes from differences often leaves the constants open so that there are several equations in levels that are compatible with a difference model.

When using logarithmic differences we may suppose the following breakdown into the short and long run elements:

$$\tilde{y}_t = F(\tilde{x}_t) \cdot G(\tilde{z}_t)e^{v_t} \tag{4.1.3.}$$

where $F(\tilde{x}_t)$ represents short-run, $G(\tilde{z}_t)$ long-run influences and v_t the error term. If the long-run term is represented by

$$G(\tilde{z}_t) = G(\tilde{z}_{t-1})e^{\gamma_t} \approx G(\tilde{z}_{t-1})(1+\gamma_t) \tag{4.1.4.}$$

where γ_t is the time specific relative growth in the long-run effect, we then have the identity

$$\Delta \ln \tilde{y}_t = \Delta \ln F(\tilde{x}_t) + \gamma_t + \Delta v_t. \qquad (4.1.5.)$$

Usually γ_t is approximately constant for long periods or at least a slowly changing function of time, because it is the logarithmic growth of the trend-term. Thus the main variation in $\Delta \ln \tilde{y}_t$ is caused by the short-run effect $\Delta \ln F(\tilde{x}_t)$ and the error term. If we knew the nature of the long-run effect, we could specify directly relationship (4.1.3.) and describe both short-run and long-run behaviour, e.g. by using absolute variables and distributed lags. This would, however, also mean the introduction of the additional problem of structural change.

With the approximation $\gamma_t = \gamma$ = constant, we may thus focus our attention on the short-run reactions and more or less forget the long-run effects, which will be determined together with the other parameters when equations of type (4.1.5.) are estimated. This kind of approach is common among those who regard models as tools and choose a suitable, specialized tool for analyzing a particular aspect of the phenomena under study. Besides the advantages, there are also dangers of specialization. A razor does not work well when used to fell trees, but we do not need to burden razor blades with all the properties of axes, if we use them only for shaving. Moreover, the tools we use shape our ideas about the whole phenomena under study. Thus until one has both the razor and the ax, it may sometimes be better to make do with a machete.

As Fisher [1966] has noted, a first difference approximation of the type (4.1.5.) (or better (4.1.6.)) may also be interpreted as the fundamental short-run reaction of the system if it is supposed that behaviour is based on differences.

It is worth stressing that it is not correct to manipulate only the deterministic part of the equations and forget about the disturbance term. If we write a linear regression equation for logarithmic differences

$$\Delta \ln \tilde{y}_t = \gamma + \alpha\Delta \ln \tilde{x}_t + u_t \qquad (4.1.6.)$$

the corresponding model in absolute variables is

$$\frac{\tilde{y}_t}{\tilde{y}_{t-1}} = \left(\frac{\tilde{x}_t}{\tilde{x}_{t-1}}\right)^{\alpha} \cdot e^{\gamma} \cdot e^{u_t} \qquad (4.1.7.)$$

These equations should not be confused with the more simple model in absolute variables

$$\tilde{y}_t = C \cdot \tilde{x}_t^{\alpha} \cdot e^{\gamma t} \cdot e^{u_t} \qquad (4.1.8.)$$

where C is constant. Transformation of this model to logarithmic differences would not give (4.1.6.) but rather the following relationship

$$\Delta \ln \tilde{y}_t = \gamma + \alpha\Delta \ln \tilde{x}_t + \Delta u_t \qquad (4.1.9.)$$

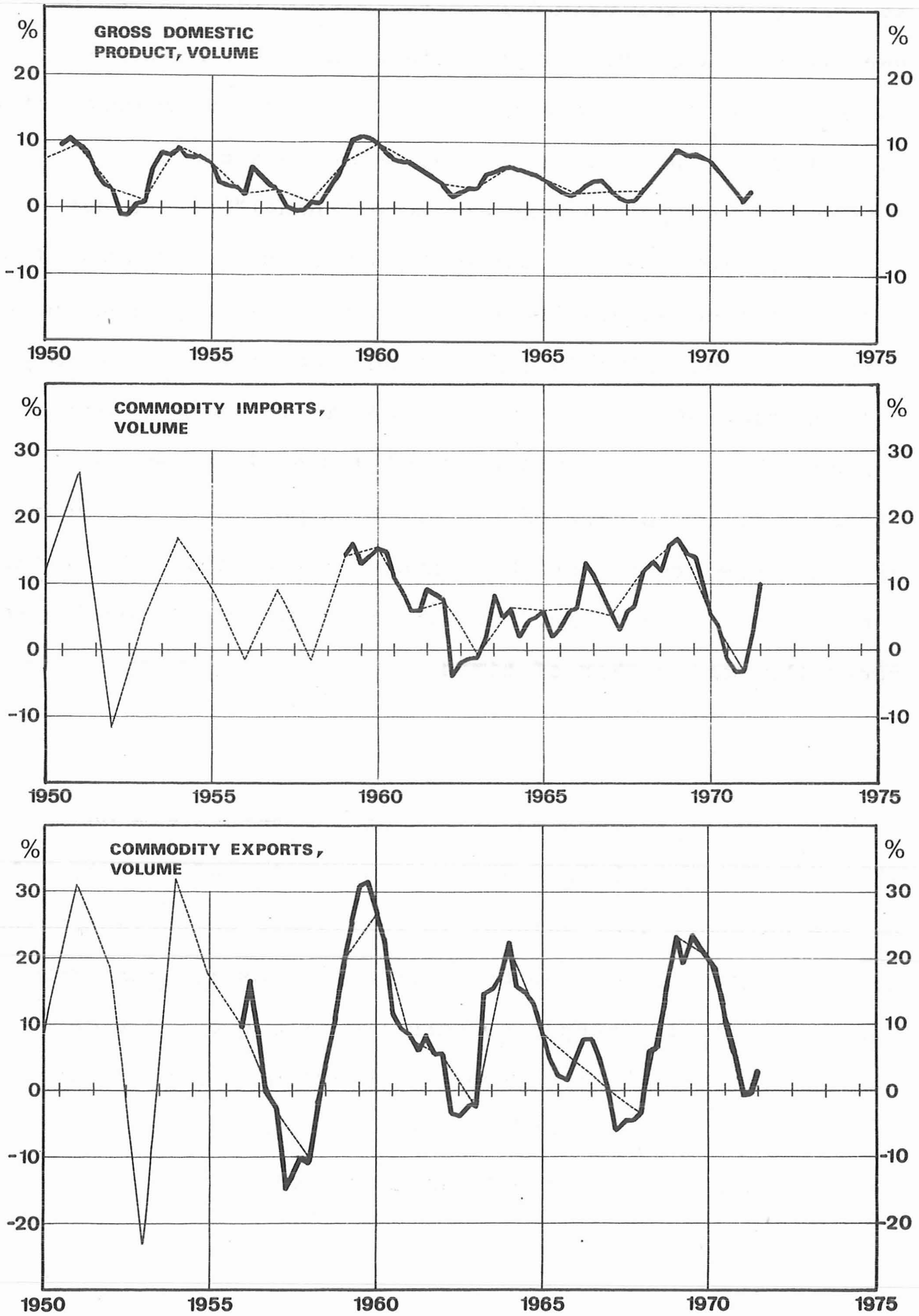
For estimation it is essential to decide whether to choose equation (4.1.6.) or (4.1.8.) as our starting point. The choice is related to the assumptions which we make about the disturbance term. If u_t in (4.1.8.) is not autocorrelated, the disturbance term Δu_t in (4.1.9.) is negatively autocorrelated. This is probably not the case in reality and it seems more natural to choose model (4.1.6.) with the standard assumptions about the error term.

As our interest is mainly in the short-run reactions - primarily year to year changes - the available annual data suits our needs rather well. Taking differences of the yearly series provides a natural starting point for estimating short-run elasticities which usually differ from the long-run ones. On the other hand, a year is long enough to allow a noticeable part of the response to take place. Of course the dynamic pattern of economic reactions varies, and it is sometimes important to examine other information, for example monthly data, to be able to determine the nature of an economic response more exactly. Naturally the length of the unit period also has implications for the simultaneity of the model.

Annual differences over calendar years are used, and the transformation thus gives the percentage change in the annual average of the variables over two consecutive years. Absolute variables are regarded as flows and expressed as the "integral" of the total flow per year. This procedure is based on existing accounting practices according to which "integrals" (=cumulative sums) for each calendar year are recorded. Much information is lost because annual averages are given only for calendar years. Quarterly data can be used to construct yearly percentage changes on other than calendar year bases (see fig. 4.2.). Every fourth observation is of course the "normal" annual percentage change. This method can be used to generate more "annual" percentage changes (which are, of course, dependent on each other) if a degree of freedom problem is encountered. In any case these series provide valuable information about the interdependencies and dynamics of the economic system. There is no reason to believe that economic behaviour on annual level would be affected by the choice of the starting point for the year. Of course there are things that happen at a certain time within the chosen calendar year, but in any four quarter period they occur the same number of times.

At the present, the lagged values of the annual changes, when the lags are not whole years, are approximated by interpolation of the calendar year values. To facilitate comparison, actual annual changes have also been presented. As is seen from fig. 4.2. annual changes constructed from quarterly data differ considerably from the interpolated values. It would be interesting to investigate the effects of different lag specifications on the estimation results.

Fig. 4.2. Annual percentage changes in gross domestic product, commodity imports and commodity exports, moving four quarter sum compared with the preceding moving four quarter sum (for comparison the values corresponding to calendar years have been connected by dotted lines)



The transformations may also be viewed as a technical device used to arrive at more convenient series for estimation. Besides reducing multicollinearity and autocorrelation in the residuals, logarithmic (and relative) differences have the advantage of reducing heteroscedasticity.

Logarithmic differences (and relative first differences) do not depend on the unit of measurement. On the other hand, it is logically incorrect to use this transformation with all variables (e.g. inventory changes and balance of trade), even though most economic variables are measured on ratio scale. Differences are more sensitive to measurement errors, and with small samples exceptional observations may have a greater relative impact on the estimates than when absolute values are used. Of course these two sets of parameters are not directly comparable. The LS-regression will give substantial weight to the exceptional years which sometimes may be fitted "almost exactly" so that most of the total variance is explained. In a case like this, leaving out the exceptional years or, more generally, changing the weights given to them in regression, may change the parameter estimates and coefficient of determination radically[1]. With difference models we encounter these problems quite frequently because of the Korean boom at the beginning of the 1950s. During this period some variables rose by more than 100 per cent in one year.

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1) Cf., e.g., Teräsvirta [1970].

Multiplicative identities between value, volume and prices of the form

$$\tilde{Y} = \tilde{p}_y \cdot \tilde{y} \qquad (4.1.10.)$$

correspond to exact additive identities of the form

$$\Delta \ln \tilde{Y} = \Delta \ln \tilde{y} + \Delta \ln \tilde{p}_y \qquad (4.1.11.)$$

when logarithmic differences are used. When percentage changes are employed, small changes can be approximated with identities of the form

$$Y = p_y + y + 0.01\ y p_y \approx p_y + y. \qquad (4.1.12.)$$

When the model is solved using techniques which allow non-linearities, the approximations can be replaced with exact relationships.

Additive identities between the absolute variables do not give rise to non-linearities when relative differences are employed. For example the identity

$$\tilde{Y} = \tilde{C} + \tilde{I} \qquad (4.1.13.)$$

in absolute variables leads to an exact weighted identity:

$$Y = \left(\frac{\tilde{C}_{-1}}{\tilde{Y}_{-1}}\right) C + \left(\frac{\tilde{I}_{-1}}{\tilde{Y}_{-1}}\right) I \qquad (4.1.14.)$$

for percentage changes.

The basic data for our model has been taken from the national accounting statistics of the Central Statistical Office. We thus have the balance of resources and expenditure both in current prices and in 1954 prices from 1948 to 1964 and in 1964 prices from the year 1964 until the present. For identities involving the percentage changes in values, it is, according to (4.1.13.) and (4.1.14.), natural to use current price absolute values of the previous period as weights.

If the aggregate volume changes are to equal those calculated from the national account statistics, weights based on the constant price absolute values of the previous year must be used. Thus in place of constant price identity

$$\tilde{y} = \tilde{c} + \tilde{i} \qquad (4.1.15.)$$

we have

$$y = \left(\frac{\tilde{c}_{-1}}{\tilde{y}_{-1}}\right) c + \left(\frac{\tilde{i}_{-1}}{\tilde{y}_{-1}}\right) i \qquad (4.1.16.)$$

Here, of course, we must calculate the weights in 1954 prices until 1964 and in 1964 prices thereafter, because the price changes have been different for the different items which make up the aggregates.

Now, however, we face a problem of finding a way to calculate aggregate price changes on the basis of changes in the prices of the various items. It is impossible to calculate the suitable weights with data from the previous period. We can, however, circumvent the problem by using value and volume changes in the aggregate and calculating price change from

$$p_y = Y - y - .01\, y p_y = \frac{Y - y}{1 + .01\, y} \approx Y - y. \qquad (4.1.17.)$$

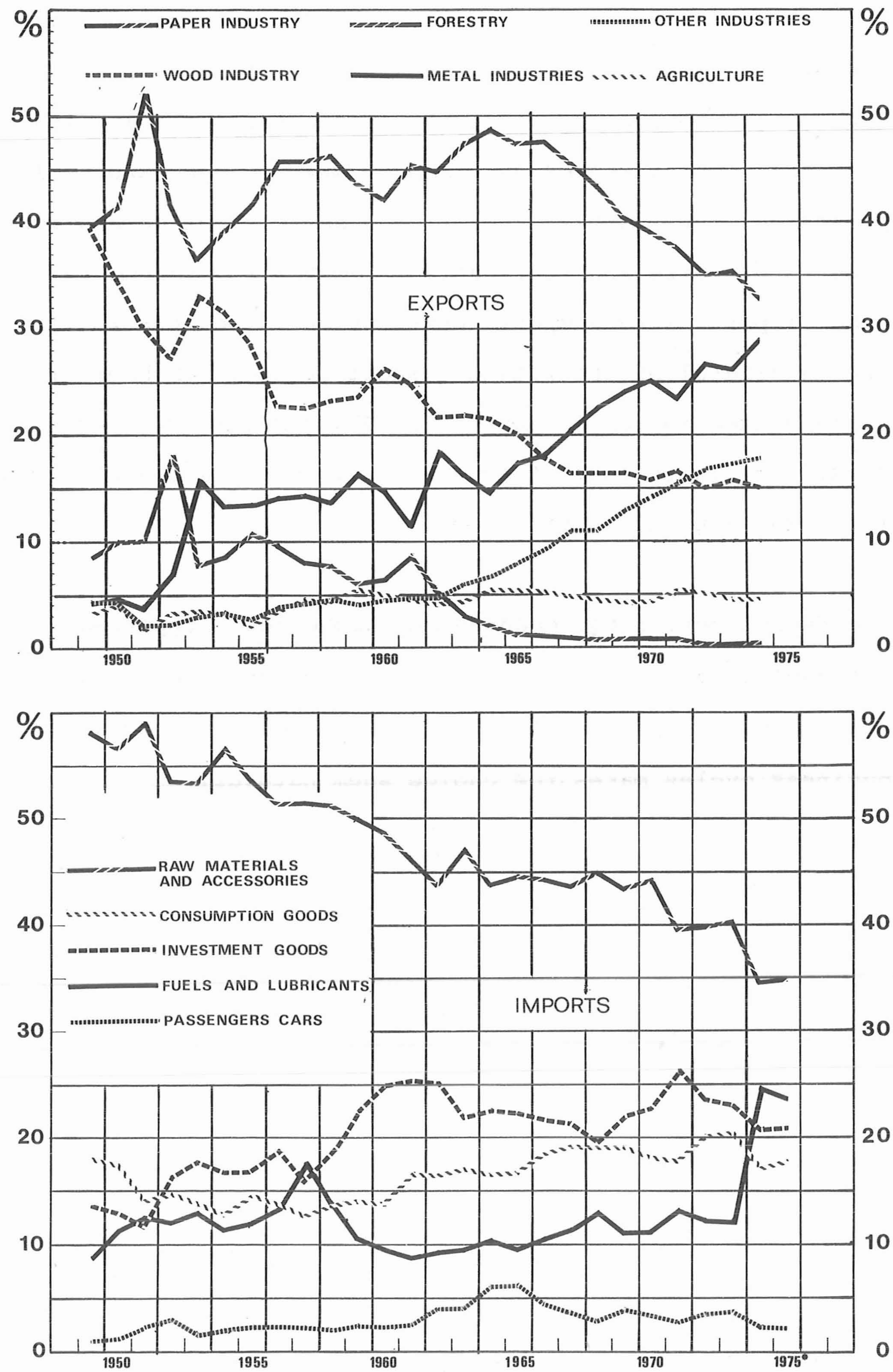
This procedure implies that our model has no equations relating changes in individual price indices to changes in the aggregate price index. This is one way in which our model differs from the Dutch annual model. Our procedure is equivalent to using a Laspeyres volume index for aggregate volume and calculating the percentage changes in the Paasche price index for aggregate prices from the value-volume-price identity.

The present model operates on an aggregate level with constant parameters. Its approximate character can be seen to be a consequence of, e.g., the assumption of structural change and the use of constant parameters with disaggregated data.

The aggregation of separate equations which contain the same explanatory variables produces changing parameters, when the weights are not constant. The composition of most aggregate series has not remained the same because of structural changes in the economy and cyclical fluctuations. In figure 4.3. the composition of commodity imports and exports is presented. For example, the price elasticity of demand for imports of fuels and lubricants is very low compared to that for other imports since import substitution is not possible to any meaningful extent within a short period. The large share of this item in total imports in 1974 reduces the price elasticity (with respect to average import prices) of demand for total imports in this year.

The use of percentage changes has above been supported with methodological considerations. Also the fact that they are traditionally in extensive use when discussing and analyzing business cycles makes the choice seem natural.

Fig. 4.3. Breakdown of commodity exports and commodity imports (figures for 1974 and 1975 are forecasts)



4.1.2. Lags

Different kinds of lags have been used to capture the dynamic nature of economic phenomena. The most common one is a discrete finite lag of x on y of the form

$$y = ax_{t-\tau} \quad (4.1.18.)$$

For non-integer values of τ we have used linear interpolations based on the values of the two adjacent calendar years. This procedure is equivalent to a distributed lag with positive weights for both of these years.

Another type of lag appearing in the model is the infinite geometrically distributed lag:

$$y_t = a + \sum_{k=0}^{\infty} \lambda^k \left(\sum_{i=1}^{n} b_i x_{i,t-k} \right) + \underline{u}_t \quad (4.1.19.)$$

This expression can, according to the Koyck transformation, be shown to be equal to

$$y_t = (1-\lambda)a + \sum_{i=1}^{n} b_i x_{it} + \lambda y_{t-1} + \underline{u}_t - \lambda \underline{u}_{t-1} \quad (4.1.20.)$$

by subtracting y_{t-1} multiplied by λ from (4.1.19.). Equation (4.1.20.) can be estimated directly if we ignore the autocorrelated disturbance term. However, the procedure presented above requires that all the explanatory variables have the same lag structure, which is a strong assumption in several cases. When only some of the explaining variables are assumed to have a distributed lag, we have the following situation:

$$y_t = a + \sum_{k=0}^{\infty} \lambda^k \left(\sum_{i=1}^{m} b_i x_{i,t-k} \right) + \sum_{i=m+1}^{n} b_i x_{it} + \underline{u}_t. \quad (4.1.21.)$$

By familiar manipulation we get

$$y_t = (1-\lambda)a + \sum_{i=1}^{m} b_i x_{it} + \sum_{i=m+1}^{n} b_i (x_{i,t} - \lambda x_{it-1}) \quad (4.1.22.)$$

$$+ \lambda y_{t-1} + \underline{u}_t - \lambda \underline{u}_{t-1}$$

Now, however, we are faced with an estimation problem which cannot be solved by standard methods. This is overcome by experimenting with different values of $\lambda (0<\lambda<1)$ in (4.1.22.) and choosing the estimate $(\hat{\lambda}, \hat{a}, \hat{b}_1, \ldots, \hat{b}_n)$, which minimizes the sum of squares of errors for y_t[1].

More general lag structures can give a more complete description of economic phenomena, but the lags used in the present model are suitable in light of its overall degree of refinement[2]. With quarterly models the accurate description of the lag structure for the first few periods is more crucial

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1) The estimation routine used does not provide all the standard statistics. Neither do those given in table 4.11. and 4.16. have all the properties of OLS-statistics.

2) For an extensive treatment of different lag schemes, we refer to Dhrymes [1971].

than with annual models, where the lag structures described above provide a sufficiently good approximation. Naturally, a model based on annual data cannot properly use or explain variations of less than one year.

4.1.3. Values, volumes and prices

When breaking value figures down into volume and price components, we are faced with the problem of choosing which two of the three variables should be explained with behavioural equations and which one should be calculated using the identity linking them. This is one instance of the more general problem met in model building: how to account for formal identities when all of the components can be explained with behavioural equations. In the case of the price, volume and value relationship, the problem is usually solved by computing one variable from the identity. I have systematically followed the practice of having behavioural equations for volume and price and of calculating value from the identity[1]. If reasons other than purely formal ones can be found to justify this procedure, we are of course better off. Usually, however, strong a priori arguments for using either value or volume

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1) In this respect the model differs from the Dutch annual model, where value of consumption and investment have been explained by behavioural equations. For reasons given on page 80, inventory changes form an exception from our general practice.

explanations cannot be sifted from economic or statistical theory. Instead we often encounter conflicting theories where the basic differences are closely connected with this problem. Two remarks on statistical grounds can be made: Value series tend to have a greater variance than volume series and they are for this reason often easier to explain in the sense that a higher degree of determination is obtained. However, measurement errors may be introduced when deflating the value series by prices.

4.2. Structural specification

4.2.1. General

In the following section the structure of the model is explained equation by equation. There are 12 behavioural equations in the present version of the model. These are presented first together with a short description of the economic reasoning behind the specification of each equation. The 30 definitional equations are also summarized. Several of the definitional equations could easily be eliminated by expanding some of the others. This reduction in number of equations means that the total number of equations in a model is not as good an indication of its size as the number of behavioural equations. For each behavioural equation, the standard errors of the parameter estimates are given in parenthesis below the corresponding parameter estimates. The coefficient of determination R^2 (R_c^2 corrected for degrees of freedom), the standard deviation of the residuals corrected for degrees of freedom $s_c(e)$ and the Durbin-Watson statistic are also given. Unless otherwise stated, the estimation period for the behavioural equations is 1951-1970.

A list of the equations is to be found after the structural specifications.

4.2.2. Behavioural equations

4.2.2.1. Domestic expenditure categories

Private consumption

The main explanatory variable in the private consumption equation is the disposable income of households $(W+Z)^D$. Most authors have proposed using a lag between income and consumption[1]. In empirical work the different theoretical approaches usually lead to the explanation of consumption with income and some kind of distributed lag adjustment. We would have liked to follow many other models and distinguish between earned and unearned income, since the time lag between consumption and the receipt of non-labour income is usually found to be longer than that between consumption and the receipt of labour income, and because a smaller share of non-labour income is consumed[2]. This, however, has not been possible as there are difficulties in dividing public transfers into labour and non-labour income components. Besides, the explanation of private consumption obtained with the present equation is satisfactory without this sophistication.

Disposable income was deflated beforehand using the implicit price index of consumption to arrive at a series suitable for

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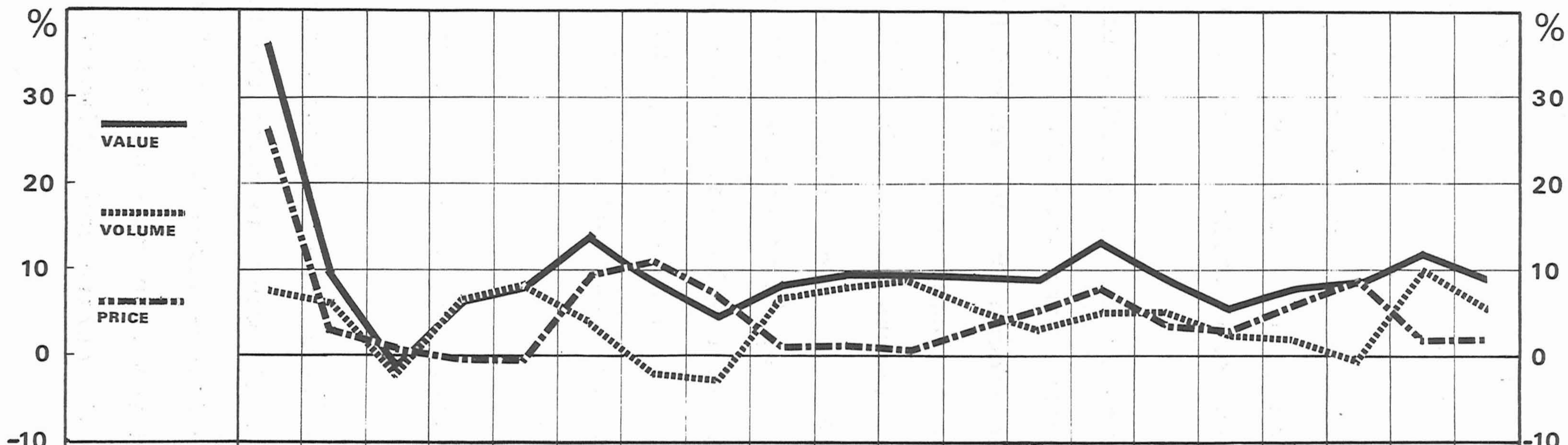
1) See, e.g., Duesenberry [1949] Modigliani [1949], Brown [1952], and Friedman [1957].

2) See, e.g., Verdoorn [1967] and Driehuis [1972].

Fig. 4.4. Finnish private consumption in 1951 - 1970, 1000 million marks in current prices and annual percentage changes in value, volume and prices



YEAR	1951	52	53	54	55	56	57	58	59	1960	61	62	63	64	65	66	67	68	69	1970
VALUE 1000 MILLION MK	4.721	5.191	5.148	5.482	5.930	6.776	7.377	7.709	8.367	9.195	10.102	11.053	12.051	13.710	14.983	15.861	17.189	18.682	20.998	22.902
VALUE CHANGE, %	36.11	9.95	-0.83	6.50	8.16	14.27	8.88	4.49	8.54	9.90	9.87	9.41	9.03	13.77	9.28	5.87	8.37	8.69	12.40	9.07
VOLUME CHANGE, %	7.72	6.23	-1.89	6.96	8.53	4.25	-1.93	-2.65	7.20	8.22	8.83	5.98	3.30	5.25	5.35	2.57	2.15	-0.20	10.05	6.66
PRICE CHANGE, %	26.36	3.50	1.08	-0.43	-0.34	9.62	11.02	7.33	1.25	1.55	0.96	3.23	5.54	8.09	3.73	3.21	6.09	8.91	2.13	2.26

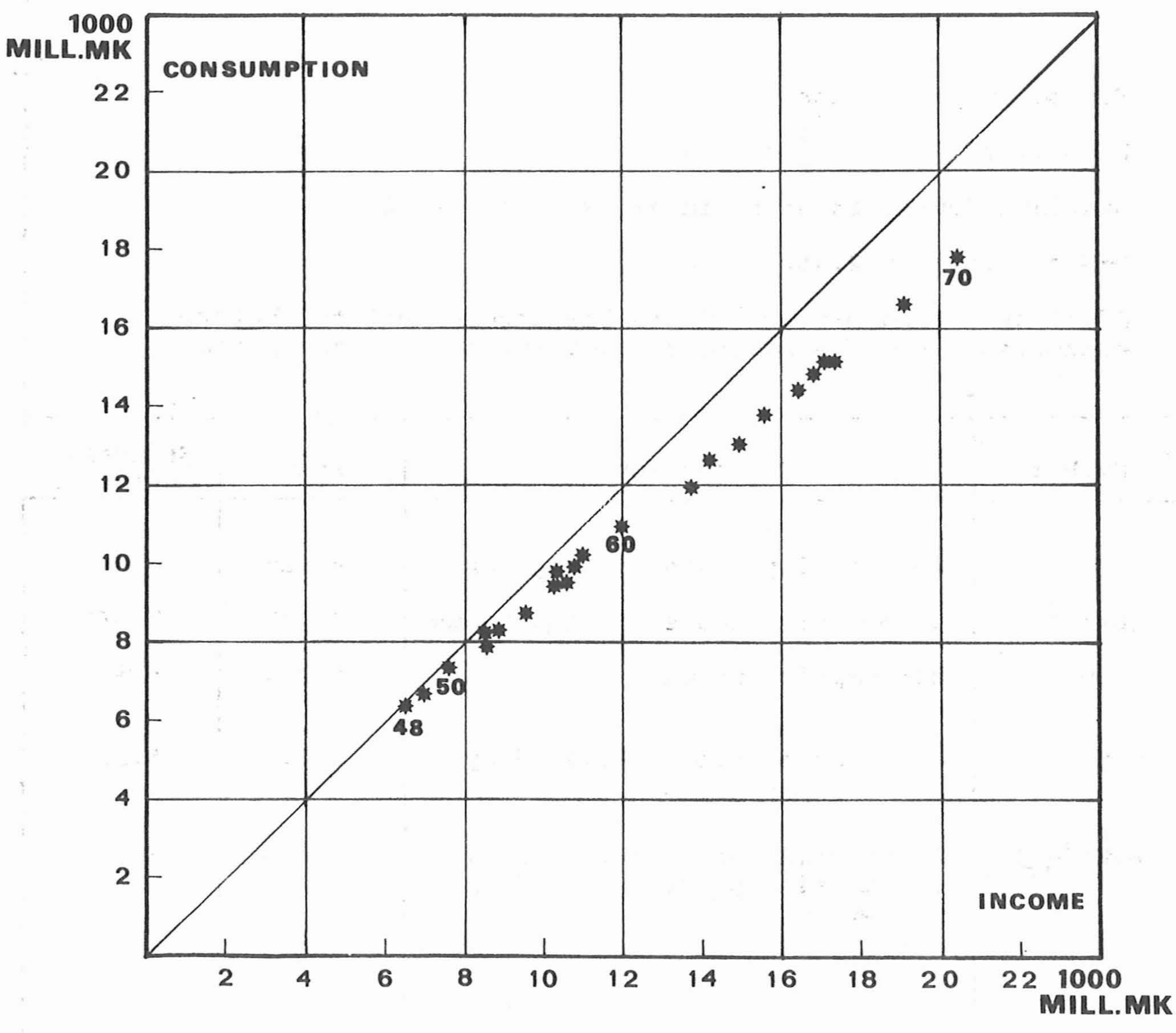
explaining the volume of private consumption. As percentage changes in the deflated variable are approximated by subtracting percentage changes in the deflator from percentage changes in the variable to be deflated, the coefficients of the deflator could also be determined freely in the regression. However, the difference in the corresponding estimates is not significant and thus their ratio was fixed at unity.

When disposable income is the only explanatory variable (apart from the constant) and when the relative weights of present and previous income are determined freely by regression we obtain the equation presented in table 4.2. and figure 4.6. Experiments to include income lagged by two years did not succeed. The positive constant may be interpreted as taking into account the effect of the income of previous periods. If the lag between consumption and income is interpreted as a discrete lag and calculated by interpolating annual observations, it is found to be about a quarter of a year:

$$.569[(W+Z)^{D}-p_{c}] + .188[(W+Z)^{D}-p_{c}]_{-1} \approx .757[(W+Z)^{D}-p_{c}]_{-\frac{1}{4}}$$

Without the constant term, the long-run constancy of the consumption-income ratio would require the sum of the coefficients of the income terms to be 1. The sum given above is smaller, but the positive constant causes $(\tilde{c}/\tilde{y})$ to remain almost constant ($\approx .9$) during the estimation period. Besides, it is difficult to decide definitely if the consumpticn-income ratio is constant in Finland or not[1).

Fig. 4.5. Private consumption and disposable income of households in 1000 millions of 1964 marks



1) For further discussion of consumption data, cf., Marjomaa [1969] and Hämäläinen [1973].

Table 4.2. Equation (1) for private consumption

$$c = .569[(W+Z)^D - p_c] + .188[(W+Z)^D - p_c]_{-1} + .495$$
$$\quad (.090) \qquad\qquad\qquad (.089) \qquad\qquad\qquad (.770)$$

Method of estimation : OLS

$R^2 = .752$ $\qquad R_c^2 = .723$

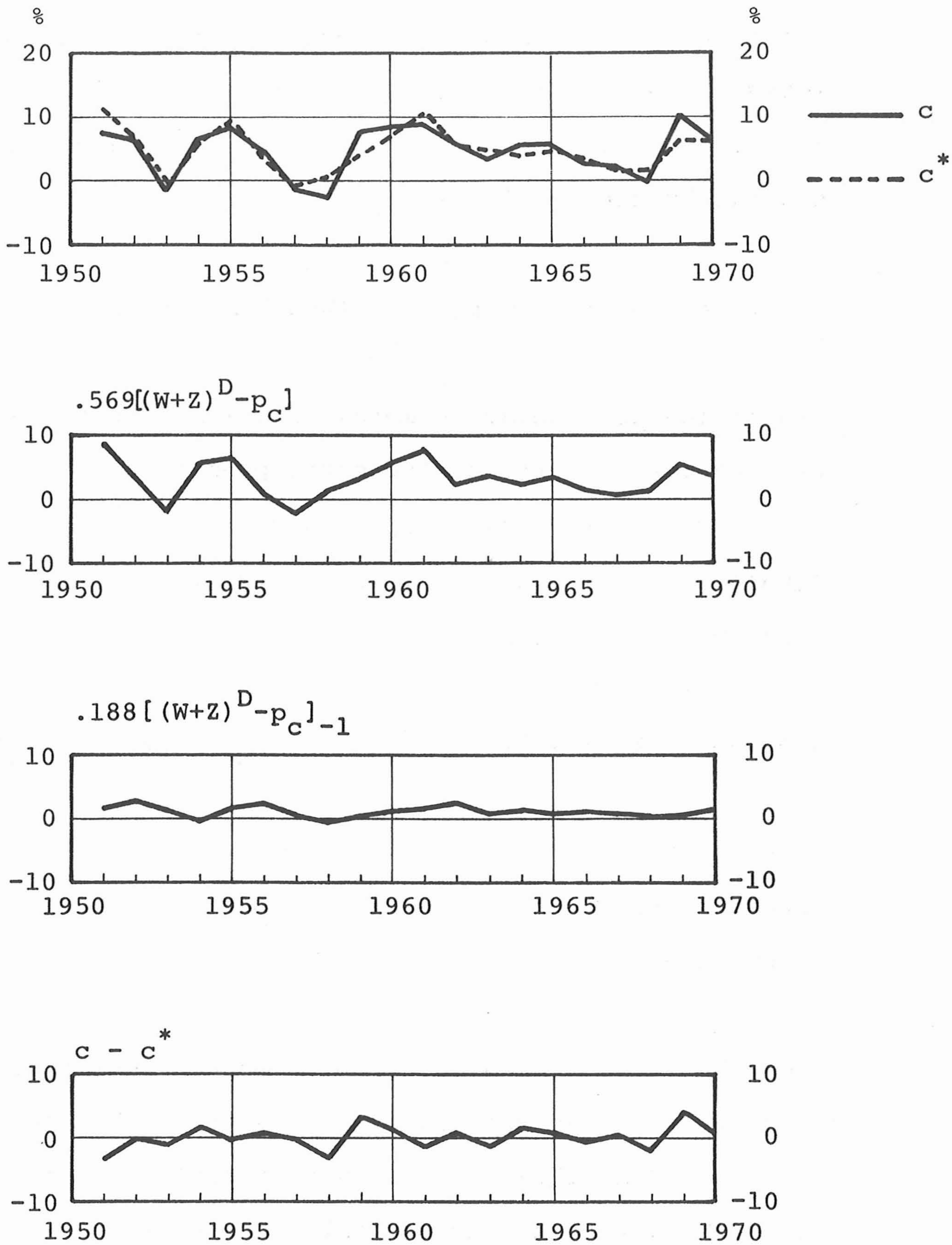
Standard deviation of residual, $s_c(e_i) = 2.021$

D-W statistic = 2.452

Additional information: disposable income deflated before estimation with the implicit price index for consumption

Symbol	Explanation	Mean	Standard deviation
c	volume of private consumption	4.629	3.744
$(W+Z)^D$	disposable income of households	10.687	7.965
p_c	consumption prices	5.254	5.856
$[(W+Z)^D - p_c]$	disposable income deflated by consumption prices	5.433	5.122
$[(W+Z)^D - p_c]_{-1}$	disposable income deflated by consumption prices, lagged by one period	5.537	5.168

Fig. 4.6. Equation (1) for private consumption



Attempts to include independent price terms in the above basic equation did not succeed. It is sometimes suggested that there is some substitution of savings for consumption in Finland when the rate of inflation is high[1], but not such effect was found on a macro level. Of course, inflation works in several directions at the same time[2]. When the coefficients of the income and price terms are estimated separately, the result is

$$c = .576(W+Z)^{D} - .726\ p_c + .195(W+Z)^{D}_{-1} - .201\ p_{c-1} + 1.247$$

indicating some negative money illusion. The difference between coefficients of the corresponding price and income terms is , however, not significant. The volume equation (1) can be transformed into an equivalent value equation by adding p_c to both sides:

$$C = .569(W+Z)^{D} + .188(W+Z)^{D}_{-1} + .243\ p_c + .188\ \Delta p_c + .495$$

Because of the lag, we end up with two price terms which, however, should not be interpreted as indicating positive money illusion.

There has been much discussion of whether unemployment can be accepted as an explanatory variable in the consumption equation. Generally it is used as a cyclical attitudinal variable, affecting particularly purchases of

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1) Cf., Leppänen [1974].

2) See, e.g., Tyrni [1964].

consumer durables[1]. As unemployment correlates with disposable income, the coefficient for the latter variable is considerably lower when unemployment is included in the consumption equation. In the equation presented in figure 4.7. we have also included the term $[(W+Z)^D-C]_{-1} \approx [(W+Z)^D-p_c]_{-1}-c_{-1}$ which corrects for discrepancies between consumption and disposable income in the previous year. This formulation is also used in the present version of the model. It may also be worth mentioning that according to our experiments with Finnish data, liquidity as indicated by deposits can be a significant explanatory variable in the consumption equation. This variable might well be included in this equation when the model is enlarged to include a monetary block.

---

1) See Evans [1969] p. 164-169. See also the Quarterly Model of Bank of Finland Institute for Economic Research [1972].

Table 4.3. Equation (2) for private consumption

$$c = .365[(W+Z)^D - p_c] + .435[(W+Z)^D - C]_{-1} - 2.407\ \Delta\tilde{U} + 2.389$$
$$\quad (.071) \qquad\qquad (.095) \qquad\qquad (.549) \qquad (.467)$$

Method of estimation : OLS

$R^2 = .922$ $\qquad R_c^2 = .907$

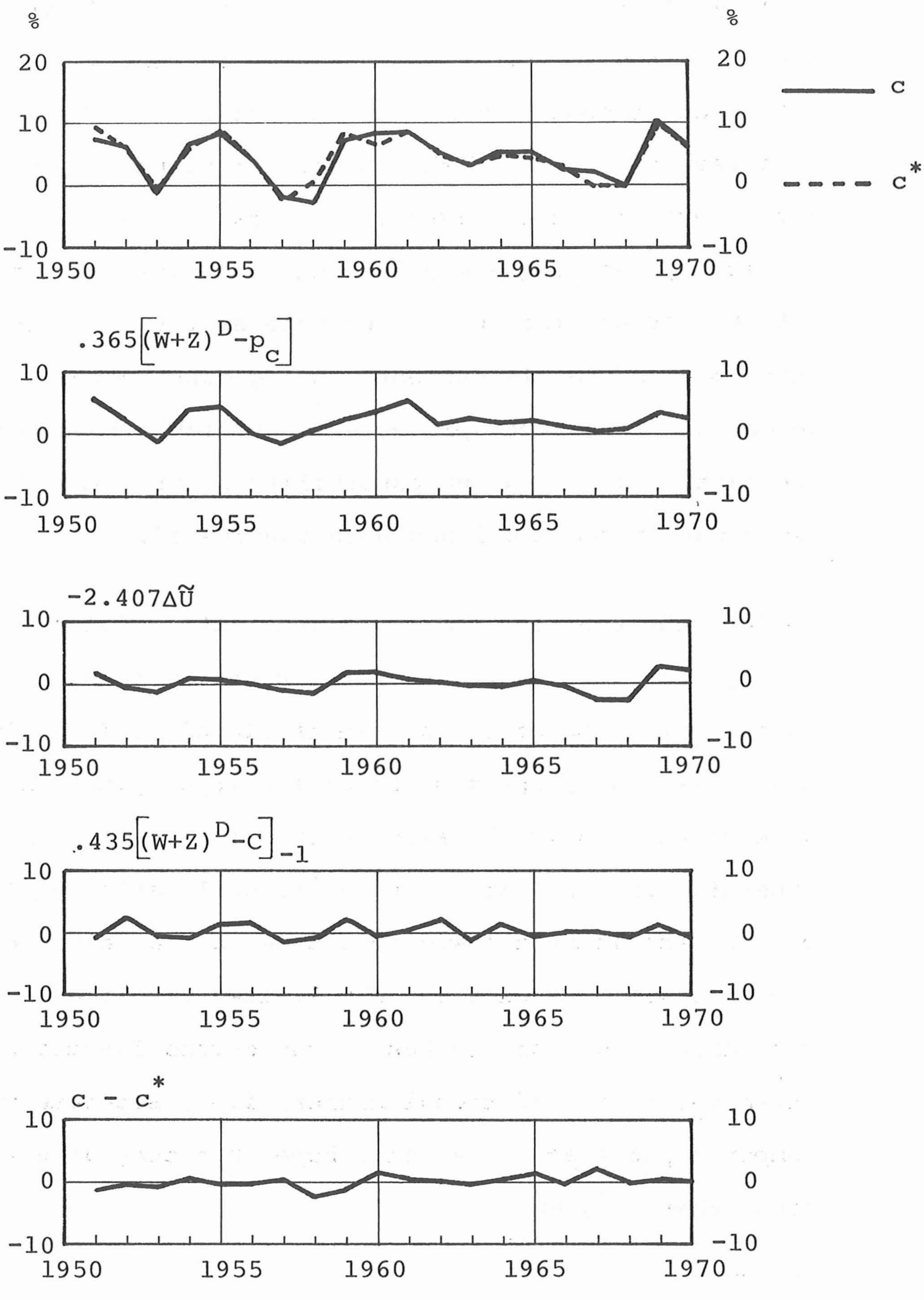
Standard deviation of residual, $s_c(e_i) = 1.172$

D-W statistic = 1.949

Additional information: disposable income deflated before estimation with the implicit price index for private consumption

Symbol	Explanation	Mean	Standard deviation
c	volume of private consumption	4.629	3.744
$(W+Z)^D$	disposable income of households	10.687	7.965
p_c	consumption prices	5.254	5.856
C	value of private consumption	10.085	6.748
$\Delta\tilde{U}$	change in unemployment rate	- .015	.673
$[(W+Z)^D - p_c]$	disposable income deflated by consumption prices	5.433	5.122
$[(W+Z)^D - C]_{-1}$	discrepancy between disposable income and consumption in the previous period	.513	2.805

Fig. 4.7. Equation (2) for private consumption



Private investment

The volume of total gross fixed private investment is the variable to be explained. A better fit could doubtless have been obtained if the series had been corrected for investment which can be considered to be autonomous for short-run purposes (e.g. some of the investment of public corporations and government enterprises). The data does not even allow us to distinguish adequately between the investment of government enterprises and that of the private sector. A better induced investment series is currently being constructed. Information on certain investment projects is available long before they are carried out, and the possibility of treating them as exogenous in the model has been considered.

Besides the equation for investment, the model also includes an equation for the demand for labour. We recognize that these factor demand functions are interrelated[1)]. In a simultaneous model like ours, optimum output and input paths should be determined jointly. Dynamic interaction between inputs, factor substitution, and variation in the utilization of labour and capital should be allowed for. However, largely because of problems with the data and our limited resources, we have not been able to do this. Robust input demand functions are estimated in a traditional manner, i.e., separately for each component, so that we can only hope that they do not contradict each other very much.

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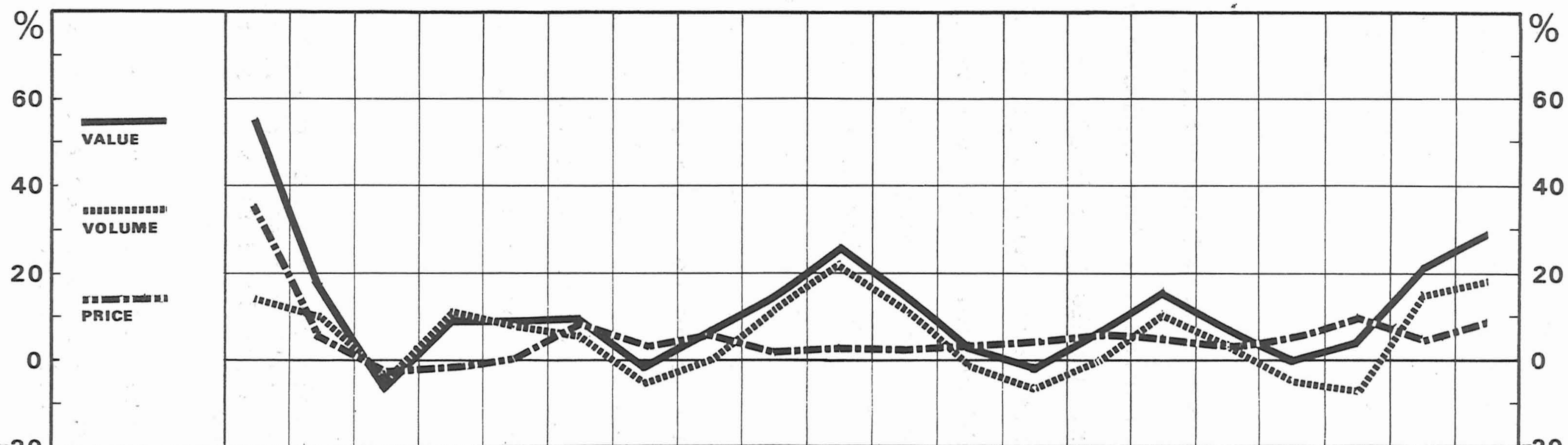
1) For a discussion of problems in this area, see Nadiri and Rosen [1971].

Fig. 4.8. Finnish private gross fixed investment in 1951-1970, 1000 million marks

in current prices and, annual percentage changes in value, volume and prices



YEAR	1951	52	53	54	55	56	57	58	59	1960	61	62	63	64	65	66	67	68	69	1970
VALUE 1000 MILLION MK	1.556	1.830	1.724	1.896	2.072	2.290	2.264	2.428	2.787	3.537	4.109	4.259	4.196	4.490	5.235	5.635	5.682	5.949	7.227	9.348
VALUE CHANGE, %	55.61	17.57	-5.77	9.97	9.28	10.53	-1.15	7.26	14.76	26.94	16.15	3.65	-1.47	6.99	16.61	7.64	0.84	4.70	21.47	29.35
VOLUME CHANGE, %	14.50	10.74	-3.14	11.77	8.37	6.02	-4.50	0.72	11.95	22.83	12.76	-0.30	-5.94	1.29	11.00	4.11	-4.55	-5.82	15.50	18.52
PRICE CHANGE, %	35.91	6.17	-2.72	-1.61	0.84	4.26	3.51	6.50	2.51	3.35	3.00	3.96	4.75	5.64	5.05	3.39	5.65	11.17	5.18	9.13

The main explanatory variable is $\Delta y'_{-3/4}$, the change in the growth rate of gross domestic product less inventories lagged by three quarters of a year. Similar accelerator-type investment equations have been used, for example, by den Hartog and Falke [1970], van der Werf [1971] and Driehuis [1972][1].

Production which is not assumed to influence investment should be removed from the series for the explanatory variable just as autonomous investment should be excluded from the series for the dependent variable. For example, parts of public production and agriculture could be left out. We have excluded inventory accumulation from this explanatory variable, since this part of production does not induce investment in the same way as other types of demand. As some of the goods held in stock are imported, and as imports are already deducted from total demand, our procedure leads to a series which is lower than the one which we would like to have[2]. One possibility would be to deduct only a part of the inventories, but here again we must contend with the poor quality of the inventory statistics[3].

---

1) The same kind of relation can be derived from different assumptions, e.g., with not so unrealistic assumptions, this type of explanation can be derived from the simple rigid accelerator theory.

2) I thank Mr. Schwartz for making this point clear to me.

3) Van der Werf [1971] has deducted a constant proportion of inventories from production.

An attempt was made to include in the investment function not only a variable representing capital stock adjustment due to changes in production but also a variable reflecting the availability of finance.

Our experiments show that non-labour income and liquidity variables based on deposits, which can be seen as a broader concept of the availability of finance, could both be chosen. As was explained above, inclusion of a monetary block has been left for a later date and our desire to form a compact set of variables led us to choose Z, though the share of internal financing out of total financing is usually considered to be low compared with other countries[1]. At present the non-labour income concept used includes components that should, for analytical reasons, be excluded. They are, however, very stable when compared with the total series, and their effect on the total performance of the model is thus small[2]. The coefficients for current and lagged non-labour income have been determined freely by regression. As the coefficient of the price term is approximately equal to the sum of the coefficients of the non-labour income terms, inflation that does not change relative prices does not greatly affect the volume of investment. Our experiments with capacity variables did not improve the present equation.

---

1) Cf., Lund [1973].

2) See section 4.2.3.5.

Table 4.4. Equation for private investment

$$i = \underset{(.497)}{3.169}\, \Delta y'_{-3/4} + \underset{(.202)}{.355}\, Z + \underset{(.188)}{.582}\, Z_{-1} - \underset{(.325)}{.756}\, p_i - \underset{(2.317)}{.466}$$

Method of estimation : OLS

$R^2 = .866$ $\quad R_c^2 = .825$

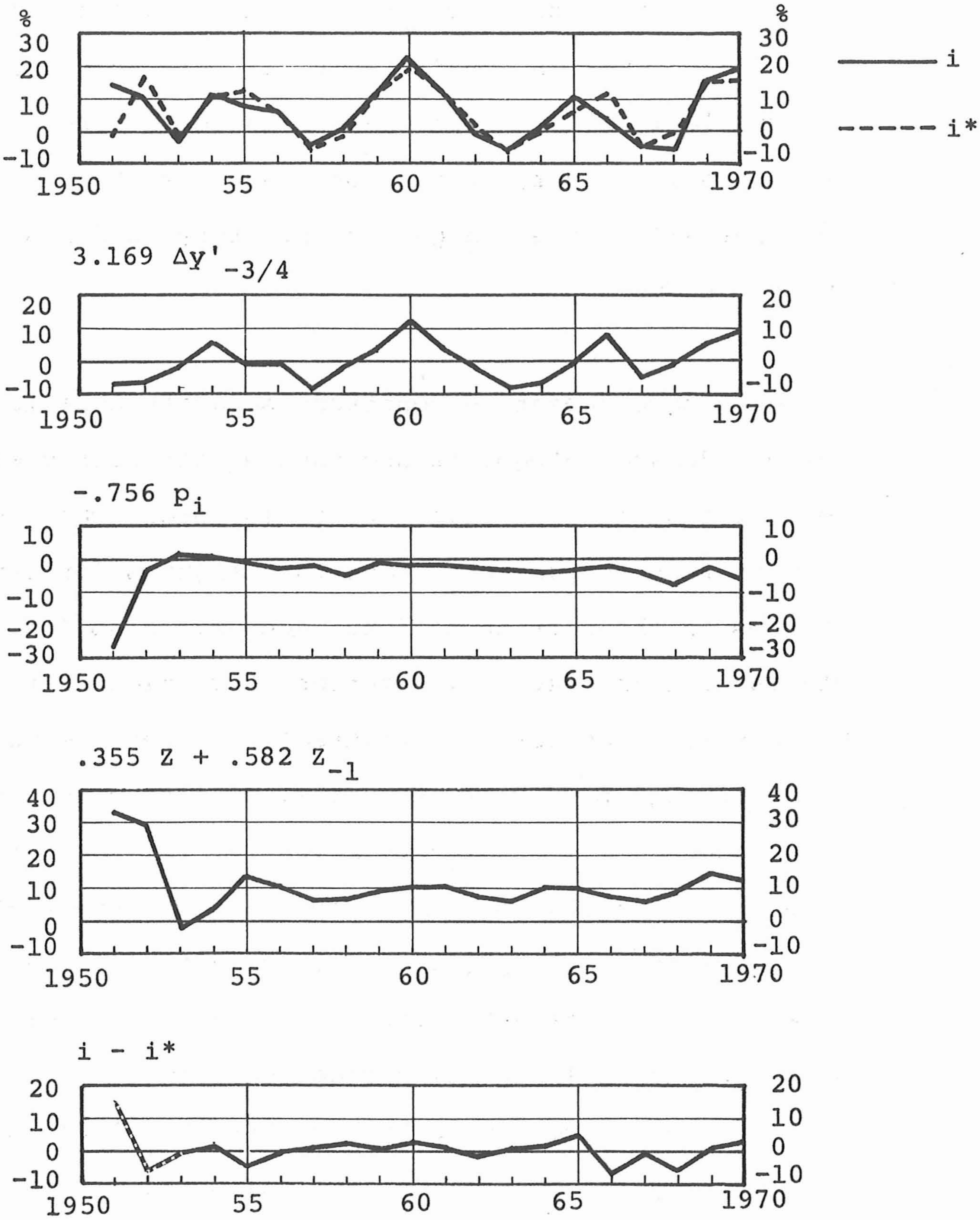
Standard deviation of residual, $s_c(e_i) = 3.735$

D-W statistic = 2.237

Additional information: lag of $\Delta y'$ has been fixed a priori, 1951-1952 excluded from the estimation period, single equation residuals (D1951:15.472, D1952:-6.990) are used as coefficients of the dummies for these years in connection with the model solutions

Symbol	Explanation	Mean	Standard deviation
i	volume of gross private fixed investment	5.587	8.671
y'	gross domestic product less inventories	4.718	2.478
$\Delta y'_{-3/4}$	lagged difference in gross domestic product less inventories	.164	1.922
Z	non-labour income	9.600	4.795
Z_{-1}	lagged non-labour income	8.950	5.429
p_i	investment prices	4.087	3.191

Fig. 4.9. Equation for private investment

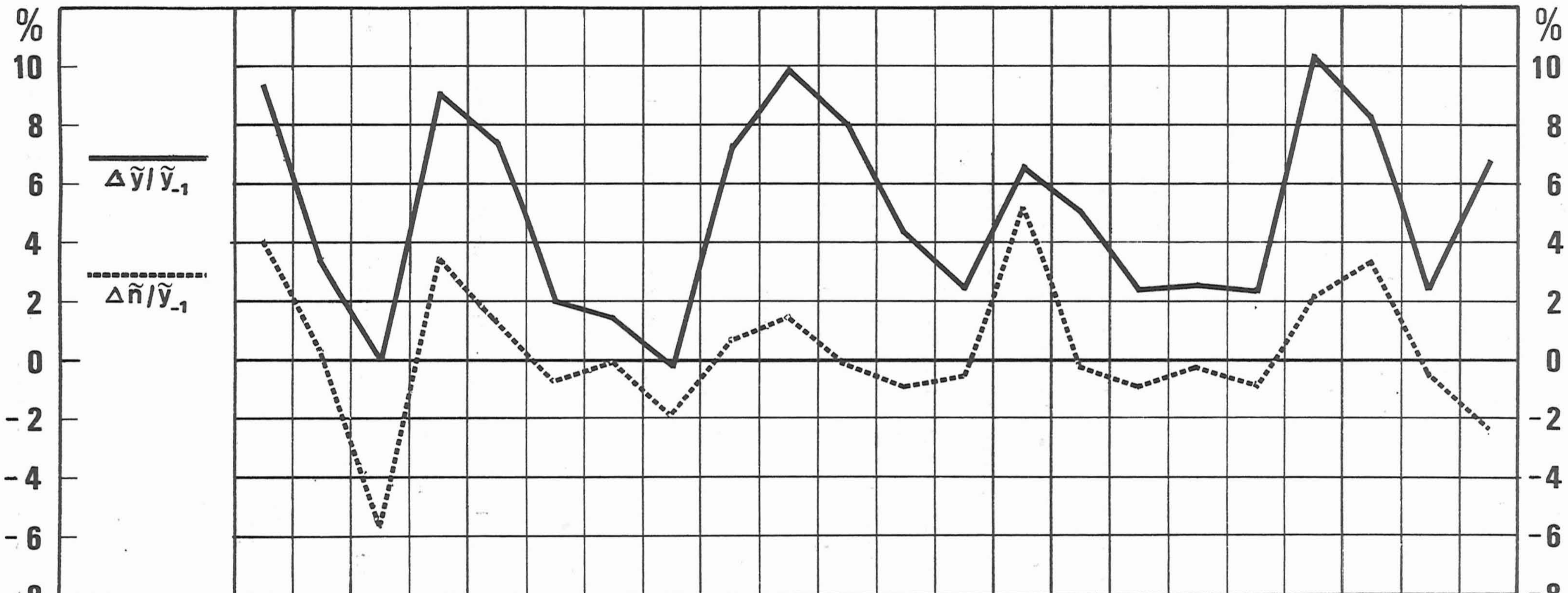


Inventory changes

Inventory changes play a strategic role in business cycle theory. As is seen from figure 4.10. the contribution of changes in inventories to percentage changes of Finland's gross domestic product is considerable. If this component is removed, the cyclical movements in GDP are quite different. It must be remembered, however, that imports are also held in stock so that not all of the changes in inventory holdings have a direct impact on GDP.

Since we have chosen to construct separate equations for various demand categories and then equate supply with demand, we must also have an equation for inventory changes. However, we must face the unhappy fact that figures for inventory changes in the Finnish national accounts also include the statistical discrepancy. Inventory formation is treated more or less as a residual by substracting other demand items from the estimated supply of resources. Thus figures for this demand category are not very reliable. This is particularly true for inventory changes in constant prices, where the shortcomings of all price indices cumulate. It is not possible to assess accurately how large the statistical discrepancy is. On the basis of information received from an annual RIFE inquiry about stocks held by industry and other information collected by the Central Statistical Office, it seems that inventory formation is more important than the error term. This is also suggested by the fact that standard theory provides

Fig. 4.10. Contribution of inventory changes to the growth in volume of gross domestic product



Year	1951	52	53	54	1955	56	57	58	59	1960	61	62	63	64	1965	66	67	68	69	1970	71	72
$\Delta\tilde{y}/\tilde{y}_{-1}$	9.3	3.4	0.1	9.1	7.5	2.0	1.5	-0.1	7.3	9.9	8.0	4.3	2.5	6.6	5.1	2.4	2.6	2.4	10.4	8.3	2.4	6.8
$\Delta\tilde{n}/\tilde{y}_{-1}$	4.1	0.3	-5.6	3.5	1.4	-0.7	0.0	-1.9	0.7	1.5	-0.1	-0.9	-0.5	5.1	-0.3	-0.9	-0.2	-0.8	2.2	3.4	-0.6	-2.3

a reasonable explanation of the time series. Although we believe that we are explaining stock formation and not the statistical discrepancy, the model is constructed with the above considerations in mind: changes in stocks occupy a less important place in the model than do other components of demand.

It seems that inventory formation has not received enough attention in the traditional forecasting work done in Finland. Contrary to the approach generally followed for forecasting demand components, this item is often treated as a residual and is calculated in the same way as it is in the national accounts. One reason for this is the poor quality of the data, which, in view of the practical and theoretical importance of inventory formation in assessing the general business cycle situation, should be corrected. For this, independent information on inventories is needed.

Instead of taking the normal percentage changes as our dependent variable, we use the ratio of the first difference in inventory changes to total output less inventories in the preceding year:

$$N = 100\frac{\Delta\tilde{N}}{\tilde{D}'_{-1}}$$

where

$\tilde{D}'$ = total demand less inventories

$\tilde{N}$ = change in stocks (as shown in the national accounts)

$\Delta\tilde{N} = \tilde{N}_t - \tilde{N}_{t-1}$ = the first difference of the inventory changes series

The reason for the use of this variable is that the inventory figures given in the national accounts are changes that can take on positive and negative values. In this situation the usual percentage change has no meaning. To put it another way: since stocks are measured on a ratio scale, differences in the series are on an interval scale, where a percentage change is not an admissible transformation.

The treatment of stock formation as a residual means that we will have the following expression for the value of the change in stocks

$$\tilde{N} = \tilde{D} - \tilde{D}'$$

Correspondingly for changes in stocks in constant prices we have

$$\tilde{n} = \tilde{d} - \tilde{d}' .$$

There is no sense in calculating the price index using

$$\tilde{p}_n = \frac{\tilde{N}}{\tilde{n}} = \frac{\tilde{D} - \tilde{D}'}{\tilde{d} - \tilde{d}'} ,$$

since both the denominator and the numerator may be either negative or positive, regardless of the sign of the other. If we define stock formation in constant prices by

$$n = 100\frac{\Delta\tilde{n}}{\tilde{d}'_{-1}},$$

we can calculate the differences between nominal and real changes using

$$N-n = 100(\frac{\Delta\tilde{N}}{\tilde{D}'_{-1}} - \frac{\Delta\tilde{n}}{\tilde{d}'_{-1}}) = 100(\frac{\Delta\tilde{D}-\Delta\tilde{D}'}{\tilde{D}'_{-1}} - \frac{\Delta\tilde{d}-\Delta\tilde{d}'}{\tilde{d}'_{-1}}) = (\frac{\tilde{D}_{-1}}{\tilde{D}'_{-1}})D-D'-(\frac{\tilde{d}_{-1}}{\tilde{d}'_{-1}})d+d'.$$

From this it is seen that the difference can be approximated by

$$N-n \approx p_d - p_d' .$$

Thus the assumption $p_d = p_d'$ is approximately equal to the assumption that N = n. If we have no information on the development of the price of inventories, we can, in a forecasting situation, set $p_d \approx p_d'$ by replacing n by N.

As inventory series are not reliable, there is no reason to try to estimate a sophisticated specification. The present equation uses an accelerator relationship which is similar to the one used in the investment equation. However, the lag in the accelerator term (total demand less inventories is used as the explanatory variable instead of production) is somewhat shorter, i.e., half a year. The term Δp_{mg} reflects speculation caused by accelerating import prices and the term N_{-1} is a correction for exceptional inventory formation in the previous year. The trend growth in inventories resulting from rising total sales is taken into account by the constant.

Fig. 4.11. Approximation of volume changes in inventories by the value changes

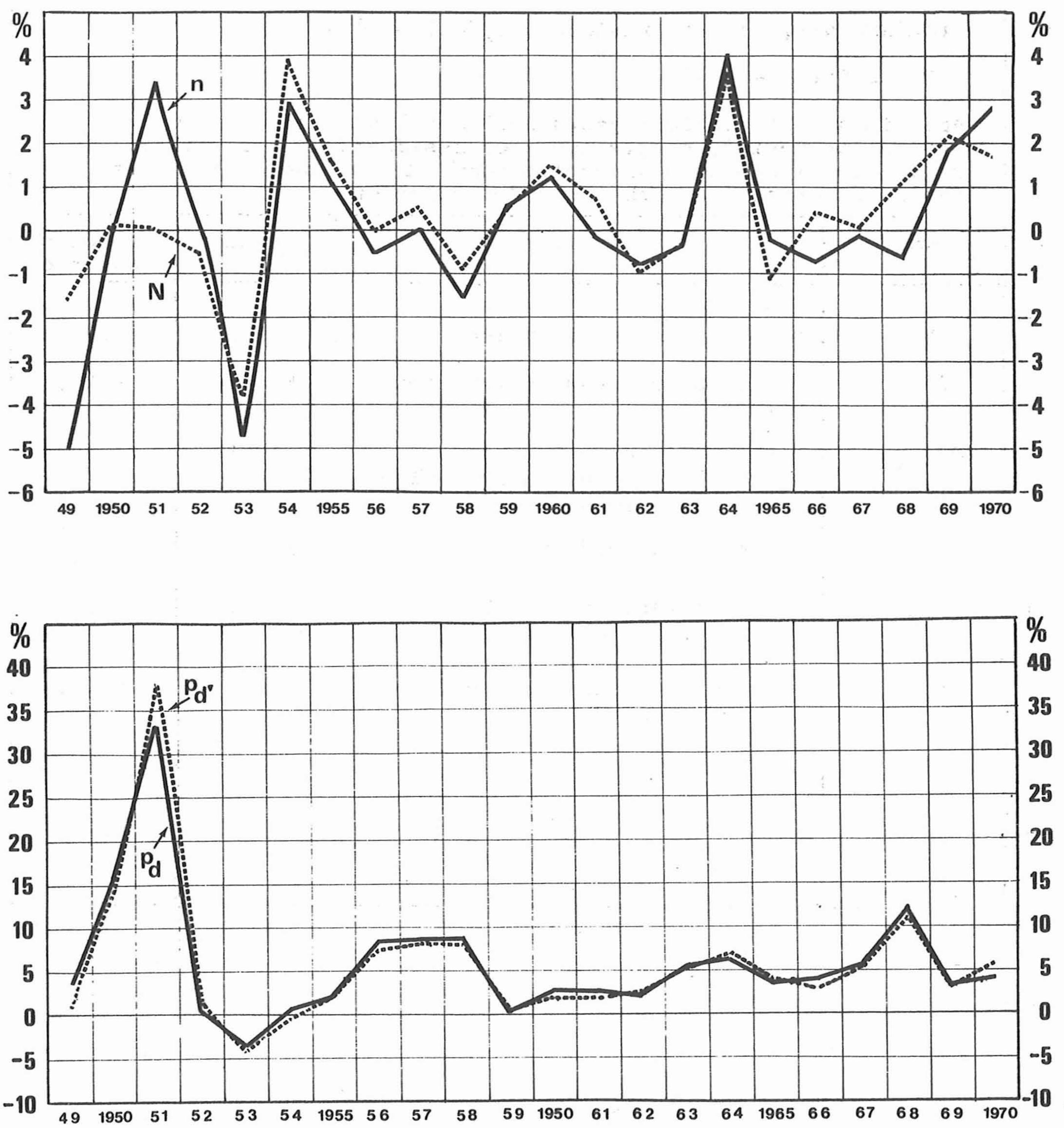


Table 4.5. Equation for inventory changes

$$N = .321\ \Delta d'_{-1/2} + .037\ \Delta p_{mg} - .369\ N_{-1} + .685$$
$$\quad (.076) \qquad\qquad (.017) \qquad\qquad (.121) \qquad (.212)$$

Method of estimation : OLS

R^2 = .631 $\qquad R_c^2$ = .552

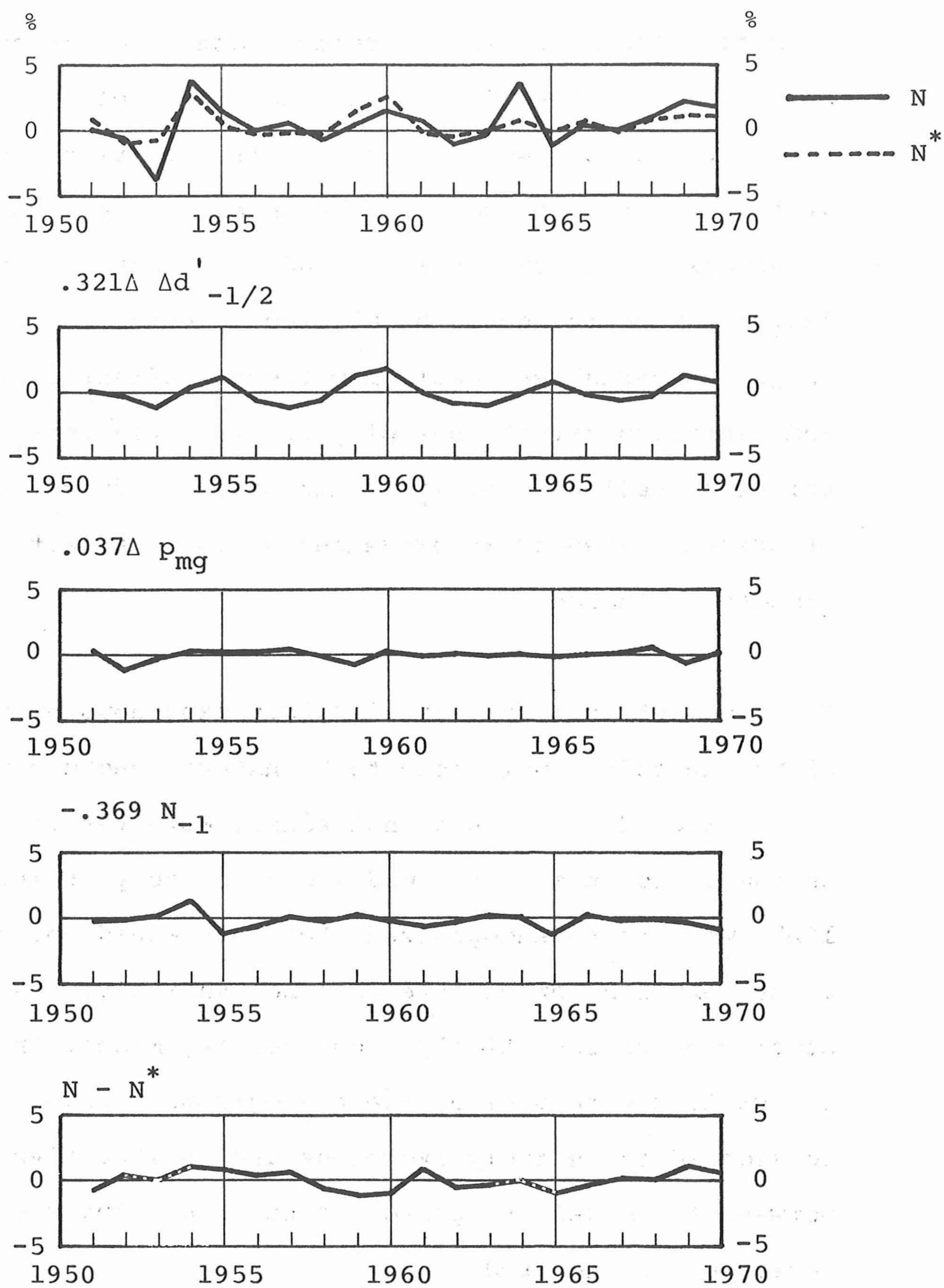
Standard deviation of residual, $s_c(e_i)$ = .860

D-W statistic = 1.210

Additional information: years 1953 and 1964 excluded from the estimation period, single equation residuals (D1953:-3.106, D1964:2.912) are used as coefficients of the dummies for these years in connection with the model solutions

Symbol	Explanation	Mean	Standard deviation
N	inventory changes, value	.432	1.265
d'	total output less inventories, volume	5.699	3.349
$\Delta d'_{-1/2}$	first difference in total output less inventories, volume half year lagged	.084	2.833
p_{mg}	prices of commodity imports	5.781	9.163
Δp_{mg}	first difference in prices of commodity imports	-.395	11.434
N_{-1}	value of inventory changes in previous period	.528	1.688

Fig. 4.12. Equation for inventory changes



4.2.2.2. Foreign sector

As a small industrialized country, Finland is involved to a great extent in the international division of labour, and this fact makes the economy very sensitive to external impulses. The model incorporates reaction equations only for trade in goods. It is felt that the explanation of trade in services would require extra equations and that at the moment this trade can be taken into account using exogenous variables. At a more advanced stage, international factor movements should be allowed to enter the model through exogenous variables. Capital movements affect liquidity, and migration affects unemployment and, via this, wages and prices as well as capacity. International factor income is at present taken as an exogenous variable affecting disposable income.

Keeping most international impulses exogenous, even in a more elaborate model, would seem to be natural because the relevant statistical data often do not exist. Moreover it would be necessary to enlarge the model considerably if international links were to be endogenized. Yet this would not provide a better explanation of international variables, as long as the model remains essentially a one-country model. In actual forecasting work some of these exogenous variables cannot be considered to be truly exogenous and an iterative procedure between the model and persons responsible for the exogenous variables is required.

In determining the volume of exports and imports, the main explanatory variables are foreign and domestic demand respectively. The next terms in both cases are relative prices and unused capacity[1]. Only the export and import equations are discussed in this section. Export prices are discussed in the wages and prices section, and import prices are exogenous.

Commodity exports

Exports to countries with which Finland has bilateral trade agreements are taken as exogenous because it is felt that the factors which determine them are different from those that influence exports to the market economy countries. The different short term variations can be seen in figure 4.13., where percentage changes in the value of multilateral and bilateral commodity exports to different regions are presented. The similarities in the beginning of the 1950s were a result of price movements.

As can be seen from figure 4.14., the long term growth in the two different trade flows has also been quite different (N.B. log scale).

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1) See Vartia, P. [1972] for a more general treatment of the problem.

Fig. 4.13. Fluctuations in bilateral and multilateral commodity exports, percentage changes in value

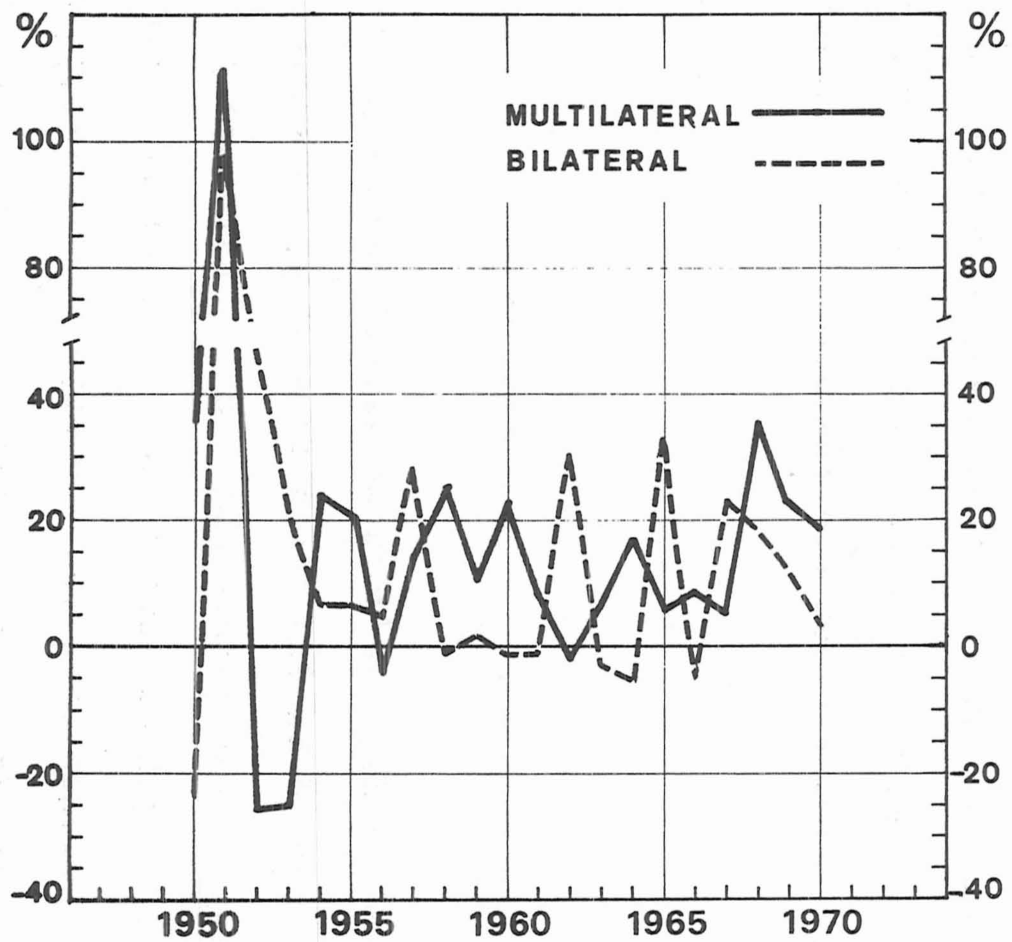


Fig. 4.14. Trends in bilateral and multilateral commodity exports, log scale

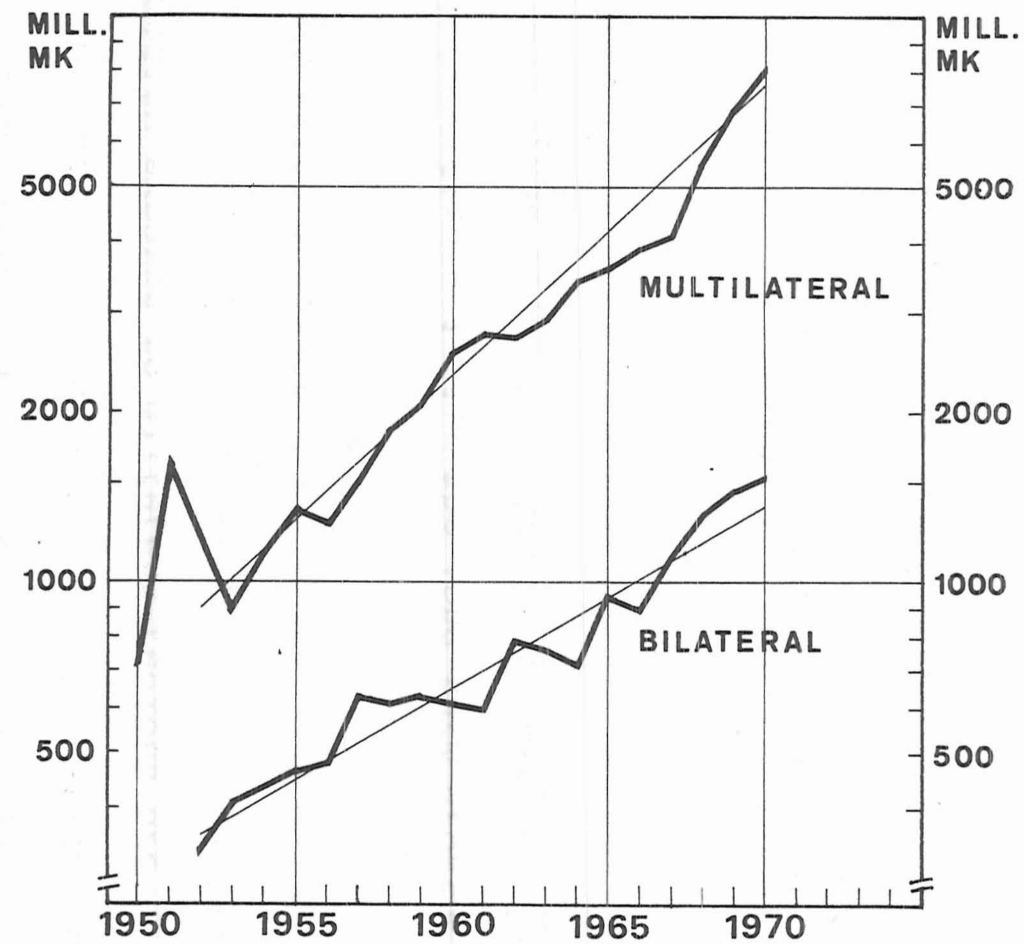
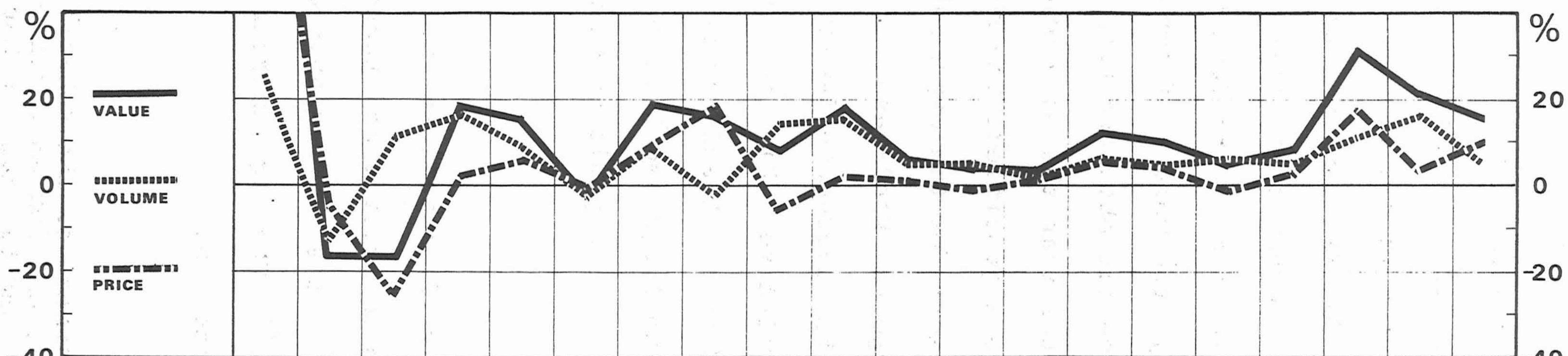


Fig. 4.15. Finnish commodity exports in 1951-1970, 1000 million marks in current prices, and annual percentage changes in value, volume and prices



YEAR	1951	52	53	54	55	56	57	58	59	1960	61	62	63	64	65	66	67	68	69	1970
VALUE 1000 MILLION MK	1.869	1.568	1.316	1.566	1.813	1.780	2.124	2.479	2.673	3.165	3.374	3.533	3.678	4.132	4.566	4.817	5.231	6.874	8.344	9.687
VALUE CHANGE, %	129.36	-16.08	-16.11	19.05	15.73	-1,80	19.33	16.73	7.82	18.39	6.62	4.71	4.10	12.34	10.51	5.50	8.60	31.41	21.39	16.08
VOLUME CHANGE, %	25.57	-11.56	11.27	16.67	9.18	-1.81	9.04	-1.87	14.45	15.72	5.04	5.49	2.16	6.49	5.40	6.35	5.42	11.57	16.75	5.22
PRICE CHANGE, %	82.66	-5.11	-24.61	2.04	6.00	0.00	9.43	18.96	-5.80	2.31	1.51	-0.74	1.90	5.49	4.84	-0.80	3.02	17.78	3.97	10.32

The main explanatory variable for the volume of commodity exports to market economy countries is export demand, m_w, which is constructed by calculating the weighted growth rate of industrial production in the ten OECD countries most important as markets for Finnish exports, the weights being the shares of Finnish exports to these countries. Some other variable representing export demand could have been chosen. Theoretically, the volume of imports would be better, but for Finland the fit obtained with industrial production is so much better than the one obtained with other variables that its use seems justified. One reason for the high value of the coefficient for the export demand variable is the composition of exports. Wood-based exports seem to have a greater variance than aggregate demand, the income elasticity of demand is relatively high for these goods and they are also easily held in stock and may be accumulated in boom years by buyers[1]. The large negative value of the constant term corresponds to the positive value of this coefficient.

The terms $(p_{xg} - p'_x)_{-1}$ (i=1,2,3) measure the effect of substitution between Finnish exports and those of her competitors, and the sum of the coefficients corresponds to our a priori expectations[2]. The lag structure has been determined freely by regression.

---

1) See Laatto [1964].

2) For a theoretical treatment of the substitution elasticity, c.f., Richardson [1973] and for an empirical treatment, c.f., e.g., Tinbergen [1951] and Hickman and Lau [1973].

Table 4.6. Equation for multilateral commodity exports

$$X_{gw} = +\ 2.338\ m_w - .520(p_{xg}-p_x') - .828(p_{xg}-p_x')_{-1} - .308(p_{xg}-p_x')_{-2}$$
$$\qquad\ (.467)\qquad (.401)\qquad\quad (.209)\qquad\quad (.253)$$
$$- 3.172$$
$$(2.447)$$

Method of estimation : OLS

R^2 = .809 R_c^2 = .748

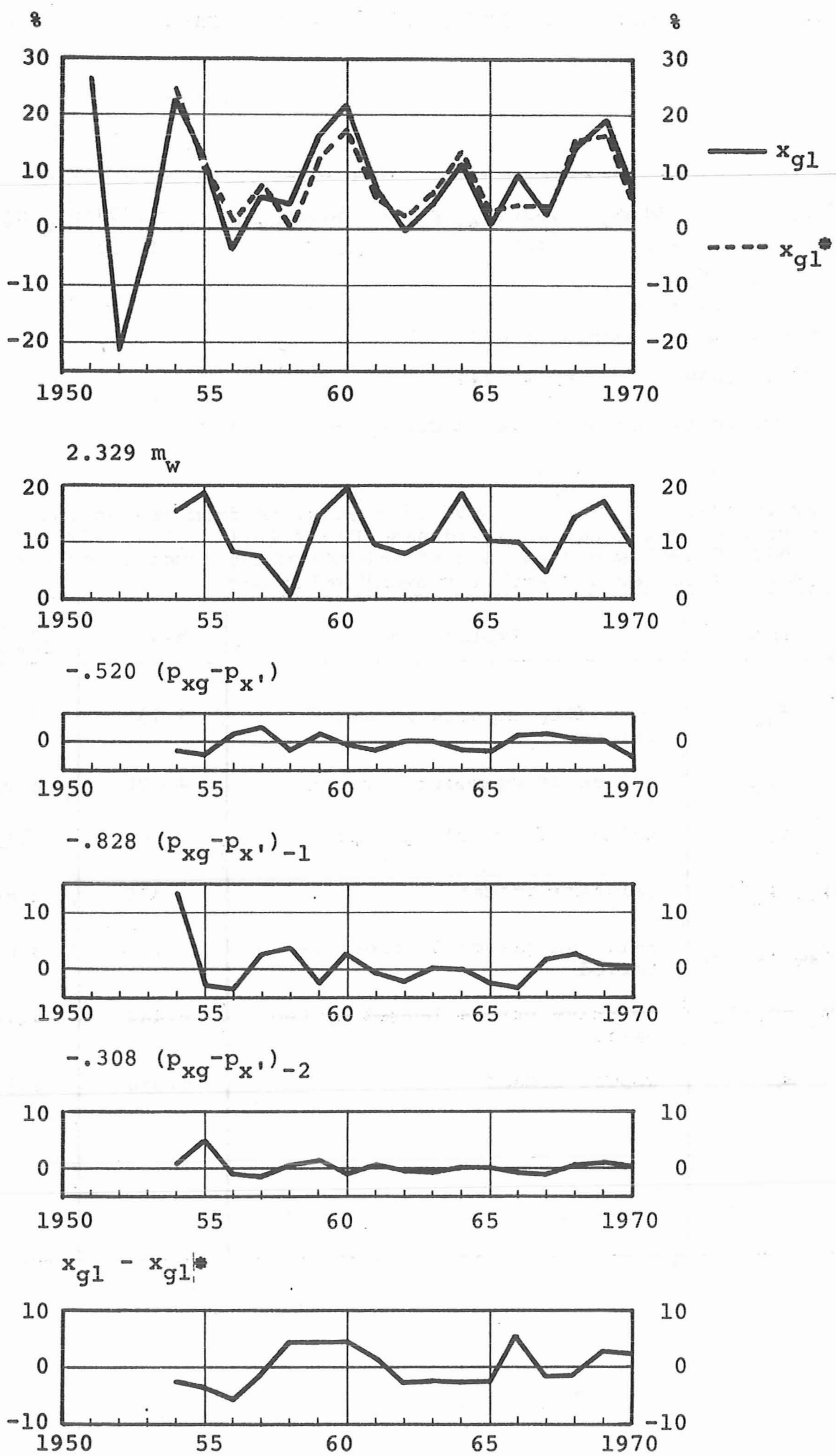
Standard deviation of residual, $s_c(e_i)$ = 3.895

D-W statistic = 1.195

Additional information: 1951-1953 excluded from the estimation period single equation residuals (D1951:27.112, D1952:21.597, D1953:-8.041) are used as coefficients of the dummies for these years in connection with the model solutions

Symbol	Explanation	Mean	Standard deviation
X_{gw}	commodity exports to west, volume	9.133	7.534
p_{xg}	prices of commodity exports	4.720	6.218
p_x'	prices of competing exports	4.285	6.137
$(p_{xg}-p_x')$	relative prices	.435	2.844
$(p_{xg}-p_x')_{-1}$	relative prices in previous period	-.710	4.672
$(p_{xg}-p_x')_{-2}$	relative prices lagged by two years	-.862	4.701
m_w	export demand	4.990	2.218

Fig. 4.16. Equation for multilateral commodity exports



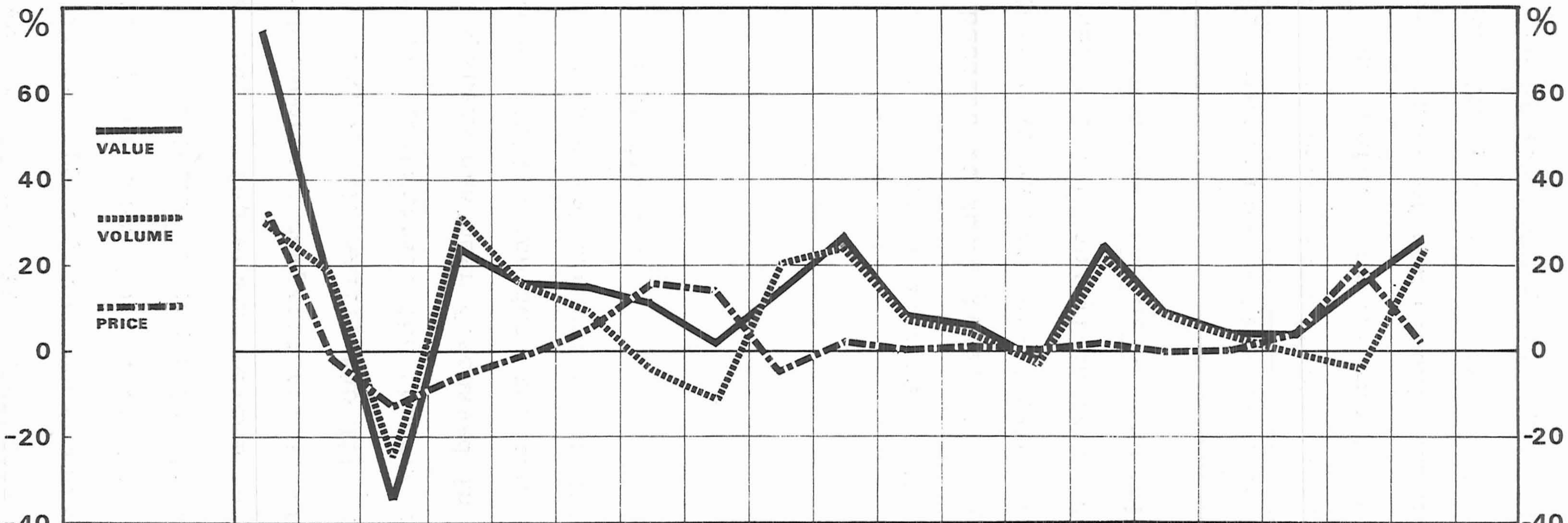
The price of the exports of competing countries, p'_x has been calculated by weighting import price developments in Finland's main export markets by the distribution of Finnish exports. This index could also be formed using a double weighting system which would include the export prices in different markets of our most important competitors. As Finland's share in any of her markets is small, the difference in these two methods cannot be substantial. The theoretical justification for the weighting systems has been discussed in detail by Hoogland and Schwartz [1971]. The data for the construction of the export demand variable and the prices of competitors' exports is given in appendix II.

Commodity imports

Imports based on bilateral trade agreements are also included in this variable because it seems reasonable to assume that imports from different areas are substitutes. If bilateral trade is exceptionally low in any given year, demand is satisfied by importing goods from other countries

Fluctuations in Finland's imports have been about twice as great as those in total sales less inventories, d', which is reflected in the high coefficient for the latter variable. Figure 4.20. gives an idea of how closely imports follow domestic production. The problem of very rapidly rising imports during years of peak GDP growth is evident. The

Fig. 4.17. Commodity imports to Finland in 1951-70, 1000 million marks, in current prices and annual percentage changes in value, volume and prices



YEAR	1951	52	53	54	55	56	57	58	59	1960	61	62	63	64	65	66	67	68	69	1970
VALUE 1000 MILLION MK	1.555	1.822	1.219	1.521	1.770	2.036	2.279	2.333	2.673	3.403	3.690	3.929	3.867	4.817	5.265	5.524	5.794	6.711	8.505	
VALUE CHANGE, %	74.38	17.19	-33.11	24.85	16.31	15.03	11.97	2.36	14.57	27.31	8.44	6.46	-1.57	24.56	9.31	4.93	4.89	15.82	26.73	
VOLUME CHANGE, %	30.43	19.13	-23.65	32.34	16.31	9.55	-3.63	-10.80	20.60	24.50	7.65	4.93	-2.55	21.90	8.79	4.12	0.07	-3.88	23.61	
PRICE CHANGE, %	33.64	-1.63	-12.40	-5.66	-0.00	5.00	16.19	14.76	-5.00	2.26	0.74	1.46	1.00	2.18	0.49	0.77	4.81	20.49	2.53	

a priori idea of a linear relationship between imports and production, if production is the only explanatory variable, is not clearly valid in the short run, though it may be a good approximation in the long run. The difference between the short and long run relationship is analyzed in figure 4.18., which shows volume of imports and GDP in absolute terms. If the relationship is approximated by a linear function between the absolute figures or their logarithms, the cyclical variation in the import/GDP ratio is not captured. A negative time trend corresponding to the constant term of the present equation and a high value for the coefficient of production in necessary. This high short-run income elasticity of demand for imports can be explained by capacity shortages

Fig. 4.18. Scatter diagram of absolute GDP and commodity imports in 1964 prices

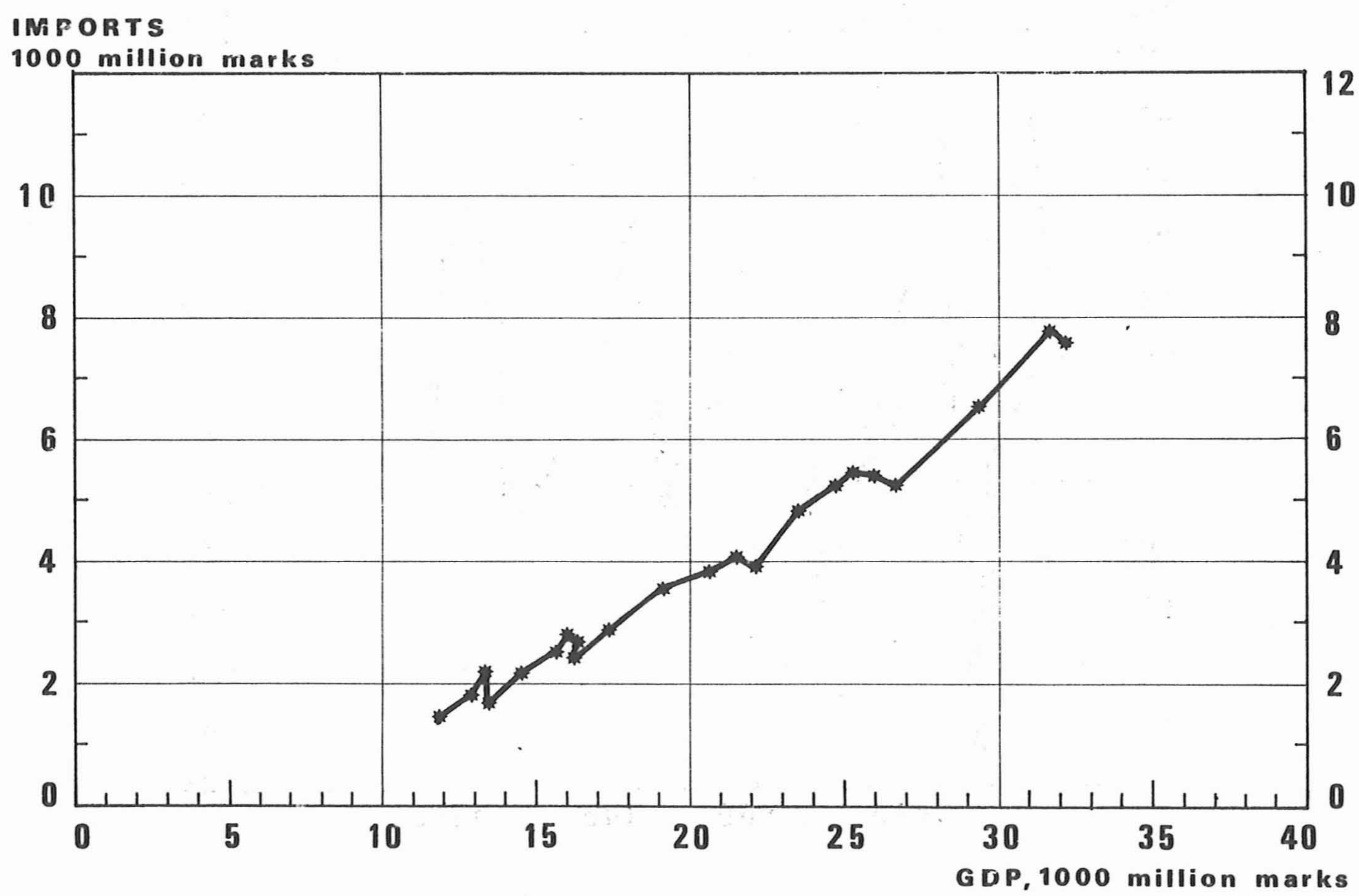


Fig. 4.19. Scatter diagram of annual percentage changes in the volume of GDP and commodity imports

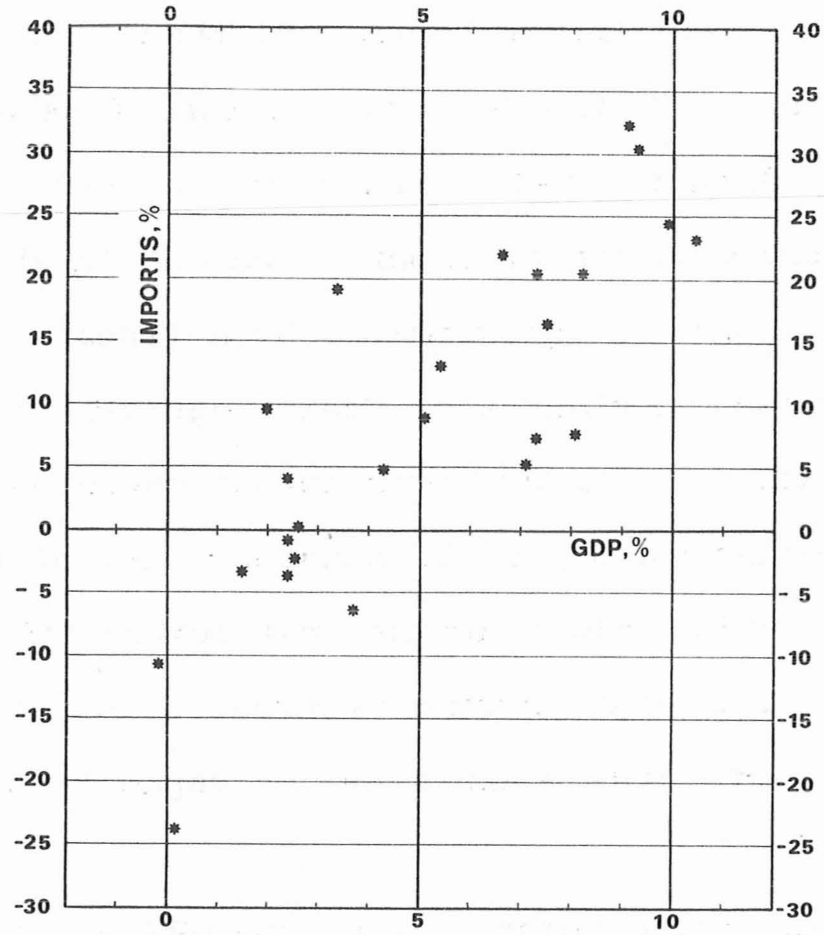
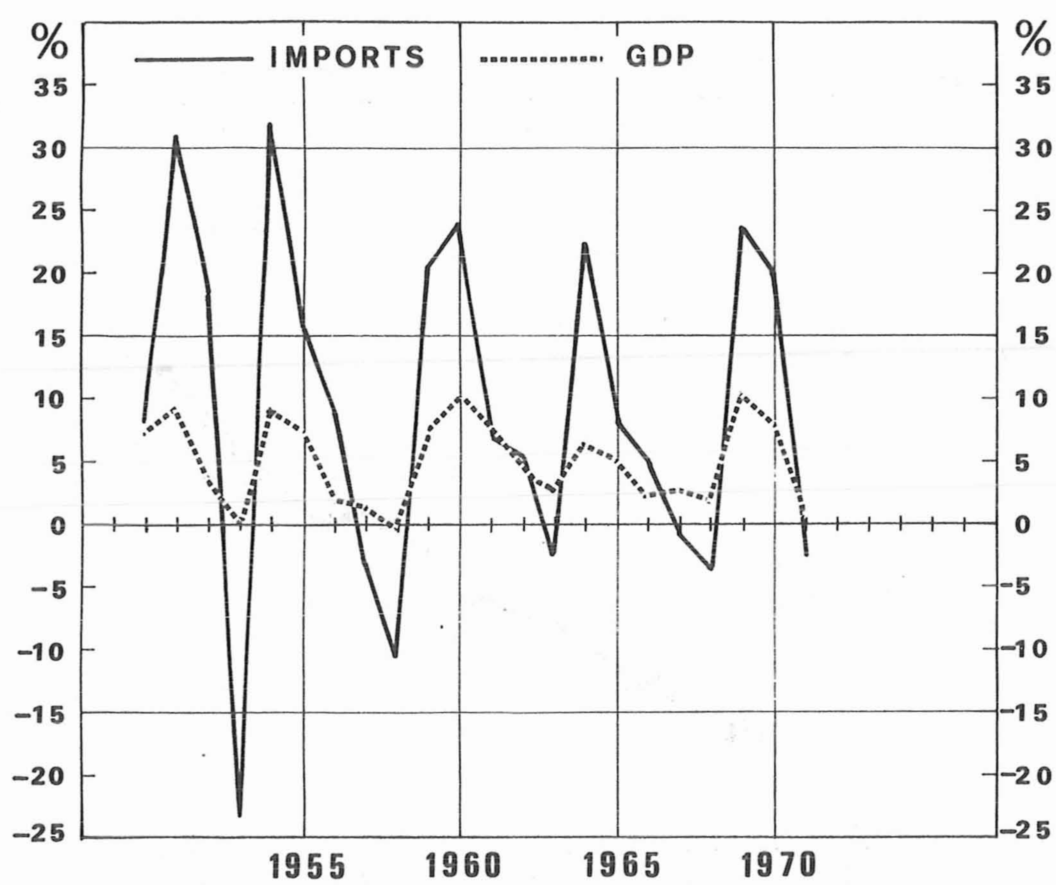


Fig. 4.20. Fluctuations in commodity imports and GDP, annual percentage changes in volume



in boom years. However, the present equation does not include any capacity variable as we are not content with the results obtained this far. We have added an accelerator term $\Delta d'$ to capture the effect of the rapid growth in domestic demand.

The estimate obtained for the short-run price elasticity of demand for imports is 0.594. The main reason for the low value in Finland is the absence of any real scope for domestic substitution in several import categories. This lends support to the pessimistic view about the use of exchange rates to remedy balance of payments difficulties. Some reasons for viewing this figure as excessively low are given in Orcutt [1950] and Aurikko [1973]. In the present specification, import prices are not adjusted to include the effects of customs duties and indirect taxes, though domestic buyers compare prices in markets where these costs are included. We have tried to construct a series to take into account this difference by summing all the costs which raise import prices after Customs and dividing this by the value of imports. These figures can be added to the import prices to arrive at a price series which approximates domestic prices[1]. However, the introduction of the new variable does not improve the results. This may be due to the fact that import duties were raised when the quantitative limitations on trade were relaxed. Additional variables or dummies are needed to take account of these effects. When using the model for policy analysis, this more comprehensive variable may be added for greater analytical precision.

1) See Lehtimäki [1973].

Table 4.7. Equation for commodity imports

$$m_g = \underset{(.347)}{1.924}\, d' + \underset{(.757)}{3.074}\, N + \underset{(.223)}{.594}(p_y - p_{mg})_{-1/3} + \underset{(.282)}{.334}\, \Delta d' - \underset{(1.996)}{3.868}$$

Method of estimation : OLS

$R^2 = .933$ $R_c^2 = .910$

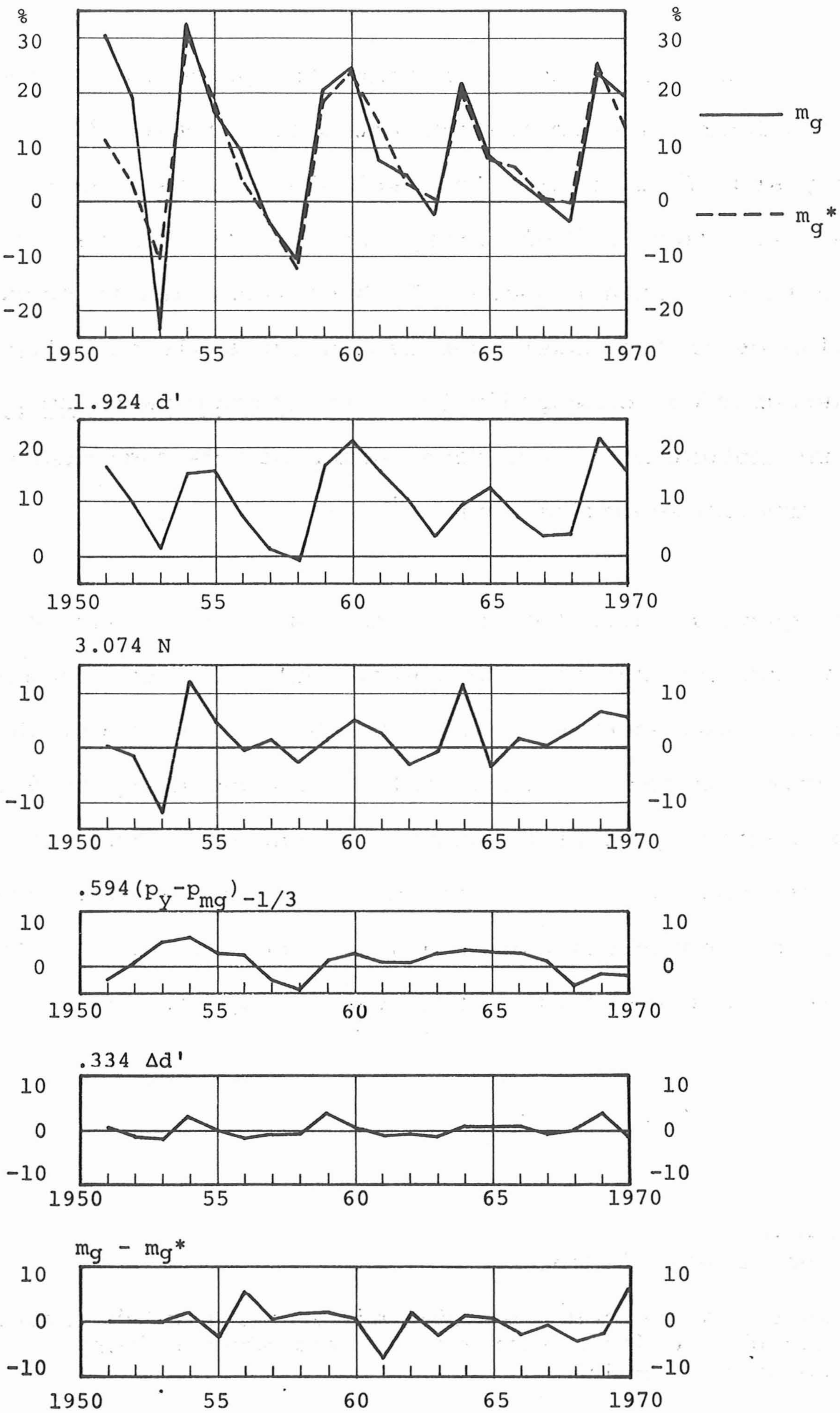
Standard deviation of residual, $s_c(e_i) = 3.685$

D-W statistic = 2.197

Additional information: 1951-1953 excluded from the estimation period single equation residuals (D1951:19.182, D1952:15.360, D1953:-12.858) are used as coefficients of the dummies for these years in connection with the model solutions

Symbol	Explanation	Mean	Standard deviation
m_g	commodity imports, volume	10.197	11.929
d'	total demand less inventories, volume	5.519	3.391
N	inventory changes, value	.858	1.431
p_y	implicit prices of GDP	4.966	7.211
p_{mg}	prices of commodity imports	4.155	6.888
$(p_y-p_{mg})_{-1/3}$	relative prices lagged by 1/3 year	1.132	4.320
$\Delta d'$	difference in total demand less inventories	.416	4.200

Fig. 4.21. Equation for commodity imports



4.2.2.3. Labour input and unemployment

Labour input

The variable explained represents the percentage changes in paid labour input in the private sector measured in man-years. This is also the variable that is used to deflate the total wage bill of enterprises to get the average wage rate in the private sector. Both of these are endogenous variables in the model. Our method to handle this typical index problem corresponds to using average wage sum per man-year as an indicator of wage rate, which may be regarded as "one of the crudest approximations" [1].

The equation indicates that there is some lag between labour input and production. The coefficients for gross domestic product have been determined freely by regression. The term K, gross profits per total sales, can be interpreted as representing present profitability and entrepreneurs' expectations of future profits[2]. What was said in connection with the investment equation about the interrelationship between factor demand functions also applies here.

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1) See Niitamo [1958].

2) This feature has been adopted from the Dutch annual model, though the definition of K is somewhat different, see Verdoorn [1967].

Table 4.8. Equation for labour input

$$a = .638\ y + .151\ y_{-1} + .102\ K - 2.376$$
$$\quad (.060) \quad (.059) \quad (.040) \quad (.421)$$

Method of estimation : OLS

R^2 = .912 $\qquad R_c^2$ = .895

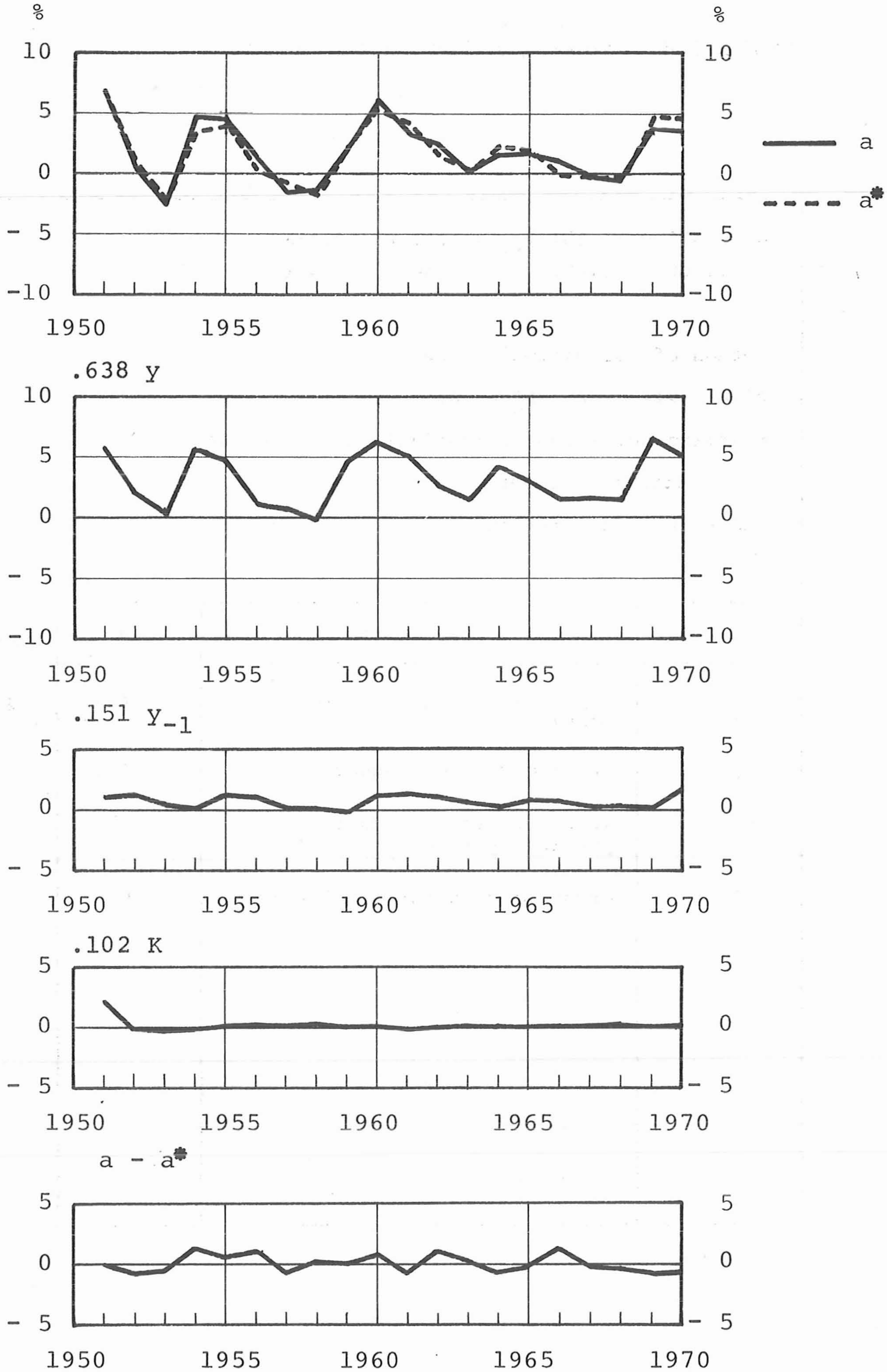
Standard deviation of residual, $s_c(e_i)$ = .849

D-W statistic = 1.990

Additional information :

Symbol	Explanation	Mean	Standard deviation
a	labour input in the private sector	1.884	2.556
y	gross domestic product	5.137	3.330
y_{-1}	gross domestic product in the previous period	5.089	3.292
K	gross profits per total sales	2.058	4.891

Fig. 4.21. Equation for labour input



Unemployment

Since 1958 the Finnish manpower authorities have measured unemployment with the aid of a labour force sample survey (the size of the sample is 30 000, while the total labour force is somewhat over 2 million persons). For the earlier years of the estimation period, the series has been constructed using the ratio of job-seekers to unfilled vacancies. The persons who are employed by the public sector in relief works are not included in the official unemployment statistics. It could be argued that the number so employed should be added to this series. It might prove useful to explain this broader concept of unemployment and then reduce it to the "present" series by using an exogenous variable. This is particularly important if the unemployment rate is used to determine unused capacity.

The equation can be seen as a combined labour demand and labour supply equation. The coefficient of the explanatory variable, labour input, seems very low. However, if we think that the supply of labour reacts to the demand for it, we have

$$\tilde{a}^s = \alpha + \beta\,\tilde{a}^d \quad (0 < \beta < 1)$$
$$\tilde{a}^d = \tilde{a}^d$$

$$\tilde{a}^s - \tilde{a}^d = \alpha - (1-\beta)\tilde{a}^d$$

i.e. $\Delta(\tilde{a}^s - \tilde{a}^d) = -(1-\beta)\Delta\tilde{a}^d$.

The response of the supply of labour to the demand for labour is described in figure 4.23. There has been a declining trend in the participation rate (the ratio of the total labour force to the number of persons of working age). However, there have been distinct cyclical fluctuations around this trend. For example, in 1968, which was a year of severe unemployment, the participation rate declined by 1.6 percentage units. If there had been no change in the participation rate the unemployment figures would have been much worse. As the participation rate is about two thirds, changes in it must be multiplied by 1.5 to get its effect on the unemployment rate.

The unemployment equation is the most unsatisfactory equation in the model at present. We are experimenting with more sophisticated equations in order to be able to take into account such supply factors as changes in the population of working age, migration and unemployment policy. So far it has been difficult to include these effects because of inadequacy in the data for the first half of the estimation period.

Fig. 4.23. Response of the participation rate to the demand for labour

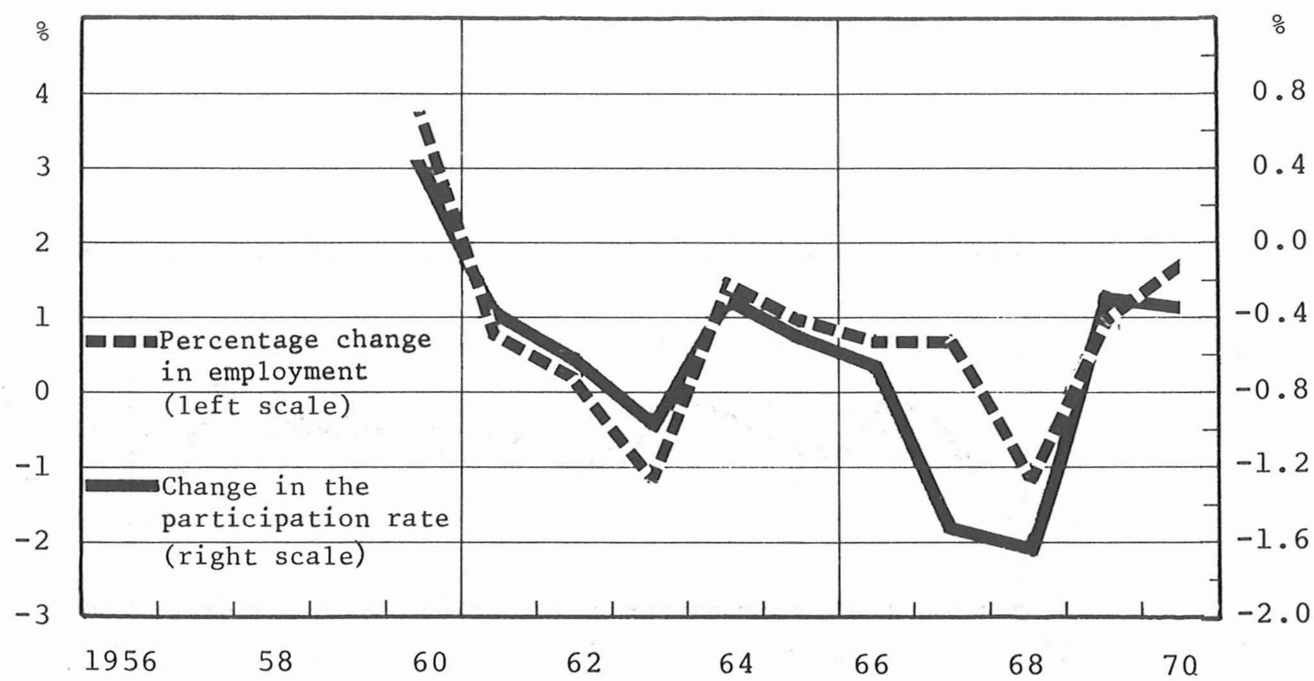


Table 4.9. Equation for the unemployment rate

$$\Delta\tilde{U} = -\underset{(.034)}{.219}\,a + \underset{(.109)}{.398}$$

Method of estimation : OLS

R^2 = .694 R_c^2 = .677

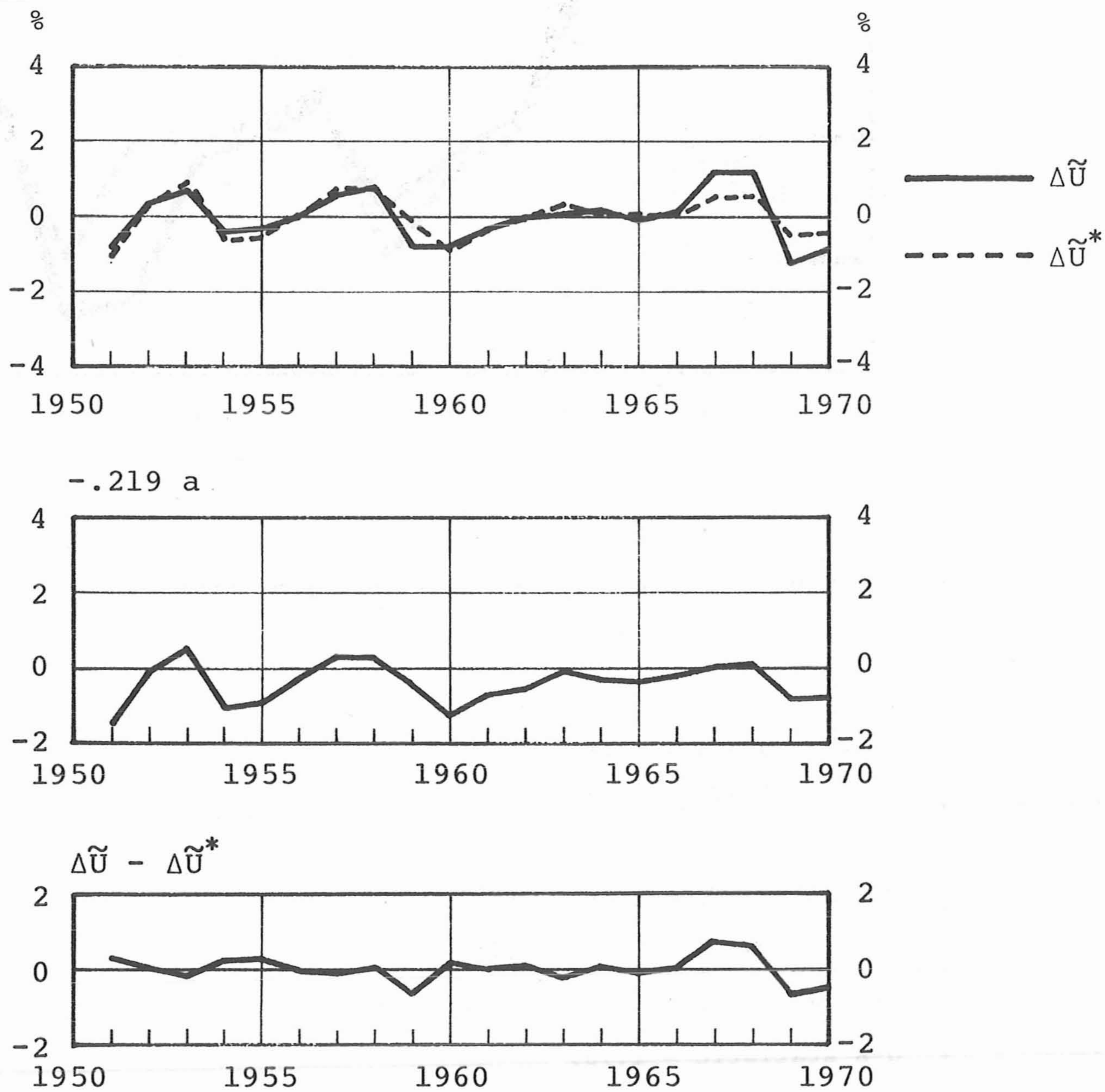
Standard deviation of residual, $s_c(e_i)$ = .393

D-W statistic = 1.789

Additional information :

Symbol	Explanation	Mean	Standard deviation
$\Delta\tilde{U}$	change in unemployment rate	-.015	.673
a	labour input in the private sector	1.884	2.556

Fig. 4.24. Equation for the unemployment rate



4.2.2.4. Wage rate and prices

The model includes a wage rate equation as well as separate price equations for all the aggregate demand categories (apart from inventory changes) which have been estimated directly. As macro-level price equations have to describe pricing behaviour in a variety of different conditions, this approach seems natural. The differences in price setting practices may, for example, be due to the fact that some sectors of the economy are more susceptible to international price movements than others[1]. Problems of this kind are more easily handled in sectoral models, where input-output techniques can also be used.

As shown by table 4.10., the variables in the wage and price block are highly correlated. The presence of multicollinearity sometimes makes it advisable to impose a priori linear restrictions on the parameters of the equations. We have thus usually used unit labour costs in the price equations instead of taking the wage rate and productivity as separate explanatory variables. Heterogeneity in the different production sectors suggests that we should consider the relaxation of this restriction in the future. The ratio between the coefficients of the cost components in the export price equation has also been fixed beforehand.

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1) This fact has been the object of much attention in the Scandinavian countries. See Aukrust [1970] for Norway, Edgren, Faxén and Odhner [1970] for Sweden and Molander, Aintila and Salomaa [1970] and Halttunen [1972] for Finland.

Table 4.10. Correlation matrix for annual percentage changes in the wage and price variables[1)]

	p_{mg}	p_x'	w	p_{xg}	p_c	p_i	p_g
p_{mg}	1.000	.984	.738	.887	.856	.842	.790
p_x'	.984	1.000	.708	.888	.836	.820	.754
w	.738	.708	1.000	.893	.861	.936	.947
p_{xg}	.887	.888	.893	1.000	.853	.942	.878
p_c	.856	.836	.861	.853	1.000	.877	.924
p_i	.842	.820	.936	.942	.877	1.000	.940
p_g	.790	.754	.947	.878	.924	.940	1.000

The main determinant in all of the price equations is wage cost per unit of output, H. The definition which we use for this variable is somewhat different from the usual one. After experimenting with different specifications, we followed Verdoorn and Post [1964] and lagged productivity by half a year. However our specification differs from the Verdoorn-Post one in that domestic production, rather than total demand, is used to calculate productivity.

Another term appearing in all the price equations is the price of commodity imports. This variable is important in a model for the Finnish economy because imports make up a large share of

1) If the dominant observations of the Korean boom are excluded, considerably lower values are obtained.

total resources. The high correlation between import prices and domestic prices suggests that domestic inflation is greatly affected by foreign price developments and exchange rate policy.

The direct estimation of the price equations also provides us with a flexible way to evaluate the different factors affecting price formation[1]. We have tried using capacity variables in the price equations to take account of possible imbalances between supply and demand. The results were not satisfactory, and the equations presented here do not include capacity variables.

Wage rate

There is one equation explaining the wage rate in the private sector. As we want to use the wage bill series from the national accounts in the model, the total corporate wage bill (including social benefits) is divided by the number of man-years worked in order to ensure commensurability in the data.

As can be seen from figure 4.25. the covariation in prices and wages has been very clear for most of the estimation

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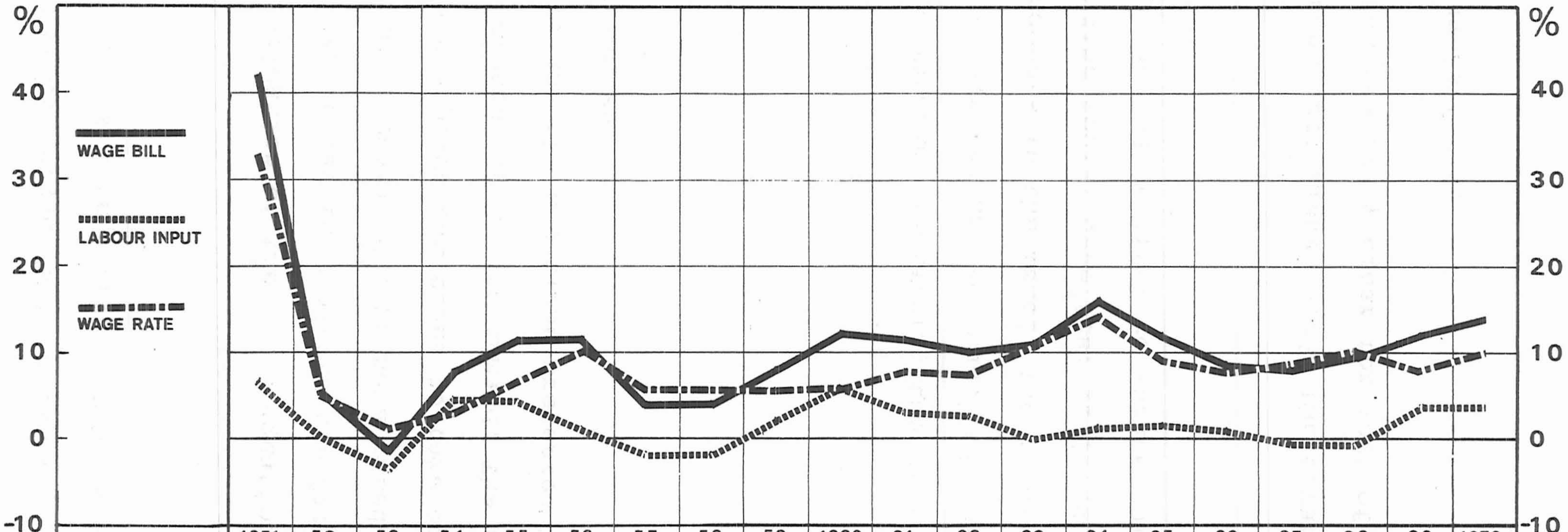
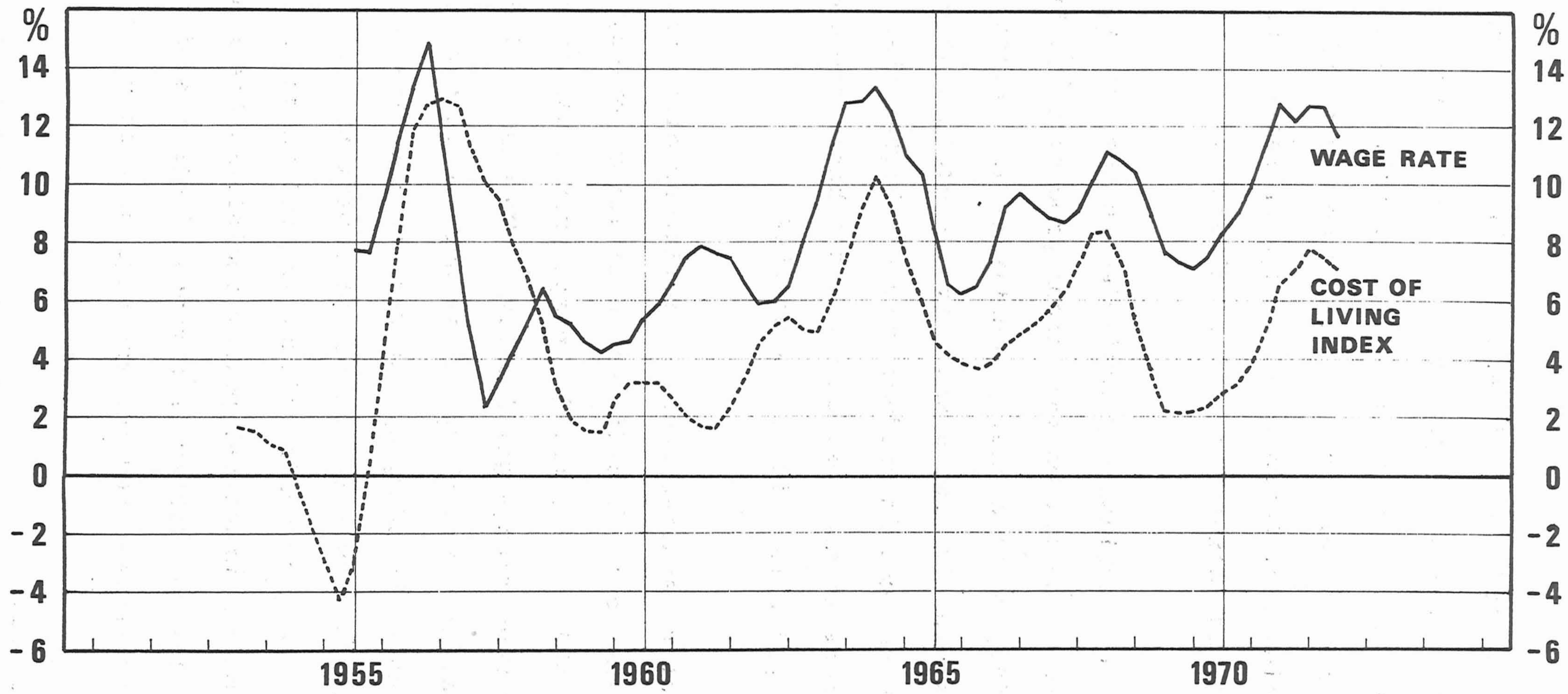
1) See Driehuis [1974].

Fig. 4.25. Finnish wage bill in the private sector in 1951-1970, 1000 million marks, and annual percentage changes in wage bill, labour input wage rate



	1951	52	53	54	55	56	57	58	59	1960	61	62	63	64	65	66	67	68	69	1970
WAGE BILL 1000 MILLION MK	3.160	3.336	3.298	3.560	3.975	4.443	4.627	4.823	5.220	5.874	6.560	7.242	8.051	9.353	10.405	11.323	12.263	13.465	15.089	17.216
WAGE BILL, %	42.18	5.58	-1.16	7.95	11.66	11.79	4.13	4.23	8.24	12.52	11.69	10.39	11.17	16.17	12.24	8.83	8.30	9.80	12.06	14.10
LABOUR INPUT, %	6.96	0.45	-2.59	4.75	4.53	1.42	-1.65	-1.57	2.36	6.09	3.43	2.58	0.12	1.53	1.77	1.06	-0.44	-0.56	3.75	3.70
WAGE RATE,%	32.92	5.11	1.48	3.06	6.82	10.23	5.88	5.89	5.74	6.12	7.93	7.61	11.04	14.42	9.31	7.69	8.78	10.42	8.01	10.03

Fig. 4.26. Development of the wage rate as measured by the official wage rate index of the Central Statistical Office and the cost of living index, annual percentage changes, moving four quarter sum compared with the preceding moving four quarter sum



period, and the difference in the average growth rates is the average change in productivity. Real annual wage changes were negative only in the second half of the 1950s. This was due to earlier high real wage rises and the 1957 devaluation. Compared with wage increases, price rises were also high after the 1967 devaluation.

The main explanatory variables in the wage rate equation are consumption prices and labour productivity. Unlike Molander [1969], we find that productivity is a significant explanatory variable. It also seems that the gradual wage rises resulting from changes in productivity are higher than the productivity changes themselves. On the other hand, the coefficient of the price term is as low as .562.

In other studies where a similar specification has been estimated for a different estimation period, the third variable of the triad, unemployment, has been found to affect the wage rate significantly[1)]. We also include it in our equation, even though it is not significant (irrespective of whether the unemployment rate or its first differences are used) and even though recent experience with inflation has made many economists doubt the relevance of using this relation in making practical policy decisions. One reason why our results may differ from those of other studies may be the proxy series used for the beginning of the estimation period.

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1) See Molander [1969], Halttunen [1972] and Halttunen [1974].

Table 4.11. Equation for the wage rate[1)]

$$w = .562p_c + .900(y-a)_{-1/2} - .846\Delta\tilde{U} + .4(w_{-1} - .562p_{c-1} + .846\Delta\tilde{U}_{-1}) + .074$$

Method of estimation : TSLS

$R^2 = .400$

Standard deviation of residual, $s(e_i) = 2.595$

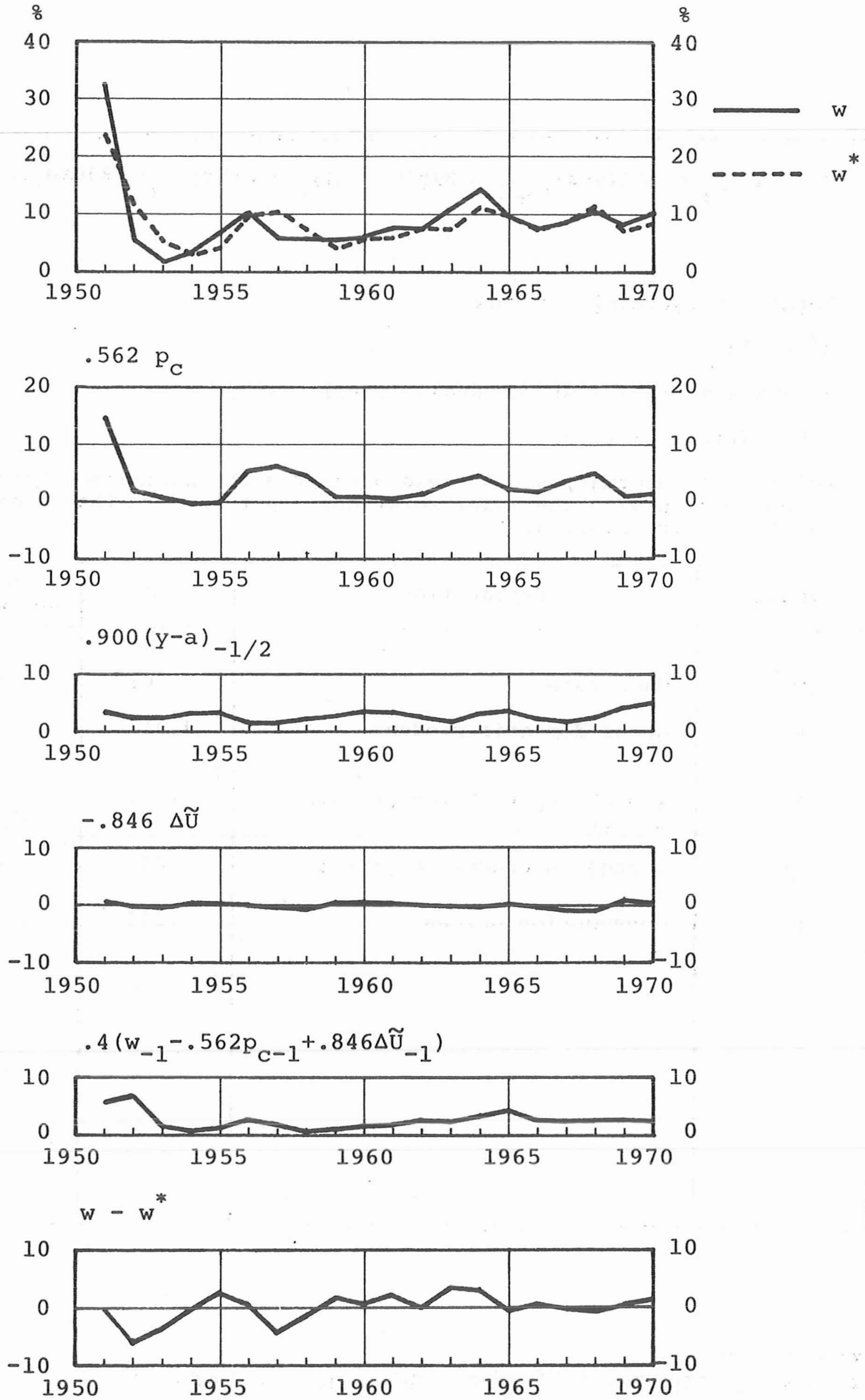
D-W statistic = .998

Additional information: 1951 excluded from the estimation period, in connection with the model solutions coefficient of the dummy for this year (D1951:8.0)

Symbol	Explanation	Mean	Standard deviation
w	wage rate	7.661	2.903
y	gross domestic product	4.917	3.272
a	labour input in the private sector	1.617	2.334
$\Delta\tilde{U}$	change in unemployment rate	.026	.666
p_c	consumption prices	4.144	3.380

1) For estimation of the equation see page 50.

Fig. 4.27. Equation for the wage rate

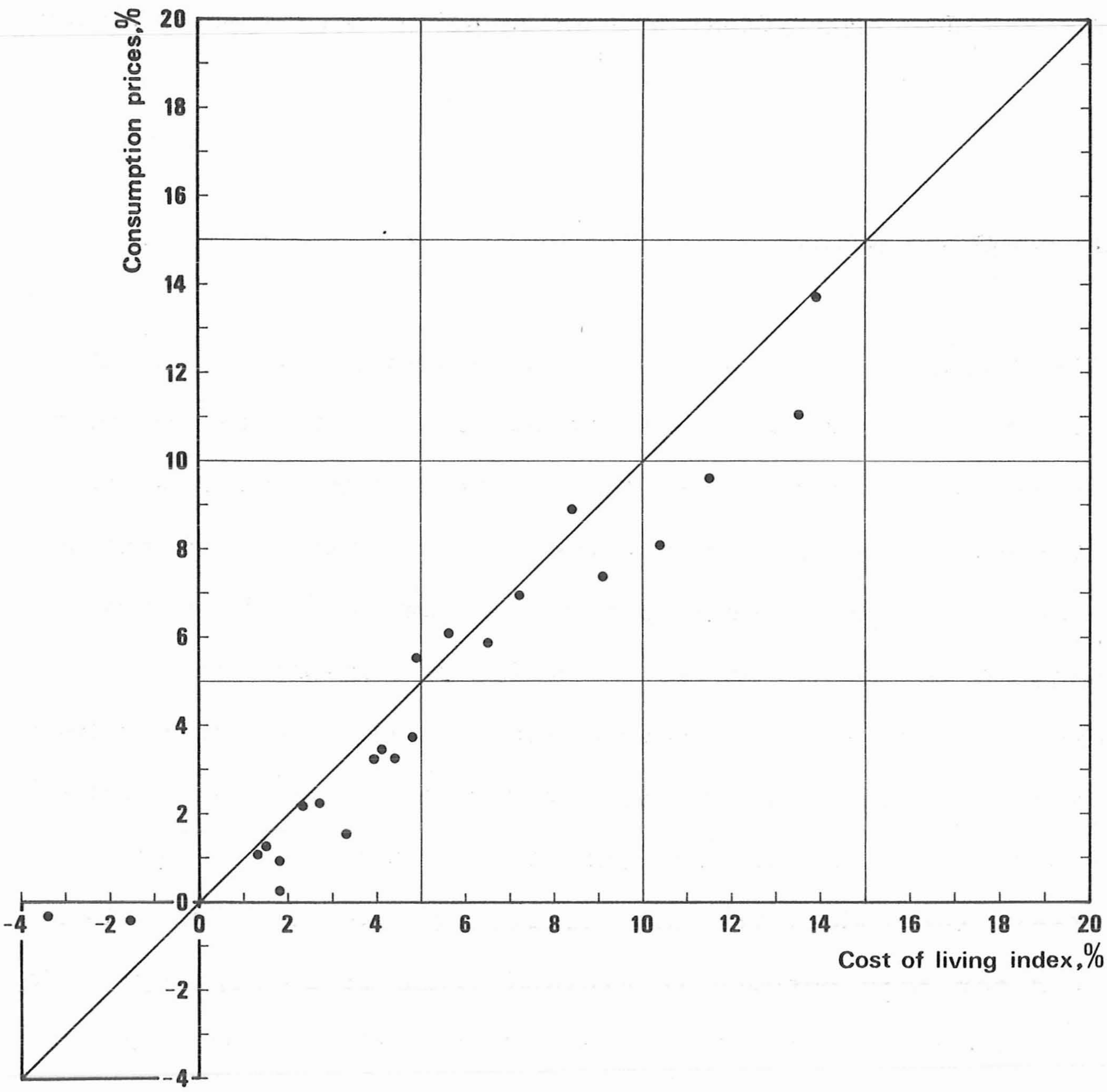


In the present specification, a Koyck transformation, which implies a geometrically distributed lag structure, is used for the productivity variable. The impact of changes in productivity on wages is thus felt only gradually. Prices and the Phillips effect are unlagged in this specification.

Consumption prices

The series which we have used to represent the dependent variable is made up of percentage changes in the implicit price index for private consumption as derived from the national accounting statistics. This is natural, since we want to use price developments together with the volume of consumption to arrive at the value of consumption. Our choice of this price index could also be based on the fact that it is used as explanatory variable in the wage rate equation and as such determines real wage developments within the model. The cost of living index is also often used for this purpose in Finland since it is kept up-to-date and published monthly. The strong correlation of these two indices means that changes in the cost of living index can be used to predict changes in the implicit price index. However, on occasion discussion has been obfuscated by confusing these two indices. Percentage changes in both indices are shown in figure 4.28.

Fig. 4.28. Relationship between annual percentage changes in the implicit consumption price index and the cost of living index in 1949-1972[1)]



1) The observation for 1951 (consumption prices rose by 24.6 % and cost of living index by 16.5 %) is excluded.

Table 4.12. Equation for consumption prices

$$p_c = .362\,H + .164\,p_{mg} + .207\,T_i' + 2.084$$
$$\quad (.196) \quad (.059) \quad (.047) \quad (.851)$$

Method of estimation : TSLS

$R^2 = .852$ $\qquad R_c^2 = .823$

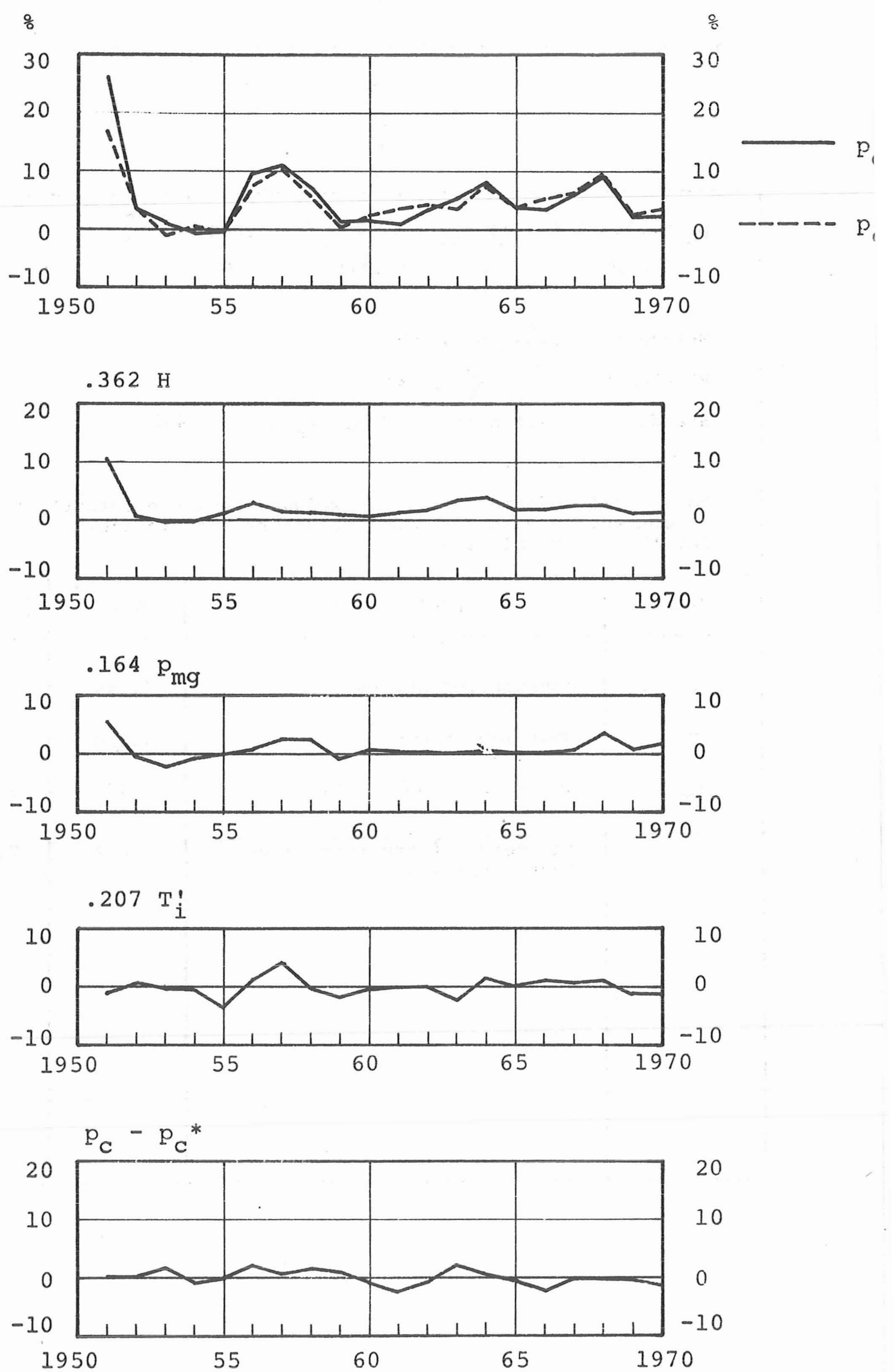
Standard deviation of residual, $s_c(e_i) = 1.462$

D-W statistic = 1.542

Additional information: 1951 excluded from the estimation period, in connection with the model solutions coefficient of the dummy for this year (D1951:9.0)

Symbol	Explanation	Mean	Standard deviation
p_c	consumption prices	4.144	3.380
H	unit labour cost	4.418	2.975
p_{mg}	price of commodity imports	2.980	7.566
T_i'	incidence of indirect taxes less subsidies	-.132	7.916

Fig. 4.29. Equation for consumption prices



All the explanatory variables have coefficients which are in line with our expectations. This relationship is quite technical and close to the one that could be derived with the aid of input-output tables. However, direct estimation allows the dynamics of price determination to be taken into account, for it does not require the instantaneous adjustment of cost to prices.

Investment prices

The main explanatory variables for the investment price equation are the same as the ones used in the consumption price equation, and the parameter estimates have about the same values. The incidence of indirect taxes is not significant. On the other hand, the introduction of a capacity variable is successful, reflecting the response of prices to excess demand, a phenomenon which is not easily detectable in the consumption price equation. The present specification does not include this capacity effect, as the simultaneous introduction of capacity considerations is left until a later date. The Koyck transformation is used for all the explanatory variables. It is interesting to note that the use of this form of the transformation in the equation for consumption prices was not successful. The total long-run effect of unit labour costs on investment prices is .363/(1-.155)=.430 and the long-run impact of changes in import prices is .255/(1-.155)=.302.

Table 4.13. Equation for investment prices

$$p_i = .363\ H + .255\ p_{mg} + .155\ p_{i-1} + 1.086$$
$$\quad (.126) \qquad (.054) \qquad (.047) \qquad (.662)$$

Method of estimation : OLS

$R^2 = .801$ $\qquad R_c^2 = .765$

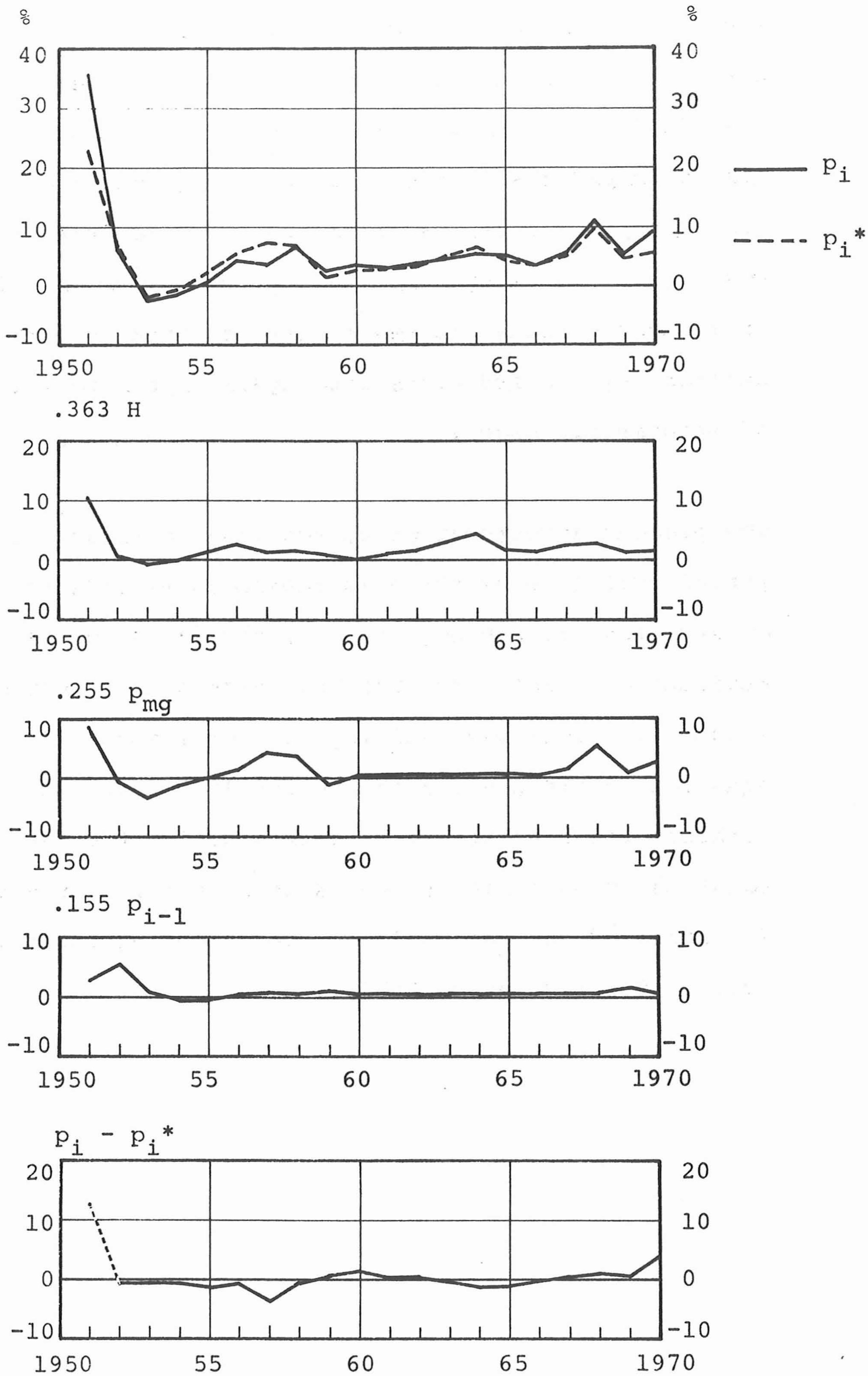
Standard deviation of residual, $s_c(e_i) = 1.564$

D-W statistic = 1.064

Additional information: 1951 excluded from the estimation period, single equation residual (D1951:12.887) used as coefficient of the dummy for this year

Symbol	Explanation	Mean	Standard deviation
p_i	investment prices	4.197	3.140
p_{i-1}	investment prices in previous period	5.606	7.714
H	unit labour cost	4.418	2.975
p_{mg}	price of commodity imports	2.980	7.566

Fig. 4.30. Equation for investment prices



We have experimented extensively with the omission of various years from the estimation period, and it seems that the parameter estimates are quite sensitive to the choice of the period. Indeed the differences obtained in this way may easily exceed the differences resulting from the use of simultaneous estimation techniques. How to determine when an observation is exceptional is a general problem which introduces personal judgment into econometric work in yet another way and indicates once again approximative character of econometric models.

The present investment price equation is estimated for the period 1952-1970 as there is reason to exclude the exceptional observation at the beginning of the 1950s. We have used the residual obtained with ordinary least squares estimation as a dummy for 1951 when solving the total model. The same equation, estimated for the period 1951-1970, is also shown. Although the coefficient of determination for the latter equation is much higher (see section 4.1.1.), the standard deviation of the residuals in the former equation is much smaller for the period 1952-1970.

Table 4.14. Investment price equation estimated for the years 1951-1970

$$p_i = .719\ H + .266\ p_{mg} + .204\ p_{i-1} - .531$$
$$\quad (.118) \quad (.074) \quad (.062) \quad (.701)$$

Method of estimation : OLS

R^2 = .940 R_c^2 = .924

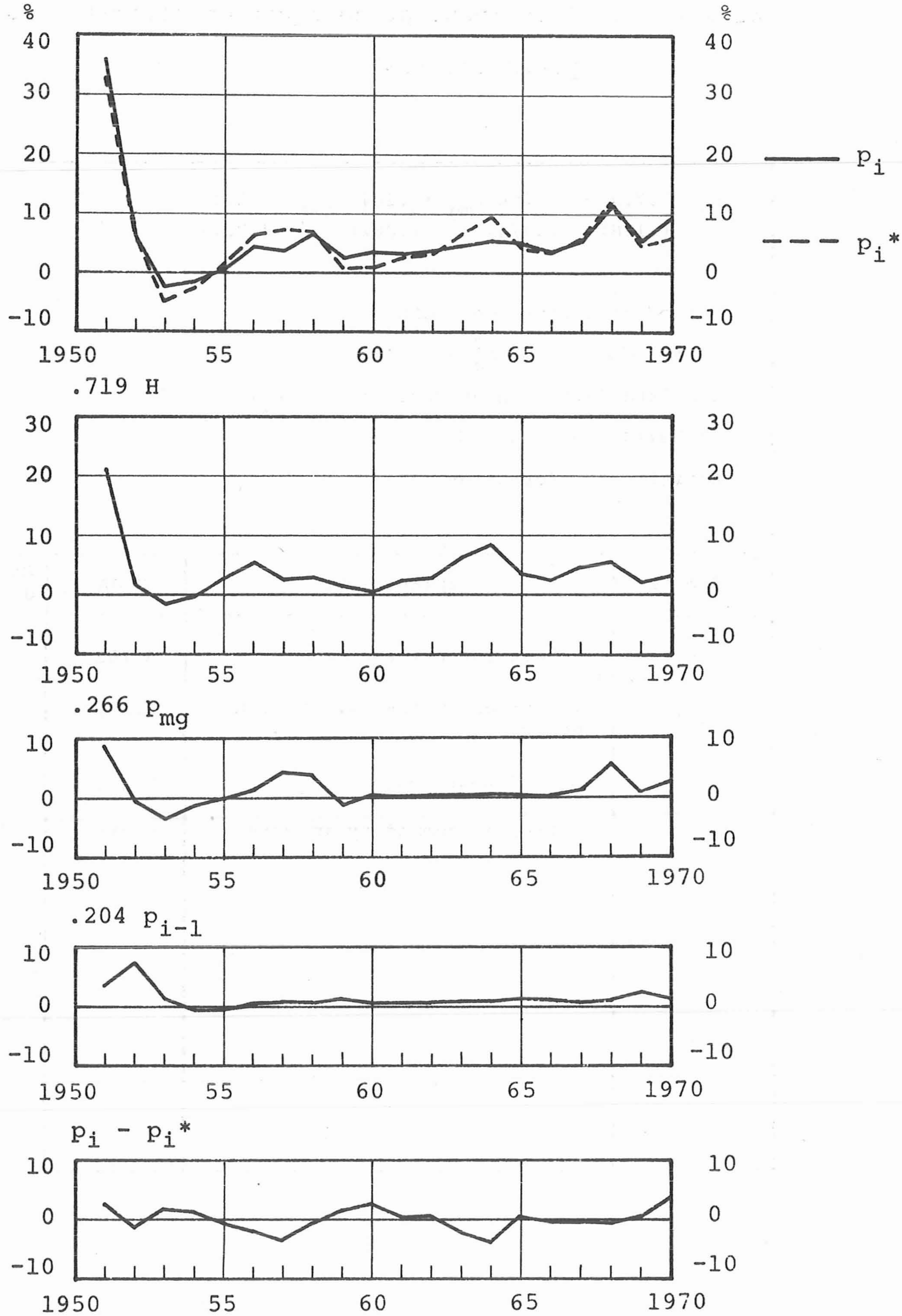
Standard deviation of residual, $s_c(e_i)$ = 2.140

D-W statistic = 1.279

Additional information :

Symbol	Explanation	Mean	Standard deviation
p_i	investment prices	5.782	7.558
p_{i-1}	investment prices in previous period	6.211	7.969
H	unit labour cost	5.649	6.099
p_{mg}	prices of commodity imports	4.515	9.960

Fig. 4.31. Equation for investment prices estimated for 1951-1970



Export prices

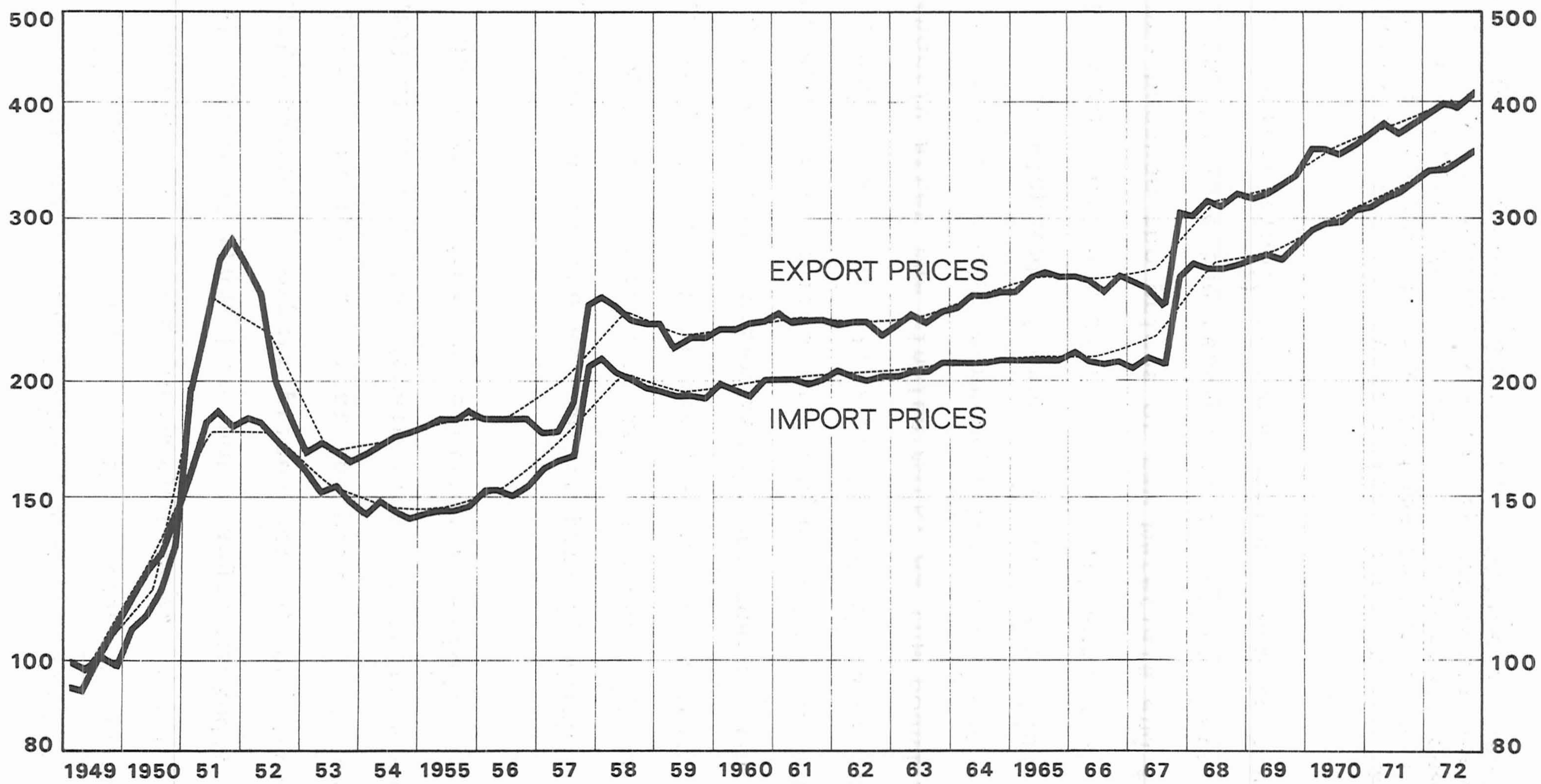
The development of export and import prices is shown in figure 4.32.[1] The development of both indices has been similar throughout the estimation period except the Korean boom, and the terms of trade have not changed markedly. The exceptional behaviour of export prices during the Korean boom is reflected by the fact that the peak of 1951 was not reached until after the 1967 devaluation. It is thus natural to exclude these years from the estimation period.

The two devaluations of the estimation period, which occured mainly because Finland's rate of inflation was high in relation to that of other countries, show that import and export prices in foreign currencies do not change much and that export and import prices in Finnish marks bear the brunt of the adjustment (see fig. 4.33.). In 1967 the Sterling was devalued shortly after the Finnish mark. As the pound has been Finland's main trading currency, this event had a clear impact on the development of export prices (see figure). In 1957 import prices did not rise by the full amount of the devaluation, because the prices of raw materials and freight rates fell and because the relaxation of import restrictions led to price competition.[2] The devaluations seem to have had

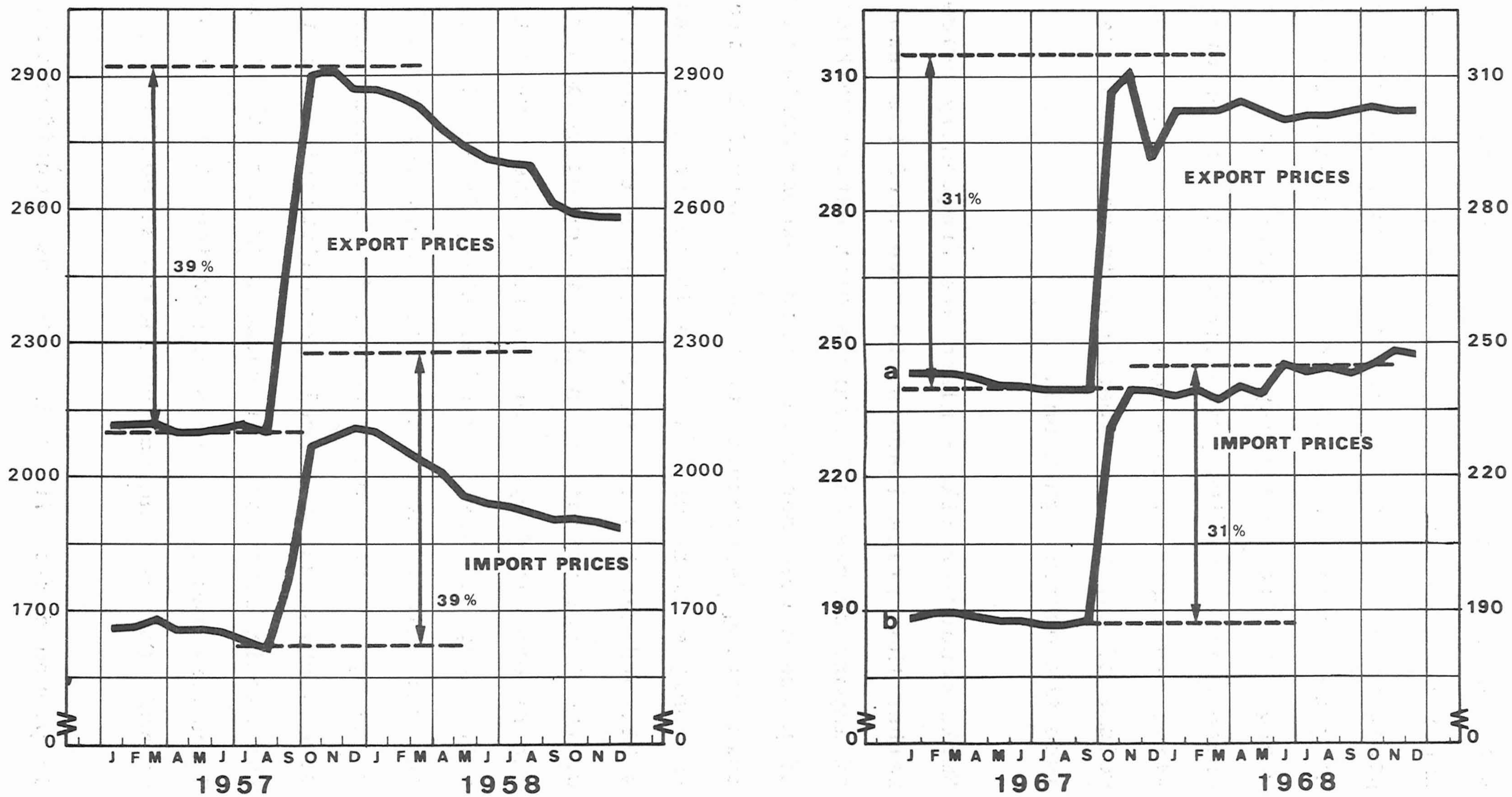
1) The figures for foreign trade prices used in the national accounts are prepared by the Customs authorities and are on quarterly basis. For the analysis of monthly changes in export and import prices, a slightly different series published by the Central Statistical Office is used.

2) Cf., Bank of Finland [1959].

Fig. 4.32. Prices of Finnish commodity exports and imports in 1949-1972, Customs' quarterly index



Figl 4.33. Response of commodity export and import prices to the devaluations in 1957 and 1967, Central Statistical Office monthly index



a slighter direct impact on the price competitiveness of our exports. A devaluation tends to shore up the competitive position of the country rather by raising profitability. Long-term agreements and difficulties associated with rapid changes in production may be reasons, why firms have not engaged in extensive price competition in export markets after devaluation. This does not, of course, mean that the volume of exports is impervious to changes in relative prices (see the export equation).

Small countries like Finland are frequently price followers rather than price leaders. We have used the weighted average of import prices in Finland's main export markets as our indicator of price developments in Finnish export markets. To illustrate this strong dependence, we have presented the regression where the only explanatory variable is competing prices in figure 4.33. and table 4.13. It can be seen that about 80 per cent of the total variation in the prices of commodity exports can be explained by international price movements and exchange rate changes. This line of thinking is surely worth further investigation. The results can almost certainly be improved by using a better price series for competing exports and a more sophisticated formula for calculating the index (see the export equation). It would seem natural to use Divisia-Törnqvist indices in this connection. Attempts should also be made to use trading currencies as weights.

It proved difficult to include cost considerations, as represented by unit labour costs and import prices, in the

Table 4.15. Equation (1) for export prices

$$p_{xg} = \underset{(.117)}{.906}\, p_x' + \underset{(.877)}{.838}$$

Method of estimation : OLS

R^2 = .799 R_c^2 = .786

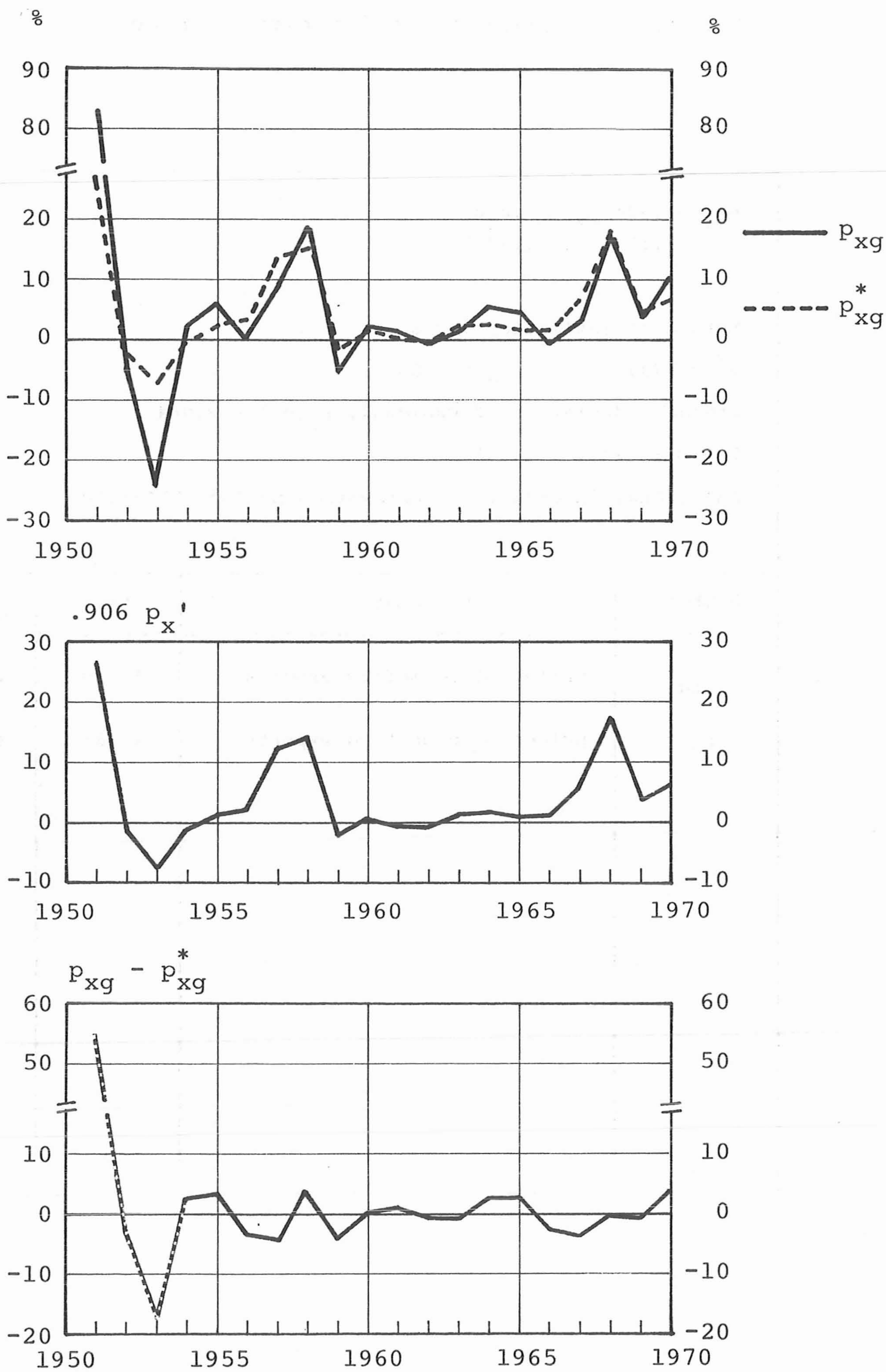
Standard deviation of residual, $s_c(e_i)$ = 2.964

D-W statistic = 2.118

Additional information : Estimation period 1954-1970

Symbol	Explanation	Mean	Standard deviation
p_{xg}	prices of commodity exports	4.720	6.218
p_x'	prices of competing exports	4.285	6.137

Fig. 4.34. Equation (1) for export prices



aggregate equation. Because all the explanatory variables are highly correlated, standard methods cannot readily be used to identify the effects of different explanatory variables. For this reason we have taken the ratio of import prices to unit labour costs to be 1:3 on the basis of their relative importance as suggested by input-output analysis. According to the equation shown in table 4.14. and fig. 4.34., the adjustment of export prices to world market prices comes about gradually. A distributed lag is not used for the other variables, and the Koyck transformation is of type (4.1.22.). A change in world market prices is followed by a change in export prices 78 per cent as large in the first year, 23 per cent as large in the second year, 7 per cent as large in the third, etc. The total adjustment to world market prices is about 110 per cent. This is of course only the ceteris paribus reaction; because all explanatory variables are highly correlated, a rise in world market prices is normally followed by a rise in our export prices of the same order of magnitude. The small coefficients of the cost variables and the negative constant correspond to this over-reaction. Even though we are not completely satisfied with this latter specification, it is used in this study as a part of the total model.

Table 4.16. Equation (2) for export prices[1)]

$$p_{xg} = .780\ p'_x + .189\ H + .069\ p_{mg} + .3(p_{xg} - .189\ H - .069\ p_{mg})_{-1} - .297$$

Method of estimation : OLS

$R^2 = .569$

Standard deviation of residual, $s(e_i) = 4.483$

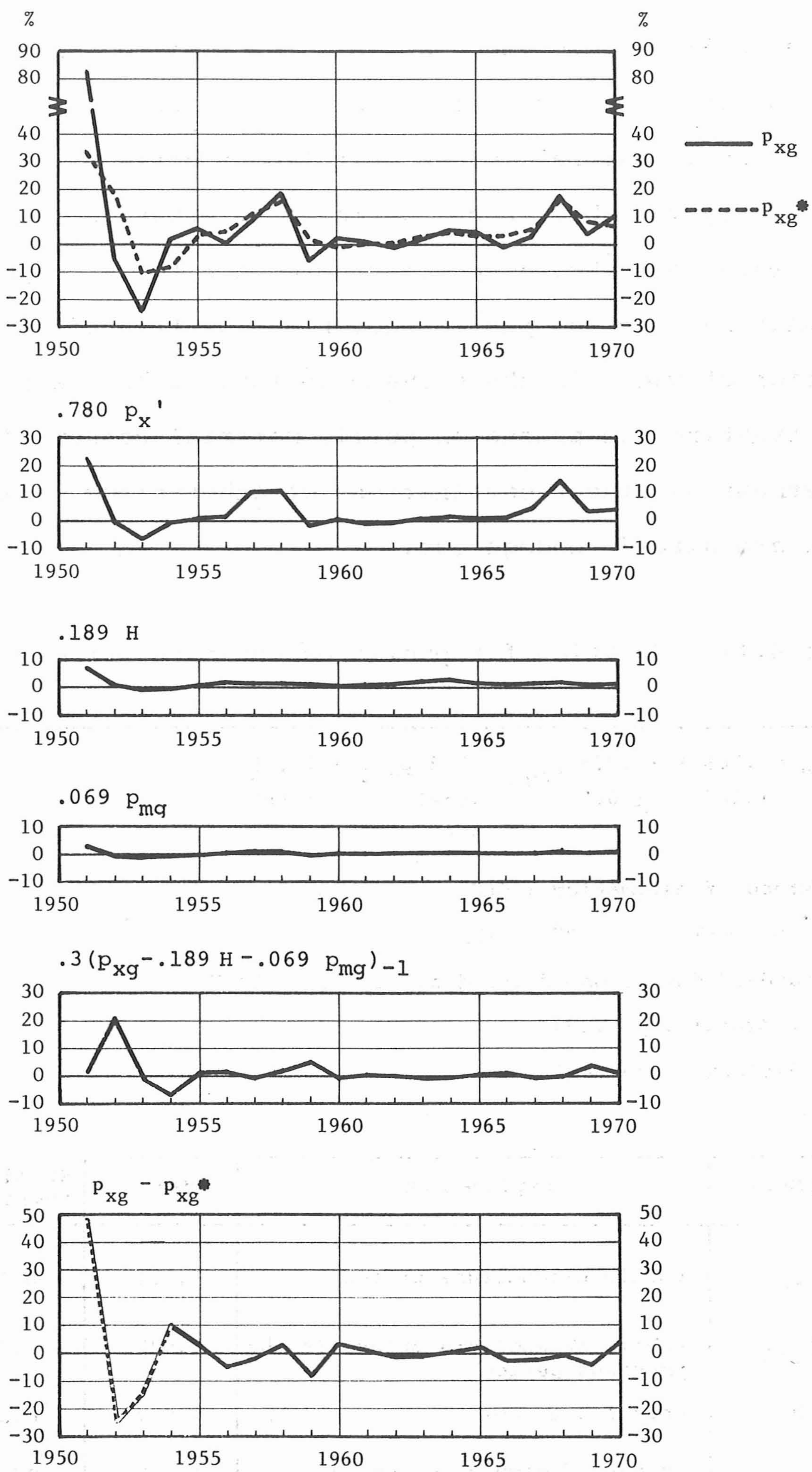
D-W statistic = 1.823

Additional information: 1951-1953 excluded from the estimation period, single equation residuals (D1951:48.805, D1952:-25.100, D1953:-14.880) are used as coefficients of the dummies for these years in connection with the model solutions

Symbol	Explanation	Mean	Standard deviation
p_{xg}	prices of commodity exports	4.720	6.218
p_x'	prices of competing exports	4.285	6.137
H	unit labour cost	4.876	2.734
p_{mg}	prices of commodity imports	4.155	6.888

1) For estimation of the equation see page 50.

Fig. 4.35. Equation (2) for export prices



Public expenditure prices

As the public expenditure variable includes not only material consumption and investment but also wages paid by the public sector, it is natural to use unit labour costs as the main explanatory variable. When the model is expanded, separate price equations should be constructed for these components. The wage rate in the public sector can be treated as a function of wages in the private sector. We have experimented with treating the prices of public material consumption and investment as linear combinations of other price variables which are already endogenous.

Table 4.17. Equation for public expenditure prices

$$p_g = \underset{(.104)}{.766\ H} + \underset{(.065)}{.088\ p_{mg}} + \underset{(.064)}{.118\ p_{g-1}} + \underset{(.669)}{1.679}$$

Method of estimation : OLS

$R^2 = .949$ $\quad R_c^2 = .913$

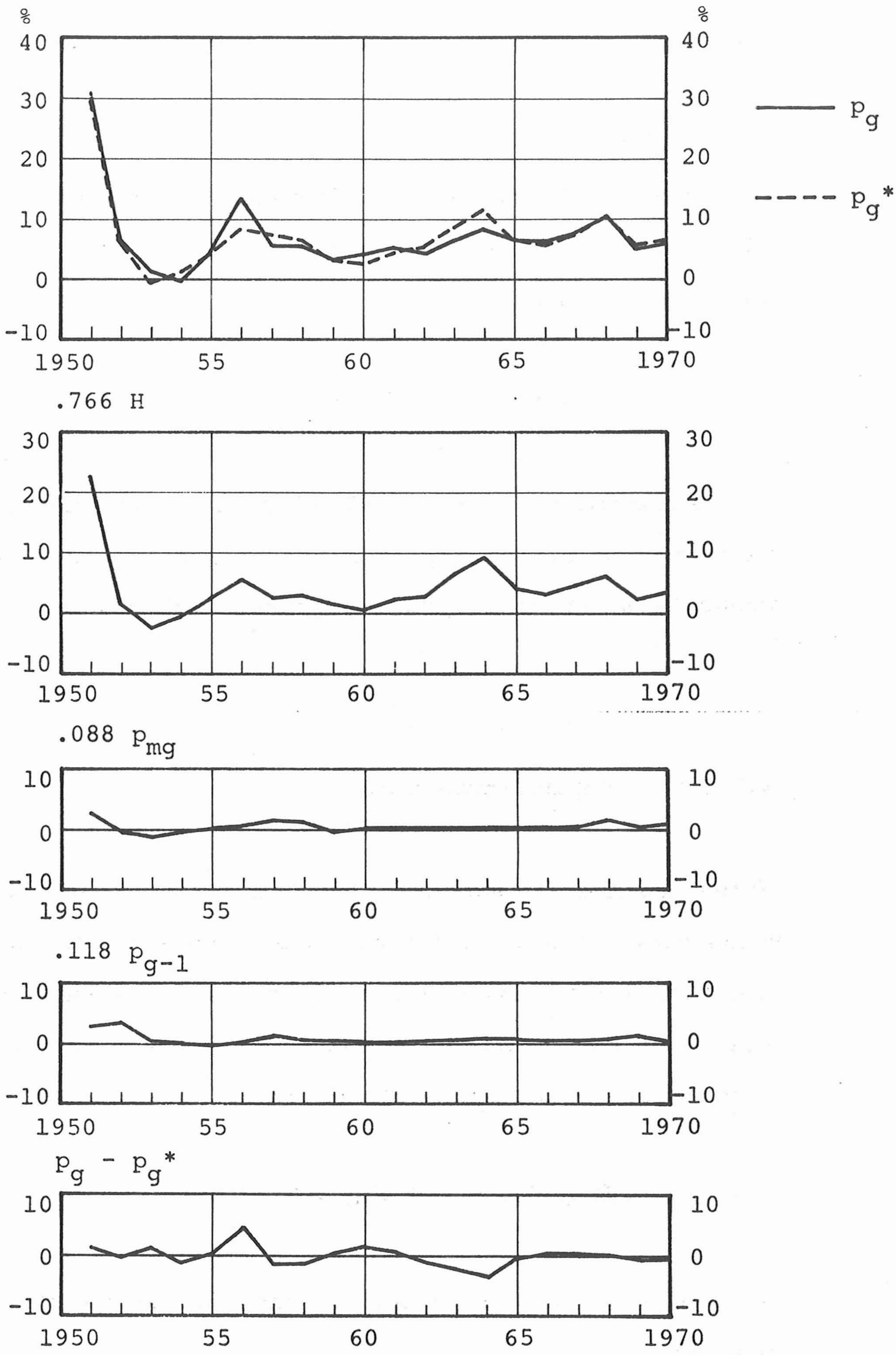
Standard deviation of residual, $s_c(e_i) = 1.877$

D-W statistic = 1.717

Additional information :

Symbol	Explanation	Mean	Standard deviation
p_g	public expenditure prices	7.121	6.204
p_{g-1}	public expenditure prices in the previous period	8.072	7.312
H	unit labour cost	5.649	6.099
p_{mg}	prices of commodity imports	4.515	9.960

Fig. 4.36. Equation for public expenditure prices



4.2.3. Definitional equations

4.2.3.1. Relations between value, volume and price variables

The model has several identities connecting changes in volumes, prices and values. We have, for example, an exact additive identity for the percentage changes in the value, volume and price of consumption:

$$C = p_c + c + .01\ cp_c$$

In the linear and linearized versions of the model, the relationship can be approximated by leaving out the cross-term, which is small compared with the other terms.

4.2.3.2. Expenditure totals

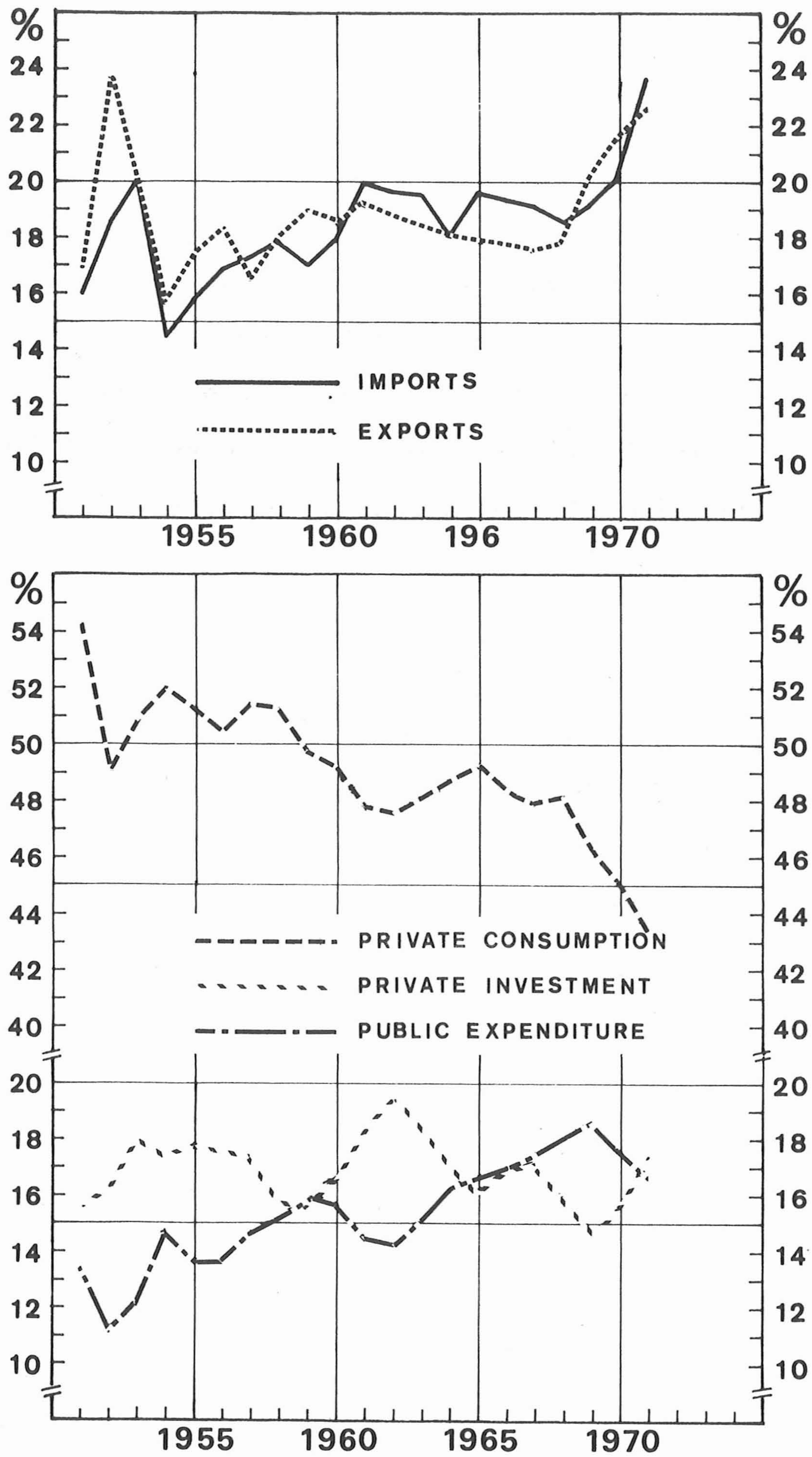
If we examine the way the value of total expenditure (= total resources) is treated in the model, we will gain some idea of the function of this type of identity. This expression indicates that total expenditure is the sum of the separate expenditure categories. The identity

$$\tilde{D} = \tilde{C} + \tilde{I} + \tilde{N} + \tilde{G} + \tilde{X}$$

between absolute variables, corresponds to the following identity:

$$D=(\tilde{C}/\tilde{D})_{-1}C+(\tilde{I}/\tilde{D})_{-1}I+(\tilde{D}'/\tilde{D})_{-1}N+(\tilde{G}/\tilde{D})_{-1}G+(\tilde{X}/\tilde{D})_{-1}X.$$

Fig. 4.37. Ratio of some variables to total demand in previous period, 1951-1971



The weights are the shares of the corresponding expenditure categories in total expenditure in the preceding year. The weight of the stock formation term has been modified to take into account the definition of N.

A similar identity is used to calculate total expenditure less inventories and export and import totals. The same type of identity is also used to derive GDP and GDP less inventories on the basis of total expenditure and total imports. As was remarked in section 4.1., the weights used to calculate volume changes in aggregates are expressed in constant price terms so that the figures will correspond to those in the national accounts.

The changing weights thus take the changing structure of the economy into account. The weights used to calculate percentage changes in the value of total expenditure are shown in figure 4.37. to give some idea of how the weights have moved during the estimation period.

4.2.3.3. Costs and margins

Unit labour costs

This variable is the main explanatory variable in the price equations. Its construction is explained in section 4.2.2.4.

Gross profits per total sales

If we define gross profits per total sales as

$$\tilde{K}' = (\tilde{Z} + \tilde{F})/\tilde{D}' ,$$

we have the following expression for percentage changes in prices

$$p_d' \approx (\tilde{W}/\tilde{D}')_{-1}w+(\tilde{M}/\tilde{D}')_{-1}p_m+(\tilde{T}_i/\tilde{D}')_{-1}T_i'+((\tilde{Z}+\tilde{F})/\tilde{D}')_{-1}K'$$

where $K' = 100(\Delta\tilde{K}'/\tilde{K}'_{-1})$. If we use the absolute values for 1969, we get

$$\Delta\tilde{K}' = p_d' -.325\ w -.093\ T_i' -.21\ p_m$$

The variable $\Delta\tilde{K}'$ is denoted by K in the model, i.e.

$$K = 100\ \Delta((\tilde{Z} + \tilde{F})/\tilde{D}').$$

and the expression above has been used to calculate the values for it.

4.2.3.4. Capacity

Capacity is a good example of a theoretical concept which can be used to give us a deeper understanding and a better explanation of economic phenomena. As is usual with this kind of auxiliary construct, there have been many different definitions and several of them point to divergent ways of making the concept operative[1]. This concept and related constructs, such as capacity utilization, are particularly important in short-term analysis. With the present model, for example, capacity utilization could be introduced into most of the behavioural equations to reflect the fact that economic activity really depends on capacity considerations. Besides being an aggregate index of the business cycle situation, capacity utilization can also be regarded as a measure of the success of economic policy.

Aggregate capacity utilization depends, of course, on the degree of utilization of different factors of production. It would thus seem natural to use a production function to weight the different utilization rates[2]. There may, of course, be special bottlenecks in production which are hard to take into account in an aggregated capacity utilization index. All the criticism of aggregate production functions applies in this context. As it is obvious that capacity

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1) On the methodological problems of auxiliary concepts in science see Tuomela [1973] and Vartia, P. [1973].

2) See for example Klein & Preston [1967] or Hilton & Dolphin [1970].

utilization indices for different factors of production are correlated, several attempts have been made to approximate the aggregate measure with an indicator measuring the utilization of a single factor. We have followed Verdoorn and Post and experimented with the unemployment rate as an indicator of unused capacity[1]. This procedure is also justified by the difficulties encountered when trying to estimate the production function. We have no reliable data on the capital stock or its degree of utilization. One problem with using unemployment is that there are no reliable unemployment figures for the years before 1958. For this period the series have been constructed using the ratio of persons seeking work at the Employment Service to the number of vacancies reported.

We have also experimented with a single aggregate measure of unused capacity, i.e., the ratio of unused capacity to potential capacity utilization expressed as a percentage. Potential capacity has been derived by drawing a straight line between the peaks of the semi-log graph of GDP (see figure 4.38.). The two measures of unused capacity are highly correlated and can be used alternatively (see figure 4.39.).

It is usually thought that the existance of a capacity limit makes itself felt before the ceiling is reached and that its effect grows non-linearly.

1) Verdoorn and Post [1964], see also Dreihuis [1973] for experiments with Finnish data, see Willman [1971].

Fig. 4.38. Construction of potential GDP

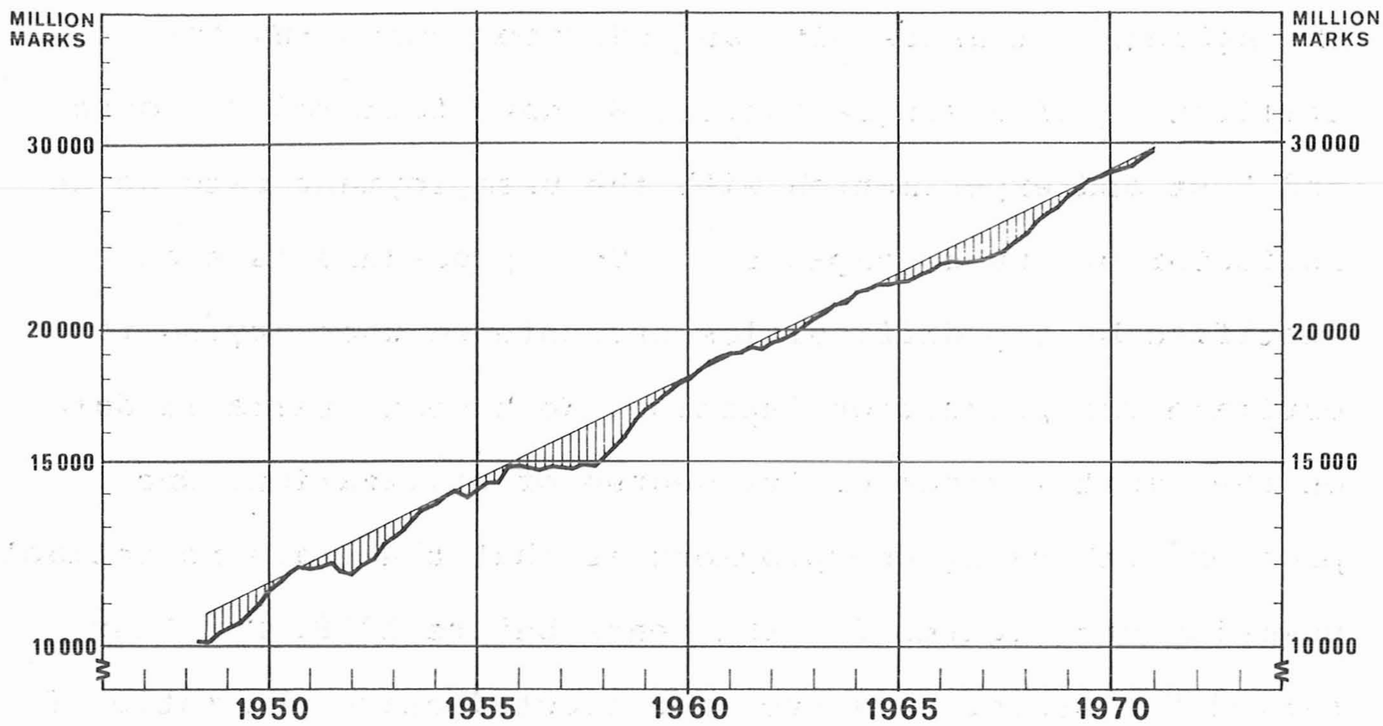
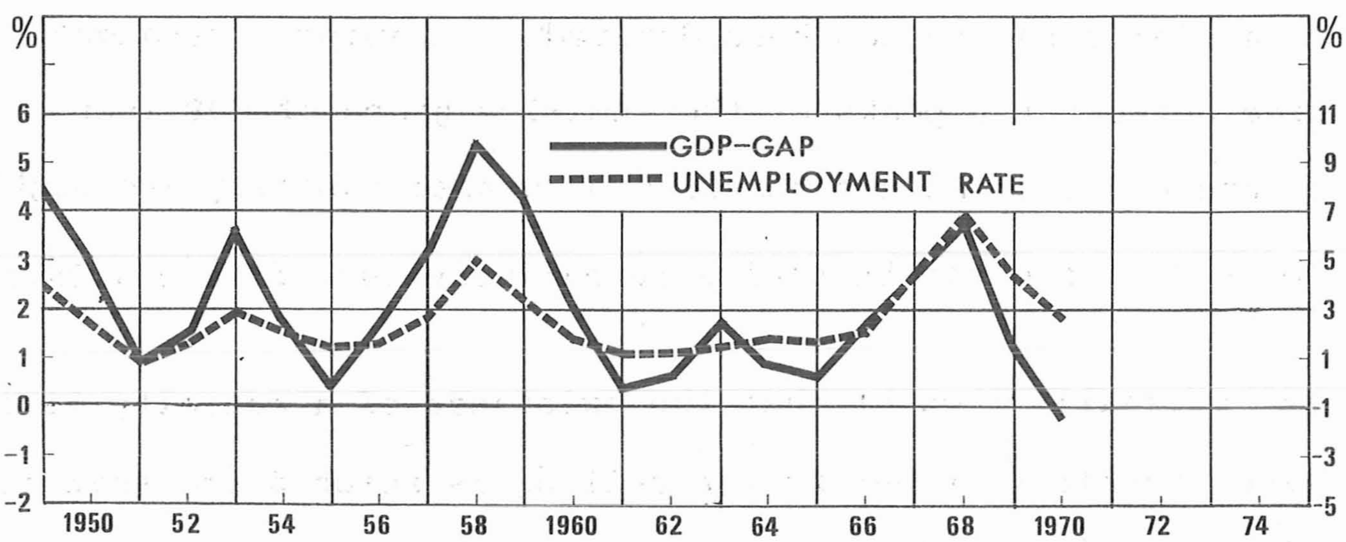


Fig. 4.39. Covariation in the unemployment rate (left scale) and the GDP-gap (right scale)



Thus, for example, a shift in the under-utilization rate from 3 per cent to 2 per cent has a greater impact than a shift from 13 per cent to 12 per cent. Naturally this kind of curvilinear transformation of unused capacity can be used regardless of the way capacity is measured. Generally the curvilinear transformation is of the form shown in figure 4.40., so that the effect of unused capacity is relatively smaller at high rates of under-utilization. In the Dutch short-term annual model, the relationship between impact of unused capacity $\tilde{IC}$ and unemployment $\tilde{U}$ is of the form[1)]

$$\tilde{IC} = 4.34 \ln (\tilde{U} + 2) - 0.2\, \tilde{U}. \qquad (4.2.1.)$$

We have also experimented with this formulation. However, a less complex indicator of the impact of unused capacity can be derived by assuming that the following relationship holds:

$$\tilde{IC} = a + b \ln (\tilde{UC} + c) \qquad (4.2.2.)$$

where $\tilde{UC}$ is any suitable measure of under-utilization. Corresponding to this, we will have the following approximation in differences

$$\Delta \tilde{IC} = b\, \Delta \ln (\tilde{UC} + c) \approx b \frac{\Delta \tilde{UC}}{(\tilde{UC}_{-1} + c)} \qquad (4.2.3.)$$

1) See Verdoorn & Post [1964].

If we take $\Delta\widetilde{IC}$ as the explanatory variable and let its parameter be determined through regression the value of b will be included in the parameter estimate. On the other hand, the value of c must be chosen on an a priori basis. If we let $c = 0$, we shall have $\Delta\widetilde{IC}$ equal to multiples of relative changes in unused capacity, which corresponds closely to our intuitive idea of the effects of capacity ceilings. The situation is much the same as in low temperature physics, where absolute Kelvin temperatures are of little relevance and where every step half way towards absolute zero seems to be equally difficult.

The constant c can also be seen as taking into account the difficulty of finding an "objective" capacity ceiling indicator. Should we use some other labour force concept or should potential GDP be c per cent higher? In this connection operating on a ratio scale means that capacity ceilings cannot be exceeded. In other words, we are dealing with absolute ceilings and not with a "normal" or "optimal" concept. To arrive at the degree of absolute unused capacity, a positive constant c must be added to these measures.

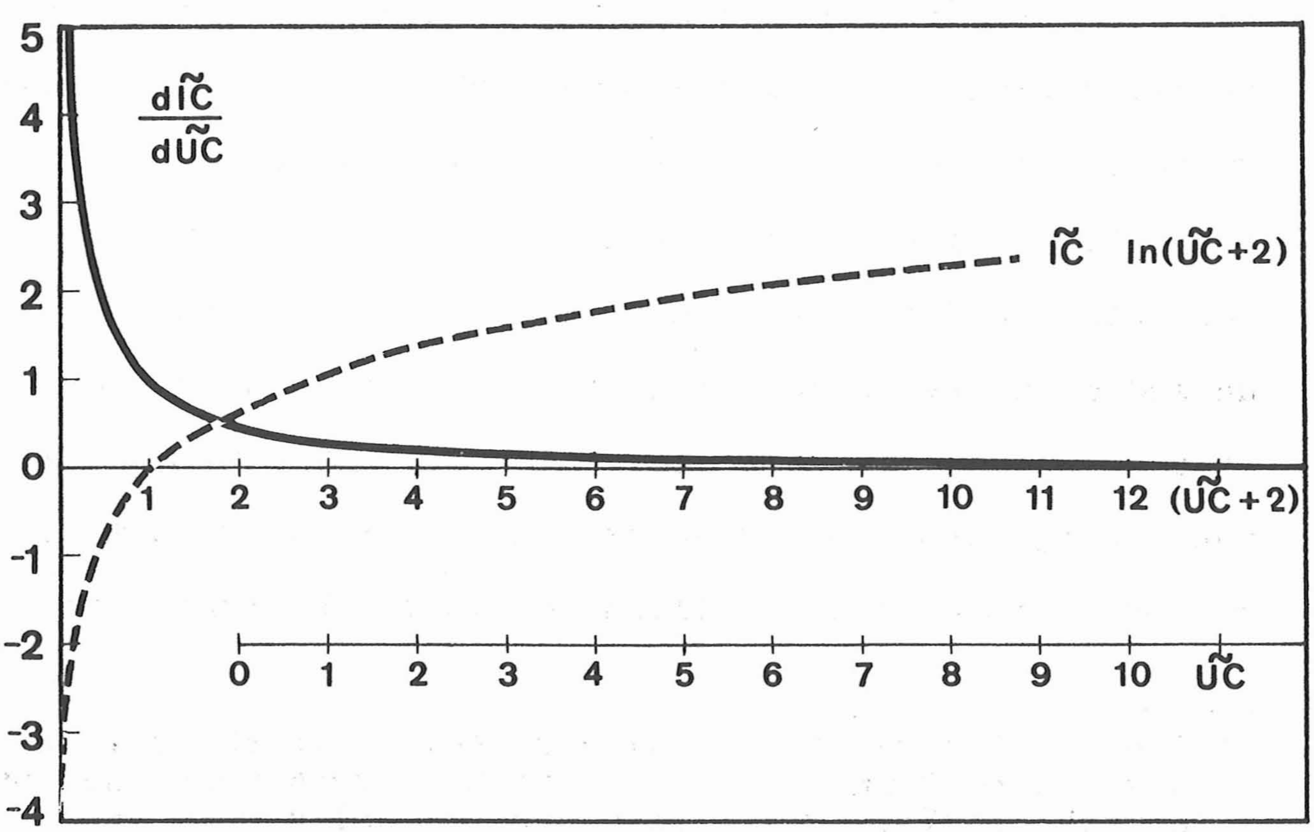
The value given to constant c determines the impact on other variables. The smaller c is, the stronger the non-linearity and the stronger the impact a given change in unused capacity at low values of unused capacity relative to the same change at higher values of unused capacity.

Definition (4.2.2.) implies symmetric effects when coming closer to or going further from a given level of capacity utilization. Approximation (4.2.3.) entails asymmetry so that the impact of unused capacity is smaller when moving towards the ceiling than when moving away from it. As our intuitive idea is rather the other way around, it may be useful to try calculating changes in the form

$$\Delta\tilde{IC} = b\,\frac{\Delta\tilde{UC}}{\tilde{UC}+C} \qquad (4.2.4.)$$

With c = 2 and b = 1, the relationship shown in figure 4.40. is obtained.

Fig. 4.40. Form of the impact of the capacity variable with c=2, b=1



Unused capacity has been measured both with unemployment and the GNP gap. During the estimation period, unemployment varied between 1 and 4 per cent and the GDP gap between 0 - 10 per cent so that the non-linearity generated by constant c is greater when unemployment figures are used.

Capacity is not used as an explanatory variable in any of the behavioural equations of the version of the model presented here. When capacity effects are introduced, they should be added simultaneously to several relationships. Thus, for example, if we have only one capacity variable, and it is present in the export equation, we would like to have it in the import equation. We have succeeded in adding capacity variables to the export equation, but there are still difficulties with the import equation[1). We have also experimented with capacity variables in the investment and price equations. However, we are not content with the results obtained so far. Capacity considerations introduce a longer memory into the equation system, and there are difficulties in combining this with the short-term character of the model. It seems that with percentage changes it is more natural to take changes in unused capacity, rather than the level of unused capacity, as the explanatory variable, which is more appropriate when using absolute variables. This does not mean that closeness to capacity ceilings could not be taken into

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1) The difficulty of including capacity variables in equations describing Finnish imports has also been mentioned by Aurikko [1973], where absolute variables were used.

account. If, for example, we use relationship (4.2.3.) between changes in capacity and changes in other variables, the distance from the capacity ceiling will be taken into account by the term $b/(\widetilde{UC}_{-1} + c)$[1].

However, there is sometimes reason to experiment with relationships where relative changes are explained with the level of unused capacity (cf., e.g., the Phillips-effect where unemployment and not changes in unemployment is usually used to explain changes in the wage rate). When unused capacity is measured by the GDP-gap, it corresponds to inverted and shifted deviations of GDP from the logarithmic trend. Using logarithmic rather than percentage differences we have:

$$\widetilde{UC} = 100 \ln\left(\frac{\tilde{y}_t^{**}}{\tilde{y}_t}\right) \qquad (4.2.5.)$$

where $\tilde{y}_t$ is the observed and $\tilde{y}_t^{**}$ the potential gross domestic product. If $\tilde{y}_t^{*}$ is the corresponding logarithmic trend value and if capacity and trend output grow at the same rate, we have $\ln\left(\frac{\tilde{y}_t^{**}}{\tilde{y}_t^{*}}\right)=K=\text{constant}$. Thus

$$\widetilde{UC} = 100\ (\ln \tilde{y}_t^{**} - \ln \tilde{y}_t) = 100\ K + \ln \tilde{y}_t^{*} - \ln \tilde{y}_t$$

$$= 100\ K - 100 \ln\left(\frac{\tilde{y}_t}{\tilde{y}_t^{*}}\right) \qquad (4.2.6.)$$

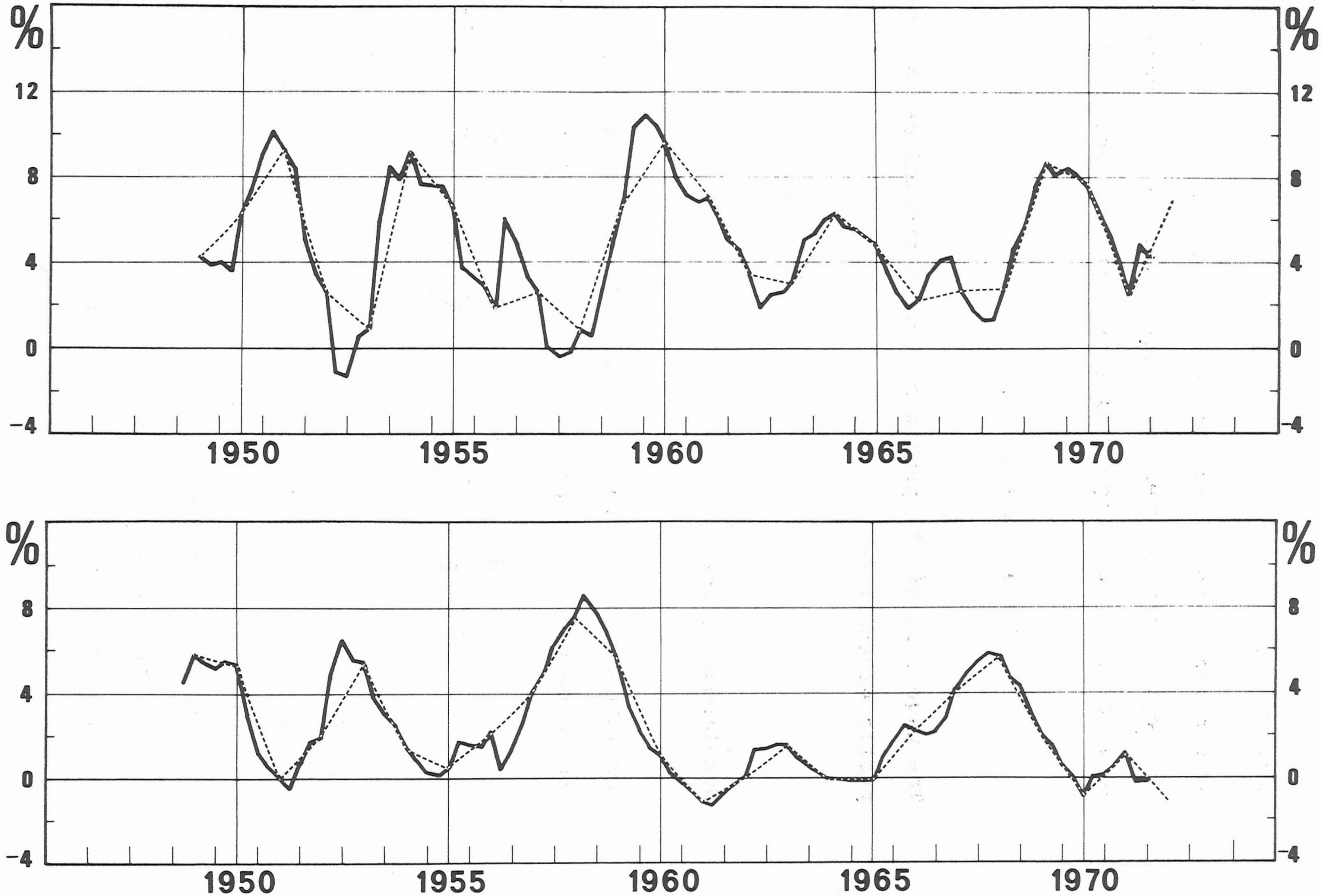
1) Cf., Chapter 6 for a discussion of the methods of solution.

Furthermore, for differences in unused capacity, the following relationship holds:

$$\Delta\widetilde{UC} = -100\ \Delta\ln\left(\frac{\tilde{y}_t}{\tilde{y}_t^*}\right) = -100[\Delta\ln\ \tilde{y}_t - \Delta\ln\ \tilde{y}_t^*] \approx \alpha - y_t \qquad (4.2.7.)$$

where α is trend growth and y_t is the observed growth rate in gross domestic product. This relationship has to be kept in mind when interpreting the results of regression in which percentage changes in the variables are used together with first differences of unused capacity as measured by the GDP-gap. Percentage changes in gross domestic product and the GDP-gap are shown in figure 4.41.

Fig. 4.41. Comparison of GDP-gap (below) and percentage changes in GDP (above)



4.2.3.5. Incomes

Labour income

Labour income in the private sector is found by making use of the identity between man-years $\tilde{a}$ and the wage rate $\tilde{w}$. Thus for the total wage bill in the private sector, we have

$$W = a + w + .01\ aw$$

The wage bill of the public sector is treated as part of public expenditure.

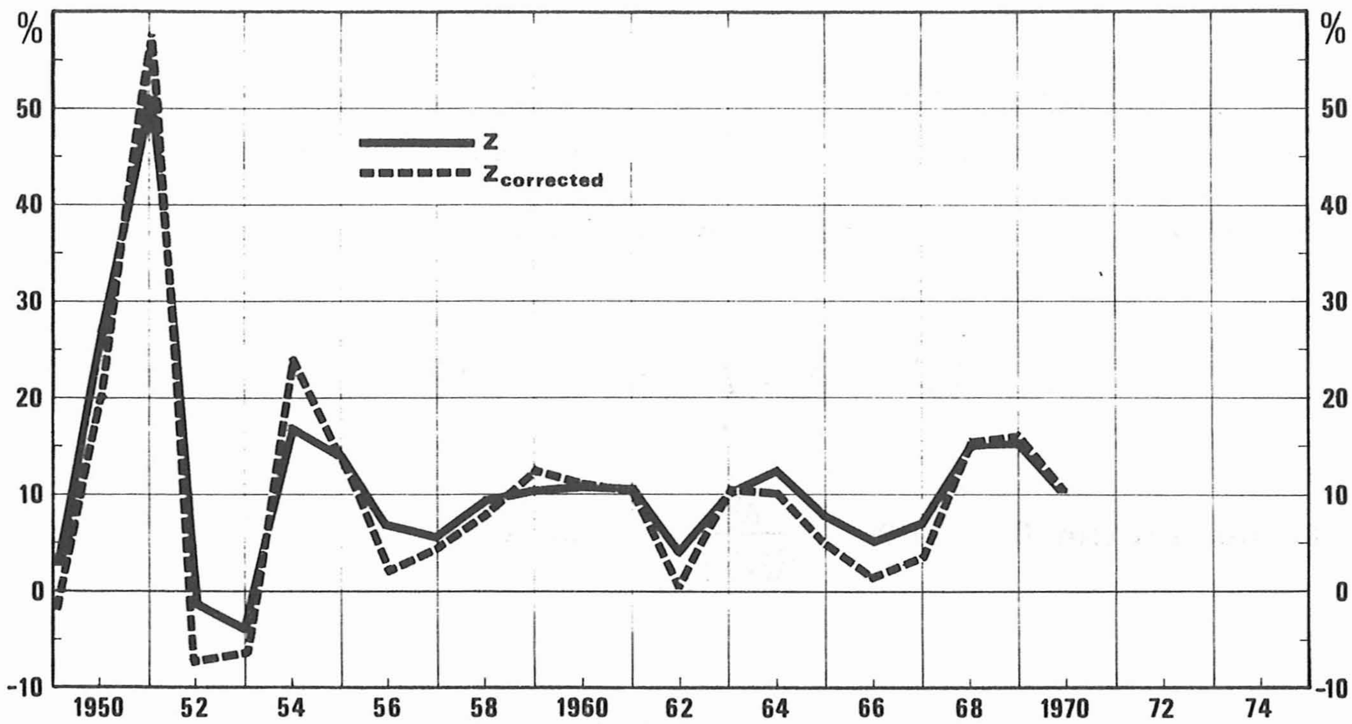
Non-labour income

Non-labour income, which includes all income other than income earned in the private sector, is treated as a residual

$$Z = \left(\frac{\tilde{D}_{-1}}{\tilde{Z}_{-1}}\right)D - \left(\frac{\tilde{W}_{-1}}{\tilde{Z}_{-1}}\right)W - \left(\frac{\tilde{T}_{i-1}}{\tilde{Z}_{-1}}\right)T_i - \left(\frac{\tilde{M}_{-1}}{\tilde{Z}_{-1}}\right)M - \left(\frac{\tilde{F}_{-1}}{\tilde{Z}_{-1}}\right)F$$

According to this definition, $\tilde{Z}$ consists of the income of unincorporated enterprices, property income of households, corporate saving, direct taxes on corporations, compensation of employees by the public sector, and general government income from property ownership and enterpreneurial activities and net factor income sent abroad less the interest paid on public and consumer debt.

Fig. 4.42. Covariation in the two non-labour income variables



When Z is used to explain private investment, some of the items it now includes should be removed so as to better reflect the financing potential and profits of the private sector. In principle a series comprising the first three non-labour income components mentioned above would be a better explanatory variable in the investment equation. However, the items that should be removed are very stable and do not contribute much to the fluctuations in the aggregate series. These two series are compared in figure 4.42.

Disposable income

As it is difficult to break down income transfers according to the functional distribution of income, we have used aggregate disposable income in the model. This is constructed by adding net income transfers $\tilde{O}$ to the sum of labour income and non-labour income:

$$(\tilde{W} + \tilde{Z})^D = \tilde{W} + \tilde{Z} + \tilde{O}$$

If we define $0 = 100 \cdot \frac{\Delta\tilde{O}}{(\tilde{W}+\tilde{Z})_{-1}}$, we get

$$(W+Z)^D = 100 \cdot \frac{\Delta(\tilde{W}+\tilde{Z})^D}{(\tilde{W}+\tilde{Z})^D_{-1}}$$

$$= 100\left[\frac{\tilde{W}+\tilde{Z}+\tilde{O}-\tilde{W}_{-1}-\tilde{Z}_{-1}-\tilde{O}_{-1}}{(\tilde{W}+\tilde{Z})^D_{-1}}\right]$$

$$= 100\left[\frac{\tilde{W}_{-1}}{(\tilde{W}+\tilde{Z})^D_{-1}} \cdot \frac{\Delta\tilde{W}}{\tilde{W}_{-1}} + \frac{\tilde{Z}_{-1}}{(\tilde{W}+\tilde{Z})^D_{-1}} \cdot \frac{\Delta\tilde{Z}}{\tilde{Z}_{-1}} + \frac{(\tilde{W}+\tilde{Z})_{-1}}{(\tilde{W}+\tilde{Z})^D_{-1}} \cdot \frac{\Delta\tilde{O}}{(\tilde{W}+\tilde{Z})_{-1}}\right]$$

$$= \left(\frac{\tilde{W}_{-1}}{(\tilde{W}+\tilde{Z})^D_{-1}}\right)W + \left(\frac{\tilde{Z}_{-1}}{(\tilde{W}+\tilde{Z})^D_{-1}}\right)Z + \left(\frac{(\tilde{W}+\tilde{Z})_{-1}}{(\tilde{W}+\tilde{Z})^D_{-1}}\right)O \ .$$

This is the form in which the equation enters in the model. The definition of non-labour income makes it clear that $\tilde{O}$ must also include some items which are not strictly transfers between the public sector and the households. To arrive at household disposable income, $(W+Z)^D$, net factor income sent abroad, general government income from property ownership and entrepreneurial activities, corporate saving, direct taxes on corporations and net income transfers to the rest of world must be deducted from the sum of labour and non-labour income, $\tilde{W}+\tilde{Z}$, and interest on the public debt must be added to it.

Several of the changing weights used in connection with the different equations of the model provide interesting information on the development of the economy. For example, in the equation for non-labour income, we have the ratio $\tilde{W}/\tilde{Z}$ describing the functional distribution of income. This ratio follows the general cyclical pattern observed in market economies, i.e., $\tilde{W}/\tilde{Z}$ is low in booms and high in recessions[1)]. We have shown the changing weights used in the non-labour income equation in figure 4.43.

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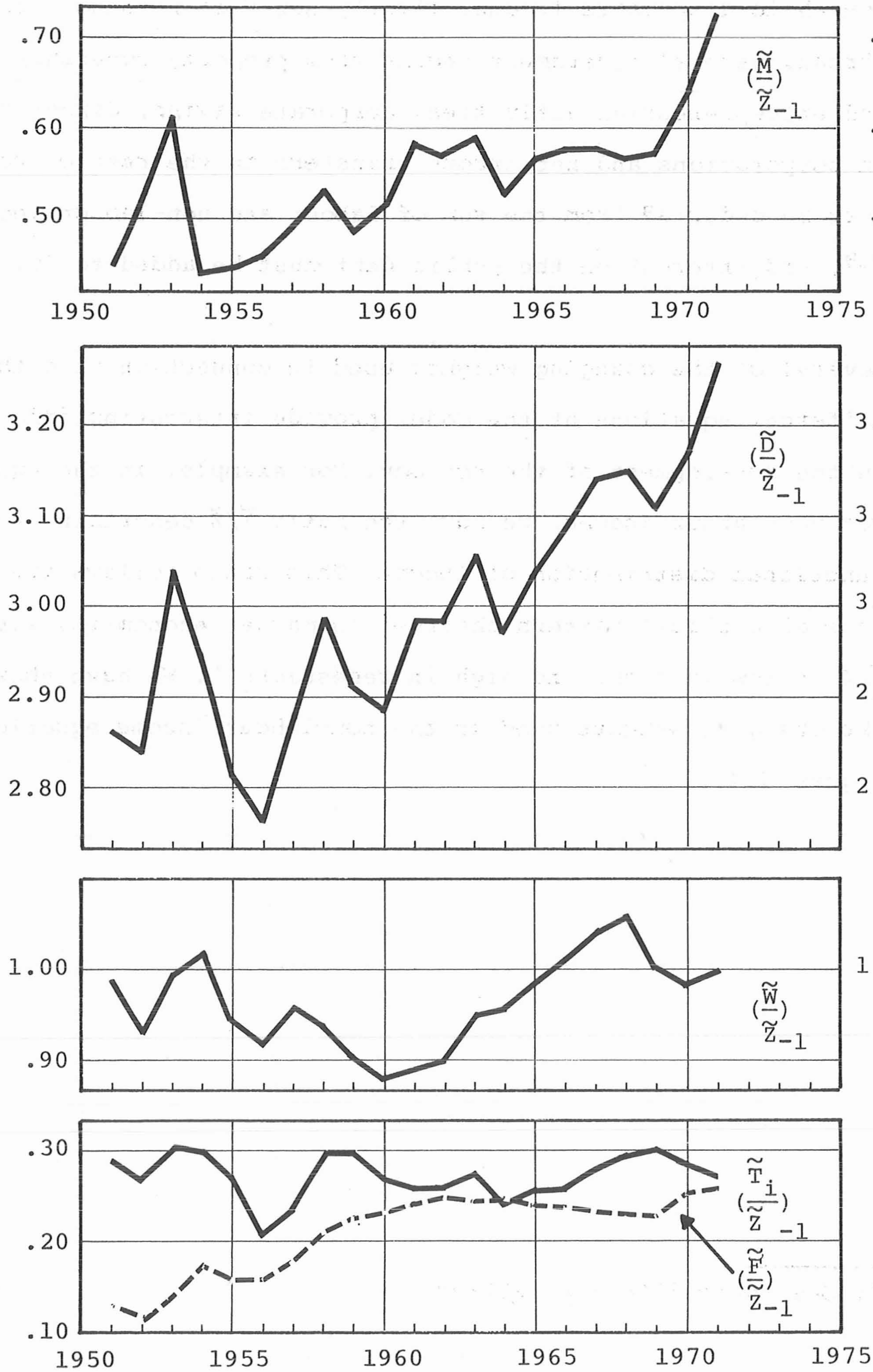
1) See Evans [1969] p. 287-289.

Fig. 4.43. Weights of the non-labour income equation



4.2.3.6. Taxes

The public sector is taken as exogenous in the model. The series for indirect taxes minus subsidies is formed by taking total demand less inventories and multiplying it by an exogenous aggregate tax incidence factor $\tilde{T}_i' = \frac{\tilde{T}_i}{\tilde{D}_i}$. With percentage changes, we have the indentity

$$T_i = T_i' + D' + .01\ T_i' \cdot D'$$

so that tax receipts are endogenous. Even though T_i' is exogenous in the model, its values are affected by the values of the endogenous variables. Since this variable is calculated outside the present version of the model, consultation between those responsible for the exogenous variables and those forecasting with the aid of the model is necessary.

Direct taxes and other income transfers are also exogenous. They enter the model through the net income transfer variable O (see disposable income).

LIST OF EQUATIONS

Domestic expenditure categories

1. $c = .365[(W+Z)^{D}-p_{c})] + .435[(W+Z)^{D}-C)]_{-1} - 2.407\Delta\tilde{U} + 2.389$

2. $i = 3.169\Delta y'_{-3/4} + .355\ Z + .582\ Z_{-1} - .756\ p_{i} - .466$

3. $N = .321\Delta d'_{-1/2} + .037\Delta p_{mg} - .369\ N_{-1} + .685$

Foreign sector

4. $x_{gw} = 2.338\ m_{w} - .520(p_{xg} - p_{x'}) - .828(p_{xg} - p_{x'})_{-1}$

   $- .308(p_{xg} - p_{x'})_{-2} - 3.172$

5. $m_{g} = 1.924\ d' + 3.074\ N + .594(p_{y} - p_{mg})_{-1/3} + .334\Delta d'$

   $- 3.868$

Labour input and unemployment

6. $a = .638\ y + .151\ y_{-1} + .102\ K - 2.376$

7. $\Delta\tilde{U} = - .219\ a + .398$

Wages and prices

8. $w = .562\ p_{c} + .900(y - a)_{-1/2} - .846\Delta\tilde{U} + .4(w_{-1} - .562\ p_{c-1}$

   $+ .846\Delta\tilde{U}_{-1}) + .074$

9. $p_{c} = .362\ H + .164\ p_{mg} + .207\ T_{i}' + 2.084$

10. $p_{i} = .363\ H + .255\ p_{mg} + .155\ p_{i-1} + 1.086$

11. $p_{xg} = .780\ p'_x + .189\ H + .069\ p_{mg} + .3(p_{xg} - .189\ H$

$- .069\ p_{mg})_{-1} - .297$

12. $p_g = .766\ H + .088\ p_{mg} + .118\ p_{g-1} + 1.679$

Definitional equations

13. $C = c + p_c + 0.01\ cp_c$

14. $I = i + p_i + 0.01\ ip_i$

15. $G = g + p_g + 0.01\ gp_g$

16. $X_{gw} = x_{gw} + p_{xg} + 0.01\ x_{gw}p_{gw}$

17. $M_g = m_g + p_{mg} + 0.01\ m_g p_{mg}$

18. $X_e = x_e + p_{xg} + 0.01\ x_e p_{xg}$

19. $X = x + p_x + 0.01\ xp_x$

20. $Y = y + p_y + 0.01\ yp_y$

21. $D' = d' + p_d' + 0.01\ d'p_{d'}$

22. $D' = .452\ C + .155\ I + .217\ X + .175\ G$

23. $d' = .468\ c + .152\ i + .219\ x + .162\ g$

24. $D = .433\ C + .149\ I + .958\ N + .208\ X + .168\ G$

25. $d = .452\ c + .147\ i + .966\ n + .211\ x + .156\ g$

26. $y' = 1.260\ d' - .260\ m$

27. $Y = 1.250\ D - .250\ M$

28. $y = + 1.249\ d - .249\ m$

29. $x_g = .824\ x_{gw} + .176\ x_e$

30. $x = .819\ x_g + .181\ x_s$

31. $X_g = .824\ X_{gw} + .176\ X_e$

32. $X = .826\ X_g + .174\ X_s$

33. $m = .885\ m_g + .115\ m_s$

34. $M = .872\ M_g + .128\ M_s$

35. $H = w - (y-a)_{-1/2}$

36. $K = p_{d'} - .325\ w - .093\ T_i' - .210\ p_m$

37. $\Delta GAP = 4.71 - y$

38. $\Delta\tilde{I}C = .385 \Delta GAP$

39. $W = a + w + 0.01\ aw$

40. $Z = 3.167\ D - .985\ W - .288\ T_i - .637\ M - .256\ F$

41. $(W+Z)^D = .625\ W + .634\ Z + 1.259\ O$

42. $T_i = D' + T_i' + 0.01\ D'T_i'$

4.3. Different versions of the model

The transformations used in the model allow us to estimate and manipulate basic non-linear relationships with techniques developed for linear systems. The standard linear model with constant coefficients (in its structural form) is written:

$$A1: \underline{y}_t = A\underline{y}_t + Bz_t + \underline{u}_t \qquad (4.3.1.)$$

$$A2: K \qquad (4.3.2.)$$

Here $\underline{y}$ is the vector of endogenous variables, z the vector of predetermined (exogenous and lagged endogenous) variables, A and B the corresponding parameter matrices and $\underline{u}$ the vector of disturbances. Lagged exogenous variables are defined as new exogenous variables. K is a set of sentences, which include all other a priori information relevant for the model (the set of a priori feasible structures) not included in A1 e.g. knowledge of the value or range of a parameter, assumptions about disturbances, etc.

With this kind of model, we have to ignore the cross-terms appearing in some of the identities. Capacity effects must be taken as linear and constancy of the structure (i.e. A and B) is required. The exogenous (but not the lagged endogenous) variables may include non-linearities. If non-linear relationships are required by the economic theory used, they have to be linearized.

In many cases standard linear model describes empirical phenomena almost as well as more sophisticated "play processes" and Occam's razor should be kept in mind when elaborating our model. On some occasions, however, it is desirable and possible to be more "accurate". The alternative versions of the model presented below reflect an attempt to introduce greater sophistication to the system.

Linear model for each period:

$$A1: \underline{y}_t = A_t\underline{y}_t + B_t z_t + F(y_{t-1},\ldots,y_{t-n},z_t,\ldots,z_{t-m}) + \underline{u}_t \qquad (4.3.3.)$$

A2: K' (4.3.4.)

This version makes it possible to allow for structural changes in each period. Non-linear combinations of the lagged endogenous variables (linear combinations are included in z_t) can also be handled. We can also use different linearizations of the capacity equation for each period and, e.g., ratios of the levels of lagged endogenous variables as explanatory variables. For calculating the value of F we have to have an additional non-linear block, if we want to move from one period to another. The changing structure of the economy (in the long run and over the cycle) can be taken into account by using changing weights in identities (different A_t and B_t) for each period. In Finland these weights vary rather much from year to year (see fig. 4.37. and fig. 4.43.), and performance of the model changes somewhat when this refinement is introduced. In the same way we could introduce changing coefficients into the behavioural equations, but this is not done in the present version. However, the cross-terms cannot be handled adequately in this framework, and a further refinement is needed.

Problems of estimation and solution are generally encountered when non-linear models are used. As our behavioural equations are introduced and estimated in a linear form, the difference between our non-linear version and the previous version is not great. The only non-linear elements in the present model are identities with cross-terms and the definition of the impact of the capacity variable. The addition of non-linearities may thus be seen as a correction to a linear model.

<u>Non-linear model</u>:

A1: $\underline{y}_t = A_t\underline{y}_t + B_t z_t + R(y_t,\ldots,y_{t-n},z_t,\ldots,z_{t-m}) + \underline{u}_t$ (4.3.5.)

A2: K" (4.3.6.)

This version can also be solved using iterative techniques which are based on the presupposition that we are not very far from the linear model. We have developed computer routines that exploit this fact (see Chapter 6.).

The approximation-oriented approach to model building leads us to start with a simple standard model and to add complicating refinements step by step. Besides, the simultaneous use of several versions is justified by different uses of the model. Generally the standard linear version of the model is very handy when one wants to evaluate rapidly the effects of a change in the endogenous variables, or to assess exogenous shocks resulting from policy measures. The approximate character of the results and the relative importance of complicating factors can subsequently be explored by using more sophisticated versions.

5. ESTIMATION OF THE MODEL

The model has been estimated using data for the years 1951 - 1970. Because of the lags, this has required knowledge of the level of variables as far back as 1948.

The use of more complicated models and the development of computational methods have generally led to the introduction of more advanced estimation techniques. Controversy on the relative merits and demerits of different methods continues, and we must face the fact that the choice of estimation techniques for use in conditions which are unknown and likely far from ideal will always remain a difficult question[1).

The present version of the model has been estimated mainly with the ordinary least squares method (OLS), which can also be regarded as an(inconsistent) "simultaneous estimation technique" that does not take any simultaneity between the equations into account. Theoretical results of the simultaneous

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1) Cf., Fisher [1965]. Y. Vartia will treat questions of this sort in a forthcoming study on stochastic specification and estimation of the model.

estimation methods deal primarily with asymptotic properties, and their use requires strong assumptions about the structural and stochastic specification that clearly do not hold in most empirical work. The disadvantages of OLS compared with other methods become much less evident in actual small samples when we know that there are bound to be specification errors in our "play process". Because of its simplicity, OLS requires less time and money. Besides, the appropriate computer programs for e.g. the two stage least squares method (TSLS) with principal components or for the limited information maximum likelihood method (not to mention the full information methods) have not been available in Finland[1].

Moreover, in the early stages of constructing a model, various economic specifications must be examined, and this affects the performance of the model more than the choice of the estimation technique. Sophisticated methods that seem to be sensitive to specification errors can be used once the economic specification of the model is set.

However, in estimating some parts of the model, we can take into account simultaneity. We can use a priori information to set values for those parameters, whose OLS-estimates we expect to be biased. The introduction of recursiveness (even lags of less than a year) will also help in this respect. For the key simultaneous blocks, such as the wage-price block, we can use

1) This has not prevented the use of these methods in some studies, which deserves special mention.

simultaneous estimation techniques inside the blocks and forget about simultaneity with the rest of the model. In the version presented here we have proceeded in this way using different estimation methods and personal judgment. The TSLS-method has been used to estimate the parameters of the wage-rate and consumption price equations[1)]. With small blocks the number of predetermined variables is small, the degrees of freedom are adequate and principal components need not be used. According to our experiments the results do not differ much from those obtained using the TSLS method with the principal components of the predetermined variables of the complete model.

Different estimation techniques form an interesting field of investigation, and it is our intention to estimate the model using simultaneous estimation techniques in order to assess the impact of different estimation techniques on the performance of the model. As our model is based on annual data problems introduced by simultaneity require more attention than in the case of, e.g., quarterly models.

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1) A similar method was used in Juhani Hirvonen [1971]. We should here distinguish between two modes of analysis: a) specification of a block-recursive model (possibly wrongly) and the subsequent application of "correct" estimation methods and b) estimation of a priori selected blocks of a truly simultaneous model by methods suitable only for block-recursive systems.

6. METHODS OF SOLUTION

The standard linear model of (4.3.1.)-(4.3.2.) lends itself to the simple estimation and solution techniques which have been developed for linear systems. The reduced form that corresponds to the structural form (4.3.1.) is

$$\underline{y}_t = (I-A)^{-1}Bz_t + (I-A)^{-1}\underline{u}_t \qquad (6.1.)$$

Corresponding to this, we have, for a given year (a realization of the process),

$$y_t = Ay_t + Bz_t + u_t = (I-A)^{-1}Bz_t + (I-A)^{-1}u_t \qquad (6.2.)$$

Here y_t and u_t are the actual values of the corresponding random vectors. Of course, only y_t and z_t are observable; u_t cannot be observed unless we know A and B. If they were known and the standard assumptions of the $\{u_t\}$-process were valid[1)], we could use the expected value of $\underline{y}$ given z_t to predict y_t (a single realization of $\underline{y}$)

$$\text{pred}(\underline{y}_t|z_t) = E(\underline{y}_t|z_t) = (I-A)^{-1}Bz_t \qquad (6.3.)$$

1) See Goldberger [1964] p. 299-302.

This implies using the "mean value" $E(\underline{y}_t|z_t)$ of the conditional distribution of $(\underline{y}|z_t)$ (the median $Md(\underline{y}_t|z_t)$ might sometimes be considered a "better" predictor) as a predictor for a single unknown observation y_t. Actually the assumptions of linearity and those concerning the $\{u_t\}$-process are very restrictive, but we can use $(I-A)^{-1}Bz$ as an <u>approximation</u> of the true (probably non-linear) function $H(Z) = E(\underline{y}|z)$. This choice is justified by linear prediction theory.

By analogy, we can proceed as follows. Denote the estimated model by

$$y_t = \hat{A}y_t + \hat{B}z_t + \hat{e}_t = (I-\hat{A})^{-1}\hat{B}z_t + (I-\hat{A})^{-1}\hat{e}_t, \qquad (6.4.)$$

where y_t and z_t are again vectors of the observed values of the endogenous and predetermined variables, $\hat{e}_t$ is a vector of the single equation residuals and $\hat{A}$ and $\hat{B}$ are the estimated parameter matrices. As can be seen, the model solution residuals are given by $(I-\hat{A})^{-1}\hat{e}_t$. This shows that the model solution residuals are linear combinations of the single equation residuals, their interrelationship being described by the inverse $(I-\hat{A})^{-1}$. For example, the model solution residual for the volume of private consumption depends on the single equation residuals for the other variables, in this case, e.g., the weight of the investment equation residual is about 0.18.

In actual ex ante forecasting situations $\hat{e}_t$ is unknown and is, in the simplest case, replaced by a zero vector. By analogy with (6.3.), we can use the systematic part of the estimated model

$$\hat{y}_t = \hat{A}y_t + \hat{B}z_t = (I-\hat{A})^{-1}\hat{B}z_t \qquad (6.5.)$$

as an estimate of the expected value of $\underline{y}$ given z_t. This systematic part is also an approximation of the linear predictor, $\text{pred}(\underline{y}|z_t)$, i.e.

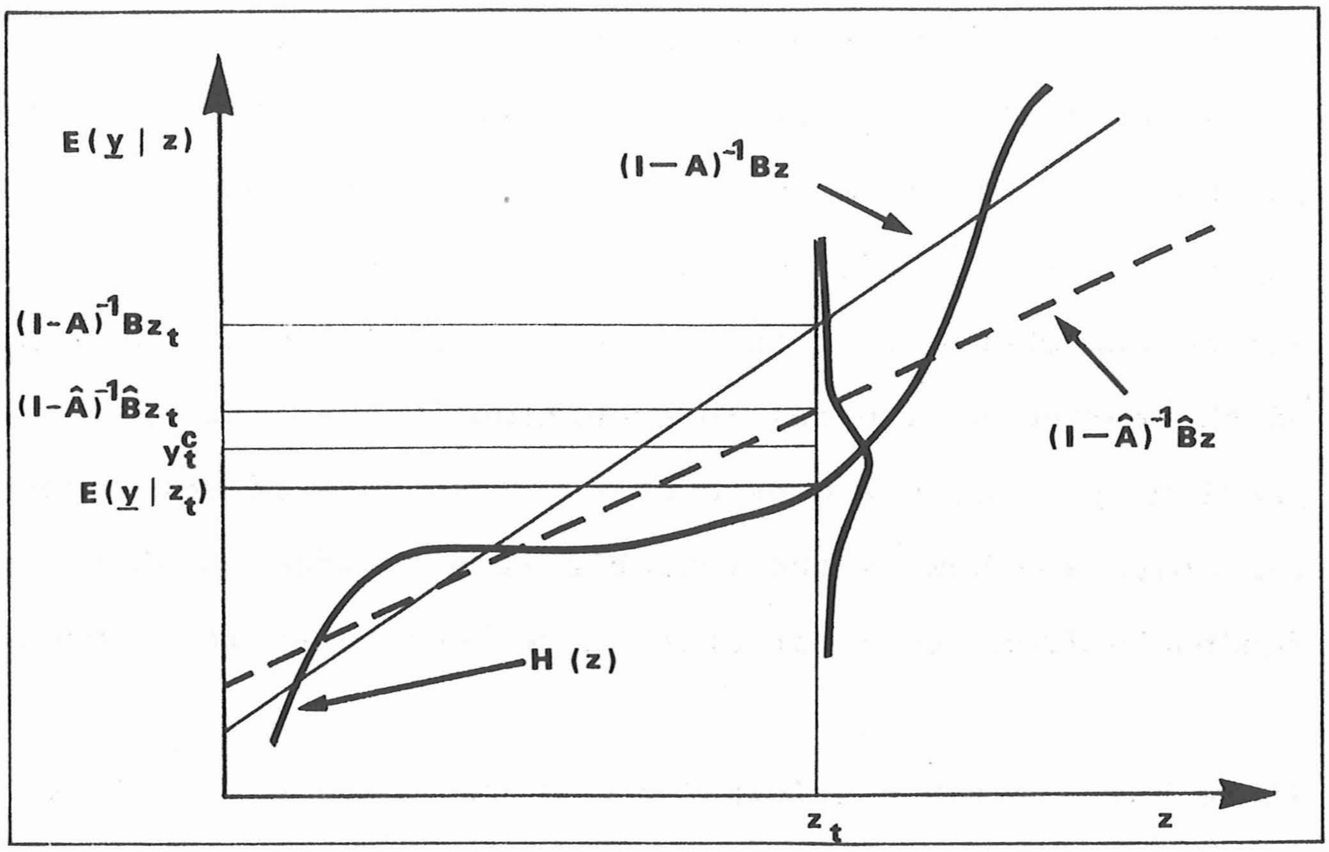
$$\hat{y}_t = \text{est } E(\underline{y}|z_t) \approx \text{pred}(\underline{y}|z_t) \qquad (6.6.)$$

In the following section we examine the application of slightly different versions of the estimated model (6.4.). The numerical values of the parameters have been given and discussed in connection with the structural specification of the separate behavioural and definitional equations (see section 4.2.).

The estimated reduced form equation (6.5.) includes information on how the endogenous variables react to changes in exogenous ones and it can be used in (short-run) impact multiplier analysis. Usually only the sub-matrix $(I-\hat{A})^{-1}\hat{B}$, which relates the endogenous variables to the exogenous variables, is referred to as the matrix of impact multipliers. A modified model solution resulting from a change in the predetermined variables can be written

$$(y+\Delta y) = (I-\hat{A})^{-1}\hat{B}(z+\Delta z) \qquad (6.7.)$$

Fig. 6.1. A schematic presentation of prediction when z and $\underline{y}$ are scalars



The change Δy in the endogenous variables caused by Δz is thus

$$\Delta y = (I-\hat{A})^{-1}\hat{B}\Delta z \qquad (6.8.)$$

This relationship also shows how forecasting errors in the exogenous variables or corrections in the lagged endogenous variables (i.e. z) affect the forecasts.

On several occasions we may also have knowledge of some autonomous changes Δy^{aut} in endogenous variables, which are not explained by the relationships present in the model. For example we may expect private investment to be unusually large due to changed expectations not taken into account by the investment equation, on the basis of disaggregated data we may know that response to price changes will not be in accordance with the aggregate equation[1], consumption habits may change because of speculative purchases, we may want to take into account decline of exports due to harbour strikes, there may be exceptional behaviour of the variables due to institutional changes, etc. When making forecasts for the present year, we may even with considerable accuracy measure these kinds of autonomous changes, if they have been realized in the beginning of the period or are due to exceptional behaviour in the previous period. How does a change like this affect other variables and how is the variable itself affected when feedbacks from other variables have been taken into account?

If we have reliable information on the value of the total annual change in some endogenous variable we may, of course, make this variable exogenous in the model and place it at the given value[2]. Flexible use of the model for forecasting as well as for analytical purposes often requires that some of the variables in the model solution be given specific (desirable, expected or realized) values. We shall refer to this process of removing a behavioural equation as exogenization. Let us denote our model solution by

$$\hat{y}_t = F(\hat{y}_t, z_t) \qquad (6.9.)$$

1) See section 7.5. for an example.

2) This has some implications for the estimation of the parameters of the model since we are in fact dealing with another model, but we will not discuss these questions here.

In our case F takes the form (6.5.) or slight modifications of it.

An easy way to perform a given exogenization can be seen, if we write the model in the form[1)]

$$\hat{y}_t = (I-E)F(\hat{y}_t, z) + Ey_t.$$

Here y_t is the vector of realized (or a priori fixed) variables and the diagonal matrix E indicates the variables that are exogenized. The i^{th} diagonal element of E equals 1 if and only if the i^{th} endogenous variable is exogenized, otherwise it is zero. Notice that the exogenized model can be interpreted as a weighted average of the original model and the completely exogenized model, the weights being (I-E) and E respectively. The above method of exogenization can be programmed easily and is now a standard option in our computer programs. Exogenization provides a straightforward method of analyzing the effects of a particular equation or group of equations on the model solutions. The possibility of easily evaluating the importance of various equations, as regards the overall performance of the model, is also an advantage in the construction of the model and may help to find its critical parts.

On the other hand, if our knowledge does not permit us to exogenize a variable, we may use the equation to describe the

1) This idea is due to Y. Vartia.

basic behaviour and interpret the outside information in terms of the error $\hat{e}_t$ in (6.4.). Thus we may expect, e.g., the growth in the volume of private investment in a given year to be one percentage unit higher than under "normal" circumstances, even if we do not know what the total change under "normal" circumstances, as described by the investment equation, would be. In cases like this we may use the extra information to set a "guestimated" value for the error term $\hat{e}_t$ in the particular year, i.e.

$$\Delta y_t^{aut} = \text{guest}(\hat{e}_t) \tag{6.10.}$$

where Δy_t^{aut} is the vector of autonomous changes. Generally taken, the corrected solution $\hat{y}_t^c$ is given by

$$\hat{y}_t^c = F(\hat{y}_t^c\ ,\ z_t) + \Delta y_t^{aut} \tag{6.11.}$$

Corresponding to (6.4.) and (6.5.) above, we have

$$\hat{y}_t^c = (I-\hat{A})^{-1}\hat{B}z_t + (I-\hat{A})^{-1}\text{ guest }\hat{e}_t = (I-\hat{A})^{-1}(\hat{B}z+\Delta y_t^{aut}) \tag{6.12.}$$

The resulting change due to autonomous changes Δy_t^{aut} is thus

$$\Delta\hat{y}_t = \hat{y}_t^c - \hat{y}_t = (I-\hat{A})^{-1}\Delta y_t^{aut} \tag{6.13.}$$

And it is seen that the effect of autonomous changes on the other variables and on the variable itself, after feedbacks during the same period are taken into account, is given by the inverse $(I-\hat{A})^{-1}$.

By combining (6.7.) and (6.12.) the modified model solution can be written

$$\hat{y}_t^c = \hat{y}_t + \Delta\hat{y} = (I-\hat{A})^{-1}(\hat{B}(z_t + \Delta z_t) + \Delta y^{aut})$$

$$= \hat{y}_t + (I-\hat{A})^{-1}(\hat{B}\Delta z + \Delta y^{aut}) \qquad (6.14.)$$

In other words a given change in y can be produced by a suitable autonomous change in y, an exogenous change in z or a change in both variables. More generally, we can investigate the interdependence of the endogenous variables using only matrix $(I-\hat{A})^{-1}$, disregarding the way in which the level of $\hat{y}$ is determined. As Bz is often of smaller dimension than z, it is also easier to handle, and for this reason $(I-\hat{A})^{-1}$ may be used instead of $(I-\hat{A})^{-1}\hat{B}$. This matrix can also be used to set some variables of the model solution at desired values by subjecting them to an autonomous shock and taking the effect of feedbacks into account with the diagonal elements of the inverse. It should be pointed out that this kind of manipulation of the model is equivalent to setting these variables at the desired values by exogenizing them. The effects on other variables will be just the same.

With the standard linear version of the model, the matrices $(I-\hat{A})^{-1}$ and $(I-\hat{A})^{-1}\hat{B}$ are constant for all the years. The version (4.3.3-4.) of the model permits similar short-term multiplier analysis, but as the structure changes from one year to the next, so do the impact multipliers. For some years the cross-terms in value-volume-price identities are not negligible, but for the estimation period we can correct these identities using the actual cross-terms. This means introducing additive terms (different each year) into the definitional equations. The inconsistency resulting from the deviation of the observed cross-terms from the model solution ones is small, since for the period examined the realized and solved variables do not differ very much from one another. The same procedure may of course be used in actual forecasting situations. This method will give "more consistent" results and is to be preferred to leaving the cross-terms out totally. Replacing the observed cross-terms by those obtained by solving the model allows us to reach perfect consistency after a few iterations. If this procedure is formalized and programmed for the computer, a non-linear solution method results. This addition of cross-terms to the equations is formally equivalent to using the error-term "guestimation" presented above.

When using the non-linear variable $\widetilde{IC}$ which describes the impact of unused capacity, the version (4.3.3-4.) may be used if we linearize the relationship between changes in unused capacity and its impact as was shown in section 4.2.3.4.:

$$\Delta \widetilde{IC} \approx \frac{b}{\widetilde{UC}_{-1}+c} \Delta \widetilde{UC} = k \, \Delta \widetilde{UC} \qquad (6.15.)$$

Thus no non-linearities will exist between the endogenous variables. The value of k can be calculated beforehand for each period when we know the level of unused capacity in the previous period. An exact relationship requires non-linear solution techniques.

The impact multipliers of the matrix $(I-\hat{A})^{-1}\hat{B}$ take into account the simultaneity of the system, but only feedbacks in the same period are allowed for. If the predetermined variables are all exogenous, there are no intertemporal feedbacks between the endogenous variables, and the reduced form will describe completely the impact of the exogenous variables on the endogenous variables. In these circumstances we would also have a full account of the dynamic properties. However in our model, as in most, there are lagged endogenous variables among the predetermined variables. We thus have a system of difference equations in which changes in the endogenous variables will affect other variables in the future. The dynamic properties of the model are thus an interesting area of research.

For analytical work, a model with complete linearity and constant structure, i.e. (4.3.1-2.), is practical because the effects of different policies are then additive in time. The principle of superposition[1] for linear systems holds: no knowledge of the absolute values of y or z is required if we want to analyze the difference (Δy_t, $\Delta y_{t+1}, \ldots$) in the time path of the endogenous variables resulting from a change in policy, Δz_t, or an autonomous shock Δy_t^{aut}. To show this let us denote the deterministic part of the estimated model (6.4.) again by

$$y_t = \hat{A}y_t + \hat{B}z_t = \hat{A}y_t + y_o + \hat{A}_1 y_{t-1} + \hat{A}_2 y_{t-2} + \ldots \hat{\bar{\bar{B}}}z_t$$

$$= \hat{A}y_t + y_o + \sum_{\tau=1}^{K} \hat{A}_\tau y_{t-\tau} + \hat{\bar{\bar{B}}}z_t \qquad (6.16.)$$

1) See: Zadeh-Desoer [1963] p. 144-152.

where y_o is the vector of single equation constants, $\bar{z}_t$ the vector of exogenous variables when the constant 1 has been removed, $y_{t-\tau}$ the vector of endogenous variables lagged by τ periods and $\hat{\bar{B}}$ and $\hat{A}_\tau$ the corresponding matrices. We have thus

$$y_t = (I-\hat{A})^{-1}\hat{B}z_t$$

$$= (I-\hat{A})^{-1}[y_o + \sum_{\tau=1}^{K} \hat{A}_\tau y_{t-\tau} + \hat{\bar{B}}\bar{z}_t] \qquad (6.17.)$$

For the difference between two input series $\{z_t^{(1)}\}$ and $\{z_t^{(2)}\}$ and between two corresponding output series $\{y_t^{(1)}\}$ and $\{y_t^{(2)}\}$ with the same initial conditions, we have

$$\Delta y_t = (y_t^{(1)} - y_t^{(2)}) = (I-\hat{A})^{-1}[y_o + \sum_{\tau=1}^{K} \hat{A}_\tau y_{t-\tau}^{(1)} + \hat{\bar{B}}\bar{z}_t^{(1)} - y_o - \sum_{\tau=1}^{K} \hat{A}_\tau y_{t-\tau}^{(2)} - \hat{\bar{B}}\bar{z}_t^{(2)}]$$

$$= (I-\hat{A})^{-1}[\sum_{\tau=1}^{K} \hat{A}_\tau (y_{t-\tau}^{(1)} - y_{t-\tau}^{(2)}) + \hat{\bar{B}}(\bar{z}_t^{(1)} - \bar{z}_t^{(2)})$$

$$= (I-\hat{A})^{-1}[\sum A_\tau \Delta y_{t-\tau} + \hat{\bar{B}}\Delta\bar{z}_t] \qquad (6.18.)$$

Thus we can use the model (with the constants y_o removed) directly to give us the differences in the effects of alternative policies by inserting differences in policy variables. Furthermore, as the constants y_o cancel out, multiples of the $\{\Delta\bar{z}_t\}$ series correspond to multiples of the $\{\Delta y_t\}$ series, which is not true for the original $\{z_t\}$ and $\{y_t\}$ series. The way a linear model can be used for long-run multiplier analysis is not discussed here, since several textbooks include passages where these standard procedures are explained[1]. These methods can be used for several purposes. However, compact formulas for obtaining multipliers may give an erroneous idea of the work involved in practical situations when the number of equations in the model is great.

We shall consider simulation to be the process of solving a problem numerically, when analytic methods are impossible, difficult or for some other reason not to be preferred. An example of the use of analytical methods can be found in multiplier analysis (impact or dynamic). The same problem can often be solved with both methods. For example the results of chapter 8.3., which deals with the impact through time of policy measures, on endogenous variables are derived using simulation techniques. As the standard linear version of the model was used for the simulations, equivalent results could have been obtained through multiplier analysis.

Non-linear models, e.g. version (4.3.5.-6.), generally do not lend themselves to manipulation with algebraic methods. For example traditional multiplier analysis is impossible. Comparison of different policy alternatives requires the solution of the model for each combination of instruments and the differences in results depend on the levels of y and z. Similarly, the response of the endogenous variables as to a given policy alternative in a specific year depends not only on the level of the predetermined variables in the base year

1) See e.g. Dhrymes [1970].

but also on the values of exogenous variables of the years between. In other words, effects are not additive, and we have to determine the time paths of the endogenous variables for each policy combination and then compare the results. Non-linear models require good knowledge of the policy alternatives - even knowledge of decisions which will be made in the future.

As was mentioned in section 4.3. our "non-linear" version of the model can be solved by exploiting the fact that the model is very close to linear. The appropriate solution techniques have been developed in RIFE by Y. Vartia and programmed by H. Vajanne[1]. Also a programme for solving non-linear models which was developed at the Bank of Canada has been used[2].

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1) The solution technique combines matrix inversion and iteration; a research report is being prepared.

2) SITRA (Finnish National Fund for Research and Development) organized a group of economists to consider the shortage of standard economic package programs in Finland. Two programs SIMULATE and MASSAGER were received through the Link-project largely due to the efforts of the Bank of Finland. For our purposes, however, SIMULATE has proved inefficient and expensive compared to our own programs.

7. TESTING THE MODEL

7.1. General

It is difficult to separate the verification of a model from its construction. Logical requirements, a priori beliefs and the model builder's ideas about economic behaviour influence both the construction and testing of the model[1]. Moreover, some of the a priori ideas are modified substantially in the course of constructing the model.

The validity of a model depends on its ability to describe, analyze and predict events. We have already emphasized that econometric models should be used with the forecaster's judgment. This also has implications for testing the model. There is some evidence that econometric models together with personal judgment may perform better in real forecasting situations than the fit obtained for the estimation period suggests[2]. Thus if we test the model only on the

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1) See, e.g. F.M. Fisher [1966].

2) Evans, et al. [1972].

basis of model solution residuals and without "fine tuning", we are apt to underrate its usefulness in real ex ante situations. In the following, however, the residuals of the model are analyzed in the traditional way. It is a mistake to suppose that the model is designed to give an exact prediction of the values of the endogenous variables for each year. Forecasts are conditional expectations, and the erros terms are usually assumed to have zero expectations. If we have outside information about the error terms, this can be taken into account when making predictions (see Ch. 6. and 8.).

7.2. Model solution residuals during the estimation period

It is natural to compare the residuals obtained when all the endogenous variables are simultaneously solved for using the equation system with the residuals obtained with single equations when using observed values for all the explanatory variables.[1)] This is particularly interesting since the model has primarily been estimated with the ordinary least squares (OLS) method and not with proper simultaneous estimation methods. It is natural to expect the model solution residuals to be somewhat larger than the single equation residuals, but if they are very much larger there is something wrong with the thinking behind the model. It is clear that even if all the individual equations are well designed, the model itself

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1) The results presented in this chapter are obtained with the non-linear version of the model. In section 7.5. the volume of inventory changes has been approximated by setting n=N (see page 74.) in equation 25. (see list of equations on page 148.), in other sections it has been replaced by its actual value.

need not be. This annoying fact, which we and many others have encountered, is just one element that complicates model building.

The single equation residuals of the behavioural equations have already been presented. In the following, model solution residuals are shown for some variables.

In figures 7.1a.-d. we present model solution residuals for private consumption, private investment, multilateral commodity exports, imports of goods and consumption prices, all of which are variables explained by behavioural equations. The corresponding single equation residuals are also shown. As may easily be seen, the degree of simultaneity for the variables varies. For example, exports are determined mainly by exogenous demand factors and lagged price effects. The only unlagged endogenous variable in the export equation is export prices and it has a small coefficient. Model solution residuals for this variable are thus very close to the single equation residuals. To give an idea of the model solutions also for some aggregate variables in different years, we have presented model solution residuals for the volume of gross domestic product, the volume of total demand and prices of gross domestic product.

The analysis of these two sets of residuals is of great help in understanding the structure of the model. As was shown in Chapter 6., there is a simple relationship between the two sets of residuals in linear models:

Fig. 7.1a. Model solutions in 1951-1970 for some of the main variables and the corresponding residuals $\hat{e}^*$ compared with single equation residuals $\hat{e}$

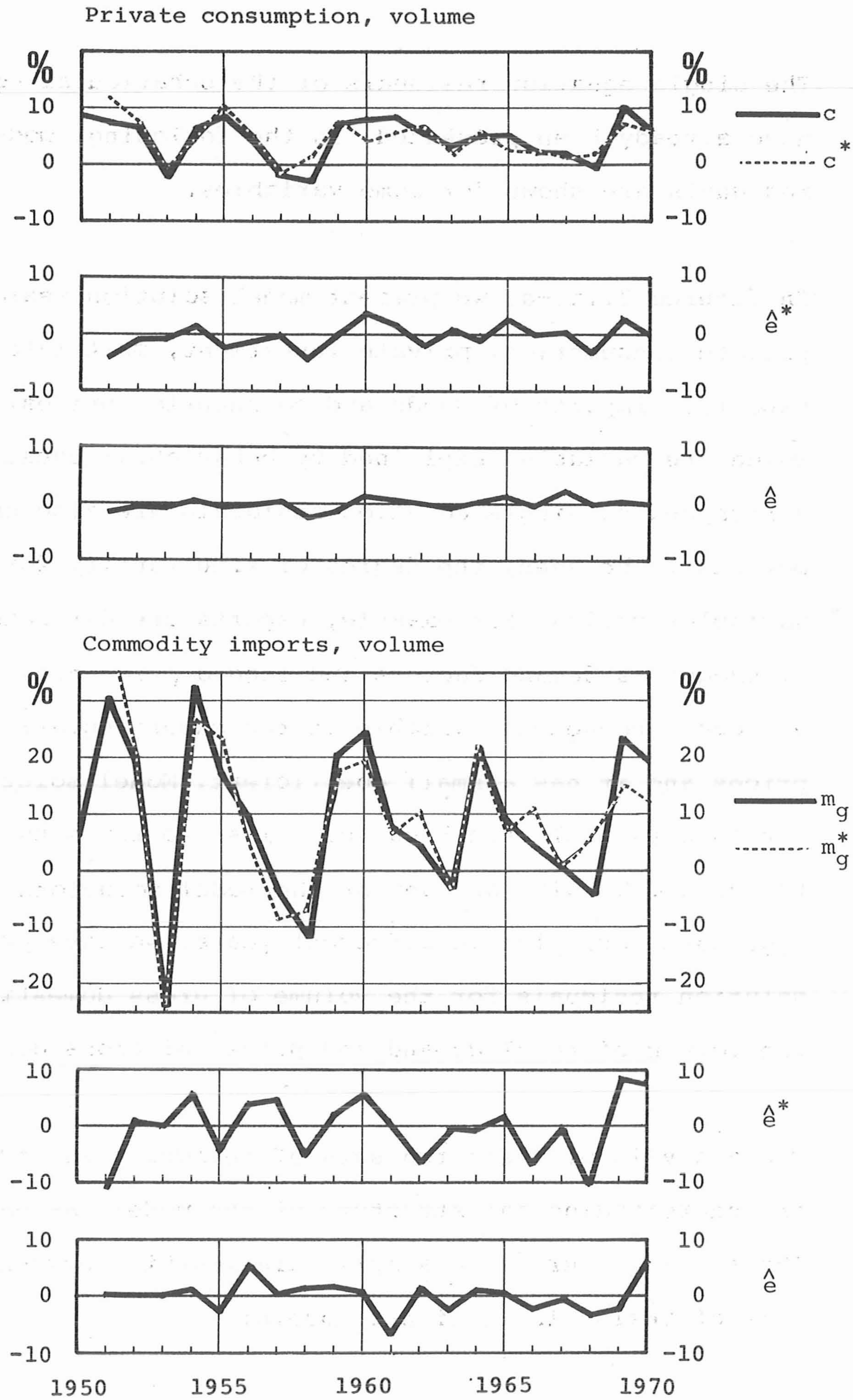
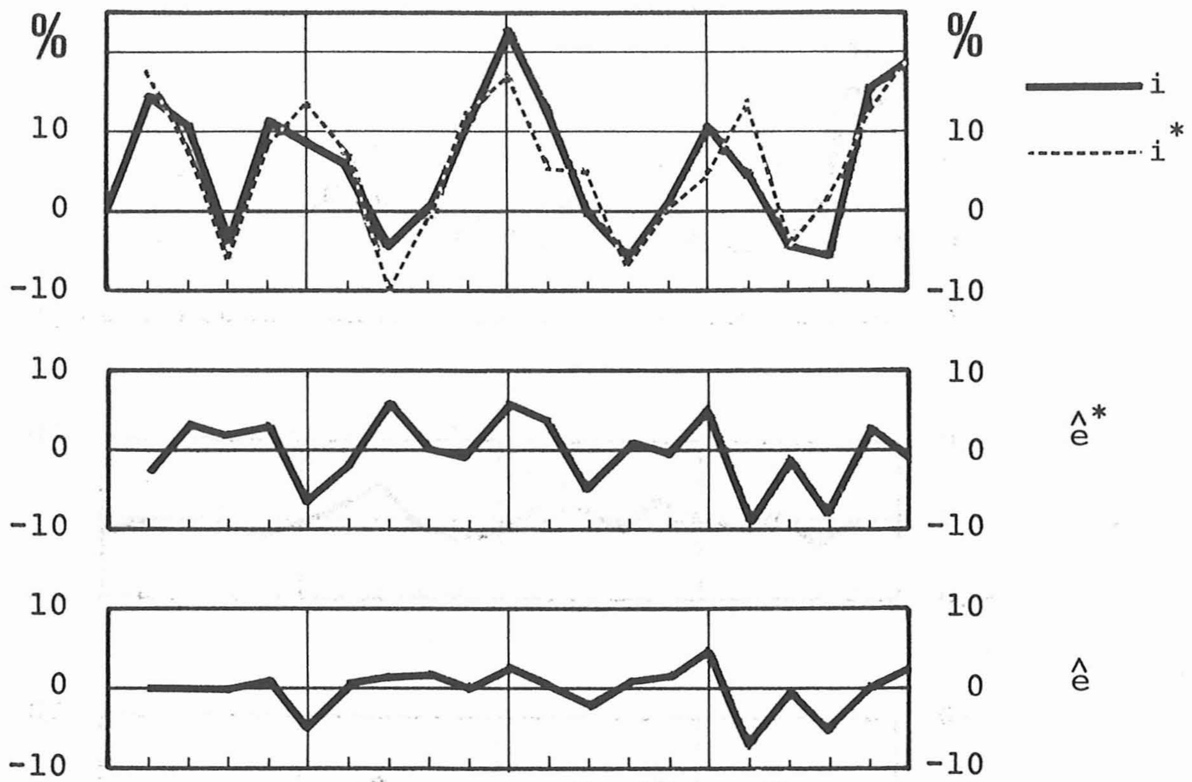


Fig. 7.1b. Model solutions in 1951-1970 for some of the main variables and the corresponding residuals $\hat{e}^*$ compared with single equation residuals $\hat{e}$

Private investment, volume



Multilateral commodity exports, volume

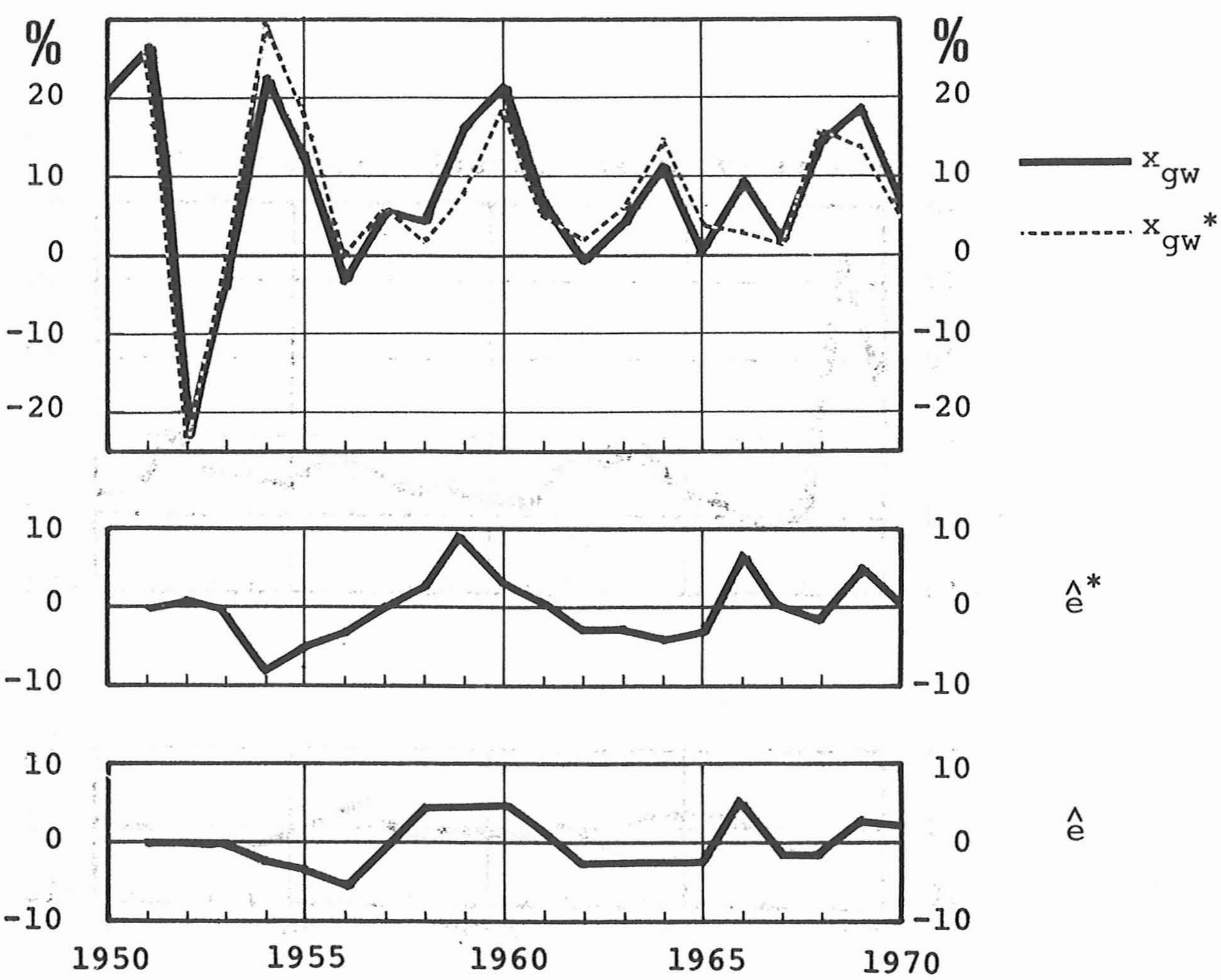
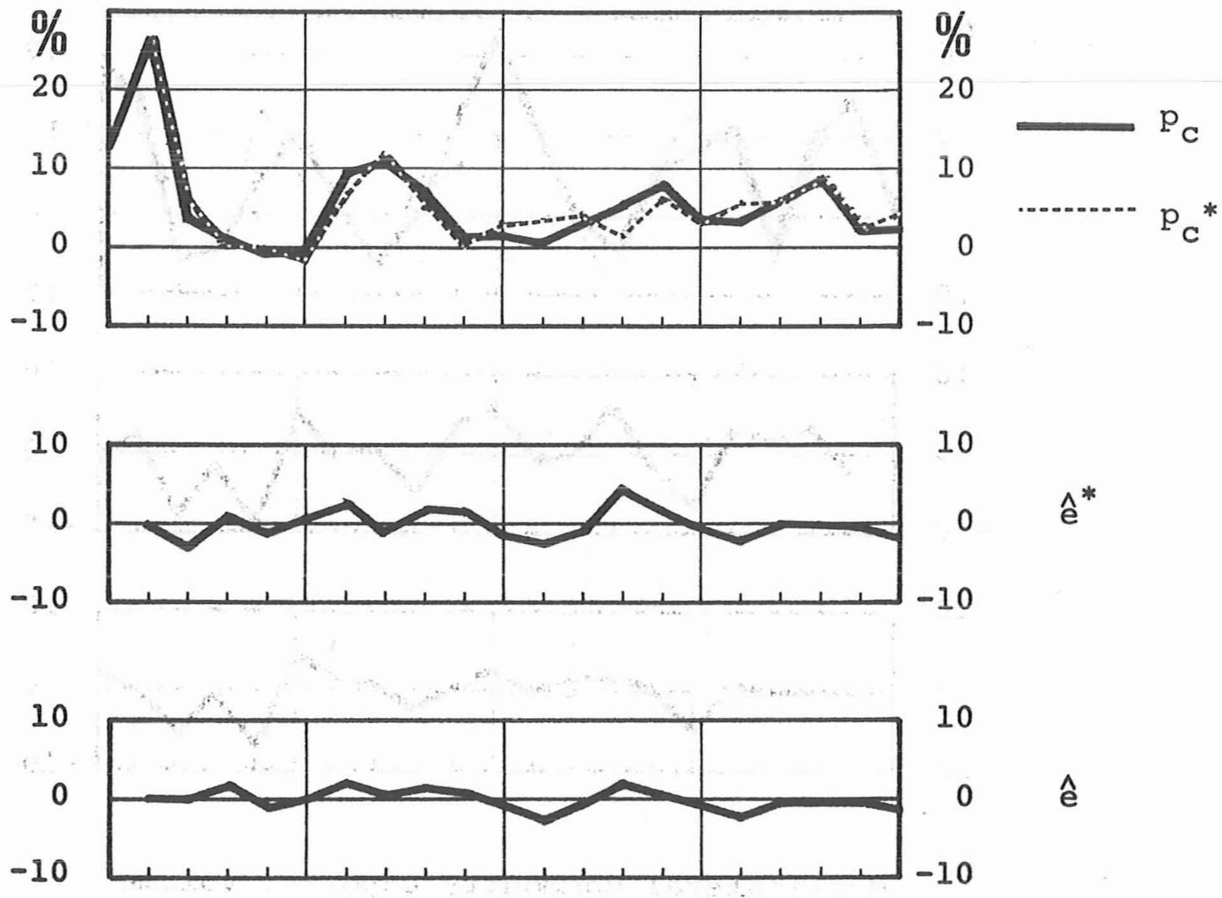


Fig. 7.1c. Model solutions in 1951-1970 for some of the main variables and the corresponding residuals $\hat{e}^*$ compared with single equation residuals $\hat{e}$

Consumption prices



Prices of gross domestic product

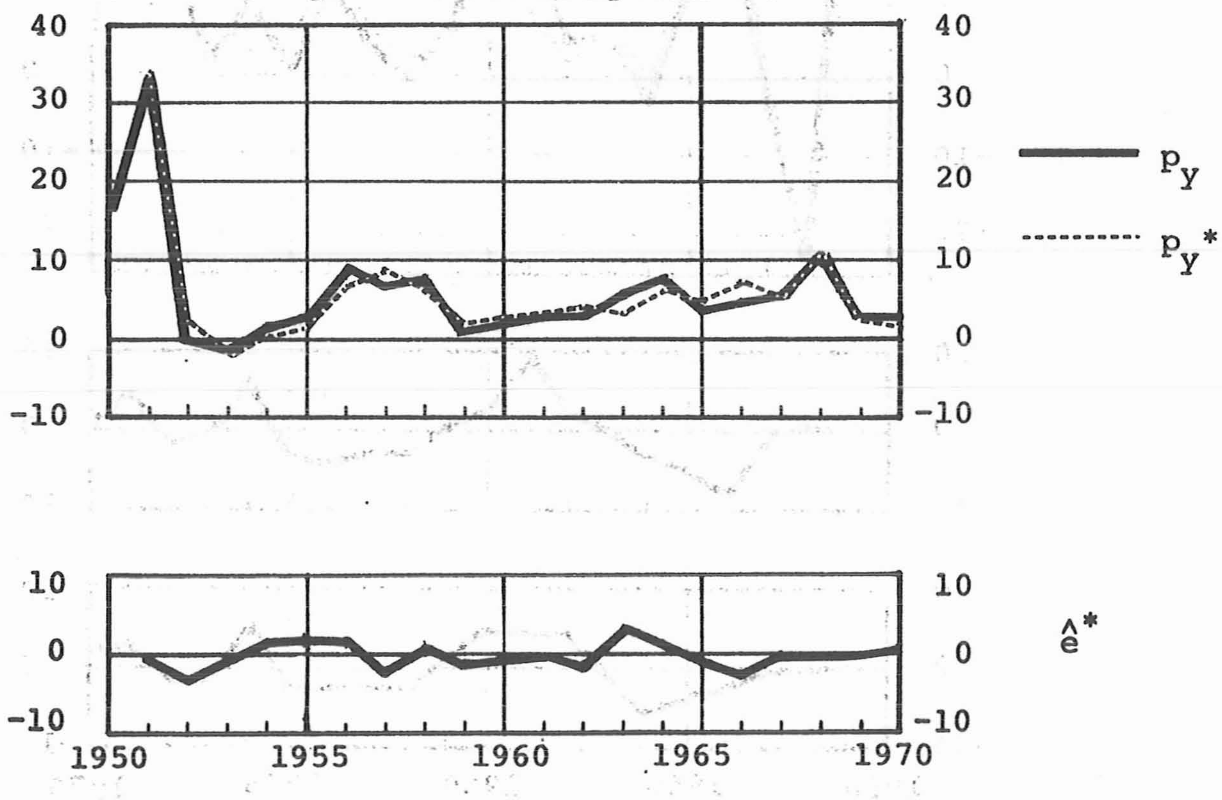
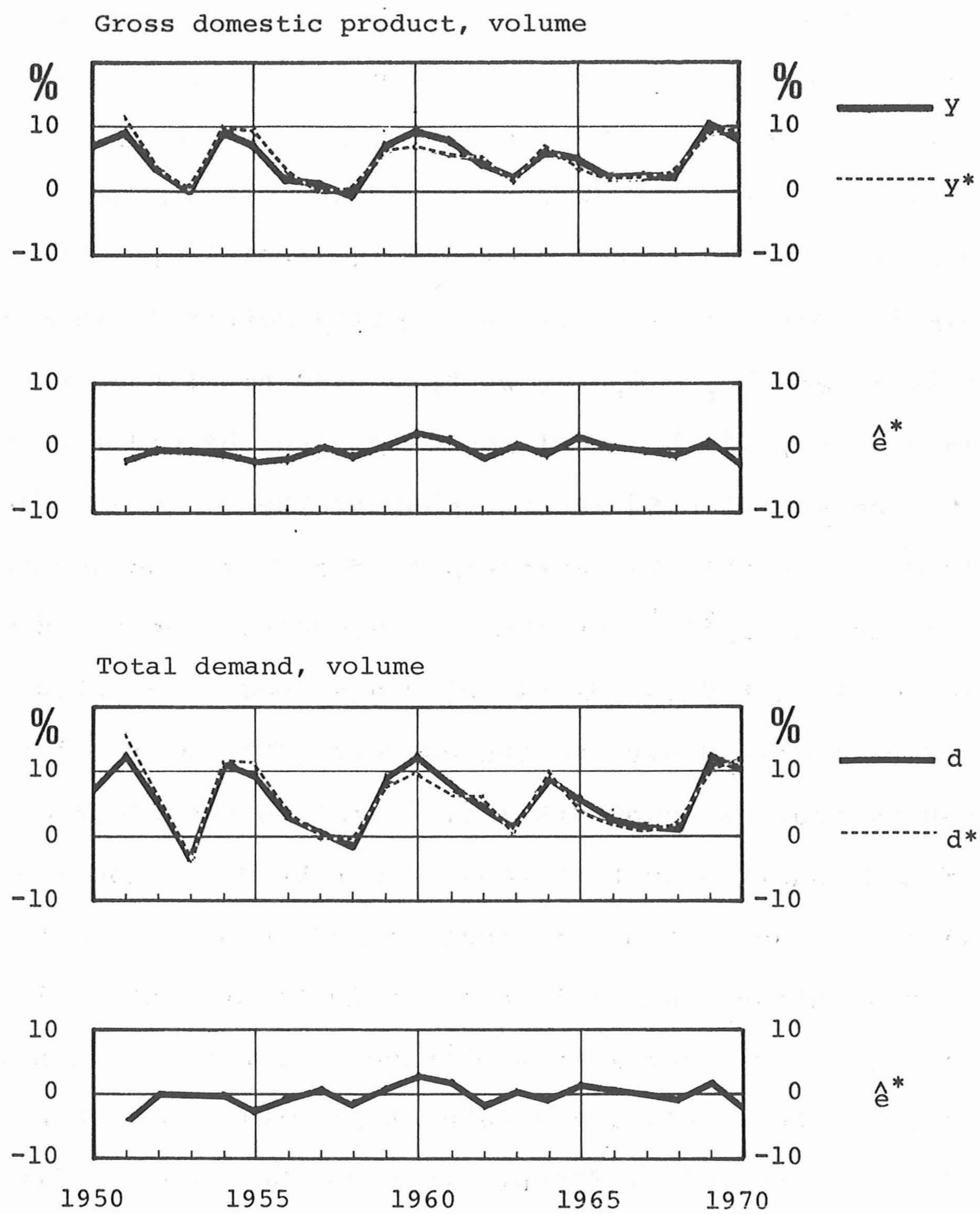


Fig. 7.1d. Model solutions in 1951-1970 for some of the main variables and the corresponding residuals $\hat{e}^*$ compared with single equation residuals $\hat{e}$



$$\hat{e}^*_t = (I-\hat{A})^{-1}\hat{e}_t \qquad (7.1.)$$

where $\hat{e}^*_t$ is the vector of model solution residuals and $\hat{e}_t$ the vector of single equation residuals. The degree of simultaneity e.g. for the export equation discussed above, can thus be verified by the elements of the row of $(I-\hat{A})^{-1}$ that correspond to the export equation. Generally the effect of the simultaneity "twist" is strong if and only if there are large off-diagonal elements in $(I-\hat{A})^{-1}$. If there is no simultaneity, $(I-\hat{A})^{-1}$ is an identity matrix ($\hat{A}$ is a zero matrix) and $\hat{e}^*_t = \hat{e}_t$. As we have used non-linear version (4.3.5.-6.) of the model for obtaining the model solution residuals presented in this chapter, the relationship (7.1.) is only approximate. However, it is a very good approximation. The matrix $(I-\hat{A})^{-1}$ for the corresponding linearized model varies slightly for different years because of structural and cyclical changes in the economy. This matrix for 1970 can be found in appendix III. At the moment the simultaneity of the model is quite strong as can be seen from the inverse $(I-\hat{A})^{-1}$. One possibility that we have explored is the building of a simultaneous model which would first contain little simultaneity. Then more simultaneous links could be added step by step. This would make it possible to obtain some idea of the effect of different links on the results. Different degrees of simultaneity can be introduced, e.g., by changing the lag structure.

Since the specifications are still being changed, the residuals are not analyzed further here. We may, however, mention that at present the residuals are largest for some particular variables in some special years. Because of the simultaneity of the model, large residuals for all the variables are obtained, even if only one equation is not well specified. After a more thorough analysis of the economic phenomena in the estimation period, we hope to be able to modify the model so that it will also describe behaviour in exceptional years. Exogenization and dummy variables can be used in order to investigate the performance of the rest of the model, even if a satisfactory specification for some part of model is missing.

We have used Theil's inequality coefficient as an aggregate measure for analyzing the accuracy of forecasts. We have chosen this one out of many possible measures because of its especially attractive decomposition properties in further analysis of accuracy. Here, however, we content ourselves with presenting only the overall measures without decomposition. Theil's inequality coefficient may be written

$$U = \frac{\sqrt{M(y_{it} - y^*_{it})^2}}{\sqrt{M(y_{it}^2)} + \sqrt{M(y^{*2}_{it})}}$$

where y_{it} is the observed and y^*_{it} the predicted value for variable i in year t. The arithmetic average M may be taken over variables, years or both, and we shall refer to the measures U_t, U_i and U, respectively. Theils inequality coefficient U has, e.g., the following properties:

1. $0 \leq U \leq 1$
2. $U = 0$ if and only if $y_{it} = y^*_{it}$ for all i and t. (perfect forecasts)
3. $U = 1$ if and only if there is non-positive proportionality between the predictions and actual outcomes.
4. U remains unchanged if y_{it}:s and y^*_{it}:s are multiplied by the same factor.
5. U is not invariant against additive variations of y_{it} and y^*_{it}.

Thus U measures relative difference between actual and predicted variables. E.g., the inequality coefficient for $\Delta\tilde{U}$ is quite high (0.372) because its relative forecasting errors are considerable. On the other hand for m_g the coefficient is 0.171 although absolute forecasting errors are much greater than for $\Delta\tilde{U}$. For a thorough discussion of the properties of the measure, we refer to Theil [1961]. The coefficients obtained with the non-linear version of the model for the main variables during the estimation period are shown in table 7.1. The same coefficients for different years are to be found in table 7.2. The coefficient for the total model solution over years and variables was .144. In calculating this coefficient as well as the coefficients for different years we have included only the observations for variables explained by behavioural equations.

Table 7.1. Inequality coefficients for the main variables indicating the accuracy of the model solutions during the estimation period

Variable	Inequality coefficient	Variable	Inequality coefficient
c	.191	y	.121
i	.213	p_y	.095
$\dot{N}$	.233	d	.119
x_{gw}	.146	p_d'	.073
m_g	.171	W	.111
a	.174	Z	.098
$\Delta\tilde{U}$	.372	C	.107
w	.130	I	.123
p_c	.120	M	.118
p_i	.097	X	.039
p_{xg}	.097	Y	.069
p_g	.138	D	.071

Table 7.2. Inequality coefficients for different years indicating the accuracy of the model solutions during the estimation period

Year	Inequality coefficient	Year	Inequality coefficient
1951	.055	1961	.150
1952	.165	1962	.287
1953	.051	1963	.326
1954	.187	1964	.106
1955	.188	1965	.231
1956	.237	1966	.376
1957	.248	1967	.123
1958	.185	1968	.222
1959	.225	1969	.191
1960	.144	1970	.164

7.3. Medium-term simulations during the estimation period

In the preceding section, the model was solved using the actual values of the predetermined variables. In true forecasting situations, ex ante forecasts for several years are required, and we have to use the values of the lagged endogenous variables that are obtained when the model is solved for the previous years. The analysis of policy alternatives and of the response of the model to different kinds of shocks also introduces a longer time horizon. Thus the ability of the model to forecast and analyze depends largely on the dynamic properties of the model.

One way to test the dynamic properties of the model is to solve it for several years in a sequence using lagged endogenous variables obtained from previous model solutions and to compare the accumulated errors with the ones obtained when solving the model with the actual lagged endogenous variables. In our case this means using solutions for the estimation period since almost all the available data has been employed in estimation. This kind of testing with different versions of the model is under way. Here we present four 5-year simulations extending over the estimation period (1951-1955, 1956-1960, 1961-1965 and 1966-1970). Figures 7.2a.-2d. show the simulation results for some key variables, i.e., private consumption, private investment, multilateral commodity exports, commodity imports, consumption prices, gross

Fig. 7.2a. Behaviour of some main variables in connection of four 5-year simulations during the estimation period

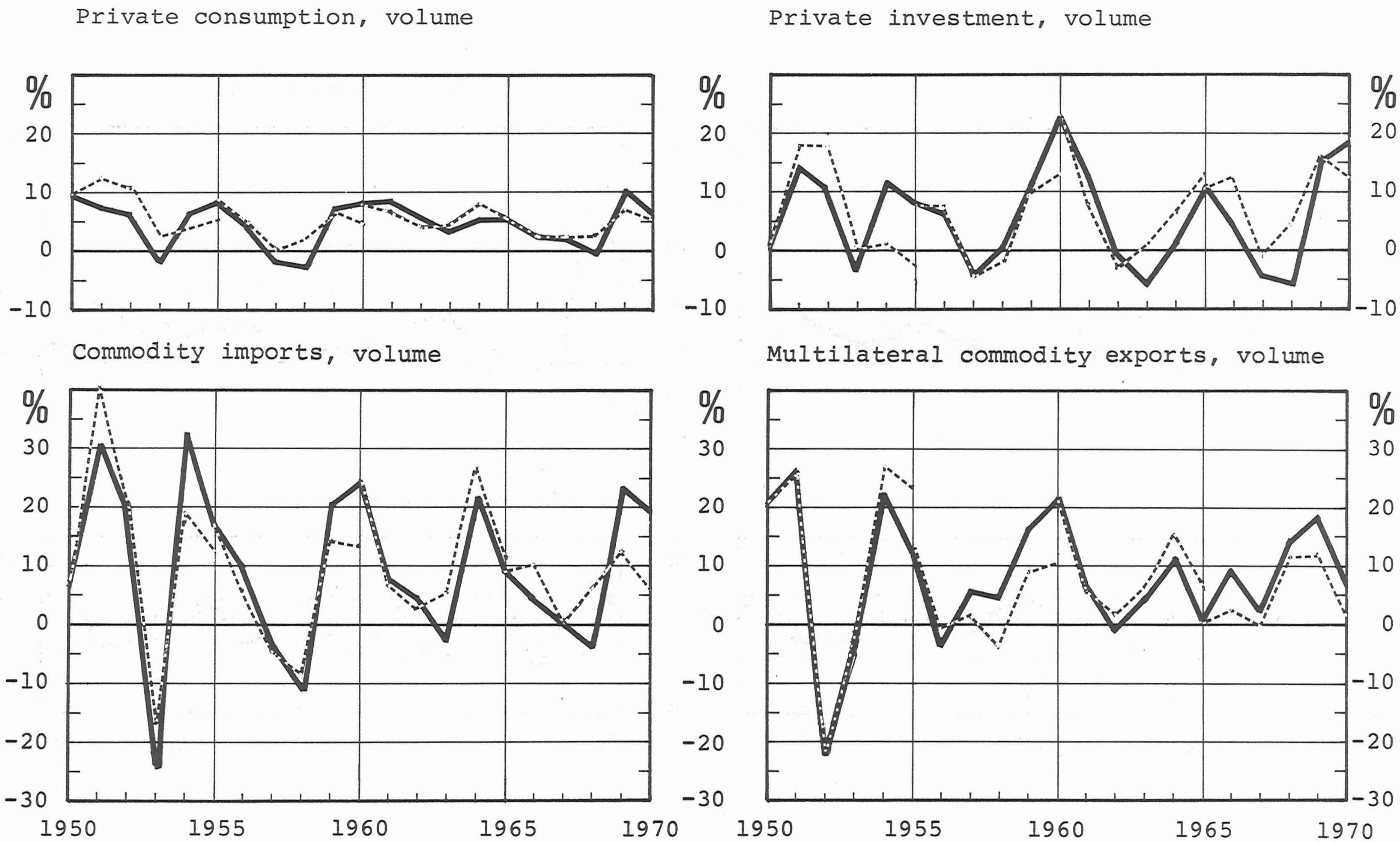
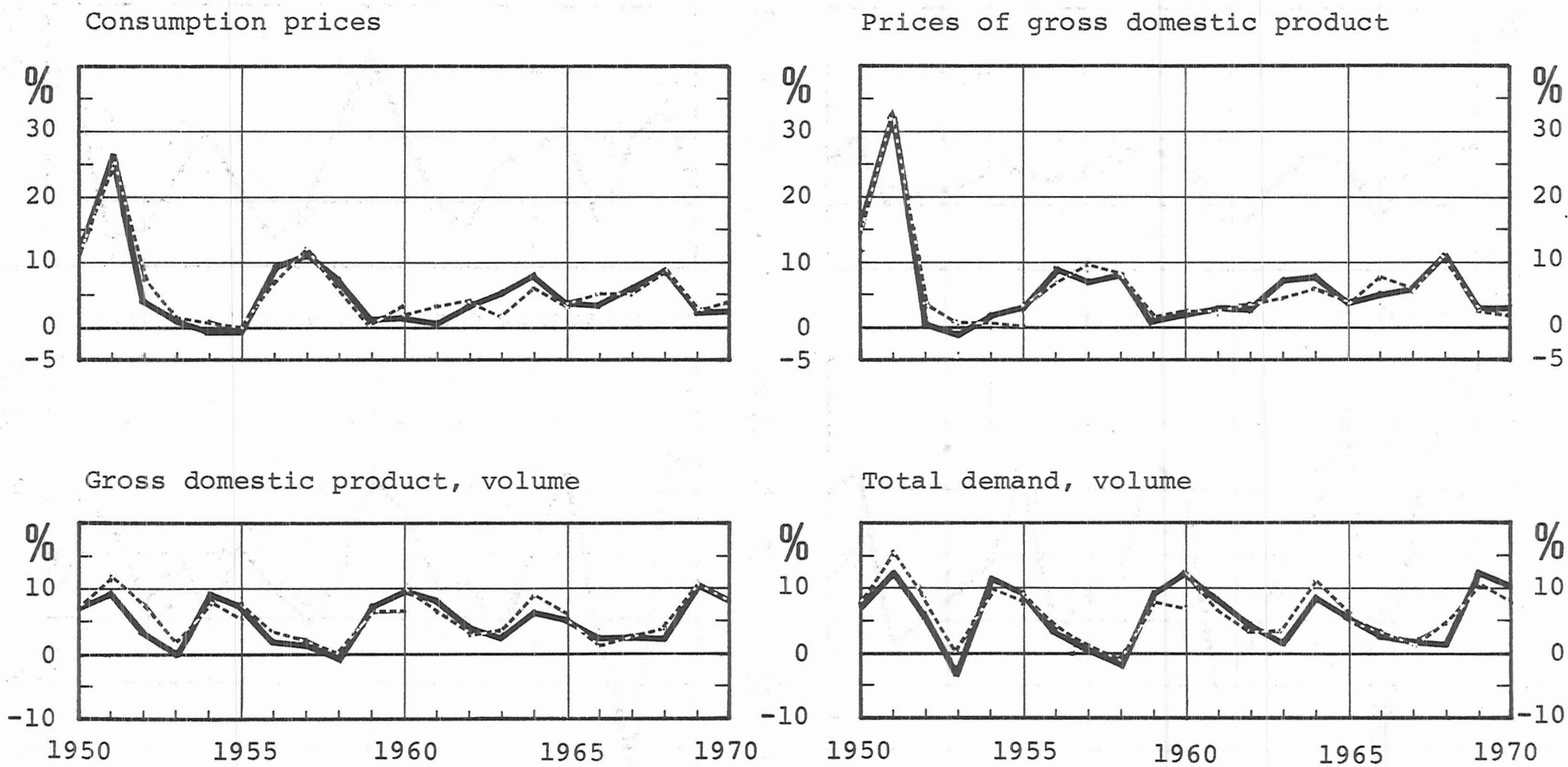


Fig. 7.2b. Behaviour of some main variables in connection of four 5-year simulations during the estimation period



domestic product, total demand and gross domestic product prices. To facilitate comparison of the results with single period model solutions, we have presented in table 7.3. Theil's inequality coefficients for different years.

On the whole the model shows a high degree of stability, at least when treated as a deterministic system, and we can present our conclusions about the long-term effects of various policy measures with some confidence (section 8.3.). As such those experiments are also a test of the dynamic properties of the model, because we have some a priori ideas of how the economy reacts to different policy measures.

Table 7.3. Inequality coefficients for different years indicating the accuracy of the four 5-year simulations during the estimation period

Year	Inequality coefficient	Year	Inequality coefficient
1951	.055	1961	.150
1952	.206	1962	.249
1953	.209	1963	.500
1954	.301	1964	.184
1955	.372	1965	.183
1956	.237	1966	.376
1957	.261	1967	.227
1958	.233	1968	.227
1959	.263	1969	.234
1960	.297	1970	.340

It is naturally desirable to have a model which behaves well in the long run and has suitable asymptotic properties, but it would be unwise to lay too much emphasis on this point. To approximate well both in the short run and in the long run may be conflicting desiderata.

7.4. Ex post prediction

Good fit in a sample period, especially when the period is short, does not guarantee that the model will function well in forecasting events outside the estimation period. The criterion of simplicity is often forgotten and both "theoretical" and "empirical" grounds can always be found for introducing extra variables or dummies in order to arrive at better fit during the sample period. This process of minimizing the residuals, which can be quite challenging in itself, is sometimes unconsciously carried too far.

As the model is based on annual data, it is not possible to leave a large number of observations outside the estimation period for testing purposes. However building a model takes time, and some years have elapsed since the beginning of the work, thus providing us with valuable observations of the "real process". The model has been estimated over a period ending with 1970. At the moment we already know the actual values of the variables in question for the years 1971, 1972 and 1973. For 1973 the figures are preliminary, but they are not expected to change much.

To investigate the ability of the model to predict ex post, we have presented the inequality coefficients for this period in table 7.4. In this kind of unrealistic prediction situation, we also know the actual values of the predetermined variables, which in a true ex ante prediction situation are only "best guesses".

Table 7.4. Inequality coefficients for the main variables indicating the accuracy of the ex post forecasts for the years 1971-1973 (investment exogenous)

Variable	Inequality coefficient	Variable	Inequality coefficient
c	.270	y	.332
i	.000	p_y	.191
N	.399	d	.210
x_{gw}	.447	p_d'	.055
m_g	.281	W	.159
a	.565	Z	.136
$\Delta\tilde{U}$	.431	C	.175
w	.169	I	.167
p_c	.125	M	.139
p_i	.247	X	.228
p_{xg}	.194	Y	.100
p_g	.151	D	.067

It seems that the investment equation does not adequately describe behaviour in these years. To be able to analyze the performance of the rest of the model, this variable has been exogenized. Even after this correction, the performance of the model outside the estimation period is clearly less satisfactory than inside it. One reason for the disappointing results is the inability of the export equation to describe the exceptionally rapid rise in exports in 1972.

The ex post predictions for 1971-1973 were produced quite mechanically without addition of any personal judgment. If the predictions are compared with those actually published by RIFE or other institutes, there are considerable differences. It is also quite obvious that the results obtained with the first run of the model would not have been accepted as final. However, this does not mean that the model is without value. After allowing for special circumstances and making the necessary adjustments, the model could still be used to determine the values of other variables and to guarantee, both formal and "bahavioural" consistency.

7.5. Ex ante prediction

In order to discuss the use of the model in true prediction situations and to give some simple illustrations of taking outside information into account, we comment briefly on the forecasts for the years 1974 and 1975 presented in table 1.1. As the actual values for 1974 are not yet available, predicted values for 1974 must be used as lagged endogenous variables for 1975. It is also necessary to use forecasts of the exogenous variables for both years.

In a true prediction situation we naturally use all the information concerning future developments, including information received from outside the model. The art of predicting depends greatly on the ability to combine different bits of information, and the model is constructed with this in mind.

The starting point for predicting is always the assesment of past developments. As was shown in table 3.1., the absolute variables in the previous period are required to arrive at the absolute variables for the forecasting period. The values for the lagged endogenous variables are also needed. When RIFE prepares its regular forecasts published in May and November, it makes use of the preliminary and "corrected" preliminary figures for the balance of resources and expenditure of the preceding year given out in the spring and summer by the Central Statistical Office. Preliminary figures are again corrected at the end of the year and in the following spring. The final figures for any given year come out in the second summer following the close of the year. At the end of the year the Statistical Office also publishes figures for the current year. They are sometimes mistakenly referred to as "preliminary data", but should actually be regarded as competing forecasts. The importance of consistency with data for previous years is stressed. It would be wrong to place too much confidence in the preliminary figures and this goes for the "final" figures as well. Often reconstructing the past is as difficult as predicting the future. The preliminary figures for past developments may change significantly. This naturally changes the forecasts of the future. For example, the preliminary figure given by the Central Statistical Office for the volume growth of gross domestic product of 1972 was 5.7 % in April 1973 and 7.1 % in April 1974.

The Central Statistical Office's resources for rapidly producing reliable information on short-term economic developments are very modest compared to those available for analyzing the data in the different economic institutes of the country. It seems that forecasts and economic policy could be improved substantially by correcting this state of affairs.

The forecasts for 1974 offer a good example of how to combine additional information with the model in an actual forecasting situation. Due to the rapid rise of oil prices, import prices will be considerably higher in 1974 than in 1973. However, the prices of goods other than fuels and lubricants have risen much less. On the basis of import equations for separate categories of goods, we know that the price elasticity of fuels and lubricants is very low compared to the average price elasticity of imports, which is used in the aggregate import equation in the model. The fact that the reaction of the volume of imports to price increases in 1974 is expected to be less than normal can be taken into account by adding a positive error term to the import equation. The expected value of the error term (about + 6 per cent) can be calculated by comparing the aggregate import equation with those for the separate categories.

The results of the two year wage agreement concluded in the spring of 1974 offer another good example of outside information affecting the forecasts. After allowing for wage drift, the wage rate equation was exogenized for the years 1974 and 1975. Because of price controls, consumer prices were also calculated outside the model and exogenized for 1974. In the forecast for 1975, prices are determined using the corresponding equation. A further correction was made to the investment equation by adding a positive error term (5 per cent) for the year 1974 on the basis of personal judgment and outside information. Exogenous variables describing export demand and international price developments in 1975 were so difficult to obtain at the time the forecast was prepared that both the volume of commodity exports and export prices were also exogenized using all possible outside information. After these and some other minor corrections, the results of table 1.1. were obtained.

Actual forecasts thus depend greatly on the ability of those using the model to incorporate all extra information and do not provide a test on the model itself. The relative weight given to the model and to other information depends of course on the personal judgment of those making the forecasts. If outside information (e.g., monthly statistics on export performance) for the current year deviates from the forecasts obtained with the model, the weights may also change in the course of the year. Of course, it is also important to keep record of the first run results to gather further information on the performance of the model.

8. USE OF THE MODEL FOR ANALYTICAL PURPOSES

8.1. General

In this chapter some examples of using the model for analytical work are given. As the basic linear version is easier to handle, we concentrate on it. The results are produced using structural matrices $\hat{A}$ and $\hat{B}$ for the year 1970. The methods used in this connection are based on the solution and simulation techniques explained earlier. In section 8.2. we investigate the reduced form of the model and the interdependencies between the endogenous variables of the model during one year. One reason for special interest in the reduced form is the possibility to derive the consequences of various policy measures on the endogenous variables. Some examples of the use of impact multipliers are also given. Due to the dynamic nature of the equation system, the first year multipliers may sometimes give an erroneous idea of the magnitude or direction of a change in the endogenous variables resulting from exogenous impulses. In section 8.3. long-run responses of variables to some key exogenous shocks are investigated.

A general difficulty with policy simulations is that it may sometimes be hard to take into account all the effects of a given measure. This is particularly true of qualitative policy[1]. Due to the aggregative character of the model, it is also difficult to take into account the effects of different patterns of public expenditure, income transfers, etc. Extra information on how the exogenous or endogenous variables are directly affected is often needed to be able to handle problems of this kind with the model. The effects of interdependency between the variables can then be calculated. Similarly, the model may sometimes be used to solve problems involving variables not directly present at the model. If this is done, it must be possible to calculate the effect of the 'external' variables on the variables present and/or the effect of the variables present on the external variables.

1) See Tinbergen [1966].

8.2. Impact multipliers

The first year effects (allowing for interaction between the endogenous variables during one period) of the exogenous variables on the endogenous variables are given by matrix $(I-\hat{A})^{-1}\hat{B}$. This matrix for the year 1970 is given in appendix III. By way of example, we present in table 8.1. the first year consequences of rise of one per cent in the volume of public expenditure, in export demand (see the export equation), in the prices of exports of competing countries, in import prices, in the incidence of indirect taxes minus subsidies and in net income transfers (see construction of the variables).

It is generally more difficult to justify the a priori values of the reduced form multipliers and of the multipliers indicating the interaction between the endogenous variables than it is to place a priori restrictions on the values of the structural parameters. This is due to the fact that structural parameters are more or less based on ceteris paribus assumptions but multipliers take into account complex networks of relationships in the equation system. Multiplier values thus depend on which relationships are endogenous in the model and how each one is specified. The results given in table 8.1. and 8.2. (and appendices III and IV) are obtained when all the variables in the model as described above are taken as endogenous and the approximation $n \approx N$ in equation 25. corresponding to actual

Table 8.1. First year consequences of one per cent rise in some of the exogenous variables

Effect on		One per cent change in					
		Volume of public expenditure	Export demand	Prices of competing exports	Prices of commodity imports	Incidence of indirect taxes	Income transfers
Variable	Symbol	g	m_w	p_x'	p_{mg}	T_i'	0
Volume of private consumption	c	.204	.405	.139	-.010	-.139	.704
Volume of private investment	i	.260	.514	.183	-.213	-.143	.310
Volume of multilateral commodity exports	x_{gw}	-.003	2.332	.113	-.049	-.013	-.004
Value of multilateral commodity exports	X_{gw}	.003	2.343	.895	.045	.012	.003
Value of commodity imports	M_g	.826	1.694	.301	.592	-.176	1.037
Wage rate	w	.071	.149	.013	.134	.119	.092
Consumption prices	p_c	.011	.022	.004	.211	.256	.013
Unemployment	$\Delta\tilde{U}$	-.032	-.067	-.010	-.013	.012	-.041
Volume of gross domestic product	y	.233	.483	.053	.069	-.087	.298

forecasting situation is made (see section on inventory changes). Multiplier values presented here seem to be in line with a priori expections and with results obtained for other countries with the aid of different kinds of models[1]. The time shapes of the dynamic responses presented in section 8.3. also seem to be similar.

The tables presented below are self-explanatory, and we shall not go into detailed analysis of the multiplier values here. An increase in public expenditure or in export demand and a fall in income transfers from the private to the public sector all show the expected rise in economic activity. However, only an increase in export demand is accompanied by an improvement in the trade account. A rise in import prices has a clear impact on prices and, as a consequence, has direct negative effects on the volume of demand. However, when the indirect effect of a shift to domestic production is allowed for, there is a small positive effect on GDP. A rise in the price of the exports of competing countries leads to higher export earnings and, even though the volume of exports does not react much, a positive effect on GDP is registered. A rise in indirect taxes raises prices and has a negative effect on domestic expenditure, imports and GDP.

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1) Cf., e.g., Evans [1966], Verdoorn [1967], Jacobson [1972] and de Ridder and Verbaan [1974].

The model also allows us to analyze the interaction between the endogenous variables. In most applications, the endogenous variables are placed at their expected values given the predetermined variables. This is done by solving the model with all error terms at zero. As was explained in Chapter 6. we may also have outside information on autonomous changes in some of the endogenous variables not explained by the present set of equations. Thus, e.g., we may expect private investment to be unusually large, we may want to take in to account strikes, there may be institutional changes, etc. The effects of an autonomous change on other variables and on the variable itself, after allowing for feedbacks, can be seen from matrix $(I-\hat{A})^{-1}$, the matrix of impact multipliers for the endogenous variables. This matrix for the year 1970 can be found in appendix IV. Table 8.2. shows the effects of an autonomous change in the volume of private investment, the volume of private consumption, the volume of multilateral commodity exports, the volume of commodity imports, the wage rate and consumption prices on each other and on GDP. From the table it can be seen, e.g., that an autonomous rise in private investment of one percent will raise imports by .754 percent and gross domestic product by .215 percent during the first year.

There may be also cases where we have information on the final extra effect when all the feedbacks are taken into account. Thus, for example, we may be interested in the effects of an extra one per cent rise in the negotiated

Table 8.2. First year consequences of one per cent autonomous rise in some of the endogenous variables

Effect on		One per cent change in					
		Volume of private consumption	Volume of private investment	Volume of multilateral commodity exports	Volume of commodity imports	Wage rate	Consumption prices
Variable	Symbol	c	i	x_{gw}	m_g	w	p_c
Volume of private consumption	c	1.533	.183	.173	-.369	.056	-.050
Volume of private investment	i	.674	1.231	.220	-.517	-.440	.134
Volume of multilateral commodity exports	x_{gw}	-.008	-.003	.997	.005	-.122	-.070
Volume of commodity imports	m_g	2.256	.754	.724	.305	.046	.298
Wage rate	w	.200	.066	.064	-.129	1.222	.667
Consumption prices	p_c	.029	.010	.009	-.019	.451	1.257
Unemployment	$\Delta\tilde{U}$	-.089	-.003	-.029	.058	.013	.001
Volume of gross domestic product	y	.649	.215	.207	-.418	-.103	-.090

wage rate. We may assume that this is the total change induced by an autonomous change (if. e.g., cumulative effects are to be eliminated in accordance with the wage agreement). If there were no agreement, an exogenous wage impulse would have effects which would be 1.22 times greater. This figure of 1.22 can be found on the diagonal of the matrix $(I-\hat{A})^{-1}$ on the row for the wage rate (8th row) and represent the total effect (during one year) of an autonomous unit rise in the wage rate on the wage rate itself. The effects of a corresponding autonomous change of 1/1.22 per cent on the other variables can now be calculated in the normal manner. One of the first problems handled with the model was of this kind[1]. As the model includes only one equation for the wage rate, we assumed for simplicity that wage drift is independent of the level of negotiated wages.

Another example of the use of impact multipliers for analytical work can be found in the calculations done in the autumn of 1973 when the so-called energy crisis changed economic forecasts considerably. The forecasts which had just been published by RIFE turned out to be too optimistic and some rough idea of the new situation was needed quickly.

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1) Tulopoliittinen Informaatiotoimikunta (Incomes Policy Information Committee) asked several research institutes their opinions about the effects of different outcomes of the wage negotiations of spring 1973.

As direct limitations on production and demand for energy were not anticipated in Finland, calculations were carried out by superimposing the effect of the fall in export demand and the rise in import prices on the old forecasts. However, it must be stressed that in cases like these thorough analysis requires the investigation of any changes in the exogenous variables and careful consideration of the ability of the model to describe the phenomena under study.

8.3. The long-term effects of policy measures

To study further the dynamic properties of the model and to demonstrate its use in policy simulations, we have investigated the response of some of the main endogenous variables to various "key" policy measures and impulses: a rise in public expenditure, a fall in income transfers from households to the public sector, a rise in export demand and a devaluation. For reasons explained in Chapter 6. we have used the linear version of the model. However we have used simulation instead of algebraic methods since equivalent results can be obtained more easily in this way. Equation (6.18.) allows us to insert an additional impulse as a predetermined variable in the first period. When the model is solved for several years in a sequence we obtain the results presented in figures 8.2.-8.5. The figures are again self-explanatory and we shall not go into detailed analysis here. Some comments, however, may be worthwhile.

The figures show percentage changes in the variables in the year of the implementation of the policy measure or of the occurrance of the exogenous impulse and the additional effects in each of the nine following years. Even though effects for a single year are both positive and negative in most of the cases, the cumulative changes may clearly deviate from zero. Figure 8.1. shows cumulative changes in gross domestic product resulting from export demand impulse, together with the original series.

Policy decisions have been simulated by introducing a unit impulse in the variable in question. As the model operates in percentage changes, this is equivalent to specifying a step function for the absolute variables. An increase in the public expenditure, a fall in income transfers from households to the public sector and an increase in export demand have been introduced by making a unit change in variables g,O and m_w, respectively (for the definition of O, see section 4.2.3.5.). A devaluation of one per cent has been simulated by a unit rise in import prices (p_{mg}, p_{ms}), prices of exports of services (p_{xg}) and in the prices of competitors'exports (p_x'). Prices of commodity exports are determined with the corresponding equation. The strong long-run reaction of commodity export prices to changes in the export prices of our competitors was already discussed in the section on the structural specification of the equation. This somewhat dubious relationship also gives rise, via relative prices, to small negative multiplier values for the volume of exports for some years.

It can be noted that the prices are affected very little by changes in the volume of different types of expenditure. This is a result of the specification of the price equations, where capacity considerations were not taken into account. Changes in the volume of expenditure affect prices only through the Phillips effect in the current version.

The response of the endogenous variables to all policy measures is for the most part felt in a few years following the implementation of the measure. This corresponds to our intuitive ideas and reflects the stability of the model. Thus the policy decisions do not have any unexpected consequences in the far future.

Fig. 8.1. Response of gross domestic product to public demand impulse, separate yearly effects and their cumulative sum

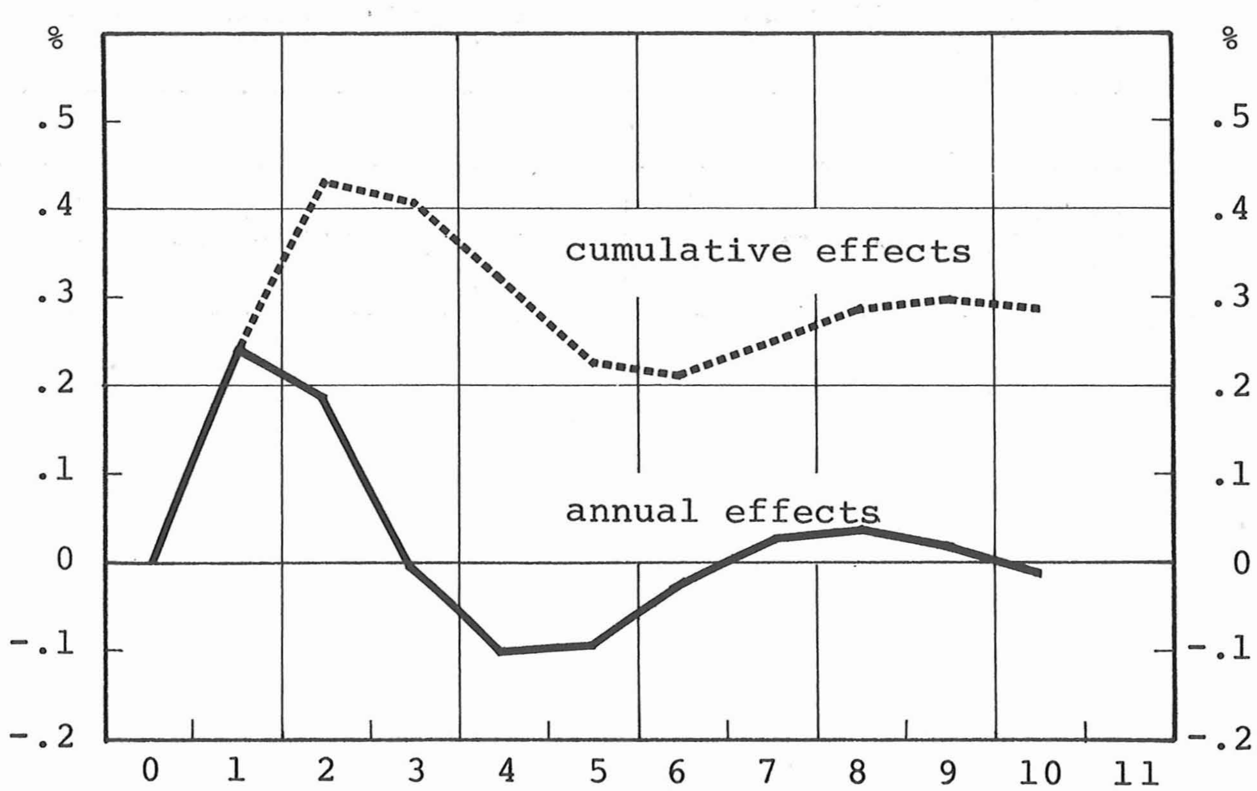


Fig. 8.2. Response of some main variables to public demand impulse

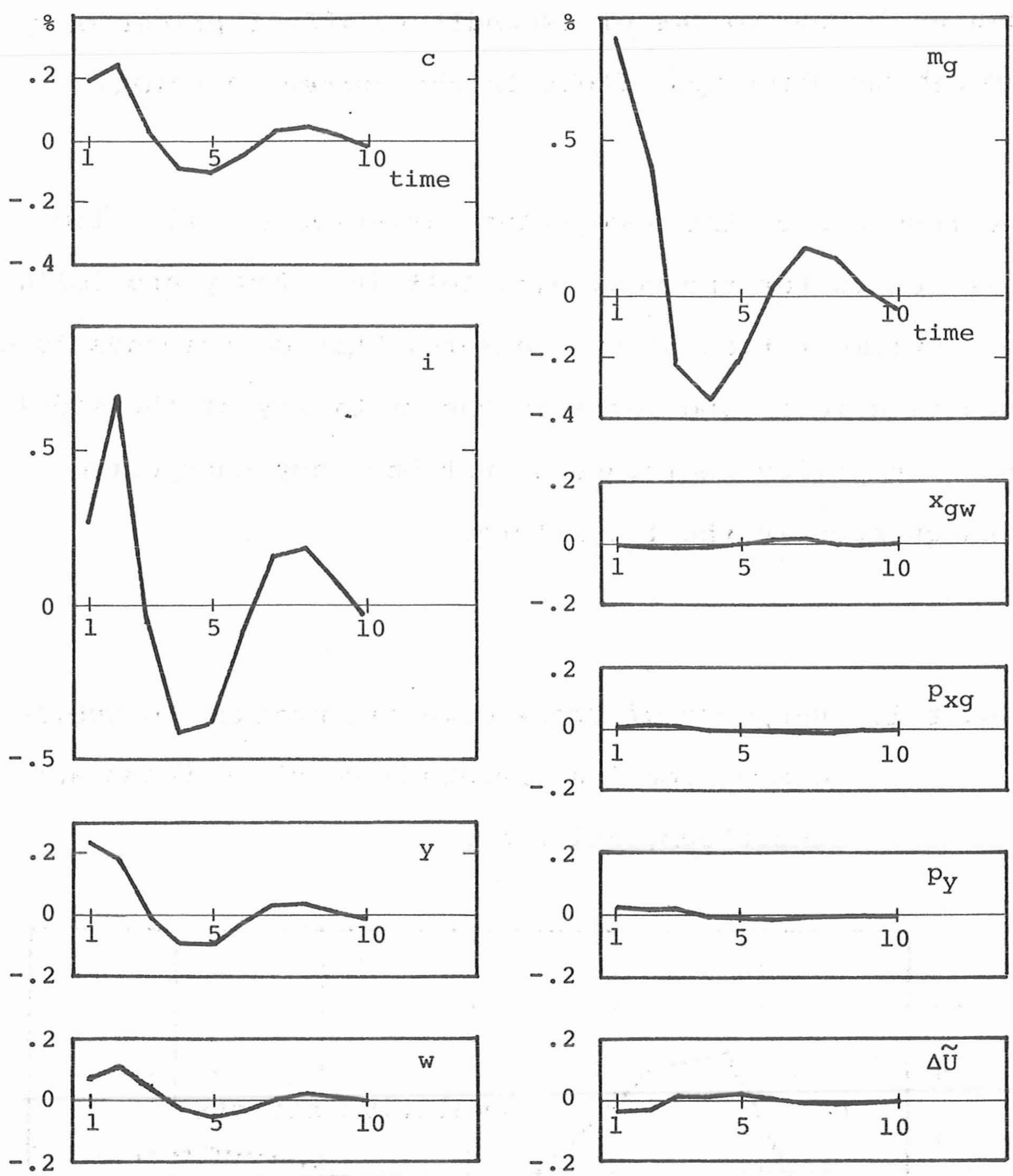


Fig. 8.3. Response of some main variables to tax reduction impulse

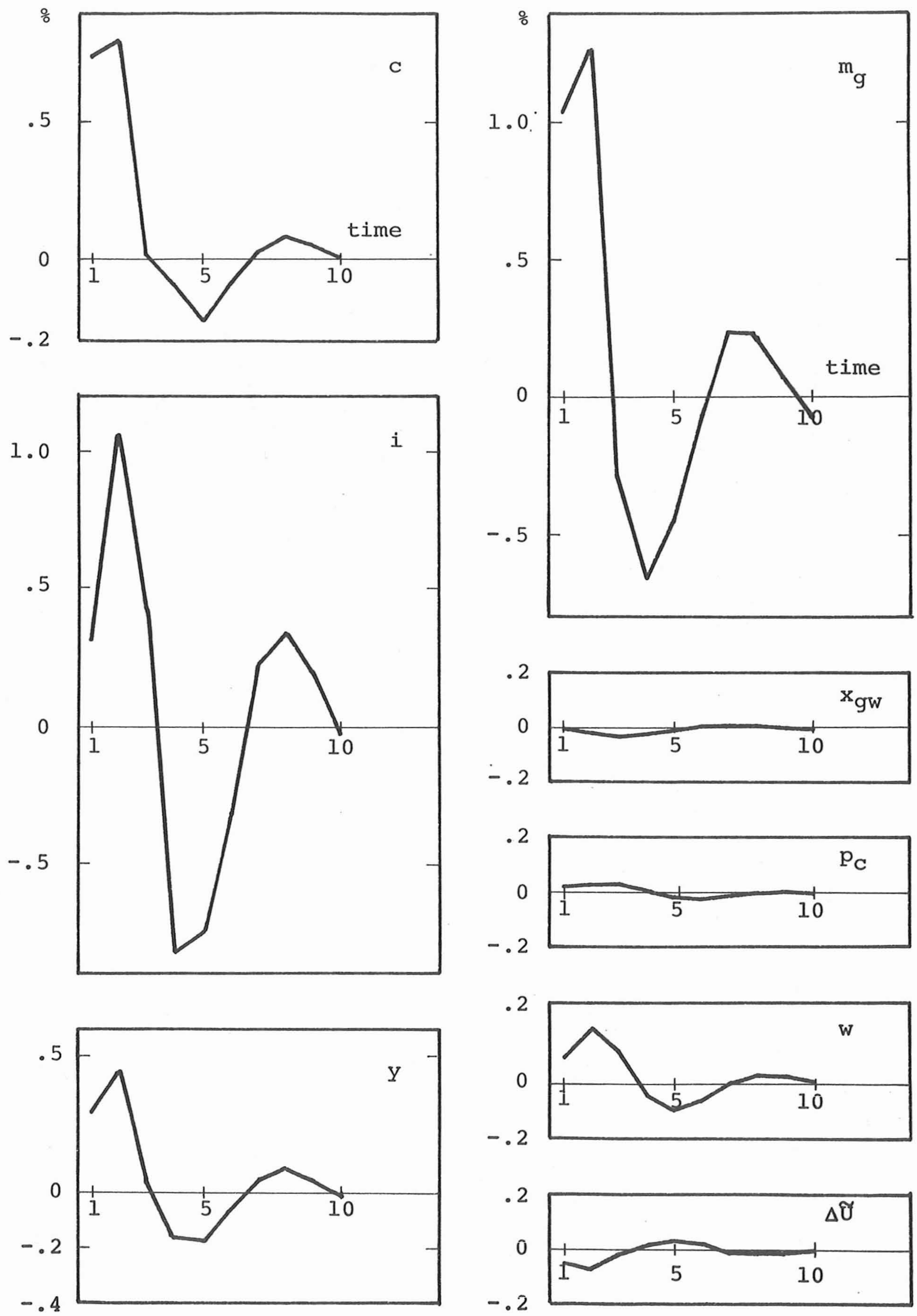


Fig. 8.4. Response of some main variables to export demand impulse

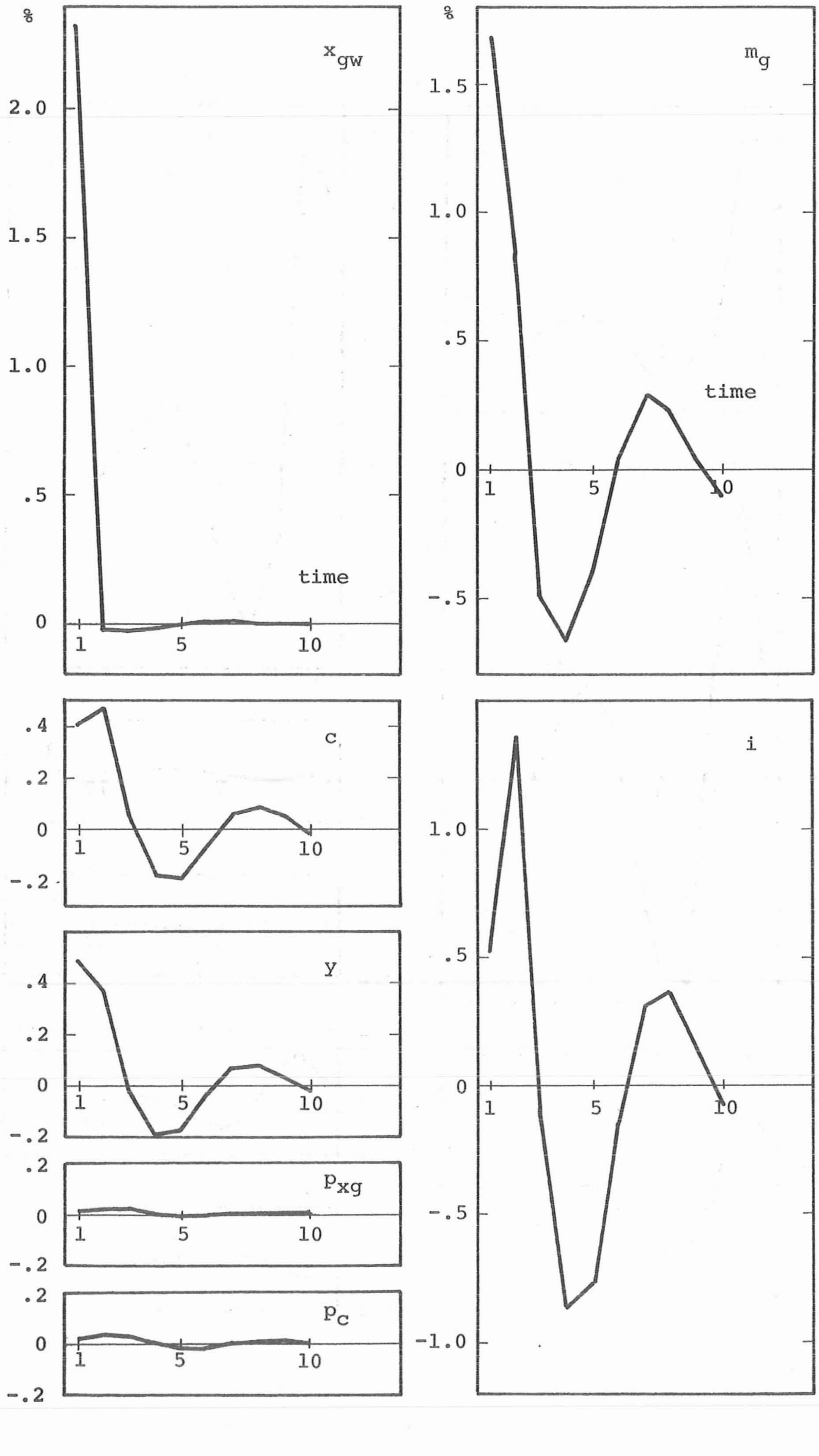
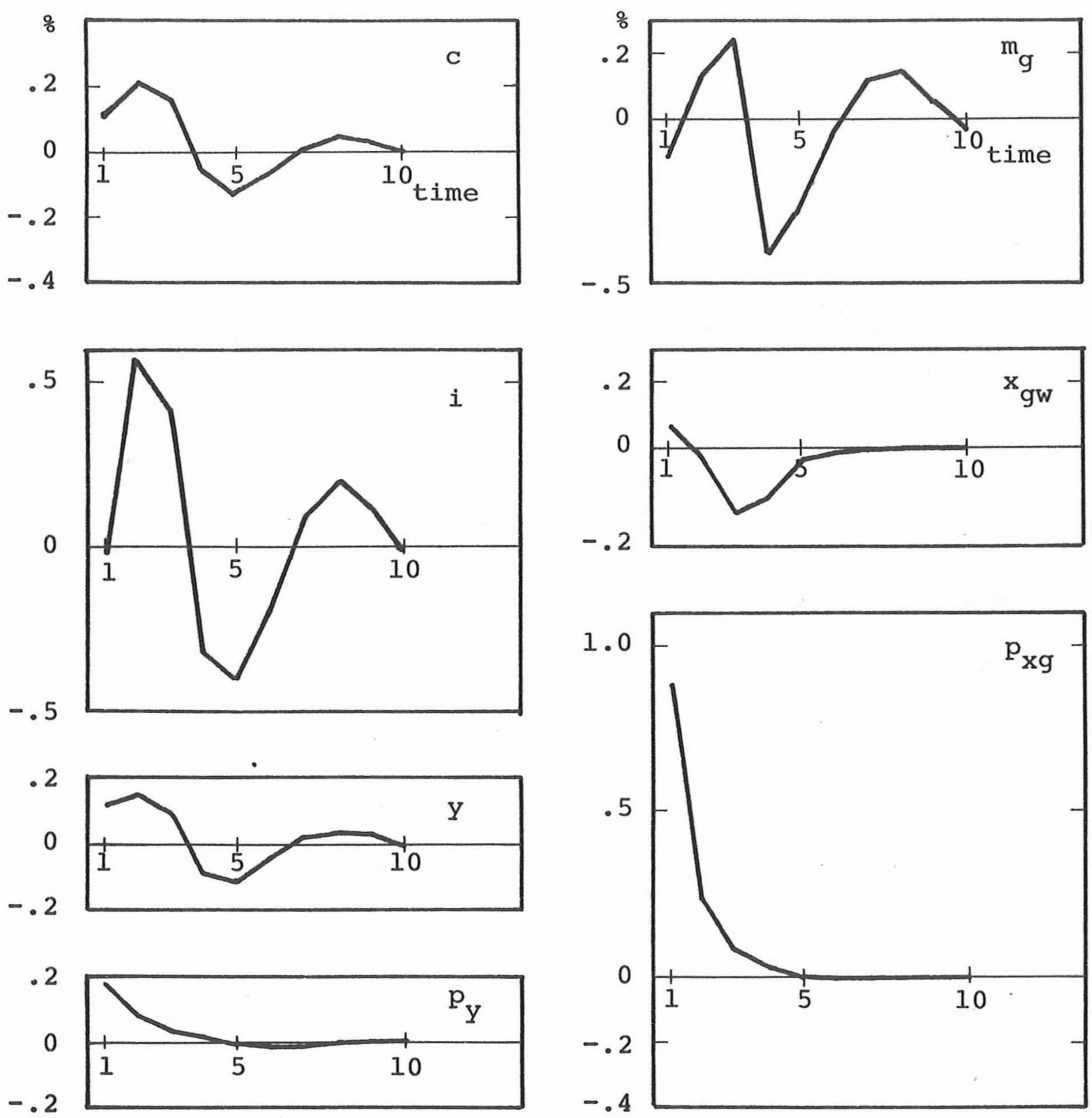


Fig. 8.5. Response of some main variables to devaluation impulse



9. CONCLUDING REMARKS

I have presented a prototype version of what we hope will grow to become a more extensive and theoretically better-grounded econometric model for the Finnish economy. It is needless to say that the relationships require improvement. In recent years a considerable number of theoretical and empirical studies relevant for the further development of the model have been carried out, and it is clear that future versions can and should benefit from this work. The model presented here is being developed continuously. In fact the changes which have already been made mean that the model outlined here cannot be considered an exact description of the one currently being used.

On the other hand, there is no end to improving an econometric model. It is necessary to regard both the structural and stochastic specification of a macro model as an approximate "play process" rather than a perfect description of the "real process". Inductive work that aims at giving a rough quantitative idea of how the economy functions need not, and cannot, account for all possible details. Although theoretical models deduced from given axioms represent "one possible world", they are as well approximations of the reality, and cannot be used as the sole guideline. The very definition of the econometric method, requires the use of both inductive and deductive reasoning and thus work of this kind is always subject to criticism focused on both of them. These comments and their implications for empirical work, however naïve they may sound, are sometimes forgotten in mathematically-oriented econometric literature. We have tried to take a realistic stand towards these problems and placed stress on the methods with which the approximate results given by the model can be improved. The inclusion of outside information in the analysis does not require discarding the framework provided by the model.

I have not discussed the problems of producing the exogenous variables for the model. The exogenous variables are chosen so that they can easily be produced in an actual forecasting situation. A model, how refined it analytically may be, is not suitable for forecasting if it is more difficult to forecast its exogenous variables that to predict the endogenous variables directly. Our intention has been to arrive at a consistent set of equations where most of the "loose ends" have been tied together. However, some of the exogenous variables still depend on the values of the endogenous variables obtained with the model. Several iterative rounds are usually needed to arrive at a consistent set of values for all the endogenous and exogenous variables. The public sector block is a good example of these difficulties. For example, in the present version income transfers between the public and private sectors are primarily handled outside the model. The iterative procedure for determining several important variables is tedious and this is one reason why these relationships should be endogenized.

Another natural way to enlarge the model is to include a monetary block. This will also be facilated by the grown interest in monetary theory in Finland. Intensive work in this field is likely to provide useful empirical results which take into account the Finnish institutional conditions. With the present version monetary relationships,which can be used to check the forecasts,are outside information and must be taken into account by manipulating the equations with the methods outlined in Chapter 6. Taking our cue from the Dutch annual model, we have experimented with using deposits as an indicator of the effect of liquidity on consumption and investment, and it seems that these relationships are statistically significant. Our limited experience suggests that the overall predictive performance of the model is not improved much by the inclusion of these variables, but they are, of course, needed for analytical work. Just how effective monetary policy in Finland has been - or could be - is still an unsettled question.

As was mentioned earlier, RIFE publishes forecasts which are more disaggregated than the ones supplied by the model. The relationship between a master model which quarantees consistency at the macro level and separate disaggregated models is an interesting area of research. This kind of work will also be valuable for the development of the model itself, because there are several ways the model can benefit from disaggregated relationships without loosing its macro character. A good example is the weighting of total demand or gross domestic product according to import or labour intensities of different expenditure categories when they are used as explanatory variables in import and labour demand equations. At a more advanced stage, the disaggregated equations can be used to produce changing parameters for the macro relations in order to allow for the changing structure of the economy.

Finally, I would also like to stress the importance of the "spill-over" effects of using an econometric model in a research institute. Construction of the model has required collecting and processing of a vast amount of data, necessary for systematic empirical analysis. As the model forces us to formulate explicitly our ideas of the relationships under study, the discussion of alternative forecasts becomes considerably easier. Personal judgment and a priori information, which must be used to prepare meaningful forecasts, are given a common frame of reference. There is little reason why science and art cannot be combined in actual forecasting situations. It is thus unfortunate that these two approaches are sometimes considered to be in opposition when their relative merits are debated.

REFERENCES:

AUKRUST, O. [1970]: PRIM I: A Model of the Price and Income Distribution of an Open Economy, "*The Review of Income and Wealth*", March 1970.

AURIKKO, ESKO [1973]: *Ulkomaankauppa Suomen kansantalouden ekonometrisessa kokonaismallissa*, (Foreign Trade in an Econometric Model for the Finnish Economy), in Finnish, Bank of Finland, D:33, Helsinki.

BANK OF FINLAND [1959]: *Yearbook 1958*, edited by Bank of Finland Institute for Economic Research, Helsinki.

BANK OF FINLAND INSTITUTE FOR ECONOMIC RESEARCH [1972]: *A Quarterly Model of the Finnish Economy*, by the Model Project Team of the Bank of Finland, Bank of Finland Institute for Economic Research, Series D:29.

VAN DEN BELD, C.A. [1968]: "An Experimental Medium-Term Macro-Model for the Dutch Economy" in *Mathematical Model Building in Economics and Industry*, C. Griffin and Company, London.

DHRYMES, P.J. [1970]: *Econometrics. Statistical Foundations and Applications*. Harper & Row, New York.

DHRYMES, P.J. [1971]: *Distributed Lags, Problems of Estimation and Formulation*, Holden-Day, San Francisco.

DRIEHUIS, W. [1970]: *A Quarterly Model of the Netherlands Economy*, Paper presented at the second world congress of the Econometric Society, September 1970, Cambridge.

DRIEHUIS, W. [1972]: *Fluctuations and growth in a near full employment economy*, Rotterdam University Press.

DUESENBERRY, J.S. [1949]: *Income, Saving and the Theory of Consumer Behaviour*, Harvard University Press, Cambridge, Mass.

ECONOMIC PLANNING CENTRE [1970]: *The Medium Term Planning Model for the Finnish Economy (MEPLAMO)*, Economic Planning Centre, Helsinki.

EDGREN, G., TAXÉN, K. and ODHNER, C. [1970]: *Lönebildning och samhällsekonomi*, Stockholm.

EVANS, M.K. [1966]: "Multiplier Analysis of a Post-war Quarterly U.S. Model and a Comparison with Several Other Models", *The Review of Economic Studies*, Vol. XXXIII (4) No. 96, October 1966.

EVANS, M.K. [1969]: *Macroeconomic activity*, Harper & Row, New York.

EVANS, MICHAEL K., HAITOVSKY, YOEL and TREYZ, GEORGE I., assisted by VINCENT SU [1972]: "An Analysis of the Forecasting Properties of U.S. Econometric Models", in *Econometric Models of Cyclical Behaviour*, edited by Bert G. Hickmann, Studies in Income and Wealth, no. 36, vol. 2, National Bureau of Economic Research, distributed by Columbia University Press, New York and London.

FISHER, F.M. [1966]: *A Priori Information and Time Series Analysis*, North Holland Publishing Company, Amsterdam.

FISHER, F.M. [1965]: "Dynamic Structure and Estimation in Economy-wide Econometric Models" in *Brookings Quarterly Model of the United States* edited by Duesenberry, Klein and Kuh, North Holland Publishing Company, Amsterdam.

GOLDBERGER, A. [1964]: *Econometric Theory*, Wiley & Sons, New York.

GRÖNLUND, PAAVO [1965]: *Suomen kansantalouden ekonometrinen malli vuosina 1950-1961 ja eräitä sen sovellutuksia*, (An Econometric Model for Finnish Economy in 1950-1961 and some Applications), in Finnish, Licensiate thesis, University of Helsinki, Helsinki.

HALTTUNEN, HANNU [1972]: *Tuotanto, hinnat ja tulot Suomen kansantalouden ekonometrisessa kokonaismallissa*, (Production, Prices and Incomes in an Econometric Model for the Finnish Economy), in Finnish, Bank of Finland Institute for Economic Research, Helsinki.

HALTTUNEN, HANNU [1974]: "Phillipsin käyrä ja inflaatio Suomessa" (The Phillips Curve and Inflation in Finland), in Finnish, *The Finnish Economic Journal* 1974:2.

DEN HARTOG, H. and Falke, H.G. [1970]: "An Explanation of Investment in Equipment by Enterprises in the Netherlands", *European Economic Review vol. I*, no. 4, summer 1970.

HICKMAN , B.G. and LAU, L.J. [1973]: "Elasticities of substitution and export demand in a world trade model", *European Economic Review*, Vol. 4, No. 4, December 1973.

HIRVONEN, JUHANI [1971]: *Kansainvälisen talouden ekonometrinen simultaanimalli*, (A Simultaneous Econometric Model for International Economy), in Finnish, Bank of Finland Institute for Economic Research, Helsinki.

HOOGLAND, J. and SCHWARTZ, A [1971]: *A survey of procedures used at the Dutch Central Planning Bureau to forecast foreign trade data*, Central Planning Bureau, The Hague.

HÄMÄLÄINEN, HEIKKI [1973]: *Yksityisten kulutusmenojen rakenne ja kehitys Suomessa vuosina 1965-1975* (The Structure and Development of Finnish Private Consumption in 1965-1975), in Finnish, Research Institute of the Finnish Economy, series B:5, Helsinki.

HÄMÄLÄINEN, HEIKKI [1971]: *Lyhyen aikavälin kokonaistaloudellinen malli suhdanneanalyysin ja -ennakoinnin välineenä,* Short-run Macro-model as a Tool for Business Cycle Analysis and Forecasts, Research Institute of the Finnish Economy, Mimeograph series No. 32.

JACOBSSON, LARS [1972]: *An econometric model of Sweden,* Beckmans Bokförlag, Stockholm.

JALAS, KARI [1969]: *Suhdanneodotuksia koskevien tiedustelujen tulosten tulkinta ja niiden ennustekyky* (Interpretation and Forecasting Ability of Inquiries Concerning Business Cycle Anticipations), in Finnish, Federation of Finnish Industries, Helsinki.

KLEIN, L.R. and PRESTON, R.S. [1967]: "Some New Results" in the Measurement of Capacity Utilization", *American Economic Review.*

KONTTINEN, JOUKO: *Experiments with a semi-annual model for the Finnish Economy,* University of Helsinki, Institute of Economics, forthcoming.

KOSKENKYLÄ, HEIKKI [1972]: *Teoreettisen ja empiirisen investointianalyysin ongelmista. Suomen tehdasteollisuuden investointitoiminta vuosina 1948-1970* (on Theoretical and Empirical Problems in Investment Analysis), in Finnish, Bank of Finland Institute for Economic Research, Series D:28, Helsinki.

LAATTO, ERKKI [1964]: "Suomen ja kilpailevien maiden markkinaosuuksien kehityksestä Ison-Britannian ja EEC-maiden selluloosan ja paperin tuonnissa" (On the Development of the Market Shares of Finland and Her Competitors in Paper and Pulp Imports of Great Britain and EEC), in Finnish, in *Taloudellisia Selvityksiä* for Economic Research, Series A:27.

LAHTINEN, SIMO [1973]: *Työn kysyntä Suomen kansantalouden ekonometrisessa kokonaismallissa,* (Labour demand in an Econometric model for the Finnish Economy), Bank of Finland, series D:31.

LEHTIMÄKI, HEIKKI [1973]: Tullit ja tuonti - ym. maksut vuosina 1948-1971 (Import duties and import levies, etc. in 1948-1971), in Finnish, unpublished report, Research Institute of the Finnish Economy.

LEPPÄNEN, Seppo [1974]: *Kotitalouksien säästäminen Suomessa vuosina 1954-1973* (Saving of the Finnish Households in 1954-1973), in Finnish, an unpublished report, Economic Planning Center, Helsinki.

LUND, UNTO [1973]: *Teollisuuden rahoituspolitiikan suunnittelu,* (The Planning of Industrial Financing Policy) in Finnish with summary in English, Economic Studies of the Finnish Economic Association XXXIII, Helsinki.

MARJOMAA, PERTTI [1969]: *Private Consumption Expenditure Patterns and Trends in Finland 1948-1965*, The Economic Research Institute of Finnish Industry, Series A VII, in Finnish with a summary in English, Helsinki.

MODIGLIANI, F. [1949]: "Fluctuations in the Saving-Income Ratio: A Problem in Economic Forecasting", in *Studies in Income and Wealth*, vol. 11, NBR, New York.

MOLANDER, AHTI [1969]: *A Study of Prices Wages and Employment in Finland*, 1957-1966, Bank of Finland Institute for Economic Research, Publications series B:31, Helsinki.

MOLANDER, AHTI, AINTILA, HEIKKI and SALOMAA, J. [1970]: *Vakautuksen vaikutus hinta- ja palkkatasoon*, (The Effects of Stabilization on the Wage and Price Level), in Finnish, SITRA, series B, no. 5, Helsinki.

MOSBAEK, E.J. and WOLD, H.O. [1970]: *Interdependent Systems, Structure and Estimation*, North Holland Publishing Company, Amsterdam.

NADIRI, M.I. & ROSEN, S. [1969]: "Interrelated factor demand functions", *American Economic Review*, September 1969.

NIITAMO, O.E. [1958]: Palkansaajien ansiotasoa ja palkkasummia kuvaava neljännesvuositilasto (Quarterly Statistics on Wages and Salaries), in Finnish with a summary in English, *Bulletin of Statistics No. 10, 1958*, Central Statistical Office of Finland, Helsinki

NORDBERG, L. and KOSKENKYLÄ, H. [1970]: *Kiinteiden investointien lyhyen ajan vaihteluiden selittämisestä ja ennustamisesta* (On the Explanation and Forecasting of Short-term Fluctuations in Fixed Investment), in Finnish, Bank of Finland Institute for Economic Research, series A:33, Helsinki.

ORCUTT, G.H. [1950]: "Measurement of Price Elasticities in International Trade", *Review of Economic and Statistics*.

RICHARDSON, J.D. [1973]: "Beyond (but back to ?) the elasticity of substitution in international trade", *European Economic Review*, Vol. 4, No. 4, December 1973.

DE RIDDER, P.B. and VERBAAN, W.C. [1974]: "An Econometric CS-Model of West Germany", *Weltwirtschaftliches Archiv*, Zeitschrift des Instituts für Weltwirtschaft, Kiel, Heft 1.

THEIL, H. [1973]: "A New Index Number Formula", *The Review of Economic and Statistics*, November 1973.

THEIL, H. [1961]: *Economic Forecast and Policy*, second edition, North Holland Publishing Company, Amsterdam.

TERÄSVIRTA, TIMO [1970]: *On Stepwise Regression and Economic Forecasting*, Economic Studies of the Finnish Economic Association, XXXI, Helsinki.

TINBERGEN, J. [1951]: *Business cycles in the United Kingdom, 1870-1914*, North Holland Publishing Co., Amsterdam.

TINBERGEN, J. [1939]: *Statistical testing of business cycle theories. I. A method and its application to investment activity. II. Business cycles in the United States of America, 1919-1932*, League of Nations, Geneva.

TINBERGEN, J. [1937]: *An econometric approach to business cycle problems*, Hermann et Cie, Paris.

TINBERGEN, J. [1951]: *Econometrics*, George Allen & Unwin Ltd, London.

TINBERGEN, J. [1966]: *On the Theory of Economic Policy*, North Holland Publishing Company, Amsterdam.

TUOMELA, R. [1973]: *Theoretical Concepts*, Library of Exact Philosophy, Springer Verlag, Wien.

TYRNI, I. [1964]: "The Effect of Price Changes on Consumer Saving", *Review of Economic Studies* Vol. 31(2), No. 88.

TÖRNQVIST, L. [1936]: *Promemoria angående förändring av beräkningssättet för Finlands Banks konsumtionsprisindex*, Bank of Finland, Helsinki.

TÖRNQVIST, L. [1971]: "The Economic Development of the Post and Telegraph Office until 1970", appendix of the *Annual Report of the Administration of Posts and Telegraphs for the year 1970*, Helsinki.

VARTIA, P. [1973]: *Comments on the Identification of Auxiliary Concepts*, in Finnish, Research Institute of the Finnish Economy, Series A:1, Helsinki.

VARTIA, P. [1972]: "Tavaraviennin suhdannevaihtelut" (Short-term fluctuation in commodity exports), in Finnish, in series *Suhdannevaihtelut Suomen kansantaloudessa, part II*, Research Institute of the Finnish Economy, Series C:1, Helsinki.

VARTIA, Y. [1974]: *Relative changes and economic indices*, Licenciate thesis, Institute of Statistics, University of Helsinki.

VERDOORN, P.J. [1967]: The short-term model of the Central Planning Bureau and its forecasting performance (1953-1963), in *Macroeconomic models for planning and policy-making*, edited by Economic Commission for Europe, Geneva, (C.P.B. reprint 108).

VERDOORN, P.J. & VAN EIJK, C.J. [1958]: *Experimental short-term forecasting models*, Paper presented at the 20th European meeting of the Econometric Society in Bilbao, Central Planning Bureau, The Hague, July 1958.

VERDOORN, P.J. & POST, J.J. [1964]: "Capacity and short-term multipliers" in Harts & Mills & Whitaker: *Economic analysis for national economic planning*, Colston papers no. 16 (Butterworths, London 1964) pp. 179-205.

VERDOORN, P.J. and HOOGLAND [1971]: *Commodity imports by four main categories for the Netherlands*, 1952-1968, Occasional papers of the Central Planning Bureau, The Hague.

VERDOORN, P.J. POST, J.J. & GOSLINGA, S.S. [1970]: *The re-estimation of the annual model*, Central Planning Bureau, The Hague.

VAN DER WERF, D. [1971]: *De westduitse economie in vijtien vergelijkingen*, Academic service, Amsterdam.

VAN DER WERF, D. [1971a]: "Merkmale westdeutscher Modelle", *IFO-studien*, Heft 1/2.

WILLMAN, A. [1971]: *Kapasiteetin käyttöaste Suomen kansantaloudessa 1959-69* (Capacity Utilization in the Finnish Economy in 1959-1969), in Finnish, unpublished thesis, University of Helsinki, Institute of Economics, November 1971.

ZADEH, L., DESOER, C. [1963]: *Linear System Theory*, McGraw-Hill Book Company, New York.

APPENDICES:

Note: Complete matrices $(I-\hat{A})^{-1}$ and $(I-\hat{A})^{-1}\hat{B}$ are presented in appendices III and IV. The structure of the model requires that caution be used when interpreting the elements of those columns in $(I-\hat{A})^{-1}$ and $(I-\hat{A})^{-1}\hat{B}$ that correspond to variables which are formed by identities in the model (e.g., aggregate price variables p_x and p_m).

AI 1. BALANCE OF RESOURCES AND EXPENDITURE IN CURRENT PRICES, MILLION MK

Year	RESOURCES		Total resources = Total expenditure	EXPENDITURE					
	Gross domestic product at market prices	Imports of goods and services		Exports of goods and services	Consumption		Investment		Change in stocks
					Private	Public	Private	Public	
1948	4089.3	729.8	4819.1	827.9	2640.5	406.5	801.9	85.2	57.1
1949	4391.3	786.9	5178.2	951.9	2788.4	470.8	834.1	153.2	-20.2
1950	5424.3	1021.3	6445.6	1084.9	3468.8	627.9	1000.1	220.2	43.7
1951	7901.1	1780.4	9681.5	2285.7	4721.3	806.7	1556.3	264.1	47.4
1952	8180.6	2056.8	10237.4	1973.3	5191.1	904.7	1829.7	346.4	-7.8
1953	8073.9	1429.4	9503.3	1567.6	5147.8	989.4	1724.1	477.9	-403.5
1954	8968.8	1689.7	10658.5	1845.8	5482.3	992.1	1895.9	459.0	-16.6
1955	9922.1	1991.3	11913.4	2157.0	5929.6	1141.6	2071.8	462.9	150.5
1956	11031.3	2281.9	13313.2	2173.0	6775.8	1359.1	2390.0	575.3	140.0
1957	12025.4	2581.8	14607.2	2587.9	7377.3	1506.0	2263.7	655.9	216.4
1958	12953.8	2641.4	15595.2	2925.3	7708.7	1659.4	2428.1	789.8	83.9
1959	14078.9	3047.8	17126.7	3153.8	8366.9	1855.7	2786.5	800.4	163.4
1960	15824.2	3834.7	19658.9	3711.9	9195.0	1996.8	3537.3	788.2	429.7
1961	17625.7	4186.4	21812.1	3995.3	10102.4	2201.3	4108.6	823.7	580.8
1962	18856.4	4504.4	23360.8	4258.0	11052.9	2523.3	4258.7	900.2	367.7
1963	20541.1	4462.0	25003.1	4463.7	12051.0	2924.7	4196.0	1073.4	294.3
1964	23553.9	5449.9	29003.8	4984.4	13710.2	3349.0	4489.5	1267.2	1203.5
1965	25827.8	5989.3	31817.1	5496.2	14982.5	3758.8	5235.0	1470.4	874.2
1966	27776.6	6309.2	34085.8	5823.5	15861.4	4235.0	5635.0	1506.5	1024.4
1967	30109.4	6635.0	36744.4	6357.7	17188.8	4852.4	5682.3	1615.6	1047.6
1968	34148.2	7757.9	41906.1	8307.9	18682.0	5693.5	5949.1	1852.4	1421.2
1969	39012.6	9758.5	48771.1	10096.4	20998.1	6212.2	7226.6	1944.4	2293.4
1970	43592.0	12554.9	56146.9	11966.3	22901.7	6914.0	9347.5	1914.8	3102.6
1971									
1972									
1973									
1974									

AI 2. BALANCE OF RESOURCES AND EXPENDITURE IN CONSTANT PRICES, MILLION MK

Year	RESOURCES		Total resources = Total expenditure	EXPENDITURE					
	Gross domestic product at market prices	Imports of goods and services		Exports of goods and services	Consumption		Investment		Change in stocks
					Private	Public	Private	Public	
				In constant prices of 1954					
1948	6528.9	1035.0	7563.9	1113.7	3962.0	778.7	1348.4	145.7	215.4
1949	6769.3	1058.0	7827.3	1350.8	4173.6	849.2	1356.0	250.2	-152.5
1950	7263.8	1155.0	8418.8	1434.3	4565.7	887.3	1381.2	308.3	-158.0
1951	7940.7	1520.0	9460.7	1673.4	4918.0	880.3	1581.5	270.5	137.0
1952	8213.0	1750.0	9964.0	1568.5	5224.5	924.1	1751.3	338.6	157.0
1953	8224.1	1363.0	9587.1	1605.8	5125.6	991.8	1696.3	474.1	-306.5
1954	8968.8	1689.7	10658.5	1845.8	5482.3	992.1	1895.9	459.0	-16.6
1955	9645.7	1989.7	11635.4	1989.9	5949.8	1081.0	2054.5	452.7	107.5
1956	9837.5	2173.9	12011.4	1959.4	6202.4	1111.2	2178.2	521.8	38.4
1957	9987.0	2134.6	12121.6	2187.6	6082.5	1157.1	2080.1	571.3	43.0
1958	9979.2	1915.2	11894.4	2170.1	5921.5	1197.0	2094.9	659.0	-148.1
1959	10702.7	2317.0	13019.7	2458.1	6347.9	1283.8	2345.3	659.7	-75.1
1960	11765.7	2848.1	14613.8	2824.9	6870.0	1330.2	2880.7	625.2	82.8
1961	12712.5	3085.6	15798.1	2990.5	7476.4	1390.0	3248.4	625.4	67.4
1962	13257.2	3264.9	16522.1	3218.4	7923.8	1526.4	3238.7	660.8	-46.0
1963	13586.7	3203.8	16790.5	3279.7	8185.6	1632.7	3046.3	757.8	-111.6
				In constant prices of 1964					
1964	23553.9	5449.9	29003.8	4984.4	13710.2	3349.0	4489.5	1267.2	1203.5
1965	24764.8	5951.7	30716.5	5243.6	14444.0	3524.5	4983.3	1389.7	1131.4
1966	25352.4	6235.8	31588.2	5611.2	14815.1	3705.3	5188.1	1366.1	902.4
1967	26023.2	6150.2	32173.4	5943.4	15133.0	3908.0	4952.0	1384.0	853.0
1968	26646.7	5975.8	32622.5	6614.7	15102.4	4141.6	4663.6	1442.6	657.6
1969	29427.4	7332.6	36760.0	7766.0	16620.7	4312.4	5386.3	1436.0	1238.6
1970	31860.7	8724.1	40584.8	8362.6	17727.4	4555.6	6384.0	1317.2	2238.0
1971									
1972									
1973									
1974									

AII 1.

Year	TOTAL DEMAND = TOTAL RESOURCES, MILLION MARK							
	Current Prices		Constant Prices			Price Indices		
	Value	Change, %	1954	1964	Change, %	"1954"=100	"1964"=100	Change, %
48	4819.1		7563.9			63.712		
49	5178.2	7.452	7827.3		3.482	66.156		3.836
1950	6445.6	24.476	8418.8		7.557	76.562		15.730
51	9681.5	50.203	9460.7		12.376	102.334		33.662
52	10237.4	5.742	9964.0		5.320	102.744		0.401
53	9503.3	-7.171	9587.1		-3.783	99.126		-3.521
54	10658.5	12.156	10658.5		11.175	100.000		0.882
1955	11913.4	11.774	11635.4		9.166	102.389		2.389
56	13313.2	11.750	12011.4		3.232	110.838		8.252
57	14607.2	9.720	12121.6		0.918	120.506		8.723
58	15595.2	6.764	11894.4		-1.874	131.114		8.803
59	17126.7	9.820	13019.7		9.461	131.545		0.329
1960	19658.9	14.785	14613.8		12.244	134.523		2.264
61	21812.1	10.953	15798.1		8.104	138.068		2.635
62	23360.8	7.100	16522.1		4.583	141.391		2.407
63	25003.1	7.030	16790.5		1.625	148.912		5.319
64	29003.8	16.001	18300.0	29003.8	8.990	158.491	100.000	6.433
1965	31817.1	9.700		30716.5	5.905		103.583	3.583
66	34085.8	7.130		31588.2	2.838		107.907	4.174
67	36744.4	7.800		32173.4	1.853		114.207	5.838
68	41906.1	14.048		32622.5	1.396		128.458	12.478
69	48771.1	16.382		36760.0	12.683		132.674	3.282
1970	56146.9	15.123		40584.8	10.405		138.345	4.274
71								
72								
73								
74								

AII 2.

Year	TOTAL DEMAND LESS INVENTORIES, MILLION MK							
	Current Prices		Constant Prices			Price Indices		
	Value	Change, %	1954	1964	Change, %	"1954"=100	"1964"=100	Change, %
48	4762.0		7348.5			64.802		
49	5198.4	9.164	7979.8		8.591	65.145		0.529
1950	6401.9	23.151	8576.8		7.481	74.642		14.578
51	9634.1	50.488	9323.7		8.708	103.329		38.433
52	10245.2	6.343	9807.0		5.184	104.468		1.102
53	9906.8	-3.303	9893.6		0.883	100.133		-4.150
54	10675.1	7.755	10675.1		7.899	100.000		-0.133
1955	11762.9	10.190	11527.9		7.989	102.039		2.039
56	13173.2	11.989	11973.0		3.861	110.024		7.825
57	14390.8	9.243	12078.6		0.882	119.143		8.288
58	15511.3	7.786	12042.5		-0.299	128.805		8.110
59	16963.3	9.361	13094.8		8.738	129.542		0.778
1960	19229.2	13.358	14531.0		10.968	132.332		2.154
61	21231.3	10.412	15730.7		8.256	134.967		1.991
62	22993.1	8.298	16568.1		5.323	138.779		2.824
63	24708.8	7.462	16902.1		2.016	146.188		5.339
64	27800.3	12.512	17720.0	27800.3	4.839	156.887	100.000	7.319
1965	30942.9	11.304		29585.1	6.420		104.590	4.59
66	33061.4	6.846		30685.8	3.720		107.742	3.014
67	35696.8	7.971		31320.4	2.068		113.973	5.783
68	40484.9	13.413		31964.9	2.058		126.654	11.126
69	46477.7	14.803		35521.4	11.126		130.844	3.308
1970	53044.3	14.129		38346.8	7.954		138.328	5.720
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AII 3.

Year	GROSS DOMESTIC PRODUCT AT MARKET PRICES, MILLION MARK							
	Current Prices		Constant Prices			Price Indices		
	Value	Change, %	1954	1964	Change, %	"1954"=100	"1964"=100	Change, %
48	4089.3		6528.9			62.634		
49	4391.3	7.385	6769.3		3.682	64.871		3.572
1950	5424.3	23.524	7263.8		7.305	74.676		15.115
51	7901.1	45.661	7940.7		9.319	99.501		33.244
52	8180.6	3.537	8214.0		3.442	99.593		0.093
53	8073.9	-1.304	8224.1		0.123	98.174		-1.425
54	8968.8	11.084	8968.8		9.055	100.000		1.860
1955	9922.1	10.629	9645.7		7.547	102.866		2.866
56	11031.3	11.179	9837.5		1.988	112.135		9.011
57	12025.4	9.012	9987.0		1.520	120.411		7.380
58	12953.8	7.720	9979.2		-0.078	129.808		7.804
59	14078.9	8.685	10702.7		7.250	131.545		1.338
1960	15824.2	12.397	11765.7		9.932	134.494		2.242
61	17625.7	11.384	12712.5		8.047	138.649		3.089
62	18856.4	6.982	13257.2		4.285	142.235		2.586
63	20541.1	8.934	13586.7		2.485	151.185		6.292
64	23553.9	14.667	14479.8	23553.9	6.573	162.667	100.000	7.595
1965	25827.8	9.654		24764.8	5.141		104.292	4.292
66	27776.6	7.545		25352.4	2.373		109.562	5.053
67	30109.4	8.398		26023.2	2.646		115.702	5.604
68	34148.2	13.414		26646.7	2.396		128.152	10.760
69	39012.6	14.245		29427.4	10.435		132.572	3.449
1970	43592.0	11.738		31860.7	8.269		136.821	3.205
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AII 4.

Year	GROSS DOMESTIC PRODUCT LESS INVENTORIES AT MARKET PRICES, MILLION MARK							
	Current Prices		Constant Prices			Price Indices		
	Value	Change, %	1954	1964	Change, %	"1954"=100	"1964"=100	Change, %
48	4032.2		6313.5			63.866		
49	4411.5	9.407	6921.8		9.635	63.733		-0.208
1950	5380.6	21.968	7421.8		7.224	72.497		13.751
51	7853.7	45.963	7803.7		5.146	100.641		38.821
52	8188.4	4.262	8057.0		3.246	101.631		0.984
53	8477.4	3.529	8530.6		5.878	99.376		-2.219
54	8985.4	5.992	8985.4		5.331	100.000		0.628
1955	9771.6	8.750	9538.2		6.152	102.447		2.447
56	10891.3	11.459	9799.1		2.735	111.146		8.491
57	11809.0	8.426	9944.0		1.479	118.755		6.846
58	12869.9	8.984	10127.3		1.843	127.081		7.011
59	13915.5	8.124	10777.8		6.423	129.113		1.599
1960	15394.5	10.628	11682.9		8.398	131.770		2.058
61	17044.9	10.720	12645.1		8.236	134.795		2.296
62	18488.7	8.471	13303.2		5.204	138.979		3.104
63	20246.8	9.509	13698.3		2.970	147.805		6.351
64	22350.4	10.390	13899.8	22380.4	1.471	160.797	100.000	8.790
1965	24953.6	11.647		23633.4	5.599		105.586	5.586
66	26752.2	7.208		24450.0	3.455		109.416	3.627
67	29061.8	8.633		25170.2	2.946		115.461	5.524
68	32727.0	12.612		25989.1	3.254		125.926	9.064
69	36719.2	12.199		28188.8	8.464		130.262	3.443
1970	40489.4	10.268		29622.7	5.087		136.684	4.930
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AII 5.

Year	PRIVATE CONSUMPTION, MILLION MK							
	Current Prices		Constant Prices			Price Indices		
	Value	Change, %	1954	1964	Change, %	"1954"=100	"1964"=100	Change, %
48	2640.5		3962.0			66.646		
49	2788.4	5.601	4173.6		5.341	66.810		0.246
1950	3468.8	24.401	4565.7		9.395	75.975		13.718
51	4721.3	36.108	4918.0		7.716	96.000		26.357
52	5191.1	9.951	5224.5		6.232	99.361		3.501
53	5147.8	-0.834	5125.6		-1.893	100.433		1.079
54	5482.3	6.498	5482.3		6.959	100.000		-0.431
1955	5929.6	8.159	5949.8		8.527	99.661		-0.339
56	6775.8	14.271	6202.4		4.246	109.245		9.617
57	7377.3	8.877	6082.5		-1.933	121.287		11.023
58	7708.7	4.492	5921.5		-2.647	130.182		7.334
59	8366.9	8.538	6347.9		7.201	131.806		1.248
1960	9195.0	9.897	6870.0		8.225	133.843		1.546
61	10102.4	9.868	7476.0		8.827	135.124		0.957
62	11052.9	9.409	7923.8		5.984	139.490		3.231
63	12051.0	9.030	8185.6		3.304	147.222		5.543
64	13710.2	13.768	8615.4	13710.2	5.251	159.136	100.000	8.093
1965	14982.5	9.280		14444.0	5.352		103.728	3.728
66	15861.4	5.866		14815.1	2.569		107.062	3.214
67	17188.8	8.369		15133.0	2.146		113.585	6.093
68	18682.0	8.687		15102.4	-0.202		123.702	8.907
69	20998.1	12.398		16620.7	10.053		126.337	2.130
1970	22901.7	9.066		17727.4	6.659		129.188	2.257
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AII 6.

Year	PRIVATE INVESTMENT, MILLION MK							
	Current Prices		Constant Prices			Price Indices		
	Value	Change, %	1954	1964	Change, %	"1954"=100	"1964"=100	Change, %
48	801.9		1348.4			59.471		
49	834.1	4.016	1356.0		.564	61.512		3.432
1950	1000.1	19.902	1381.2		1.858	72.408		17.714
51	1556.3	55.614	1581.5		14.502	98.407		35.906
52	1829.7	17.567	1751.3		10.737	104.477		6.168
53	1724.1	-5.771	1696.3		-3.141	101.639		-2.716
54	1895.9	9.965	1895.9		11.767	100.000		-1.613
1955	2071.8	9.278	2054.5		8.365	100.842		0.842
56	2290.0	10.532	2178.2		6.021	105.133		4.255
57	2263.7	-1.149	2080.1		-4.504	108.827		3.514
58	2428.1	7.262	2094.9		0.712	115.905		6.504
59	2786.5	14.761	2345.3		11.953	118.812		2.508
1960	3537.3	26.944	2880.7		22.829	122.793		3.351
61	4108.6	16.151	3248.4		12.764	126.481		3.003
62	4258.7	3.653	3238.7		-0.299	131.494		3.963
63	4196.0	-1.472	3046.3		-5.941	137.741		4.751
64	4489.5	6.995	3085.5	4489.5	1.287	145.503	100.000	5.635
1965	5235.0	16.605		4983.3	10.999		105.051	5.051
66	5635.0	7.641		5188.1	4.110		108.614	3.392
67	5682.3	0.839		4952.0	-4.551		114.748	5.648
68	5949.1	4.695		4663.6	-5.824		127.565	11.170
69	7226.6	21.474		5386.3	15.497		134.166	5.175
1970	9347.5	29.349		6384.0	18.523		146.421	9.134
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AII 7.

Year	EXPORTS OF GOODS AND SERVICES, MILLION MK							
	Current Prices		Constant Prices			Price Indeces		
	Value	Change, %	1954	1964	Change, %	54=100	64=100	Change, %
48	827.9		1113.7			74.338		
49	951.9	14.978	1350.8		21.289	70.469		-5.205
1950	1084.9	13.972	1434.3		6.182	75.640		7.338
51	2285.7	110.683	1673.4		16.670	136.590		80.579
52	1973.3	-13.668	1568.5		-6.269	125.808		-7.894
53	1567.6	-20.560	1605.8		2.378	97.621		-22.405
54	1845.8	17.747	1845.8		14.946	100.000		2.437
1955	2157.0	16.860	1989.9		7.807	108.397		8.397
56	2173.0	.742	1959.4		-1.533	110.901		2.310
57	2587.9	19.093	2187.6		11.646	118.299		6.671
58	2925.3	13.038	2170.1		-.800	134.800		13.949
59	3153.8	7.811	2458.1		13.271	128.302		-4.821
1960	3711.9	17.696	2824.9		14.922	131.399		2.414
61	3995.3	7.635	2990.5		5.862	133.600		1.675
62	4258.0	6.575	3218.4		7.621	132.302		-.972
63	4463.7	4.831	3279.7		1.905	136.101		2.872
64	4984.4	11.665	3471.0	4984.4	5.833	143.601	100.000	5.511
1965	5496.2	10.268		5243.6	5.200		104.817	4.817
66	5823.5	5.955		5611.2	7.011		103.784	-.986
67	6357.7	9.173		5943.4	5.920		106.971	3.071
68	8307.9	30.675		6614.7	11.295		125.598	17.413
69	10096.4	21.528		7766.0	17.405		130.008	3.511
1970	11966.3	18.521		8362.6	7.682		143.093	10.065
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AII 8.

Year	COMMODITY EXPORTS, MILLION MARK							
	Current Prices		Constant Prices			Price Indices		
	Value	Change, %	1954	1964	Change, %	"1954"=100	"1964"=100	Change, %
48	565.0		826.1			68.394		
49	656.1	16.124	979.3		18.545	66.997		-2.043
1950	814.8	24.188	1086.4		10.936	75.000		11.945
51	1868.8	129.357	1364.1		25.562	136.999		82.665
52	1568.3	-16.080	1206.4		-11.561	129.998		-5.110
53	1315.6	-16.113	1342.4		11.273	98.004		-24.611
54	1566.2	19.048	1566.2		16.672	100.000		2.037
1955	1812.6	15.732	1710.0		9.182	106.000		6.000
56	1779.9	-1.804	1679.1		-1.807	106.003		0.003
57	2123.9	19.327	1830.9		9.041	116.003		9.434
58	2479.3	16.733	1796.6		-1.873	138.000		18.964
59	2673.2	7.821	2056.3		14.455	130.001		-5.796
1960	3164.7	18.386	2379.5		15.718	132.999		2.306
61	3374.1	6.617	2499.3		5.035	135.002		1.506
62	3533.1	4.712	2636.6		5.494	134.002		-0.741
63	3678.0	4.101	2693.6		2.162	136.546		1.899
64	4131.9	12.341	2868.4	4131.9	6.490	144.049	100.000	5.495
1965	4566.0	10.506		4355.1	5.402		104.843	4.843
66	4816.9	5.495		4631.5	6.347		104.003	-0.801
67	5231.2	8.601		4882.6	5.423		107.140	3.016
68	6874.2	31.408		5447.5	11.570		126.190	17.781
69	8344.7	21.392		6360.3	16.756		131.200	3.970
1970	9686.7	16.082		6692.3	5.220		144.744	10.323
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AII 9.

Year	MULTILATERAL COMMODITY EXPORTS, MILLION MK							
	Current Prices		Constant Prices			Price Indices		
	Value	Change, %	1954	1964	Change, %	"1954"=100	"1964"=100	Change, %
48	466.4		681.9			68.394		
49	525.7	12.714	784.7		15.067	66.997		-2.043
1950	715.4	36.085	953.9		21.561	75.000		11.945
51	1652.6	131.004	1206.3		26.463	136.999		82.665
52	1228.0	-25.693	944.6		-21.691	129.998		-5.110
53	903.6	-26.417	922.0		-2.396	98.004		-24.611
54	1128.6	24.900	1128.6		22.408	100.000		2.037
1955	1345.6	19.227	1269.4		12.481	106.000		6.000
56	1293.7	-3.857	1220.4		-3.861	106.003		0.003
57	1500.0	15.947	4293.1		5.956	116.003		9.434
58	1863.0	24.200	1350.0		4.402	138.000		18.964
59	2046.0	9.823	1573.8		16.578	130.001		-5.796
1960	2547.2	24.497	1915.2		21.689	132.999		2.306
61	2766.4	8.606	2049.2		6.996	135.002		1.506
62	2737.8	-1.034	2043.1		-.295	134.002		-0.741
63	2911.0	6.326	2131.9		4.346	136.546		1.899
64	3410.8	17.169	2367.8	34.108	11.065	144.049	100.000	5.495
1965	3608.6	5.799		34.419	.912		104.843	4.843
66	3914.5	8.477		37.638	9.352		104.003	-0.801
67	4122.5	5.314		38.478	2.232		107.140	3.016
68	5558.8	34.841		44.051	14.484		126.190	17.781
69	6875.6	23.689		56.365	18.964		131.200	3.970
1970	8158.5	18.659		56.365	7.557		144.744	10.323
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AII 10.

Year	INVENTORY CHANGES, MILLION MARK					BILATERAL EXPORTS		EXPORT DEMAND, m_w
	Current Prices		Constant Prices			Current Prices		
	Value	N, % 1)	1954	1964	n, % 2)	Value	Change, %	Change, %
1948	57.1		215.4			98.6		
1949	-20.2	-1.623	-152.5		-5.007	130.4	32.252	4.643
1950	43.7	0.123	-158.0		-0.069	99.4	-23.773	9.753
1951	47.4	0.058	137.0		3.440	216.2	117.505	7.270
1952	-7.8	-0.573	157.0		0.215	340.3	57.401	-0.360
1953	-403.5	-3.862	-306.5		-4.726	412.0	21.070	6.166
1954	-16.6	3.905	-16.6		2.930	437.6	6.214	6.676
1955	150.5	1.565	107.5		1.163	467.0	6.719	8.028
1956	140.0	-0.089	38.4		-0.599	486.2	4.111	3.469
1957	216.4	0.580	43.0		0.038	623.9	28.322	3.218
1958	83.9	-0.921	-148.1		-1.582	616.3	-1.218	0.036
1959	163.4	0.513	-75.1		0.606	627.2	1.769	6.426
1960	429.7	1.570	82.8		1.206	617.5	-1.547	8.296
1961	580.8	0.786	67.4		-0.106	607.7	-1.587	4.121
1962	367.7	-1.004	-46.0		-0.721	795.3	30.871	3.474
1963	294.3	-0.319	-111.6		-0.396	767.0	-3.558	4.435
1964	1203.5	3.680	580.0	1203.5	4.092	721.1	-5.984	7.837
1965	874.2	-1.185		1131.4	-0.259	957.4	32.769	4.624
1966	1024.4	0.485		902.4	-0.774	902.4	-5.745	4.316
1967	1047.6	0.070		853.0	-0.161	1108.7	22.861	2.092
1968	1421.2	1.047		657.6	-0.624	1315.4	18.649	6.404
1969	2293.4	2.154		1238.6	1.818	1469.1	11.685	7.296
1970	3102.6	1.741		2238.0	2.814	1528.2	4.023	4.077
1971								
1972								
1973								
1974								

1) Change as percentage of total demand less inventories in current prices in previous year

2) Change as percentage of total demand less inventories in constant prices in previous year

AII 11.

Year	PUBLIC EXPENDITURE, MILLION MARK							
	Current Prices		Constant Prices			Price Indices		
	Value	Change, %	1954	1964	Change, %	"1954"=100	"1964"=100	Change, %
48	491.7		924.4			53.191		
49	624.0	26.907	1099.4		18.931	56.758		6.706
1950	848.1	35.913	1195.6		8.750	70.935		24.978
51	1070.8	26.259	1150.8		-3.747	93.048		31.174
52	1251.1	16.838	1262.7		9.724	99.081		6.484
53	1467.3	17.281	1465.9		16.093	100.096		1.024
54	1451.1	-1.104	1451.1		-1.010	100.000		-0.096
1955	1604.5	10.571	1533.7		5.692	104.616		4.616
56	1934.4	20.561	1633.0		6.475	118.457		13.230
57	2161.9	11.761	1728.4		5.842	125.081		5.592
58	2449.2	13.289	1856.0		7.383	131.961		5.500
59	2656.1	8.448	1943.0		4.688	136.701		3.592
1960	2785.0	4.853	1955.4		0.638	142.426		4.188
61	3025.0	8.618	2015.4		3.068	150.094		5.384
62	3423.5	13.174	2187.2		8.524	156.524		4.284
63	3998.1	16.784	2390.5		9.295	167.250		6.853
64	4616.2	15.460	2548.1	4616.2	6.593	181.162	100.000	8.318
1965	5229.2	13.279		4914.2	6.456		106.410	6.410
66	5741.5	9.797		5071.4	3.199		113.213	6.393
67	6468.0	12.653		5292.0	4.350		122.222	7.958
68	7545.9	16.665		5584.2	5.522		135.130	10.561
69	8156.6	8.093		5748.4	2.940		141.893	5.005
1970	8828.8	8.241		5872.8	2.164		150.334	5.949
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AII 12.

Year	IMPORTS OF GOODS AND SERVICES, MILLION MARK							
	Current Prices		Constant Prices			Price Indices		
	Value	Change, %	1954	1964	Change, %	"1954"=100	"1964"=100	Change, %
48	729.8		1035.0			70.512		
49	786.9	7.824	1058.0		2.222	74.376		5.480
1950	1021.3	29.788	1155.0		9.168	88.424		18.888
51	1780.4	74.327	1520.0		31.602	117.132		32.466
52	2056.8	15.525	1750.0		15.132	117.531		.341
53	1429.4	-30.504	1363.0		-22.114	104.872		-10.771
54	1689.7	18.210	1689.7		23.969	100.000		-4.646
1955	1991.3	17.849	1989.7		17.755	100.080		0.080
56	2281.9	14.593	2173.9		9.258	104.968		4.884
57	2581.8	13.143	2134.6		-1.808	120.950		15.226
58	2641.4	2.308	1915.2		-10.278	137.918		14.029
59	3047.8	15.386	2317.0		20.980	131.541		-4.624
1960	3834.7	25.819	2848.1		22.922	134.641		2.357
61	4186.4	9.172	3085.6		8.339	135.675		0.768
62	4504.4	7.596	3264.9		5.811	137.964		1.687
63	4462.0	-0.941	3203.8		-1.871	139.272		0.948
64	5449.9	22.140	3820.2	5449.9	19.240	142.660	100.000	2.433
1965	5989.3	9.897		5951.7	9.208		100.632	0.632
66	6309.2	5.341		6235.8	4.773		101.177	0.542
67	6635.0	5.164		6150.2	-1.373		107.883	6.628
68	7757.9	16.924		5975.8	-2.836		129.822	20.336
69	9758.5	25.788		7332.6	22.705		133.084	2.513
1970	12554.9	28.656		8724.1	18.977		143.911	8.136
71								
72								
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AII 13.

Year	IMPORTS OF GOODS, MILLION MARK							
	Current Prices		Constant Prices			Price Indices		
	Value	Change, %	1954	1964	Change, %	"1954"=100	"1964"=100	Change, %
48	663.7		968.5			68.529		
49	662.8	-0.136	904.6		-6.598	73.270		6.918
1950	891.5	34.505	969.0		7.119	92.002		25.566
51	1554.6	74.380	1263.9		30.433	123.000		33.693
52	1821.9	17.194	1505.7		19.131	121.000		-1.626
53	1218.6	-33.114	1149.6		-23.650	106.002		-12.395
54	1521.4	24.848	1521.4		32.342	100.000		-5.662
1955	1769.6	16.314	1769.6		16.314	100.000		0.000
56	2035.6	15.032	1938.6		9.550	105.004		5.004
57	2279.3	11.972	1868.3		-3.626	121.999		16.185
58	2333.0	2.356	1666.4		-10.807	140.002		14.757
59	2673.0	14.574	2009.8		20.607	132.998		-5.003
1960	3403.0	27.310	2502.2		24.500	136.000		2.257
61	3690.2	8.440	2693.6		7.649	136.999		0.735
62	3928.7	6.463	2826.4		4.930	139.000		1.461
63	3866.9	-1.573	2754.4		-2.547	140.390		1.000
64	4816.5	24.557	3357.7	4816.5	21.903	143.446	100.000	2.177
1965	5265.1	9.314		5239.7	8.787		100.485	0.485
66	5524.4	4.925		5455.7	4.122		101.259	0.770
67	5794.4	4.887		5459.5	0.070		106.134	4.814
68	6710.9	15.817		5247.9	-3.876		127.878	20.487
69	8504.8	26.731		6486.6	23.604		131.113	2.530
1970	11071.4	30.178		7772.6	19.826		142.441	8.640
71								
72								
73								
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AII 14.

Year	WAGE SUM IN THE PRIVATE SECTOR, MILLION MARKS						UNEMPLOYMENT	
	Current prices		Labour input (man-years)		Wage rate		Unemployment as percentage of labour force	Ratio of applicants for work to vacancies
	Value	Change, %	In thousands	Change, %	Wage sum/ man years	Change, %		
1948	1623.8		920.9		1763.3		..	0.92
1949	1769.5	8.973	904.7	-1.759	1955.9	10.923	..	2.56
1950	2222.5	25.600	921.8	1.890	2411.0	23.268	..	1.76
1951	3159.9	42.178	986.0	6.964	3204.8	32.924	..	1.03
1952	3336.1	5.576	990.4	.446	3368.4	5.105	..	1.31
1953	3297.5	-1.157	964.7	-2.594	3418.2	1.478	..	2.00
1954	3559.7	7.951	1010.5	4.747	3522.7	3.057	..	1.59
1955	3974.7	11.658	1056.3	4.532	3762.9	6.819	..	1.29
1956	4443.4	11.792	1071.3	1.420	4147.7	10.226	..	1.34
1957	4627.1	4.134	1053.6	-1.652	4391.7	5.883	..	1.93
1958	4823.0	4.234	1037.1	-1.566	4650.5	5.893	3.1	2.66
1959	5220.3	8.238	1061.6	2.362	4917.4	5.739	2.3	2.34
1960	5873.9	12.520	1126.2	6.085	5218.3	6.119	1.5	1.52
1961	6560.3	11.686	1164.8	3.427	5632.1	7.930	1.2	1.19
1962	7241.9	10.390	1194.9	2.584	6060.7	7.610	1.2	1.07
1963	8051.1	11.174	1196.3	0.117	6730.0	11.043	1.3	1.37
1964	9353.3	16.174	1214.6	1.529	7700.7	14.423	1.5	1.49
1965	10404.7	11.241	1236.1	1.770	8417.4	9.307	1.4	1.59
1966	11323.3	8.829	1249.2	1.059	9064.4	7.686	1.6	1.52
1967	12262.6	8.295	1243.7	-0.440	9859.8	8.775	2.8	3.80
1968	13464.6	9.802	1236.7	-0.562	10887.5	10.423	4.0	3.91
1969	15088.9	12.063	1283.1	3.752	11759.7	8.011	2.8	3.29
1970	17216.1	14.098	1330.6	3.702	12938.6	10.025	1.9	1.71
1971								
1972								
1973								
1974								

AII 15.

Year	NET DOMESTIC PRODUCT AT FACTOR COST		NON LABOUR INCOME (Z̃)		NET INCOME TRANSFERS (Õ)		DISPOSABLE INCOME	
	Current Prices		Current Prices		Current Prices		Current Prices	
	Value	Change, %	Value	Change, %	Value	0, %[1]	Value	Change, %
1948	3351.5		1727.7		-664.7		2706.8	
1949	3542.5	5.699	1773.0	2.621	-613.0	1.543	2929.5	8.227
1950	4476.3	26.360	2253.8	27.118	-886.9	-7.732	3589.4	22.526
1951	6568.9	46.748	3409.0	51.256	-1471.7	-13.064	5097.2	42.007
1952	6692.0	1.874	3355.9	-1.558	-1135.0	5.126	5557.0	9.021
1953	6531.5	-2.398	3234.0	-3.632	-1114.3	0.309	5417.2	-2.516
1954	7347.4	12.492	3787.7	17.121	-1407.6	-4.491	5939.8	9.647
1955	8295.0	12.897	4320.3	14.061	-1660.3	-3.439	6634.7	11.699
1956	9066.1	9.296	4622.7	7.000	-1732.2	-0.867	7333.9	10.539
1957	9516.8	4.971	4889.7	5.776	-1694.6	0.415	7822.2	6.658
1958	10180.2	6.971	5357.2	9.561	-1638.9	0.585	8541.3	9.193
1959	11153.1	9.557	5932.8	10.744	-2033.1	-3.872	9120.0	6.775
1960	12464.4	11.757	6590.5	11.086	-2352.3	-2.862	10112.1	10.878
1961	13873.5	11.305	7313.2	10.966	-2254.0	0.789	11619.5	14.907
1962	14867.9	7.168	7626.0	4.277	-2457.9	-1.470	12410.0	6.803
1963	16475.8	10.815	8424.7	10.473	-2580.1	-0.822	13895.7	11.972
1964	18872.1	14.544	9518.8	12.987	-3297.5	-4.354	15574.6	12.082
1965	20691.3	9.640	10286.6	8.066	-3627.5	-1.749	17063.8	9.562
1966	22178.8	7.189	10855.5	5.530	-4074.6	-2.161	18104.2	6.097
1967	23931.8	7.904	11669.2	7.496	-4533.9	-2.071	19397.9	7.146
1968	26945.2	12.592	13480.6	15.523	-5377.8	-3.526	21567.4	11.184
1969	30676.3	13.847	15587.4	15.628	-6711.1	-4.948	23965.2	11.118
1970	34382.6	12.082	17166.5	10.131	-8267.8	-5.075	26114.8	8.970
1971								
1972								
1973								
1974								

1) Change as percentage of net domestic product at factor cost in current prices in previous year

AII 16.

Year	LAGGED EXPORT SHARES OF THE 10 MOST IMPORTANT OECD-COUNTRIES, MILLION MARK									
	UK	Sweden	Fed.Rep. of Ger.	USA	Holland	France	Denmark	Italy	Bel&Lux	Norway
48	41.933	8.004	0.167	16.036	6.342	5.378	10.001	2.053	7.236	2.856
49	41.024	7.903	1.193	13.751	10.455	8.115	9.212	0.786	5.525	2.023
1950	40.403	6.102	4.503	11.249	10.474	6.929	9.929	2.189	6.190	1.937
51	32.804	5.853	7.686	13.166	11.292	7.602	10.327	3.450	5.741	2.074
52	43.783	4.452	10.145	9.712	7.182	8.379	6.365	3.248	4.221	2.508
53	37.752	6.407	14.682	8.718	7.855	11.112	5.375	1.924	4.232	1.938
54	39.101	5.592	12.392	12.769	8.080	7.868	6.185	1.569	4.940	1.499
1955	39.671	4.841	13.061	10.177	7.988	8.247	6.085	2.412	5.197	2.317
56	40.874	3.192	15.523	9.725	7.533	7.931	5.029	2.026	5.912	2.250
57	37.804	3.803	15.258	11.744	6.390	9.323	4.376	2.417	7.748	1.133
58	38.361	5.502	15.697	8.935	7.320	9.888	4.432	2.203	6.984	0.673
59	36.319	5.914	17.855	7.601	7.264	10.157	4.916	2.884	5.980	1.106
1960	37.105	5.119	17.410	9.160	8.525	7.587	5.268	2.817	5.871	1.131
61	36.450	7.207	17.187	7.420	9.009	7.029	5.192	3.133	5.480	1.888
62	32.340	8.283	18.879	6.397	9.133	7.550	5.139	3.959	5.599	2.714
63	31.177	8.840	18.380	8.23	9.335	6.986	5.658	4.240	5.239	1.911
64	32.317	8.539	18.071	7.810	9.485	7.482	5.311	4.806	4.970	1.206
1965	32.639	9.139	16.375	8.186	9.664	8.248	5.304	4.213	4.927	1.290
66	30.753	11.171	16.699	8.879	8.884	6.648	5.774	4.533	4.962	1.691
67	29.917	12.806	16.188	9.317	8.443	6.626	5.123	4.374	4.485	2.716
68	31.542	14.683	12.998	8.751	7.707	6.388	5.760	4.677	3.813	3.677
69	30.296	16.023	15.397	8.562	6.783	5.883	5.366	4.328	3.545	3.812
1970	26.923	20.262	14.643	8.726	6.403	6.096	5.813	4.058	3.577	3.491
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AII 17.

Year	INDUSTRIAL PRODUCTION IN 10 MOST IMPORTANT OECD-COUNTRIES, "1958" = 100									
	UK	Sweden	Fed.Rep. of Ger.	USA	Holland	France	Danmark	Italy	Bel&Lux	Norway
49	77	78	38	69	62	55	73	48	70	63
1950	83	80	49	80	68	58	81	55	74	69
51	85	84	58	87	72	65	82	62	91	74
52	83	82	61	90	72	66	78	64	91	74
53	89	83	67	97	79	68	81	70	83	79
54	94	87	74	92	87	75	89	77	85	85
1955	99	92	85	103	94	82	89	84	96	92
56	99	96	92	107	98	88	90	90	103	98
57	101	98	97	107	100	96	96	97	104	100
58	100	100	100	100	100	100	100	100	100	100
59	105	106	107	113	109	101	112	111	105	105
1960	112	116	119	116	122	110	121	128	114	113
61	114	125	127	117	128	116	127	142	118	119
62	115	132	132	126	134	123	137	156	112	124
63	119	141	137	133	141	130	142	169	113	131
64	128	153	149	141	154	138	160	171	124	140
1965	132	165	157	153	163	141	168	178	125	151
66	134	172	161	170	173	153	173	200	126	160
67	136	179	156	174	182	159	179	216	128	166
68	143	189	175	184	202	164	185	230	135	172
69	146	209	196	192	224	185	204	239	148	181
1970	148	221	212	186	247	196	210	254	152	189
71										
72										
73										
74										

AII 18.

Year	IMPORT PRICES IN 10 MOST IMPORTANT OECD-COUNTRIES, "1963" = 100									
	UK	Sweden	Fed.Rep. of Ger.	USA	Holland	France	Denmark	Italy	Bel&Lux	Norway
48	113.0	104.1	127.6	87.6	116.0	117.0	128.3	133.7	102.0	121.1
49	101.0	102.0	112.2	83.5	103.0	107.4	109.1	117.4	105.1	106.3
1950	86.0	82.7	106.1	90.7	88.0	95.7	92.9	101.0	93.9	92.6
51	114.0	105.1	132.7	113.4	111.0	123.4	118.2	132.6	117.3	111.6
52	112.0	110.2	121.4	107.2	110.0	122.3	115.2	128.3	114.3	111.6
53	102.0	101.0	107.1	103.1	99.0	108.5	105.1	117.4	107.1	104.2
54	101.0	100.0	106.1	105.2	97.0	107.4	101.0	112.0	103.1	98.9
1955	104.0	101.0	108.2	105.2	98.0	106.4	103.0	114.1	103.1	102.1
56	106.0	105.1	110.2	107.2	101.0	110.6	107.1	117.4	106.1	108.4
57	108.0	108.2	112.2	108.2	106.0	116.0	109.1	123.9	109.2	113.7
58	100.0	102.0	102.0	103.1	100.0	106.4	101.0	108.7	102.0	105.3
59	99.0	100.0	99.0	102.1	97.0	98.9	97.0	101.1	100.0	100.0
1960	99.0	100.0	101.0	103.1	97.0	102.1	99.0	100.0	100.0	101.1
61	97.0	98.0	102.0	101.0	99.0	98.9	99.0	97.8	102.0	100.0
62	96.0	96.9	100.0	99.0	99.0	100.0	98.0	97.8	100.0	99.0
63	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
64	103.0	105.0	100.0	102.0	102.0	102.0	101.0	103.0	102.0	101.0
1965	103.0	107.0	103.0	104.0	103.0	104.0	102.0	104.0	101.0	101.0
66	104.0	109.0	104.0	106.0	104.0	105.0	103.0	105.0	102.0	102.0
67	104.0	106.0	103.0	107.0	103.0	105.0	102.0	106.0	100.0	101.0
68	101.0	106.0	100.0	109.0	100.0	102.0	100.0	106.0	101.0	99.0
69	104.0	114.0	105.0	112.0	103.0	104.0	102.0	107.0	104.0	101.0
1970	109.0	122.0	110.0	120.0	110.0	107.0	108.0	111.0	108.0	109.0
71										
72										
73										
74										

AII 19.

Year	COMPETING PRICES, IMPORT PRICE INDEX OF MAIN EXPORTMARKETS			
	Dollar-based index	Exchange rate	Mark-based index	%-change
48	110.0	1.36	149.60	
49	100.7	1.69	170.23	13.79
1950	89.7	2.31	207.30	21.77
51	116.4	2.31	268.94	29.73
52	113.9	2.31	263.20	- 2.13
53	104.0	2.31	240.20	- 8.74
54	102.5	2.31	236.85	- 1.39
1955	104.3	2.31	241.01	1.75
56	107.1	2.31	247.33	2.62
57	109.9	2.57	282.38	14.17
58	101.7	3.21	326.58	15.65
59	99.2	3.20	317.34	- 2.83
1960	99.9	3.21	320.82	1.10
61	99.0	3.22	318.78	- 0.64
62	98.1	3.22	315.79	- 0.94
63	100.0	3.22	322.00	1.97
64	102.2	3.22	329.08	2.20
1965	103.4	3.22	332.95	1.18
66	104.7	3.22	337.13	1.26
67	104.1	3.45	359.15	6.53
68	102.1	4.19	427.80	19.12
69	106.3	4.20	446.46	4.36
1970	112.7	4.18	471.09	5.52
71				
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73				
74				

AIII 1.

	C	I	N	x_{gw}	m_g	a	$\Delta\tilde{U}$	w	p_c	p_i
C	1.493	0.170	0.735	0.183	-0.388	0.924	-4.188	0.506	1.207	0.024
I	0.641	1.221	0.043	0.229	-0.536	0.159	-1.703	0.012	0.391	0.283
N	0.051	0.018	1.053	0.042	-0.040	0.060	-0.308	-0.011	-0.003	-0.015
x_{gw}	-0.004	-0.001	-0.010	0.997	0.005	-0.033	0.122	-0.122	-0.070	0.001
m_g	1.096	0.377	3.985	0.724	0.305	1.086	-5.468	0.046	0.298	-0.193
a	0.176	0.061	0.496	0.131	-0.264	1.198	-0.935	-0.057	-0.005	-0.042
$\Delta\tilde{U}$	-0.039	-0.013	-0.109	-0.029	0.058	-0.262	1.205	0.013	0.001	0.009
w	0.054	0.018	0.242	0.064	-0.129	-0.120	-1.516	1.222	0.667	-0.032
p_c	0.014	0.005	0.035	0.009	-0.019	0.122	-0.451	0.451	1.257	-0.002
p_i	0.014	0.005	0.035	0.009	-0.019	0.122	-0.452	0.452	0.258	0.998
p_{xg}	0.007	0.003	0.018	0.005	-0.010	0.063	-0.235	0.235	0.134	-0.001
p_g	0.030	0.010	0.074	0.020	-0.040	0.257	-0.954	0.954	0.544	-0.005
c	0.479	0.165	0.700	0.173	-0.369	0.803	-3.737	0.056	-0.050	0.027
i	0.627	0.216	0.007	0.220	-0.517	0.037	-1.251	-0.440	0.134	-0.715
G	0.030	0.010	0.074	0.020	-0.040	0.257	-0.954	0.954	0.544	-0.005
X_{gw}	0.004	0.001	0.009	1.002	-0.005	0.030	-0.113	0.113	0.064	-0.001
M_g	1.096	0.377	3.985	0.724	0.305	1.086	-5.468	0.046	0.298	-0.193
D	0.797	0.274	1.347	0.299	-0.294	0.529	-2.539	0.387	0.679	0.037
D'	0.780	0.268	0.353	0.270	-0.266	0.492	-2.341	0.414	0.711	0.054
d'	0.319	0.110	0.327	0.262	-0.250	0.374	-1.914	-0.066	-0.017	-0.096
$p_{d'}$	0.461	0.158	0.027	0.008	-0.016	0.118	-0.427	0.481	0.728	0.150
H	0.039	0.013	0.097	0.026	-0.052	0.336	-1.246	1.245	0.710	-0.007
$\Delta\tilde{I}C$	-0.079	-0.027	-0.303	-0.080	0.161	-0.110	0.568	0.040	0.035	0.035
K	0.444	0.152	-0.052	-0.013	0.026	0.157	0.066	0.083	0.512	0.160
W	0.230	0.079	0.738	0.194	-0.393	1.077	-2.451	1.165	0.662	-0.074
Z	1.464	0.504	1.223	0.275	-0.636	-0.130	-1.914	-0.066	1.127	0.281
$(W+Z)^D$	1.071	0.369	1.237	0.296	-0.649	0.591	-2.745	0.686	1.129	0.132
T_i	0.780	0.268	0.353	0.270	-0.266	0.492	-2.341	0.414	0.711	0.054
x_e	-0.007	-0.003	-0.018	-0.005	0.010	-0.063	0.235	-0.235	-0.134	0.001
x_g	-0.004	-0.002	-0.011	0.821	0.006	-0.038	0.142	-0.142	-0.081	0.001
x	-0.004	-0.001	-0.009	0.672	0.005	-0.031	0.117	-0.116	-0.066	0.001
X_g	0.003	0.001	0.007	0.826	-0.004	0.025	-0.093	0.093	0.053	-0.001
X	0.002	0.001	0.006	0.682	-0.003	0.021	-0.077	0.077	0.044	-0.000
p_x	0.006	0.002	0.015	0.010	-0.008	0.052	-0.193	0.193	0.110	-0.001
m	0.970	0.334	3.527	0.641	0.270	0.961	-4.839	0.041	0.264	-0.171
M	0.955	0.329	3.475	0.632	0.266	0.947	-4.768	0.040	0.260	-0.168
y'	0.149	0.051	-0.505	0.163	-0.385	0.222	-1.153	-0.094	-0.091	-0.077
ΔGAP	-0.205	-0.071	-0.786	-0.207	0.418	-0.285	1.475	0.103	0.090	0.092
d	0.357	0.123	1.333	0.293	-0.281	0.420	-2.146	-0.074	-0.019	-0.108
y	0.205	0.071	0.786	0.207	-0.418	0.285	-1.475	-0.103	-0.090	-0.092
Y	0.757	0.260	0.815	0.216	-0.433	0.425	-1.981	0.474	0.784	0.088
p_y	0.552	0.190	0.029	0.009	-0.016	0.140	-0.506	0.577	0.874	0.180

AIII 2.

	p_{xg}	p_g	c	i	G	X_{gw}	M_g	D	D'	d'
C	0.062	0.191	1.562	0.192	0.191	0.161	-0.205	1.169	-0.029	-0.659
I	0.086	0.249	0.703	1.241	0.249	0.210	-0.289	1.645	-0.157	0.020
N	-0.011	0.020	0.132	0.044	0.020	0.017	-0.022	0.126	-0.007	0.116
x_{gw}	-0.520	-0.001	-0.008	-0.003	-0.001	-0.001	0.001	-0.006	-0.003	0.011
m_g	-0.097	0.425	2.256	0.754	0.425	0.358	-0.465	2.652	-0.117	1.972
a	-0.026	0.068	0.408	0.136	0.068	0.058	-0.057	0.322	0.081	-0.502
$\Delta\tilde{U}$	0.006	-0.015	-0.089	-0.030	-0.015	-0.013	0.012	-0.070	-0.018	0.110
w	-0.025	0.021	0.200	0.066	0.021	0.018	-0.028	0.158	-0.032	-0.173
p_c	-0.001	0.005	0.029	0.010	0.005	0.005	-0.004	0.023	0.009	-0.039
p_i	-0.001	0.006	0.029	0.010	0.006	0.005	-0.004	0.023	0.010	-0.039
p_{xg}	0.999	0.003	0.015	0.005	0.003	0.002	-0.002	0.012	0.005	-0.021
p_g	-0.002	1.012	0.061	0.020	0.012	0.010	-0.008	0.048	0.020	-0.083
c	0.063	0.186	1.533	0.183	0.186	0.157	-0.201	1.146	-0.039	-0.620
i	0.087	0.243	0.674	1.231	0.243	0.205	-0.285	1.623	-0.167	0.059
G	-0.002	1.012	0.061	0.020	1.012	0.010	-0.008	0.048	0.020	-0.083
X_{gw}	0.480	0.001	0.007	0.002	0.001	1.001	-0.001	0.006	0.002	-0.010
M_g	-0.097	0.425	2.256	0.754	0.425	0.358	0.535	2.652	-0.117	1.972
D	0.097	0.309	0.919	0.314	0.309	0.260	-0.155	1.881	-0.039	-0.187
D'	0.112	0.302	0.827	0.283	0.302	0.255	-0.139	0.793	0.966	-0.311
d'	-0.066	0.124	0.818	0.272	0.124	0.104	-0.137	0.782	-0.044	0.721
$p_{d'}$	0.177	0.179	0.008	0.011	0.179	0.151	-0.002	0.011	1.010	-1.032
H	-0.003	0.015	0.080	0.027	0.015	0.013	-0.011	0.063	0.026	-0.109
$\Delta\tilde{I}C$	0.027	-0.031	-0.250	-0.083	-0.031	-0.026	0.035	-0.197	0.014	0.243
K	0.186	0.172	-0.057	-0.010	0.172	0.145	0.007	-0.040	1.021	-0.976
W	-0.051	0.089	0.609	0.202	0.089	0.075	-0.084	0.479	0.049	-0.675
Z	0.379	0.568	0.819	0.294	0.568	0.479	-0.664	3.783	-0.386	-0.932
$(W+Z)^D$	0.208	0.416	0.899	0.313	0.416	0.350	-0.474	2.698	-0.214	-1.013
T_i	0.112	0.302	0.827	0.283	0.302	0.255	-0.139	0.793	0.966	-0.311
x_e	-0.999	-0.003	-0.015	-0.005	-0.003	-0.002	0.002	-0.012	-0.005	0.021
x_g	-0.604	-0.002	-0.009	-0.003	-0.002	-0.001	0.001	-0.007	-0.003	0.012
x	-0.495	-0.001	-0.007	-0.003	-0.001	-0.001	0.001	-0.006	-0.002	0.010
X_g	0.395	0.001	0.006	0.002	0.001	0.825	-0.001	0.005	0.002	-0.008
X	0.326	0.001	0.005	0.002	0.001	0.681	-0.001	0.004	0.002	-0.007
p_x	0.821	0.002	0.012	0.004	0.002	0.683	-0.002	0.010	0.004	-0.017
m	-0.086	0.376	1.996	0.667	0.376	0.317	-0.411	2.347	-0.103	1.745
M	-0.084	0.371	1.967	0.657	0.371	0.312	0.467	2.312	-0.102	1.720
y'	-0.061	0.058	0.512	0.169	0.058	0.049	-0.066	0.375	-0.029	0.455
ΔGAP	0.070	-0.079	-0.649	-0.215	-0.079	-0.067	0.090	-0.511	0.036	0.631
d	-0.073	0.139	0.918	0.305	0.139	0.117	-0.154	0.877	-0.050	-0.157
y	-0.070	0.079	0.649	0.215	0.079	0.067	-0.090	0.511	-0.036	-0.631
Y	0.142	0.294	0.657	0.228	0.294	0.247	-0.310	1.773	-0.024	-0.663
p_y	0.213	0.214	0.007	0.013	0.214	0.181	-0.220	1.262	0.012	-0.032

AIII 3.

	p_d'	H	$\Delta\tilde{IC}$	K	W	Z	$(W+Z)^D$	T_i	x_e	x_g
C	0.094	0.604	0.	0.094	-0.067	0.430	0.570	-0.124	0.005	0.026
I	0.016	0.451	0.	0.016	-0.434	0.603	0.257	-0.174	0.004	0.024
N	0.006	0.007	0.	0.006	-0.015	0.046	0.048	-0.013	0.005	0.031
x_{gw}	-0.003	-0.124	0.	-0.003	0.001	-0.003	-0.003	0.001	-0.000	-0.002
m_g	0.111	0.345	0.	0.111	-0.263	0.790	0.823	-0.227	0.078	0.444
a	0.122	0.030	0.	0.122	-0.048	0.143	0.149	-0.041	0.016	0.089
$\Delta\tilde{U}$	-0.027	-0.007	0.	-0.027	0.010	-0.031	-0.033	0.009	-0.003	-0.019
w	-0.012	0.241	0.	-0.012	-0.023	0.070	0.073	-0.020	0.010	0.056
p_c	0.012	0.458	0.	0.012	-0.003	0.010	0.011	-0.003	0.001	0.006
p_i	0.012	0.459	0.	0.012	-0.003	0.010	0.011	-0.003	0.001	0.006
p_{xg}	0.006	0.239	0.	0.006	-0.002	0.005	0.006	-0.002	0.001	0.003
p_g	0.026	0.969	0.	0.026	-0.007	0.021	0.022	-0.006	0.002	0.012
c	0.082	0.146	0.	0.082	-0.064	0.420	0.560	-0.121	0.004	0.021
i	0.004	-0.008	0.	0.004	-0.430	0.593	0.246	-0.171	0.003	0.018
G	0.026	0.969	0.	0.026	-0.007	0.021	0.022	-0.006	0.002	0.012
X_{gw}	0.003	0.115	0.	0.003	-0.001	0.003	0.003	-0.001	0.000	0.001
M_g	0.111	0.345	0.	0.111	-0.263	0.790	0.823	-0.227	0.078	0.444
D	0.054	0.514	0.	0.054	-0.110	0.324	0.335	-0.093	0.008	0.047
D'	0.050	0.530	0.	0.050	-0.099	0.292	0.302	-0.084	0.003	0.018
d'	0.038	0.041	0.	0.038	-0.095	0.286	0.299	-0.082	0.034	0.191
p_d'	1.012	0.488	0.	0.012	-0.004	0.006	0.003	-0.002	-0.031	-0.174
H	0.034	1.265	0.	0.034	-0.009	0.028	0.029	-0.008	0.003	0.016
$\Delta\tilde{IC}$	-0.011	0.007	1.000	-0.011	0.029	-0.087	-0.091	0.025	-0.011	-0.065
K	1.016	0.410	0.	1.016	0.004	-0.017	-0.021	0.005	-0.034	-0.192
W	0.110	0.271	0.	0.110	0.929	0.213	0.222	-0.061	0.025	0.145
Z	-0.013	1.017	0.	-0.013	-1.088	1.294	0.299	-0.373	-0.043	-0.247
$(W+Z)^D$	0.060	0.814	0.	0.060	-0.109	0.953	1.328	-0.275	-0.012	-0.066
T_i	0.050	0.530	0.	0.050	-0.099	0.292	0.302	0.916	0.003	0.018
x_e	-0.006	-0.239	0.	-0.006	0.002	-0.005	-0.006	0.002	0.999	-0.003
x_g	-0.004	-0.145	0.	-0.004	0.001	-0.003	-0.003	0.001	0.176	0.998
x	-0.003	-0.118	0.	-0.003	0.001	-0.003	-0.003	0.001	0.144	0.818
X_g	0.003	0.095	0.	0.003	-0.001	0.002	0.002	-0.001	0.000	0.001
X	0.002	0.078	0.	0.002	-0.001	0.002	0.002	-0.000	0.000	0.001
p_x	0.005	0.197	0.	0.005	-0.001	0.004	0.005	-0.001	-0.144	-0.817
m	0.098	0.305	0.	0.098	-0.233	0.699	0.729	-0.201	0.069	0.393
M	0.097	0.301	0.	0.097	-0.230	0.689	0.718	-0.198	0.068	0.388
y'	0.023	-0.028	0.	0.023	-0.059	0.179	0.187	-0.051	0.024	0.139
ΔGAP	-0.029	0.018	0.	-0.029	0.075	-0.227	-0.237	0.065	-0.030	-0.170
d	0.043	0.046	0.	0.043	-0.107	0.321	0.335	-0.092	0.038	0.214
y	0.029	-0.018	0.	0.029	-0.075	0.227	0.237	-0.065	0.030	0.170
Y	0.043	0.567	0.	0.043	-0.080	0.233	0.240	-0.067	-0.007	-0.039
p_y	0.014	0.586	0.	0.014	-0.004	0.006	0.003	-0.002	-0.037	-0.208

AIII 4.

	x	X_g	X	p_x	m	M	y'	ΔGAP	d	y
C	0.032	0.196	0.237	0.	-0.206	-0.235	0.152	0.	0.836	0.669
I	0.029	0.254	0.308	0.	-0.279	-0.331	0.983	0.	0.117	0.094
N	0.038	0.020	0.025	0.	-0.021	-0.025	0.035	0.	0.058	0.046
x_{gw}	-0.002	-0.002	-0.002	0.	0.005	0.001	-0.002	0.	-0.020	-0.016
m_g	0.543	0.435	0.526	0.	-0.260	-0.533	0.597	0.	0.525	0.420
a	0.108	0.070	0.085	0.	-0.234	-0.065	0.108	0.	1.034	0.828
$\Delta\tilde{U}$	-0.024	-0.015	-0.019	0.	0.051	0.014	-0.024	0.	-0.226	-0.181
w	0.068	0.021	0.026	0.	-0.114	-0.032	0.052	0.	0.504	0.403
p_c	0.007	0.006	0.007	0.	-0.017	-0.005	0.008	0.	0.073	0.059
p_i	0.007	0.006	0.007	0.	-0.017	-0.005	0.008	0.	0.074	0.059
p_{xg}	0.004	0.003	0.004	0.	-0.009	-0.002	0.004	0.	0.038	0.031
p_g	0.015	0.012	0.014	0.	-0.035	-0.010	0.016	0.	0.155	0.124
c	0.025	0.190	0.230	0.	-0.190	-0.231	0.145	0.	0.762	0.610
i	0.022	0.249	0.301	0.	-0.262	-0.327	0.975	0.	0.043	0.035
G	0.015	0.012	0.014	0.	-0.035	-0.010	0.016	0.	0.155	0.124
X_{gw}	0.002	0.001	0.002	0.	-0.004	-0.001	0.002	0.	0.018	0.015
M_g	0.543	0.435	0.526	0.	-0.260	-0.533	0.597	0.	0.525	0.420
D	0.057	0.316	0.383	0.	-0.157	-0.177	0.249	0.	0.463	0.371
D'	0.022	0.309	0.375	0.	-0.143	-0.160	0.224	0.	0.426	0.341
d'	0.234	0.126	0.153	0.	-0.128	-0.157	0.215	0.	0.359	0.288
p_d'	-0.212	0.183	0.222	0.	-0.016	-0.002	0.009	0.	0.067	0.053
H	0.019	0.016	0.019	0.	-0.046	-0.013	0.021	0.	0.203	0.162
$\Delta\tilde{I}C$	-0.080	-0.031	-0.038	0.	0.143	0.040	-0.066	0.385	-0.630	-0.504
K	-0.234	0.176	0.213	0.	0.022	0.008	-0.008	0.	-0.097	-0.078
W	0.177	0.091	0.110	0.	-0.348	-0.097	0.160	0.	1.538	1.231
Z	-0.302	0.581	0.703	0.	0.031	-0.761	0.233	0.	-0.462	-0.370
$(W+Z)^D$	-0.081	0.425	0.515	0.	-0.198	-0.543	0.248	0.	0.669	0.535
T_i	0.022	0.309	0.375	0.	-0.143	-0.160	0.224	0.	0.426	0.341
x_e	-0.004	-0.003	-0.004	0.	0.009	0.002	-0.004	0.	-0.038	-0.031
x_g	-0.002	-0.002	-0.002	0.	0.005	0.001	-0.002	0.	-0.023	-0.019
x	0.998	-0.001	-0.002	0.	0.004	0.001	-0.002	0.	-0.019	-0.015
X_g	0.001	1.001	0.001	0.	-0.003	-0.001	0.002	0.	0.015	0.012
X	0.001	0.827	1.001	0.	-0.003	-0.001	0.001	0.	0.013	0.010
p_x	-0.997	0.828	1.003	1.000	-0.007	-0.002	0.003	0.	0.031	0.025
m	0.460	0.385	0.466	0.	0.770	-0.472	0.528	0.	0.465	0.372
M	0.473	0.379	0.459	0.	-0.227	0.535	0.521	0.	0.458	0.367
y'	0.170	0.059	0.072	0.	-0.361	-0.076	1.134	0.	0.332	0.266
ΔGAP	-0.207	-0.081	-0.098	0.	0.371	0.103	-0.170	1.000	-1.636	-1.310
d	0.262	0.142	0.172	0.	-0.143	-0.177	0.242	0.	1.403	0.323
y	0.207	0.081	0.098	0.	-0.371	-0.103	0.170	0.	1.636	1.310
Y	-0.047	0.300	0.364	0.	-0.140	-0.355	0.181	0.	0.465	0.372
p_y	-0.254	0.219	0.265	0.	0.231	-0.252	0.010	0.	-1.172	-0.938

AIII 5.

	Y	p_y
C	-0.154	-0.154
I	-0.212	-0.212
N	-0.016	-0.016
x_{gw}	0.002	0.002
m_g	0.121	0.121
a	-0.104	-0.104
$\Delta\tilde{U}$	0.023	0.023
w	-0.051	-0.051
p_c	-0.007	-0.007
p_i	-0.007	-0.007
p_{xg}	-0.004	-0.004
p_g	-0.016	-0.016
c	-0.146	-0.146
i	-0.205	-0.205
G	-0.016	-0.016
X_{gw}	-0.002	-0.002
M_g	0.121	0.121
D	-0.116	-0.116
D'	-0.105	-0.105
d'	-0.099	-0.099
$p_{d'}$	-0.006	-0.006
H	-0.020	-0.020
$\Delta\tilde{I}C$	0.064	0.064
K	0.010	0.010
W	-0.155	-0.155
Z	-0.252	-0.252
$(W+Z)^D$	-0.257	-0.257
T_i	-0.105	-0.105
x_e	0.004	0.004
x_g	0.002	0.002
x	0.002	0.002
X_g	-0.002	-0.002
X	-0.001	-0.001
p_x	-0.003	-0.003
m	0.107	0.107
M	0.105	0.105
y'	-0.153	-0.153
ΔGAP	0.165	0.165
d	-0.111	-0.111
y	-0.165	-0.165
Y	0.828	-0.172
p_y	0.994	0.994

AIV 1.

	const.	g	p_{mg}	F	T_i'	O	m_w	p_x'	$p_x'-1$	$p_{mg}-1$
C	4.085	0.215	0.201	-0.110	0.117	0.718	0.427	0.143	0.151	0.048
I	2.935	0.270	0.089	-0.154	-0.094	0.323	0.536	0.187	0.190	0.103
N	0.785	0.048	0.029	-0.012	-0.014	0.061	0.099	0.014	0.035	-0.031
x_{gw}	-3.082	-0.003	-0.049	0.001	-0.013	-0.004	2.332	0.113	0.826	0.010
m_g	0.690	0.826	-0.408	-0.202	-0.176	1.037	1.694	0.301	0.600	-0.206
a	-1.299	0.148	0.059	-0.037	-0.054	0.188	0.305	0.048	0.108	0.034
$\Delta\tilde{U}$	0.682	-0.032	-0.013	0.008	0.012	-0.041	-0.067	-0.010	-0.024	-0.008
w	2.081	0.071	0.134	-0.018	0.119	0.092	0.149	0.013	0.053	0.017
p_c	2.323	0.011	0.211	-0.003	0.256	0.013	0.022	0.004	0.008	0.002
p_i	1.326	0.011	0.302	-0.003	0.049	0.013	0.022	0.004	0.008	0.002
p_{xg}	-0.172	0.006	0.093	-0.001	0.026	0.007	0.011	0.782	0.004	-0.020
p_g	2.185	0.022	0.187	-0.005	0.104	0.028	0.046	0.008	0.016	0.005
c	1.762	0.204	-0.010	-0.107	-0.139	0.704	0.405	0.139	0.144	0.046
i	1.610	0.260	-0.213	-0.152	-0.143	0.310	0.514	0.183	0.182	0.100
G	2.185	1.022	0.187	-0.005	0.104	0.028	0.046	0.008	0.016	0.005
X_{gw}	-3.255	0.003	0.045	-0.001	0.012	0.003	2.343	0.895	0.830	-0.009
M_g	0.690	0.826	0.592	-0.202	-0.176	1.037	1.694	0.301	0.600	-0.206
D^g	2.864	0.351	0.166	-0.083	0.042	0.422	0.699	0.231	0.247	0.006
D'	2.203	0.318	0.144	-0.075	0.058	0.380	0.630	0.227	0.223	0.037
d'	0.619	0.296	-0.047	-0.073	-0.090	0.376	0.612	0.085	0.217	0.039
p_d'	1.584	0.022	0.191	-0.002	0.148	0.004	0.018	0.142	0.006	-0.002
H	0.660	0.029	0.129	-0.007	0.136	0.037	0.060	0.011	0.021	0.007
$\Delta\tilde{I}C$	1.219	-0.090	-0.026	0.022	0.033	-0.115	-0.186	-0.020	-0.066	-0.021
K	0.907	-0.001	0.147	0.004	0.016	-0.026	-0.030	0.138	-0.011	-0.007
W	0.783	0.220	0.192	-0.054	0.066	0.280	0.454	0.061	0.161	0.051
Z	7.283	0.345	-0.034	-0.331	-0.138	0.376	0.643	0.439	0.228	0.073
$(W+Z)^D$	5.106	0.356	0.099	-0.244	-0.047	1.672	0.692	0.316	0.245	0.078
T_i	2.203	0.318	0.144	-0.075	1.058	0.380	0.630	0.227	0.223	0.037
x_e	0.172	-0.006	-0.093	0.001	-0.026	-0.007	-0.011	-0.782	-0.004	0.020
x_g	-2.510	-0.003	-0.056	0.001	-0.015	-0.004	1.920	-0.044	0.680	0.012
x^g	-2.055	-0.003	-0.046	0.001	-0.013	-0.003	1.572	-0.036	0.557	0.010
X_g	-2.682	0.002	0.037	-0.001	0.010	0.003	1.931	0.738	0.684	-0.008
X^g	-2.215	0.002	0.030	-0.000	0.008	0.002	1.595	0.609	0.565	-0.006
p_x	-0.160	0.005	0.077	-0.001	0.021	0.006	0.023	0.646	0.008	-0.016
m	0.610	0.731	-0.361	-0.179	-0.156	0.917	1.499	0.267	0.531	-0.182
M	0.601	0.721	0.516	-0.176	-0.153	0.904	1.477	0.263	0.523	-0.179
y'	0.622	0.183	0.035	-0.046	-0.072	0.235	0.382	0.038	0.135	0.096
ΔGAP	3.166	-0.233	-0.069	0.058	0.087	-0.298	-0.483	-0.053	-0.171	-0.055
d	1.358	0.332	-0.017	-0.082	-0.100	0.422	0.686	0.095	0.243	0.008
y	1.544	0.233	0.069	-0.058	-0.087	0.298	0.483	0.053	0.171	0.055
Y	3.430	0.259	0.079	-0.060	0.091	0.302	0.504	0.223	0.179	0.053
p_y	1.886	0.026	0.010	-0.002	0.178	0.003	0.021	0.170	0.007	-0.002

AIV 2.

	P_{xg-1}	P_{c-1}	P_{i-1}	P_{g-1}	H_{-1}	Z_{-1}	d'_{-1}	a_{-1}	N_{-1}	$(W+Z)^{D}_{-1}$
C	-0.133	-0.114	0.004	0.023	-0.004	0.112	0.129	0.074	-0.271	0.079
I	-0.164	-0.003	0.044	0.029	-0.005	0.722	0.179	0.220	-0.016	0.306
N	-0.038	0.002	-0.002	0.002	0.001	0.025	0.013	0.008	-0.388	0.057
x_{gw}	-0.982	0.028	0.000	-0.000	0.030	-0.002	-0.002	-0.007	0.004	-0.003
m_g	-0.629	-0.010	-0.030	0.050	0.006	0.439	-0.102	0.152	-1.471	0.981
a	-0.116	0.013	-0.007	0.008	0.001	0.079	0.088	0.041	-0.183	0.178
$\Delta\tilde{U}$	0.025	-0.003	0.001	-0.002	-0.000	-0.017	-0.019	-0.009	0.040	-0.039
w	-0.060	-0.275	-0.005	0.002	0.001	0.039	0.043	-0.429	-0.089	0.087
p_c	-0.008	-0.101	-0.000	0.001	0.000	0.006	0.006	0.026	-0.013	0.013
p_i	-0.008	-0.102	0.155	0.001	0.000	0.006	0.006	0.026	-0.013	0.013
p_{xg}	0.296	-0.053	-0.000	0.000	-0.057	0.003	0.003	0.014	-0.007	0.007
p_g	-0.017	-0.215	-0.001	0.119	0.000	0.012	0.013	0.056	-0.027	0.027
c	-0.125	-0.013	0.004	0.022	-0.004	0.106	0.123	0.048	-0.258	0.667
i	-0.156	0.099	-0.111	0.029	-0.005	0.717	0.173	0.194	-0.003	0.293
G	-0.017	-0.215	-0.001	0.119	0.000	0.012	0.013	0.056	-0.027	0.027
X_{gw}	-0.686	-0.025	-0.000	0.000	-0.027	0.001	0.002	0.007	-0.003	0.003
M_g	-0.629	-0.010	-0.030	0.050	0.006	0.439	-0.102	0.152	-1.471	0.981
D	-0.218	-0.087	0.006	0.036	-0.006	0.183	0.098	0.083	-0.497	0.400
D'	-0.190	-0.093	0.008	0.036	-0.006	0.165	0.089	0.078	-0.130	0.360
d'	-0.237	0.015	-0.015	0.015	0.004	0.158	0.084	0.050	-0.121	0.356
p_d'	0.047	-0.108	0.023	0.021	-0.010	0.006	0.005	0.028	-0.010	0.004
H	-0.022	-0.280	-0.001	0.002	0.000	0.016	0.017	0.072	-0.036	0.035
$\Delta\tilde{I}C$	0.074	-0.009	0.005	-0.004	-0.002	-0.048	-0.054	-0.014	0.112	-0.109
K	0.066	-0.019	0.025	0.020	-0.011	-0.006	-0.009	0.167	0.019	-0.025
W	-0.176	-0.262	-0.011	0.011	0.003	0.118	0.131	-0.389	-0.272	0.265
Z	-0.114	0.015	0.044	0.067	-0.022	0.171	0.212	0.538	-0.451	0.356
$(W+Z)^D$	-0.182	-0.154	0.020	0.049	-0.012	0.182	0.217	0.098	-0.456	0.391
T_i	-0.190	-0.093	0.008	0.036	-0.006	0.165	0.089	0.078	-0.130	0.360
x_e	-0.296	0.053	0.000	-0.000	0.057	-0.003	-0.003	-0.014	0.007	-0.007
x_g	-0.861	0.032	0.000	-0.000	0.034	-0.002	-0.002	-0.008	0.004	-0.004
x	-0.705	0.026	0.000	-0.000	0.028	-0.001	-0.002	-0.007	0.003	-0.003
X_g	-0.565	-0.021	-0.000	0.000	-0.023	0.001	0.001	0.005	-0.003	0.003
X	-0.467	-0.017	-0.000	0.000	-0.019	0.001	0.001	0.004	-0.002	0.002
p_x	0.238	-0.044	-0.000	0.000	-0.047	0.002	0.003	0.011	-0.006	0.005
m	-0.556	-0.009	-0.026	0.044	0.005	0.388	-0.090	0.134	-1.301	0.868
M	-0.548	-0.009	-0.026	0.044	0.005	0.383	-0.089	0.132	-1.282	0.856
y'	-0.153	0.021	-0.012	0.007	0.003	0.099	0.129	0.029	0.186	0.223
ΔGAP	0.192	-0.023	0.014	-0.009	-0.004	-0.125	-0.140	-0.037	0.290	-0.282
d	-0.265	0.017	-0.017	0.016	0.004	0.178	0.094	0.057	-0.492	0.399
y	-0.192	0.023	-0.014	0.009	0.004	0.125	0.140	0.037	-0.290	0.282
Y	-0.136	-0.107	0.014	0.035	-0.008	0.133	0.145	0.071	-0.301	0.286
p_y	0.056	-0.130	0.028	0.025	-0.012	0.007	0.005	0.033	-0.011	0.003

AIV 3.

	$\widetilde{\Delta U}_{-1}$	X_e	X_s	x_s	M_s	m_s	P_m	P_{y-1}	y'_{-1}	d'_{-2}
C	0.171	0.039	0.041	0.006	-0.030	-0.024	-0.020	-0.077	0.304	-0.118
I	0.004	0.049	0.054	0.005	-0.042	-0.032	-0.003	-0.106	1.966	-0.007
N	-0.004	0.009	0.004	0.007	-0.003	-0.002	-0.001	-0.008	0.069	-0.169
x_{gw}	-0.041	-0.001	-0.000	-0.000	0.000	0.001	0.001	0.001	-0.004	0.002
m_g	0.016	0.155	0.092	0.098	-0.068	-0.030	-0.023	0.060	1.194	-0.642
a	-0.019	0.028	0.015	0.020	-0.008	-0.027	-0.026	-0.052	0.216	-0.080
$\Delta\widetilde{U}$	0.004	-0.006	-0.003	-0.004	0.002	0.006	0.006	0.011	-0.047	0.017
w	0.413	0.014	0.004	0.012	-0.004	-0.013	0.003	-0.025	0.105	-0.039
p_c	0.152	0.002	0.001	0.001	-0.001	-0.002	-0.003	-0.004	0.015	-0.006
p_i	0.153	0.002	0.001	0.001	-0.001	-0.002	-0.003	-0.004	0.015	-0.006
p_{xg}	0.080	0.001	0.001	0.001	-0.000	-0.001	-0.001	-0.002	0.008	-0.003
p_g	0.322	0.004	0.003	0.003	-0.001	-0.004	-0.006	-0.008	0.032	-0.012
c	0.019	0.037	0.040	0.005	-0.030	-0.022	-0.017	-0.073	0.289	-0.113
i	-0.149	0.047	0.052	0.004	-0.042	-0.030	-0.001	-0.102	1.950	-0.001
G	0.322	0.004	0.003	0.003	-0.001	-0.004	-0.006	-0.008	0.032	-0.012
X_{gw}	0.038	0.000	0.000	0.000	-0.000	-0.000	-0.001	-0.001	0.004	-0.001
M_g	0.016	0.155	0.092	0.098	-0.068	-0.030	-0.023	0.060	1.194	-0.642
D	0.131	0.064	0.067	0.010	-0.023	-0.018	-0.011	-0.058	0.497	-0.217
D'	0.140	0.058	0.065	0.004	-0.020	-0.016	-0.011	-0.053	0.449	-0.057
d'	-0.022	0.056	0.027	0.042	-0.020	-0.015	-0.008	-0.050	0.431	-0.053
P_d'	0.162	0.002	0.039	-0.038	-0.000	-0.002	-0.003	-0.003	0.018	-0.004
H	0.421	0.005	0.003	0.003	-0.002	-0.005	-0.007	-0.010	0.042	-0.016
$\Delta\widetilde{IC}$	0.013	-0.017	-0.007	-0.014	0.005	0.016	0.002	0.032	-0.131	0.049
K	0.028	-0.003	0.037	-0.042	0.001	0.002	-0.213	0.005	-0.016	0.008
W	0.394	0.041	0.019	0.032	-0.012	-0.040	-0.023	-0.078	0.321	-0.119
Z	-0.022	0.059	0.122	-0.055	-0.097	0.004	0.003	-0.126	0.466	-0.197
$(W+Z)^D$	0.232	0.063	0.090	-0.015	-0.070	-0.023	-0.013	-0.128	0.496	-0.199
T_i	0.140	0.058	0.065	0.004	-0.020	-0.016	-0.011	-0.053	0.449	-0.057
x_e	-0.080	0.999	-0.001	-0.001	0.000	0.001	0.001	0.002	-0.008	0.003
x_g	-0.048	0.175	-0.000	-0.000	0.000	0.001	0.001	0.001	-0.005	0.002
x^g	-0.039	0.144	-0.000	0.181	0.000	0.000	0.001	0.001	-0.004	0.001
X_g	0.031	0.176	0.000	0.000	-0.000	-0.000	-0.001	-0.001	0.003	-0.001
X^g	0.026	0.146	0.174	0.000	-0.000	-0.000	-0.000	-0.001	0.003	-0.001
P_x	0.065	0.002	0.175	-0.180	-0.000	-0.001	-0.001	-0.002	0.007	-0.002
m	0.014	0.137	0.081	0.087	-0.060	0.089	-0.021	0.053	1.057	-0.568
M	0.014	0.135	0.080	0.086	0.068	-0.026	-0.020	0.053	1.041	-0.559
y'	-0.032	0.035	0.012	0.031	-0.010	-0.042	-0.005	-0.076	0.268	0.081
ΔGAP	0.035	-0.044	-0.017	-0.037	0.013	0.043	0.006	0.083	-0.341	0.127
d	-0.025	0.063	0.030	0.047	-0.023	-0.016	-0.009	-0.056	0.484	-0.215
y	-0.035	0.044	0.017	0.037	-0.013	-0.043	-0.006	-0.083	0.341	-0.127
Y	0.160	0.046	0.063	-0.009	-0.045	-0.016	-0.009	-0.086	0.361	-0.131
P_y	0.195	0.002	0.046	-0.046	-0.032	0.027	-0.003	-0.003	0.020	-0.005

AIV 4.

	w_{-1}	y'_{-2}	p'_{x-2}	p_{xg-2}	C_{-1}	y_{-1}
C	0.203	-0.457	0.056	-0.056	-0.679	0.065
I	0.005	-2.948	0.071	-0.071	-0.306	-0.196
N	-0.004	-0.104	0.013	-0.013	-0.057	0.001
x_{gw}	-0.049	0.006	0.307	-0.307	0.003	0.002
m_g	0.018	-1.791	0.223	-0.223	-0.981	0.012
a	-0.023	-0.324	0.040	-0.040	-0.178	0.140
$\Delta\tilde{U}$	0.005	0.071	-0.009	0.009	0.039	-0.031
w	0.489	-0.157	0.020	-0.020	-0.087	0.411
p_c	0.180	-0.023	0.003	-0.003	-0.013	-0.008
p_i	0.181	-0.023	0.003	-0.003	-0.013	-0.008
p_{xg}	0.094	-0.012	0.001	-0.001	-0.007	-0.004
p_g	0.381	-0.049	0.006	-0.006	-0.027	-0.017
c	0.022	-0.434	0.053	-0.053	-0.667	0.073
i	-0.176	-2.925	0.068	-0.068	-0.293	-0.188
G	0.381	-0.049	0.006	-0.006	-0.027	-0.017
X_{gw}	0.045	-0.006	0.309	-0.309	-0.003	-0.002
M_g	0.018	-1.791	0.223	-0.223	-0.981	0.012
D	0.155	-0.746	0.092	-0.092	-0.400	-0.003
D'	0.166	-0.673	0.083	-0.083	-0.360	-0.004
d'	-0.027	-0.646	0.081	-0.081	-0.356	0.006
$p_{d'}$	0.192	-0.026	0.002	-0.002	-0.004	-0.010
H	0.498	-0.064	0.008	-0.008	-0.035	-0.022
$\Delta\tilde{I}C$	0.016	0.197	-0.025	0.025	0.109	-0.002
K	0.033	0.025	-0.004	0.004	0.025	-0.144
W	0.466	-0.481	0.060	-0.060	-0.265	0.551
Z	-0.027	-0.699	0.085	-0.085	-0.356	-0.558
$(W+Z)^D$	0.274	-0.744	0.091	-0.091	-0.391	-0.009
T_i	0.166	-0.673	0.083	-0.083	-0.360	-0.004
x_e	-0.094	0.012	-0.001	0.001	0.007	0.004
x_g	-0.057	0.007	0.253	-0.253	0.004	0.002
x	-0.047	0.006	0.207	-0.207	0.003	0.002
X_g	0.037	-0.005	0.254	-0.254	-0.003	-0.002
X	0.031	-0.004	0.210	-0.210	-0.002	-0.001
p_x	0.077	-0.010	0.003	-0.003	-0.005	-0.003
m	0.016	-1.585	0.197	-0.197	-0.868	0.011
M	0.016	-1.562	0.195	-0.195	-0.856	0.011
y'	-0.038	-0.402	0.050	-0.050	-0.223	0.005
ΔGAP	0.041	0.511	-0.064	0.064	0.282	-0.006
d	-0.030	-0.725	0.090	-0.090	-0.399	0.007
y	-0.041	-0.511	0.064	-0.064	-0.282	0.006
Y	0.190	-0.542	0.066	-0.066	-0.286	-0.006
p_y	0.231	-0.030	0.003	-0.003	-0.003	-0.012