FINAL REPORT OF
PEREZ - GURRERO TRUST FUND (PGTF)
ON THE DEVELOPMENT AND USE OF
A COMPUTER SIMULATION MODEL FOR FORECASTING SUPPLY, DEMAND, AND PRICES OF AGRICULTURAL COMMODITIES IN ASEAN COUNTRIES

28 FEBRUARY 1994

PGTF PROJECT MANAGEMENT
MINISTRY OF AGRICULTURE
REPUBLIC OF INDONESIA

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FINAL REPORT OF
PEREZ-GUERRERO TRUST FUND PROJECT
OF THE DEVELOPMENT AND USE OF A COMPUTER SIMULATION MODEL FOR FORECASTING SUPPLY, DEMAND, AND PRICES OF AGRICULTURAL COMMODITIES IN ASEAN COUNTRIES

I. BACKGROUND

01. The Ministry of Agriculture of the Republic of Indonesia has been awarded grant amounting to a sum of US $ 81,600 from Perez-Guerrero Trust Fund (PGTF) of G-77 to conduct a training programme on Computer Simulation Model for Forecasting Supply, Demand, and Prices of Agricultural Commodities in ASEAN member countries. Indonesia proposed this project to follow up one of the decisions of ASEAN Ministers on Agriculture and Forestry Meeting in 1991 held in Chiang Rai, Thailand in strengthening joint-efforts to promote ASEAN Agricultural Products. The grant was received on 16th April 1993 through The Ministry of Foreign Affairs. The project document of the grant is appended as Annex-11.

02. All ASEAN member countries were invited to participate in the training. Four of the six ASEAN member countries sent their participants, i.e., Indonesia, Malaysia, The Philippines and Thailand. Singapore was not able to sent its participants. Brunei Darussalam had sent the names of its participants, but for some reasons the participants were not able to attend the programme. The Brunei Darussalam information for not attending the training was received shortly before the programme was started.

`II. PROJECT OBJECTIVES

03. The overall goal of this project was to improve policies and plan of production, development, and trade of major agriculture export commodities in ASEAN Countries. Within the overall goal, the specific objective of this project was to improve forecasting methods and information on supply, demand, and prices of major agriculture export commodities. It was envisaged that by the end of the project, participants would able to exchange, share, and utilize data on major agriculture export commodities for forecasting supply, demand, and prices.

III. PROJECT OUTPUTS

04 . The outputs expected from the project were :

(a). Computer Simulation Model

(b). Trained commodity analyst :
- ASEAN Training for Trainers
- National Training for Commodity Analysts

(c). Computer-based system (installed computer hardware and software) for forecasting supply, demand and prices of agriculture export commodities in ASEAN countries.

IV. PROJECT MANAGEMENT

05. This project had been executed by the Ministry of Agriculture (MOA) of the Republic of Indonesia. The project management comprised of the following personnel :

Project coordinator	:	Dr. Ruyat Wiratmadja Director, Bureau for International Cooperation of MOA
Project Manager	:	Dr. I Gusti Ketut Swastika Chief of Multilateral Division, Bureau for International Cooperation of MOA.
Project Secretariat	:	Mr. Ishaka H. Mustamin Chief of Sub Division for International Fund Institutions, Bureau for International Cooperation of MOA.
Liaison between PGTF and Project Management	:	Mr. Mochamad Alimudin Arifin Pohan Directorate for Economic Relations Among Nations of Developing Countries Ministry of Foreign Affairs.
Treasurer	:	Mrs. Inayah Staff, Bureau for International Cooperation of MOA.

06. The Project management was responsible for the following :

(a) Project coordination among participating countries
(b) Control and disbursement of PGTF Funds
(c) Overseeing the project implementation and
(d) Evaluation and Reporting the progress of the project

07. Technical inputs to the project were provided by a project team consisting of :

(a) Project manager
(b) National Consultants

The National Consultants consisted of the following :

(a) Commodity Analyst : Dr. Kaman Nainggolan
Specialist

(b) Training specialist : Mr. Sutrisno

08. The National Consultants were responsible for the following :

(a) Commodity Analyst Specialist :

(1) To coordinate and supervise the project's team members in the collection of data for constructing computer simulation model for forecasting and projecting supply, demand, and prices of major agricultural export commodities.

(2) To analyze data for construction of computer simulation model for forecasting and projecting supply, demand, and prices of major agriculture export commodities.

(3) To construct a computer simulation model including :

- Modelling of commodity markets
  (i) structure model
  (ii) supply model
  (iii) demand model
  (iv) prices model

- Regression analyses
  (i) supply analyses
  (ii) demand analyses
  (iii) price analyses

- Regression analyses using Time Series Package (TSP) software

(i) data inputs and manipulation
(ii) graphs
(iii) regression analysis

- Market Model
  (i) data input
  (ii) specification
  (iii) parameter changes
  (iv) forecasting

- Changing the model
  (i) re-estimation with regression model
  (ii) further simulations

(4) to conduct commodity analysis training classes;

(5) to evaluate results of the training classes;

(6) to prepare final report on the activities carried out during the subscriber assignment .

(b) Training Specialist

(1) to prepare training manuals and training kit including training models for the participants in close coordination with the commodity analyst specialist;
(2) to coordinate and supervise the preparation of training schedules ;
(3) to monitor the implementation of the training programme;
(4) to evaluate the training programme ;
(5) to prepare final report on the activities carried out during the subscriber assignment.

V. IMPLEMENTATION OF THE PROJECT

09. The purpose of this report is to highlight the implementation of the scheduled activities for the period of March 1993 through February 1994. The complete list of activities appears in Table 1.

Table 1

SCHEDULED ACTIVITIES OF THE PROJECT
MARCH 1993 - FEBRUARY 1994

No.	Activities	Proposed Date of Completion	State of Progress
1.	Appointment of consultants	6 March 1993	Completed
2.	Notification to ASEAN countries	10 March - 30 June 1993	Completed
3.	Procurement of hardware : One Wearnes 486DX2-50DT 4MB RAM, 200 MB Harddisk 2 HD FDD, SVGA Monitor Color, Mouse, HP Desk Jet 550C Printer and Accessories.	4 May 1993	Completed
4.	Data Collection	19 April - 30 June 1993	Completed
5.	Model Construction	17 April - 31 July 1993	Completed
6.	ASEAN Training for Trainers	4-15 August 1993	Completed
7.	Preliminary progress report	December 1993	Completed
8.	Post evaluation	January 1994	Completed
9.	Final Report	February 1994	Completed

10. All activities were carried out from March 1993 to February 1994 as follows :

- Appointment of consultants;
- Notification to ASEAN countries;
- Data collection and construction of computer simulation model;
- Procurement of hardware and software (One PC computer);
- ASEAN Training for Trainers;
- Preliminary progress report ;
- Post evaluation ;
- Final Report.

11. The Computer simulation model was developed by the consultant from March to July 1993. Some of the activities for developing the model were data collection, analyses, processing and simulation. Pepper was the commodity used to construct the model. All the training materials prepared by the Consultant is appended as Annex-5 through Annex-10.

ASEAN Training for Trainers

12. The ASEAN Training for Trainers was conducted in the Agricultural In-Service Training Centre (BLPP) Ciawi, Bogor from 4 - 15 August 1993. The training was opened by Dr. Soetatwo Hadiwigeno, Secretary General Ministry of Agriculture. The training attracted strong interest in the region because of the kind of analysis and computer skills to be taught and because of the application to agriculture export commodities, which is of major importance to the governments concerned. However, because of its intensive and applied computer-based character, the training had to be limited to 15 participants from the four countries participated (Indonesia, Malaysia, the Philippines, and Thailand). The list of participants is appended as Annex-1.

13. The objective of the training was to improve capability of participants in methods of analyses of information on supply, demand, and prices of major agriculture export commodities in ASEAN member countries to improve policy and strategy formulation in promoting ASEAN agricultural products. By the end of the training programme, the participants were expected to be able to understand and develop model for forecasting supply, demand, and prices for major agriculture export commodities for their respective countries.

14. Following this ASEAN Training for Trainers, efforts should be made by each participants to conduct a national training for commodity analysis. For this purpose, the trainers would become instructors for the National Training of Commodity Analysis their respective countries.

15. The programme of the ASEAN Training for Trainers included ;

- Use of Personal Computer,
- Spreadsheet programme (Lotus),
- Regression Analysis,
- Software for regression analysis (TSP),
- Modelling and policy formulation for commodity markets,
- An annual model of the world pepper economy as an example.

16. The training started on Thursday, 5 August 1993 and closed on Saturday, 14 August 1993. Daily training sessions were held from 8 a.m. to 5.30 p.m. with two short coffee breaks and a lunch break. Details of the training programme is appended as Annex-2.

17. The training commenced with an introduction by the consultant on modelling of commodity markets and long-term and short-term outlook. This introduction gave a description of the model including its mathematical presentation as well as economic interpretation of the whole model.

18. The consultants gave detailed explanations of the theoretical and computational bases used to calculate "normal production" toward the year 2000. The method utilized historical data and, where necessary, assumptions on total area planted, new area planted, replanting, and uprooting to arrive at a calculation of productive area in a given year as broken down by the year of planting and therefore by the age of the trees in the area. Production was then calculated by use of yields related to technical change, both of the type that is embodied in the quality of the clones and of the type that is related to the growing conditions in a given year using trees of various ages and qualities.

19. Discussions took place on a number of technical features of the models for the smallholding and estate sectors. The Lotus worksheets were used for computation as well as data availability and requirements of the model. Considerable time was spent by the participants utilizing personal computers to carry out exercises to familiarize themselves with the models. The participants also ran computer simulations under alternative assumptions, such as the value of Indonesian production to the year 2000 and the effects on world consumption, prices and production in other countries under various assumptions about Indonesian production levels and other conditions. Important components of the model for the smallholdings and estate sectors were reviewed and improvements were made in these models on the basis of new data and other information provided by the participants. It was suggested that desegregation of the models for both the estate and the smallholdings sector should lead to improve results.

20. The consultant gave detailed explanations of the structure and use of the Lotus worksheet "ESIPEP" which contained the annual model of supply, demand and price of pepper and provided forecasts to the year 2000. The consultant had prepared for this purpose a note entitled "Guide to the Lotus worksheet ESIPEP.WK1 and the annual model of the pepper market". The model utilized the projections of "normal production" that resulted from the above mentioned annual models. It included influences of price and other factors on normal production, as well as explanatory relations for demand and price. Extensive discussions took place on a number of questions on the annual approach.

21. The participants carried out exercises using personal computers to familiarize themselves with the annual model of supply, demand, and prices. They also undertook regression analysis in an effort to further improve the estimated structural relationships for production, consumption and price, which could then be incorporated in the model. In a discussion on these exercises, the participants made suggestions regarding the inclusion of exchange rates and social factors in smallholdings, supply function.

22. The participants expressed strong interest in extending the projections to the year 2020 and making other improvements in the models for Indonesian smallholdings and estates and in the annual model of supply, demand and prices. To do this, more complete data would be needed, particularly on the smallholder sector. The participants would undertake efforts to improve the data base for the model. Development of a desegregated world demand model would also be highly useful. It was recognized that the model could be used for forecasting, and for use in making decisions on new planting, replanting and uprooting of pepper area.

The participants requested that the consultants provide further assistance for the purpose of carrying out the above activities, and emphasized the need to have another national training of this type.

23. The training also strongly felt that after completion of the programme, it would be beneficial for participants from the ASEAN member countries to inform each other on updating and other improvements that they had made, particularly as regards supply projections, and to coordinate further work on the simulation model.

24. At the end of the training, an evaluation exercise was conducted to assess the usefulness of the training. Details of results of the evaluation is appended as Annex-3.

National Training for Commodity Analyst

25. So far, only Indonesia of the four (4) participating countries had conducted the national training for commodity analysts. The Indonesian national training took place at Agricultural In-Service Training Centre (BLPP) Ciawi, Bogor from 31 August - 11 September 1993. The Training was organized by the Bureau of Agricultural Personnel Training of Agency for Agricultural Education and Training (AAET) and Bureau of International Cooperation, Ministry of Agricultural (MOA). Financial support for the Training was given by the Government of Indonesia. The Training was opened by Mr. Abdurrazak, Director of Bureau for Agricultural Personnel Training, Agency for Agricultural Education and Training and was attended by 19 officials from government agencies, private organizations and research institutions. The list of participants is appended as Annex-4.

26. The purpose of the Indonesian National Training was to introduce to users in the country forecasting model of agricultural commodities and give them hands-on experience in the use of the model as well as to exchange views on its possible applications. In addition, the participants were also exposed to the possible future work to be done to update the data base or otherwise improve the model.

27. The training programme of the National Training for Commodity Analysts consisted of the Programme of ASEAN Training for Trainers. All participants from ASEAN Training for Trainers from Indonesia became Instructors for the national programme.

Post Evaluation of ASEAN Training for Trainers

28. For the purpose of post evaluation, the Project Manager has travelled to Manila, Bangkok, and Kuala Lumpur to discuss with the ex-trainees the progress made by them on the application of knowledge and skills obtained during their training in Indonesia. The six-day travel was made in January 1994. Results indicated that the ex-participants have tried very hard to apply their working knowledge on their daily office activities. Depending on the priorities of their respective office programmes, the application of the knowledge and skill for forecasting ranges from intensive to less intensive effort.

29. The Philippines. There were three participants from this country. One of them has at present been moved to other office which has completely different function than forecasting. The other two participants have been actively engaged in forecasting supply of rice and maize. The SAS programme has been used to prepare and analyze data forecasting. TSP and Lotus Programme have been occasionally used.

One of the participants is also preparing a proposal to include coconut in commodity modelling. In general, it can be said that the training programme has positive impact on the improvement of the participants skills in doing their forecasting activities.

30. The PGTF Project Manager suggested that a seminar be held to prepare and organize a training on commodity analysis. The ex-participants' supervisor agreed to hold such seminar in the earliest possible time.

31. Thailand. There was only one participant from this country. After coming back from the training in Indonesia, the participant was actively engaged in forecasting important Thai agriculture export commodities in relation to GATT agreement. The programme package utilized in forecasting export commodities under the GATT agreement is different than TSP and Lotus so that it was difficult for the participant to accommodate her knowledge and skill obtained during the training. It was however mentioned that the training has helped her greatly in understanding the forecasting principles used in her activities.

32. The ex-participants mentioned that it was not possible for her to prepare a training programme for commodity analyst in the near future due to different emphasize of office programme activities set forth by her supervisor.

33. Malaysia. The three participants from Malaysia indicated that they were busy with other activities than forecasting so that they were not able to apply their knowledge and skills in forecasting five months after the training. One of the participants however was successful in proposing to

the Government of Malaysia that a commodity forecasting aspect with the use of regression model be included in a training programme for doctoral candidates in May 1994. During the discussion with the ex-participants, it was indicated that they are going to prepare a project on forecasting of supply and demand of the Malaysian import of vegetable from Indonesia because Malaysia is the main importer of the Indonesian vegetable.

34. Upon the question on the possibility of organizing a training programme on commodity analysis, the ex-participants responded that a national training institution has been working on such programme. One of the ex-participants mentioned that he is at present actively engaged in preparing curriculum development for commodity analysis within the framework of the Operational Research Programme of the Malaysian National Training Institute.

ANNEX-1

LIST OF PARTICIPANTS OF
ASEAN TRAINING FOR TRAINERS

PARTICIPANT OF
THE TRAINING ON DEVELOPMENT AND USE OF COMPUTER SIMULATION MODEL FOR FORECASTING SUPPLY, DEMAND, AND PRICES OF AGRICULTURAL COMMODITIES IN ASEAN COUNTRIES

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3. **Mr. Hj. Munir Rashidy bin Hj.Osman**
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4. **Ms. Nenita Tumangday-Yanson**
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10. **Mr. Sadullah Muhdi**
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11. **Mrs. Magda Adriani**
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12. **Mr. Muchtar**
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15. **Mr. Sumidjo PWR**
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ANNEX-2

PROGRAMME OF
ASEAN TRAINING FOR TRAINERS

PROGRAMME OF
THE TRAINING ON DEVELOPMENT AND USE OF
COMPUTER SIMULATION MODEL FOR FORECASTING SUPPLY,
DEMAND, AND PRICES OF AGRICULTURAL COMMODITIES
IN ASEAN COUNTRIES

Date	**Activities**
Wednesday, 4 August 1993	Arrival of the Participants
Thursday, 5 August 1993	
08.30 - 09.30	Opening Address
09.30 - 10.00	Coffee Break
10.00 - 12.00	Introduction and Review of the Course
12.00 - 13.00	Lunch Break
13.00 - 15.00	Introduction to modelling of commodity markets
15.00 - 15.30	Coffee Break
15.30 - 17.30	Discussion
Friday, 6 August 1993	
08.00 - 10.00	Model Structure Hypothetical Example
10.00 - 10.15	Coffee Break
10.15 - 12.15	Continued
12.15 - 13.15	Lunch Break
13.15 - 15.15	Simulation
15.15 - 15.30	Coffee Break
15.30 - 17.30	Modelling Pepper Economy
Saturday, 7 August 1993	Regression Theory
08.00 - 10.00	Supply Analysis, Demand Analysis
10.00 - 10.15	Coffee Break
10.15 - 12.15	Price Analysis
12.15 - 13.15	Lunch Break
13.15 - 15.15	Lotus & TSP
15.15 - 15.30	Coffee Break
15.30 - 17.30	Continued

Sunday, 8 August 1993

09.00 - 17.00	Additional class, Discussion and exercises

Monday, 9 August 1993 — Regression using TSP

08.00 - 10.00	Data input and manipulation graphs
10.00 - 10.15	Coffee Break
10.15 - 12.15	Regression analysis exercises
12.15 - 13.15	Lunch Break
13.15 - 15.15	Continued
15.15 - 15.30	Coffee Break
15.30 - 17.30	Continued

Tuesday, 10 August 1993

08.00 - 10.00	Data input
10.00 - 10.15	Coffee Break
10.15 - 12.15	Estimation of parameter
12.15 - 13.15	Lunch Break
13.15 - 15.15	Estimation
15.15 - 15.30	Coffee Break
15.30 - 17.30	Estimation continued
19.30 - 22.00	Exercises

Wednesday, 11 August 1993 — Changing the model

08.00 - 10.00	Estimation
10.00 - 10.15	Coffee Break
10.15 - 12.15	Estimation
12.15 - 13.15	Lunch Break
13.15 - 15.15	Estimation
15.15 - 15.30	Coffee Break
15.30 - 17.30	Estimation
19.30 - 22.00	Exercises

Thursday, 12 August 1993 Discussion of result

08.00 - 10.00	Re-estimation
10.00 - 10.15	Coffee Break
10.15 - 12.15	Continued
12.15 - 13.15	Lunch Break
13.15 - 15.15	Combining results of estimation
15.15 - 15.30	Coffee Break
15.30 - 17.30	Continued
19.30 - 22.00	Exercises

Friday, 13 August 1993

08.00 - 10.00	Simulation Exercises
10.00 - 10.15	Coffee Break
10.15 - 11.45	Applicability
11.45 - 13.15	Lunch Break
13.15 - 15.15	Continued
15.15 - 15.30	Coffee Break
15.30 - 17.30	Improvements Cost
19.30 - 22.00	Exercises

Saturday, 14 August 1993

08.00 - 10.00	Forecasting
10.00 - 10.15	Coffee Break
10.15 - 12.15	Discussion for Improvements
12.15 - 13.15	Lunch Break
13.15 - 15.15	Review of Training
15.15 - 15.30	Coffee Break
15.30 - 17.30	Planning for further action in each country
19.00 - 21.00	Closing ceremony

Sunday, 15 August 1993 Departure of all participants to each country

ANNEX-3

TRAINING EVALUATION OF
ASEAN TRAINING FOR TRAINERS

TRAINING EVALUATION OF ASEAN TRAINING FOR TRAINERS

A. TRAINING COMPONENTS

1. Most of the participants responded that the time allocated for theoretical background on regression analysis was sufficient 67 percent. Nevertheless, 33 percent of the participants suggested the time be extended for discussing theoretical background provided in the training. Therefore, for future simulation training, topics on theoretical background should be given sufficient time, especially if participants have insufficient experience in theory or application, including application of software, e.g., Lotus, despite the fact that participants were required to have minimum standard of knowledge of topics given in the training.

2. Laboratory practices using computers were considered sufficient. Time allocated for laboratory practices was appropriate.

B. USEFULNESS

Most participants considered the model developed in the training courses could be used in their modelling-works. Techniques for model-building were provided sufficiently, both in theoretical as well as practical aspects.

C. NEED FOR FURTHER TRAINING

1. Most participants considered the model developed in the training courses could be used in their modelling-works. Techniques for model-building were provided sufficiently, both in theoretical as well as practical aspects.

2. Most participants had knowledge and were familiar with the Lotus and TSP programmes used to operate the model. High performance was showed by the participants in class participation and no more training on the application of those programmes (Lotus, TSP, Regression Analysis, ESIPEP) is needed for some 72 - 82 percent of the participants.

3. Most participants (80 percent) considered that application of regression analysis was enough for the purpose of the model. Presentation exercises and discussion among the participants during the class had helped participants to understand regression analysis.

4. ESIPEP application through Lotus spread-sheet had confused most participants for the first few days because the programme was quite new for them. ESIPEP is the final model for Pepper built by the Dr. Smit and Mr. Bade from ESI-University. The model consists of production side, demand (consumption) side and price side of pepper for the whole world. By the end of the training, participants (80 percent) got familiar for operating the model and said no more training in the use of ESIPEP is needed.

5. Seventy eight percent of the participants felt confidence with the model (ESIPEP). Only 18.6 percent expressed their need to improve the model.

Some 80 percent of the participants confidence with the results. However, it was believe that participant's pre-qualification such as knowledge of Lotus and TSP programmes, regression analysis, and the educationed background which includes economics and statistics supports most of the success of the training. Therefore, this pre-qualifications should be fulfilled for similar training.

PARTICIPANT RESPONSES IN %

A	THE COMPONENTS OF THE TRAINING	too long (%)	OK (%)	too brief (%)	Total (%)
a.	Introduction to LOTUS	0	53.33	46.67	100
b.	Introduction to regression analysis				
	- theory	0	66.67	33.33	100
	- application	0	64.29	35.71	100
c.	Introduction to TSP	6.67	80.00	13.33	100
d.	Practising LOTUS	0	80.00	20.00	100
e.	Practising regression analysis and TSP	0	80.00	20.00	100
f.	Practising the transfer of data between LOTUS and TSP	0	86.67	13.33	100
g.	Introduction to the annual ESIPEP	0	80.00	20.00	100
h.	Practising the working of the model	0	80.00	20.00	100
i.	Lengh of the training	13.33	73.33	13.33	100
	A V E R A G E	2.00	74.43	23.57	100

B.	USEFULNESS OF THE TRAINING	Yes (%)	Perhaps (%)	No (%)	Total (%)
a.	Can the annual model be used in your work?	73.33	26.67	0	100
b.	Will the annual model be used in your works?	73.33	26.67	0	100
c.	Will you be using the tecgniques discussed at this Workshop (Lotus, TSP) ?	66.67	33.33	0	100
d.	Did the training provide sufficient training for these techniques ?	86.67	13.33	0	100
e.	Did to workshop provide sufficient training for the use of the annual model ?	85.71	14.29	0	100
	AVERAGE	77.14	22.86	0	100

C.	NEED FOR FURTHER TRAINING	Yes (%)	Perhaps (%)	No (%)	Total (%)
a.	Is it necessary to receive more training in LOTUS	13.33	5.00	81.67	100
b.	Is it necessary to receive more training in TSP	17.67	10.00	72.33	100
c.	Is it necessary to receive more training in regression analysis ?	16.67	3.33	80.00	100
d.	Is it necessary to receive more training in the use of ESIPEP	13.33	6.67	80.00	100
e.	Is it necessary to improve ESIPEP	18.67	3.33	78.00	100

ANNEX-4

LIST OF PARTICIPANTS OF NATIONAL TRAINING FOR COMMODITY ANALYST

LIST OF PARTICIPANTS
NATIONAL TRAINING ON THE DEVELOPMENT AND USE OF A COMPUTER SIMULATION MODEL FOR FORECASTING SUPPLY, DEMAND, AND PRICES OF AGRICULTURAL COMMODITIES
CIAWI, 31 AUGUST - 11 SEPTEMBER 1993

1. Mr. Widodo Rohadi
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3. Mr. Abdul Hamid
   Bureau for International Cooperation,
   Ministry of Agriculture
   Jl. Harsono RM No. 3
   Jakarta Selatan

4. Mr. Achmadi
   Bureau of Planning
   Ministry of Agriculture
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   Jakarta Selatan

5. Mr. Syuhaeri
   Association of Indonesian Pepper Exporters
   Jl. Roa Malaka Selatan 35
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6. Mr. Miftakhul Kiron
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Jakarta Pusat

7. Mr. Edi Sudaryatno
Agency of Agricultural Extention and Training
Ministry of Agriculture
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Jakarta Selatan

8. Ms. Ella Rosalawati
Agency of Agricultural Extention and Training
Ministry of Agriculture
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Jakarta Selatan

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ANNEX-5

MICRO TIME SERIES PROCESSOR 6.53

MICRO TIME SERIES PROCESSOR 6.53

Dr. Kaman Nainggolan

Workshop
The Development and Use of Computer Simulation Model
for Forecasting Supply, Demand, and Prices of Agricultural Commodities
in ASEAN Countries

August 4 - 15, 1993
Ciawi - Bogor, INDONESIA

From direktori C:\TSP65 we call :
C:\TSP65\TSP (Press enter)
The TSP screen we look :

```
MICRO
TSP
                                   Version
                                     6.53

          by David M. Lilien

       Copyright (C) 1983-1989
    Quantitative Micro Software
         All Rights Reserved

              SN 600000

range                | series: current=   maximum= |      output LPT1:
         No work file in memory -  Use CREATE or LOAD command
current SMPL              | path C:\DATA\                  print POFF
>

F1-BREAK  F2-LAST COMMAND | F3-FILES   F4-DATA   F5-STATISTICS  F6-TSP CONTROL
```

```
═══════════╡ TSP Control ╞═══════
(1) End session/Exit to DOS   EXIT
(2) Run a MicroTSP program    RUN
(3) Run DOS commands          SYSTEM
(4) Print output settings
(5) Configure for hardware    CONFIG    <-
(6) Session options           OPTION
(7) Report on memory use      FREMEM
(8) Update & Clear screen     C
 F1 Break (F3-F6 menus)
```

```
   Press ENTER to keep the current default
Default data drive or path ?  C:\DATA\
 Auto C(atalog) // Y
```

```
══════════════════════╡ Printer Type ╞══════════════════════
(0) No printer
(1) Epson MX,FX,EX & LX, IBM Graphics                            <-
(2) Okidata with IBM or plug'n play ROM
(3) Star Gemini
(4) IBM Proprinter
(5) Epson JX or LQ series
(6) HP LaserJet (serial)
(7) HP LaserJet Plus/Series II standard memory (parallel)
(8) HP LaserJet Plus/Series II with added memory board
(9) HP Think Jet
(A) Xerox 4045
(B) Toshiba P1351 & P351
(C) Other printer (no graphics)
 F1 Break - cancel procedure
```

```
═══════╡ Printer Port ╞═══════
(1) LPT1:                          <-
(2) LPT2:
(3) LPT3:
(4) Other
 F1 Break - cancel procedure
```

```
Top of form ? (y/n) Y
 Standard column width ? (80,132) 80
```

```
            Pen Plotter
(0) No plotter or MicroTSP not on hard disk
(1) HP7470
(2) HP7475
(3) HP7550
(4) HP7510
 F1 Break - cancel procedure
```

```
                          Screen Output
(1) IBM Monochrome Adapter (printer graphics only)
(2) CGA - IBM Color Graphics - COMPAQ Dual Mode - EGA with 64K (640x200)
(3) EGA with 128k - IBM Enhanced Graphics (640x350)
(4) MCGA - VGA monochrome - PS/2 Models 25,30 & monochrome (640X480)
(5) VGA color - PS/2 Models 50 and above (640x480)
(6) Hercules Monochrome Graphics (720x348)
(7) AT&T 6300 - COMPAQ Portable III & 386 (640x400)
(8) AT&T Display Enhancement Board (640x400)
(9) Paradise Professional - AST VGA Plus (800x600)
(A) Video-7 VRAM (800x600 or 1024x768)
(B) ATI VGA Wonder (800x600 or 1024x768)
(C) Tecmar VGA/AD (800x600)
(D) Orchid Designer VGA - Tseng Labs ET-3000 (800x600 or 1024x768)
 F1 Break - cancel procedure
Activate color (color monitors only) ? (y/n) Y
```

COLOR MENU

********	COLOR 8	COLOR 16	COLOR 24	COLOR 32	COLOR 40	COLOR 48	COLOR 56
********	COLOR 9	COLOR 17	COLOR 25	COLOR 33	COLOR 41	COLOR 49	COLOR 57
********	COLOR 10	COLOR 18	COLOR 26	COLOR 34	COLOR 42	COLOR 50	COLOR 58
********	COLOR 11	COLOR 19	COLOR 27	COLOR 35	COLOR 43	COLOR 51	COLOR 59
********	COLOR 12	COLOR 20	COLOR 28	COLOR 36	COLOR 44	COLOR 52	COLOR 60
********	COLOR 13	COLOR 21	COLOR 29	COLOR 37	COLOR 45	COLOR 53	COLOR 61
********	COLOR 14	COLOR 22	COLOR 30	COLOR 38	COLOR 46	COLOR 54	COLOR 62
********	COLOR 15	COLOR 23	COLOR 31	COLOR 39	COLOR 47	COLOR 55	COLOR 63

```
Suggestions: [Main=56,Highlight=11,Menu=17]
Main text color // 2
Highlight (status window, etc.) color // 8
Menu color ?  50
            Screen Graphics
(1) Monochrome/White on Black
(2) Monochrome/Black on White
(3) Monochrome/White on Blue (EGA/VGA)
(4) Color on Black (EGA/VGA)              <-
(5) Color on White (EGA/VGA)
 F1 Break - cancel procedure
```

```
range                          | series: current=   maximum=  |      output LPT1:
              No work file in memory -  Use CREATE or LOAD command
current SMPL                   |  path C:\DATA\                      print POFF
```

```
Default data drive or path // C:\TSP65\DATA\
Auto C(atalog) // Y
Printer Type // Epson MX,FX,EX & LX, IBM Graphics
Printer Port // LPT1:
Top of form // Y
Standard column width // 80
Pen Plotter // No plotter or MicroTSP not on hard disk
Screen Output // VGA color - PS/2 Models 50 and above (640x480)
Activate color (color monitors only) // Y
Main text color // 2
Highlight (status window, etc.) color // 8
Menu color // 50
Screen Graphics // Color on White (EGA/VGA)

Is this o.k. ? (y/n) Y
```

And the TSP Screen

```
  range                      | series: current=   maximum= |      output LPT1
            No work file in memory -  Use CREATE or LOAD command
  current SMPL               |  path C:\TSP65\DATA\               print POFF

>




F1-BREAK  F2-LAST COMMAND | F3-FILES   F4-DATA   F5-STATISTICS  F6-TSP CONTROL
```

MICROTSP MENUS

MENU 1 <- F3

```
              File Operation
(1) Work files (begin session)
(2) Data bank operations
(3) Disk directory          DIR
(4) Change directory        CD
(5) Edit a text file        EDIT
(6) Rename a file           REN
(7) Delete a file           DEL
(8) Display file            TYPE
(9) Read Text-Lotus-DIF     READ
(A) Write Text-Lotus-DIF    WRITE
 F1 Break (F3-F6 menus)
```

1 ->

```
                 Work Files
(1) Create a new WF in RAM    CREATE
(2) Load a WF from disk       LOAD
(3) Save a WF to disk         SAVE
(4) Expand the sample range   EXPAND
(5) Sort data by series       SORT
 F1 Break (F3-F6 menus)
```

2 ->

```
              Data Bank Operation
(1) Fetch series from DB file   FETCH
(2) Store series in DB file     STORE
(3) Display DB file comment     LABEL
(4) Append DB file comment      LABEL(A)
(6) Convert DB file frequency   CONV
(7) Fetch Citibase series       CFETCH
(8) Display Citibase comment    CLABEL
(9) Copy Citibase to DB file    CCOPY
 F1 Break (F3-F6 menus)
```

9 ->

```
              Data File Format
(S) Data ordered by series
(O) Data ordered by observation
(C) Lotus .PRN - series in columns
(R) Lotus .PRN - series in rows
(W) Lotus .WKS - series in columns
(X) Lotus .WKS - series in row
(D) DIF [Data Interchange Format]
(I) Inverted DIF
(H) Header file (READ ONLY)
 F1 Break - cancel procedure
```

```
10 ->  ══════╡ Data File Format ╞══════
       (S) Data ordered by series
       (O) Data ordered by observation
       (C) Lotus .PRN - series in columns
       (R) Lotus .PRN - series in rows
       (W) Lotus .WKS - series in columns
       (X) Lotus .WKS - series in row
       (D) DIF [Data Interchange Format]
       (I) Inverted DIF
       (H) Header file (READ ONLY)
        F1 Break - cancel procedure
```

```
MENU 2 <- F4

══════╡ Data Management ╞══════
(1) Set sample range        SMPL
(2) Generate by equation    GENR
(3) Data editor             DATA
(4) Seasonal adjustment     SEAS
(5) Groups of series        GROUP
(6) Rename series in WF     R
(7) Delete series from WF   D
(8) Graphics
(9) Show data table         SHOW
(A) Print data table        PRINT
 F1 Break (F3-F6 menus)
```

```
8 ->  ══════╡ Graphics Command ╞══════
      (1) Line graph          PLOT
      (2) Scatter diagram     SCAT
      (3) Bar graph           BAR
      (4) Pie chart           PIE
      (5) Histogram           HIST(G)
      (6) Load a graph file   LGRAPH
      (7) Print a graph file  PGRAPH
       F1 Break (F3-F6 menus)
```

MENU 3 <- F5

```
         Statistical Operation
(1) Descriptive & test statistics
(2) Single equation estimation
(3) Equations and forecasting
(4) System (file) estimation      SYS
(5) Vector Autoregression         VAR
(6) Solve a model (file)          SOLVE
(7) Edit system or model file     EDIT
(8) Exponential smoothing         SMOOTH
 F1 Break (F3-F6 menus)
```

1 ->

```
             Descriptive Statistic
(1) Descriptive (means.sd.max-min.covar) COVA
(2) Descriptive (no covariance matrix)   COVA(M)
(3) Histogram                            HIST
(4) Auto & Partial correlograms          IDENT
(5) Cross correlogram                    CROSS
 F1 Break (F3-F6 menus)
```

2 ->

```
           Single Equation Estimation
(1) Ordinary Least Squares & ARMA     LS
(2) OLS (White Covariance & S.E.)     LS(H)
(3) Two-Stage Least Squares & ARMA    TSLS
(4) Nonlinear Least Squares           NLS
(6) Weighted Least Squares            LS(W)
(5) Weighted Two-Stage Least Squares  TSLS(W)
(7) Weighted Nonlinear Least Squares  NLS(W)
(8) Starting values for NLS           PARAM
(9) Logit  - binary dependent var.    LOGIT
(A) Probit - binary dependent var.    PROBIT
 F1 Break (F3-F6 menus)
```

3 ->

```
            Equation Operation
(1) Show the equation in RAM     SHOWEQ
(2) Fetch an equation from disk  FETEQ
(3) Store an equation to disk    STOREQ
(4) Set or display coef. vector  PARAM
(5) Fit-static simulation        FIT
(6) Forecast-dynamic simulation  FORCST
 F1 Break (F3-F6 menus)
```

MENU 4 <- F6

```
═══════════╡ TSP Control ╞═══════════
(1) End session/Exit to DOS   EXIT
(2) Run a MicroTSP program    RUN
(3) Run DOS commands          SYSTEM
(4) Print output settings
(5) Configure for hardware    CONFIG
(6) Session options           OPTION
(7) Report on memory use      FREMEM
(8) Update & Clear screen     C
 F1 Break (F3-F6 menus)

          4 -> ═══════════════╡ Print Setting ╞═══════════════
                (1) User specified printing            POFF
                (2) Always print statistical results   PON
                (3) Print commands & stat. results     TRACE
                (4) Direct output to printer or file   OUTPUT
                 F1 Break (F3-F6 menus)
```

MENU 1 (FILE OPERATIONS)

HEADINGS	KEYS	COMMAND	EXPLANATION
MENU1	F3	KEYS	
Disk directory	3	DIR or CAT	Catalog files on the data disk dir *.*
Change directory	4	CD or CHDIR	Change current default direktory cd c:\datatsp
Edit a text file	5	EDIT	Create and modify models and other text files
Rename a file	6	REN	Rename a file ren data.txt data1.txt
Delete a file	7	DEL	Delete a file del data.txt
Display file	8	TYPE	Type contents of a text file type data1.txt
Read Text-Lotus-DIF	9	READ	Read files in lotus worksheet format, lotus PRN format, DIF format and other formats read rice.wk1
Write Text-Lotus-DIF	A	WRITE	Write files in lotus format, etc.

MENU 1.1 and 1.2

HEADINGS	KEY	KEY	COMMAND	EXPLANATION
MENU1	F3			
WorkFiles	1	1	CREATE	to start a work file <u>create a 1968 1990</u>
		2	LOAD	to load a workfile from disk <u>load ricedat</u>
		3	SAVE	to save a workfile to disk <u>save ricedat</u>
		4	EXPAND	to lengthen workfile <u>expand 54.1 95.4</u>
		5	SORT	Sort the workfile based on value of one or more series <u>sort ricedat</u>
Data bank operations	2	1	FETCH	Fetch a series from disk to RAM (for files previously created by STORE) <u>fetch x1 x2 x4</u>
		2	STORE	Store time series in data disk <u>Store area yield cons</u>
		3	LABEL	Label a databank file, also display the information store with the series <u>label c:\tps65\data</u> <u>label(p) gnp</u>
		4	LABEL(A)	
		6	CONV	Frequency convertion-creates a new series (eq. quartely to annual) <u>conv(Q,A) PROD PRODQ</u>
		7	CFETCH	Fecth a series from CITIBASE into RAM
		8	CLABEL	Read a CITIBASE series description
		9	CCOPY	Copies a series from CITIBASE to disk

MENU 2 (DATA MANAGEMENT)

HEADINGS	KEYS	COMMAND	EXPLANATION
MENU 2	F4	KEYS	
Set sample range	1	SMPL	Define the sample of analysis smpl 70 90 smpl 70.1 90.12
Generate by equation	2	GENR	Generate a new series, based on a formula (+,-,/,*) genr yield=prod/area genr ly=log(y)
Data editor	3	DATA	Invoke the data editor; for entering extending, and correcting time series data data area prod
Seasonal adjustment	4	SEAS	Carry out seasonal adjusment(either ratio to moving average or multiplicative technique)
Groups of series	5	GROUP	Referencing groups of series
Rename series in WF	6	R	Rename a series in RAM r prod rprod
Delete series from WF	7	D	Delete series in RAM d prod yield area
Show data table	9	SHOW	Display time series show sales cons yd
Print data table	A	PRINT	Print a table of series print area prod yield

MENU 2.6 (GRAPHICS COMMAND)

HEADINGS	KEY	KEY	COMMAND	EXPLANATION
MENU1	F3			
Line graph	8	1	PLOT	Produce high resolution plot of series on screen or printer plot area prod yield
Scatter diagram		2	SCAT	Scater diagram of two series scat area prod
Bar graph		3	BAR	Bar diagram of series bar prod
Pie Chart		4	PIE	Pie diagram of series pie area
Histogram		5	HIST(G)	
Load a graph file		6	LGRAPH	Load a graph file lgraph grprod
Print a graph file		7	PGRAPH	Print a graph file pgraph grprod

MENU 3 (STATISTICAL OPERATION)

HEADINGS	KEYS	COMMAND	EXPLANATION
MENU 3	F5	KEYS	
Descriptive & test statistics	1		
Single equation estimation	2		
Equations and forecasting	3		
System (file) estimation	4	SYS	Estimate of systems of equations, Can specify the estimation method O Ordinary least squares 2 two stage least squares S seemingly unrelated regression 3 three stage least square
Vector Autoregre ssion	5	VAR	Vector autoregression systems
Solve a model (file)	6	SOLVE	Solve a simultaneous equation model with several variabels and to carry out simulations
Edit system or model file	7	EDIT	Edit batch program or other file
Exponential smoothing	8	SMOOTH	Exponential smoothing

MENU 3.1, 3.2 and 3.3

HEADINGS	KEY	KEY	COMMAND	EXPLANATION
MENU	F5			
escriptive & test statistics	1	1	COVA	Descriptive statistics; computes and displays means, maximum, minimum, standart deviation, covariance matrix and correlation matrix *cova hgt wgt ege*
		2	COVA(M)	*cova(m) unem eig*
		3	HIST	Histogram *hist area prod*
		4	IDENT	Identification a series *ident prod*
		5	CROSS	Cross correlations for a pair of series
Single Equation Estimation	2	1	LS	Ordinary least square regression *ls prod c prod(-1)*
		2	LS(H)	*ls(h) prod c prod(-1)*
		3	TSLS	Two stage least square regression
		4	NLS	Non-linier least square regression
		5	LS(W)	Weighted least square regression *ls(w) prod c prod(-1)*
		6	TSLS(W)	Weighted two stage least square regression
		7	NLS(W)	Non-linier Weighted least square regression
		8	PARAM	Set parameters for estimation
		9	LOGIT	Estimation of logit model
		10	PROBIT	Estimation of probit model binary choice

HEADINGS	KEY	KEY	COMMAND	EXPLANATION
MENU	F5			
Equation Operation	3	1	SHOWEQ	Display equation
		2	FETEQ	Fetch a forecasting equation on disk and load into RAM
		3	STOREQ	Store a forecasting equation on disk
		4	PARAM	Set parameters for estimation
		5	FIT	Calculate fitted values from equation currently in RAM (for lagged dependent variables)
		6	FORCST	Compute a forcast for the dependent variable in an equation currently in RAM forcst fprod

MENU 4 (TSP CONTROL)

HEADINGS	KEYS	COMMAND	EXPLANATION
MENU	F6	KEYS	
End session/Exit to DOS	1	EXIT	Exit from MicroTSP
Run a MicroTSP program	2	RUN	Run a MicroTSP program
Run DOS commands	3	SYSTEM	Execute DOS comands and programs
Print output settings	4		
Configure for hardware	5	CONFIG	Configure MicroTSP for your machine
Session options	6	OPTION	Set option
Report on memory use	7	FREMEM	Display memory allocation
Update & Clear screen	8	C	Catalog series in RAM

MENU 4.4 (PRINT OUTPUT SETTINGS)

HEADINGS	KEYS	KEYS	COMMAND	EXPLANATION
MENU	F6->4		KEYS	
Print Setting	User specified printing	1	POFF	Discontinue automatic printing of results
	Always print statistical results	2	PON	Start automatic printing of results
	Print commands & stat. results	3	TRACE	Make a printed log of a session
	Direct output to printer or file	4	OUTPUT	

BASIC Micro TSP Commands

CREATE - to create a new <u>workfile</u>

(U) *undated*
(A) *annual*
(Q) *quarterly*
(M) *monthly*

Starting date?

Annual	1968
Quarterly	1980.2
Monthly	1985.01

Ending date?

SMPL - to set the sample of observations

SMPL 1980 1988

SMPL 80 88

SMPL 75.1 88.4

GENR - to generate new series by transforming existing ones

GENR LY = LOG(Y)

GENR YLD=PROD/AREA

COVA - computes means, maximum, and minimum values, standard deviation, covariances, and correlation matrices of a set of series

COVA X1 X2 X3

COVA APIO QPIO XPIO

LS - least squares regression of a dependent variable on a set of independent variables

LS LAPIO C T70

do a regression of LAPIO (Logaritma total black pepper area Indonesia) on a constant (intercept) and on the series T70.

FORCST - to compute a forecast of the dependent variable in the equation.

SMPL 1992 1995

FORCST fAPIO

DATA FILES ON DISK

SAVE - to save a workfile, ie., save everything until the next work session

SAVE PEPDAT

LOAD - to load a workfile

LOAD PEPDAT

STORE - creates a disk file containing a single series (a databank file)

STORE QPIO

FETCH - to read the data from the disk file and create a series in RAM

FETCH QPIO

LABEL - to add descriptions to your databank files

LABEL RAPIO Total black pepper rice area (IPC)

DATA DISK

CAT or DIR : to show the names of the databank files on the disk

LABEL *dbfilename* : to find out what the file is about.

LABEL RAPIO

SHOW : to see data for a particular file

SMPL 1970 1980

FETCH GDP

SHOW GDP

DISPLAYS

SHOW : show a table of data on the screen with dates down the side and up to six series across the top

SHOW APIO QPIO

PRINT : brings the data to the printer

PRINT APIO QPIO XPIO

PLOT : makes a high resolution plot of any number of time series on the graphics monitor

PLOT APIO QPIO XPIO

SCAT : makes a scatter diagram of two series on the graphics monitor

SCAT APIO QPIO

OPTION OUTPUT *txtfile* : to direct any text output to a disk file

OPTION OUTPUT C:\TSP65\RESULTS.TXT

USE OF DATA EDITOR :

DATA *series names*

Positioning Commands

ENTER : move on to the next series or if all series for this observation have been filled to the next observation number.

B : backup to the previous series or to the previous observation

N*i* : position the cursor at observation *i*. For example N85.09 says you want to change the data for Sept 1985

I*i* : tells the editor that you want to insert a new observation at date or number *i*

D*i* : tells the editor to delete the observation with date or number *i*

X : to exit from data editor

Exercise 1

CREATE
A
1970
1991

DATA APIO QPIO XPIO

Total black pepper Indonesia			
YEAR	APIO	QPIO	XPIO
1970	41504	17219	2655
1971	47291	26656	24239
1972	42484	30801	25704
1973	42853	28510	25625
1974	44525	27492	15558
1975	46954	22934	14526
1976	51057	26875	28845
1977	58500	30700	30856
1978	57100	36600	37091
1979	58000	25600	24956
1980	60000	31500	29315
1981	64000	32000	33996
1982	69000	33773	36339
1983	79000	39555	45061
1984	80000	41236	33817
1985	80000	41000	26201
1986	80000	37000	29569
1987	80000	36000	29995
1988	89870	47000	41512
1989	100000	50000	42138
1990	104000	60500	47675
1991	108110	61000	51850

Exercise 2

CREATE A 1970 1991

READ ESIPPEP8.WK1 (inpot data from lotus with file name ESIPPEP8.WK1, series name APIO QPIO XPIO and Upper-Left cell containing data or adress first data AH10 AI10 AJ10)

Display the data series :

SHOW APIO QPIO XPIO

Print series :

PRINT APIO QPIO XPIO

Save to PEPPER

SAVE PEPPER

EXERCISE 3

OBJECTIVES:

To learn the following commands :

CREATE, DATA, SHOW, PRINT, SAVE, LOAD , STORE FETCH, PLOT, SCAT, COVA, GENR, LS, SMPL,

METHOD:

Enter data on black pepper

DATA APIO QPIO XPIO

1970	41504.00	17219.00	2655.000
1971	47291.00	26656.00	24239.20
1972	42484.00	30801.00	25704.20
1973	42853.00	28510.00	25624.70
1974	44525.00	27492.00	15557.70
1975	46954.00	22934.00	14525.60
1976	51057.00	26875.00	28845.20
1977	58500.00	30700.00	30856.30
1978	57100.00	36600.00	37090.50
1979	58000.00	25600.00	24955.50
1980	60000.00	31500.00	29314.90
1981	64000.00	32000.00	33996.00
-			
-			
1990	104000.0	60500.00	47675.00
1991	108110.0	61000.00	51850.00
1992	X	NA	NA

Display the data entered to the screen:

SHOW APIO QPIO XPIO

Output this command :

obs	APIO	QPIO	XPIO
1970	41504.00	17219.00	2655.000
1971	47291.00	26656.00	24239.20
1972	42484.00	30801.00	25704.20
1973	42853.00	28510.00	25624.70
1974	44525.00	27492.00	15557.70
1975	46954.00	22934.00	14525.60
1976	51057.00	26875.00	28845.20
1977	58500.00	30700.00	30856.30
1978	57100.00	36600.00	37090.50
1979	58000.00	25600.00	24955.50
1980	60000.00	31500.00	29314.90
1981	64000.00	32000.00	33996.00
1982	69000.00	33773.00	36339.00
1983	79000.00	39555.00	45061.00
1984	80000.00	41236.00	33817.00
1985	80000.00	41000.00	26201.30
1986	80000.00	37000.00	29569.00
1987	80000.00	36000.00	29994.80
1988	89870.00	47000.00	41512.00
1989	91708.45	50000.00	42138.00
1990	104000.0	60500.00	47675.00
1991	108110.0	61000.00	51850.00

Generate a new series RYIELD:

GENR LAPIO = LOG(APIO)

GENR LQPIO = LOG(QPIO)

GENR LXPIO = LOG(XPIO)

Show the result of computations:

SHOW LAPIO LQPIO LXPIO

Print series:

PON

PRINT APIO QPIO XPIO LAPIO LQPIO LXPIO

Save to workfile PEPPER :

SAVE PEPPER

Look at files on disk:

CAT

STORE APIO QPIO XPIO

DIR

Limit the sample to 1970 - 1991

SMPL 1970 1991

SHOW APIO QPIO XPIO

Generate a high resolution plot

PLOT QPIO XPIO

PLOT LQPIO LXPIO

Generate a scatter diagram between area and production

SCAT APIO QPIO

Save workfile to PEPPER :

SAVE PEPPER

Import a file from Lotus 123

CREATE A 1970 1991

Fetch area, production and export

FETCH APIO QPIO XPIO

Show all 3 variables

SHOW APIO QPIO XPIO

obs	LAPIO	LQPIO	LXPIO
1970	10.63354	9.753769	7.884200
1971	10.76408	10.19077	10.09573
1972	10.65688	10.33530	10.15441
1973	10.66553	10.25801	10.15131
1974	10.70381	10.22165	9.652311
1975	10.75692	10.04038	9.583668
1976	10.84070	10.19895	10.26970
1977	10.97678	10.33202	10.33710
1978	10.95256	10.50780	10.52112
1979	10.96820	10.15035	10.12485
1980	11.00210	10.35774	10.28585
1981	11.06664	10.37349	10.43400
1982	11.14186	10.42742	10.50065
1983	11.27720	10.58545	10.71577
1984	11.28978	10.62707	10.42872
1985	11.28978	10.62133	10.17356
1986	11.28978	10.51867	10.29448
1987	11.28978	10.49127	10.30878
1988	11.40612	10.75790	10.63374
1989	11.42637	10.81978	10.64871
1990	11.55215	11.01040	10.77216
1991	11.59090	11.01863	10.85611

Save to a new work file

SAVE PEPPER1

Export data to a lotus file

WRITE PEPPER1.WK1

EXERCISE 4

Load PEPPER workfile

LOAD PEPPER

COVA APIO QPIO XPIO

and output this command :

```
Date: 7-28-1993 / Time: 12:49
SMPL range: 1970  -  1991
Number of observations: 22
      Series       Mean          S.D.         Maximum       Minimum
       APIO      67088.929    20365.016     108110.00     41504.000
       QPIO      35634.136    11196.761     61000.000     17219.000
       XPIO      30796.450    11365.630     51850.000     2655.0000
                                Covariance         Correlation
       APIO,APIO                 395882356          1.0000000
       APIO,QPIO                 202858056          0.9320055
       APIO,XPIO                 178975788          0.8100641
       QPIO,QPIO                 119668930          1.0000000
       QPIO,XPIO                 105437609          0.8679866
       XPIO,XPIO                 123305841          1.0000000
```

```
Repeat the output ? (P,S,ENTER)
```

Generate new series with series name T70 (1970 -> 1, 1971 -> 2, ... etc)

SMPL 1970 1970

GENR T70 = 1

SMPL 1971 1991

GENR T70 = T70(-1) + 1

Display the data series :

SHOW T70 APIO QPIO XPIO

Regression analysis :

SMPL 1970 1991

LS QPIO C APIO

LS LQPIO C LAPIO

LS APIO C T70

LS APIO C APIO(-1) APIO(-2)

LS QPIO C QPIO(-1) QPIO(-2)

LS LAPIO C T70 LAPIO(-1)

Expanded range series data and forcast :

EXPAND 1970 2010

SMPL 1992 2010

GENR T70 = T70(-1) + 1

SMPL 1970 1991

LS APIO C T70

Output this command :

```
                LS // Dependent Variable is APIO
Date: 7-28-1993 / Time: 12:22
SMPL range: 1970  -  1991
Number of observations: 22
     VARIABLE    COEFFICIENT   STD. ERROR     T-STAT.   2-TAIL SIG.
        C         32021.166     2151.9700     14.879931     0.000
       T70        3049.3707     163.84819     18.610951     0.000

R-squared                0.945410   Mean of dependent var   67088.93
Adjusted R-squared       0.942681   S.D. of dependent var   20365.02
S.E. of regression       4875.688   Sum of squared resid    4.75E+08
Durbin-Watson stat       0.724080   F-statistic             346.3675
Log likelihood          -216.9926


Display the Coefficient Covariance Matrix ? (P,S,ENTER)
```

```
SMPL 1970 2010
FORCST FAPIO
SHOW APIO FAPIO
PLOT APIO FAPIO
SMPL 1970 1991
LS APIO C APIO(-1)
SMPL 1971 2010
FORCST FAPIO1
SMPL 1980 2010
SHOW APIO FAPIO
PLOT APIO FAPIO
```

ANNEX-6

AN ANNUAL MODEL OF THE WORLD PEPPER ECONOMY

Economic and Social Institute (ESI-VU)

Date	Your letter dated	Telefax	Enclosure(s)
8 July 1993	30 June 1993	31-20-644 4057	
Our reference	**Your reference**	**Telephone**	
HPS/JvW A 013		31-20-548 4915	

Mailing address: De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands

Dr. Ruyat Wiratmadja,
head of Bureau for International Cooperation
Ministry of Agriculture
Jl. Harsono RM No. 3
Jakarta Selatan
Ragnunan Pasar Minggu Indonesië

vrije Universiteit *amsterdam*

Re: pepper model

Dear Dr. Ruyat,

Thank you very much for your letter of 30 June 1993. Congratulations with your project "Development and use of a Computer Simulation Model for Forecasting Supply, Demand and Prices of Agricultural Commodities in ASEAN Countries". We agree that the pepper model is very well suited for an activity as you suggest. You are most welcome to use the material we presented during the June 1992 workshop in Jakarta. Proper reference to the authors and the ESI would be appreciated. The forecast resulting from the model are on the optimistic side because the forecasts for world income were to optimistic in retrospect. Some downward adjustment is in order. We are likely to do some update in the coming half a year. Please let me know when the seminar will be held and whether you would like to make use of an update should such become available.

Kind regards.

Sincerely Yours

i.h.a.

Dr. Hidde P. Smit,
Division Chief Economic Research

AN ANNUAL MODEL OF THE WORLD PEPPER ECONOMY

Jan Bade
Hidde P. Smit
Economic and Sosial Institute
Free University, P.O. Box 7161
1007 MC Amsterdam
Netherlands

Workshop
The Development and Use of Computer Simulation Model
for Forecasting Supply, Demand, and Prices of Agricultural Commodities
in ASEAN Countries

August 4 - 15, 1993
Ciawi - Bogor, INDONESIA

Introduction

This paper focusses on analyzing and forecasting supply and demand of pepper. First, in Chapter 1, a description of the pepper economy and the model applied to analyze the pepper economy is given. This model is the first detailed one for the pepper economy. Data and time constraints did not allow a further and more in-depth analysis. Such an analysis is clearly called for when more sound policy conclusions are to be drawn up. The model used for the current paper is a somewhat revised version of the model described in Bade and Smit (1991) in view of comments made during and after the Workshop of the International Pepper Community. The model is again presented in full in the Appendix. It is hoped that in follow-up work the model can be extended, so as to allow for more precise answers to questions on concrete policies. Projections for a number of scenarios are presented in Chapter 2. The results of the scenarios are not discussed in detail as the current paper aims at showing the analysis rather than the implications. This chapter also contains a section in broad terms on formulation and evaluation of policies. A review of data availability and data problems is presented in Chapter 3.

1. Description of the model

In this chapter the model of the pepper economy is presented and discussed. It was already mentioned that data limitations provide the major hurdles in model building. Therefore many comments in this chapter will point to restricted data availability or the dubious quality of data. Nevertheless this chapter will also provide insight in the ways that can be exploited to estimate relationships. The large number of assumptions provide an equal amount of challenges to check their validity. Relatively more attention was given to modelling supply by IPC member countries than by other producing countries. All quantities of pepper mentioned in this chapter are in tonnes unless stated otherwise.

1.1 Area, production and exports

We will deal with supply of pepper on a country basis, looking at area, production and exports. The best approach would be to base the analysis on the number of productive vines, to be multiplied by the average yield of a vine to receive what may be called "normal production". Although measurement by vines must be considered much better, the same line of reasoning can be applied with area and average yield per hectare. The major draw back of this method in comparison to using vines is that the it adds a source of variation. Not only does the yield per vine fluctuate, but of course also the number of vines per hectare. In some countries, like India e.g. this variation is very strong, while in others (e.g. Thailand) the number of vines per hectare is almost the same all over the country. If there is no significant change in cultivation patterns and the intensity of cultivation is relatively constant it is possible to estimate a nation-wide normal average yield per hectare. If however the average number of vines per hectare cannot be expected to be constant an assumption is needed about the change. If intensification takes place or superior varieties are introduced, it can be assumed e.g. that there will be an upward trend in the "normal yield per hectare" some two years after the start of the intensification, when the planted vines become productive. We will come back on this when discussing Indian yields.

If "normal yield" can be used as a basis for forecasting, the actual yield will deviate from it because of weather influences, amount of fertilizer applied and time spent on maintenance. Regretfully, these effects are not confined to one year. In the occurrence of a very wet year, there will be a smaller crop, but perhaps even more important is that there will be more foot-rot and other diseases. These diseases also influence next year's crop. Also the effects of neglect or exceptionally good maintenance will spread over more than one year.

This illustrates that, even when data on productive vines and average yields were available and absolutely reliable, there would be enough scope for simulation and expert interpretation. Unfortunately we live in a world where information is costly. Gathering data on agricultural activities is even very costly, because it is time consuming. As a matter of fact it is not one of the priorities of developing countries. Planning however depends largely on information and a model cannot compensate for lack of quality of data. As far as quality of information is concerned it can only interpret and detect inconsistences. The conclusion of this paragraph is therefore that the modelling of production and supply presented in this section must be seen as a step on the road towards a more sophisticated modelling analysis based on superior data.

Brazil

Although there are different systems of cultivation in Brazil, there are no time series on area by cultivation system. In fact we do not know how the Brazilian Pepper Exporters Association gets the data that are presented at IPC meetings. The relevant data are shown in Figure 1.1. The assumption on which the area equation is based is that the data are on productive area. That means that the price of pepper three years ago has been an incentive or disincentive to plant or replant. So that price will be a good explanatory variable for current productive area under pepper.

When looking at area and production one would expect that yields have gone up over time. Unfortunately the opposite is true. If production is divided by area the result is a decreasing function over time. There is even a strong fall in yield from '78 to '79 when area increased rapidly, suggesting that in those years data on area did also include area with immature newplanting. However after '79 the correlation between area and production is strong. At the end of the eighties yields start to rise again. This we assume must have been the result of growing price-consciousness leading to variation in fertilizer use and maintenance. We therefore imposed a positive price correlation.

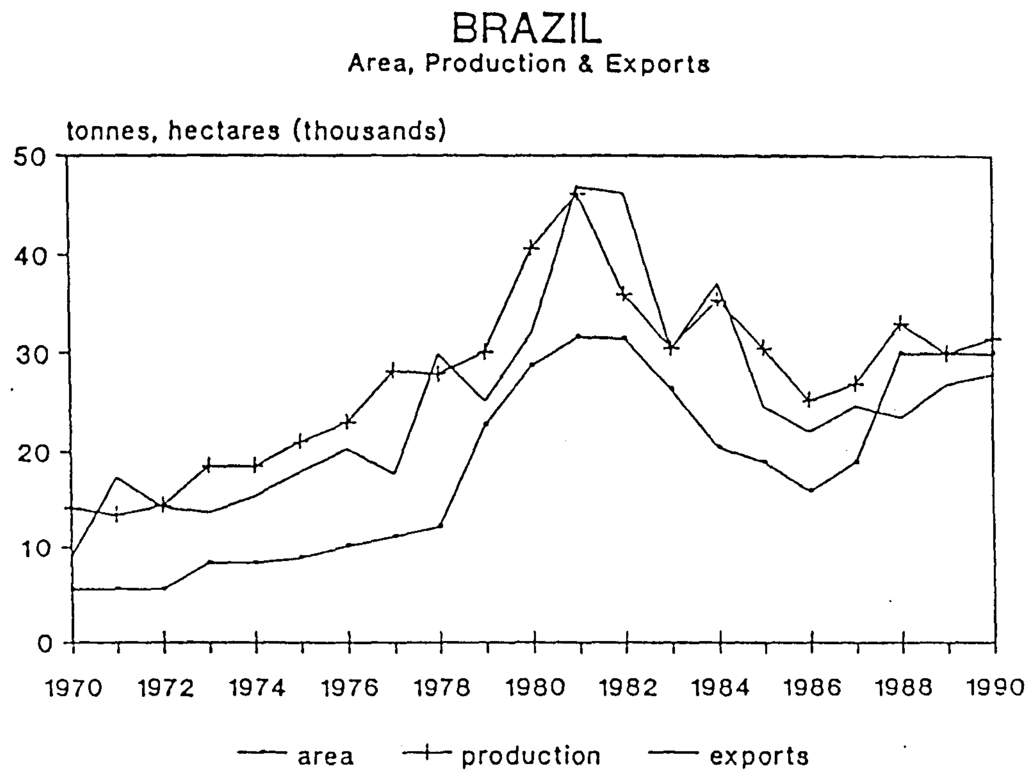


Figure 1.1

Finally exports are analysed. As pepper consumption in Brazil is negligible compared to production and presumably kept out of production statistics as there are some other small pepper producing region outside Para state, it can be expected that total production will be exported. As the crop arrives at the end of the year, this will partly happen in the crop year and partly in the next year.

The resulting equations are:

$$lapbr = 1.81 + 0.81\ lapbr_{-1} + 0.27\ lpcbr_{-3} \qquad (A.1)$$
$$[2.35]\ [10.11]\qquad [2.47]$$

$$1973 - 1990;\quad \bar{R}^2 = 0.87;\quad D.W. = 1.75$$

$$lqpbr = 5.60 + 0.47\ lapbr + 0.06\ l(pcbr_{-1}/pcbr_{-2}) \qquad (A.2)$$
$$[9.59]\ [7.93]\qquad [.56]$$

$$1972 - 1990;\quad \bar{R}^2 = 0.79;\quad D.W. = 1.04$$

$$lxpbr = 0.15 + 0.98\ l((qpbr_{-1} + qpbr)/2) \qquad (A.3)$$
$$[0.13]\ [9.02]$$

$$1971 - 1990;\quad \bar{R}^2 = 0.81;\quad D.W. = 1.79$$

where

apbr = total area under pepper in hectares in Brazil
pcbr = f.o.b. price of black pepper in Brazil in constant 1980 dollars
. 1980 M$
qpbr = total production of pepper in Brazil
constant 1980 dollars.
xpbr = total exports of pepper from Brazil

India

Indian data are shown in Figure 1.2. Area under pepper in India was 168,260 hectares in 1989. Enough to supply the whole world with pepper if yields were only in the order of one third of what they are in Sarawak. Plenty of reason to take a close look and ask some questions about the way these data are collected. Up to three years ago a survey among extension workers was held in randomly chosen parts of Kerala State, in such a way that within five years every part was visited once. The total area under pepper from the population was then multiplied by the inverse of the (sample area / state area) ratio. The question asked was to estimate area on the basis of 560 vines per hectare. The method was applied, asking the same people, to get production estimates. Since 1987 the Department for Economics and Statistics is trying to introduce a more sophisticated system, especially to estimate production. The reason that this method of data gathering is described here is that it gives a plain indication of the quality of data we have to deal with. Especially when it is considered that India is a country with a long history where it comes to organized collection of statistical information. Probably the data on area and production of other countries are not collected in a better way. Consistency of data of other countries could on the other hand even be interpreted as an indication that they were calculated backwards with export figures as a starting point.

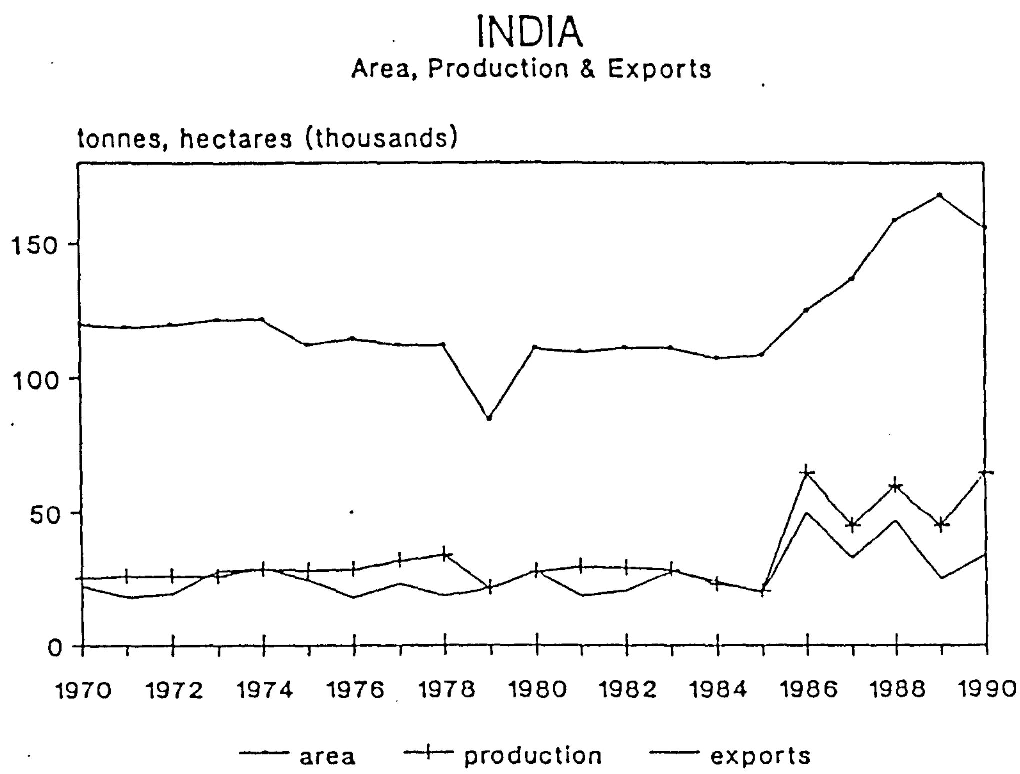


Figure 1.2

Returning to Indian area, the equation that was estimated does not differ much from the one for Brazil. The difference is that the price of two years ago is taken instead of three years ago, implying pepper vines in India bear substantial fruit in the second year after planting. For 1979 a dummy variable was used, as the official area figure is suddenly 10000 hectares less in that year with a complete recovery in the next. This could very well be due to the system of estimating the area. Comparing the coefficients with Brazil it is noteworthy that the price-elasticity is much lower (0.18 compared to 0.32). The reason for this is that vines in India get much older. A large part of the Indian vines stand over 20 years.

Due to the fact that yield per hectare varies considerably in India and due to the subjective way of estimating production, it could be expected that the relation between production and area is rather weak. The elasticity is about one, wich means that an increase in area of 2% will cause production to rise also by 2%. The fact that last years price is significantly influencing production illustrates probably two things. Firstly, that the use of manure and better maintenance and perhaps more picking rounds are effective. The higher last year's price the greater the incentive. Secondly farmers keep pepper in stock. If stocks at farm level are not part of production figures it is obvious that when the price goes up and farmers release there stocks it will seem as if production has gone up. The opposite will happen if the price goes down and farmers are reluctant to sell. If this latter explanation would be the most important one it would have been better to take the current year's price as explanatory variable.

Indian exports depend largely on last year's crop, because that is the way the data base we used was organized. The other factor is the influence of price changes on stocks of traders. Note that if there is a sudden increase in price the total amount of exports may even exceed production.

The resulting equations are:

$$\underset{}{lapia} = \underset{[2.74]}{4.16} + \underset{[4.46]}{0.60}\, lapia_{-1} + \underset{[3.66]}{0.18}\, lpcia_{-2} - \underset{[5.90]}{0.39}\, d79 \qquad (A.4)$$

1972 - 1989; $\bar{R}^2 = 0.84$; D.W. = 1.53

$$lqpia = \underset{[0.59]}{-2.29} + (\underset{[2.83]}{0.99} + \underset{[1.61]}{0.001}\, t70)\, lapia + \underset{[2.36]}{0.33}\, lpcia_{-1} \qquad (A.5)$$

1971 - 1989; $\bar{R}^2 = 0.66$; D.W. = 2.50

$$lxpia = \underset{[1.39]}{2.05} + \underset{[5.49]}{0.78}\, lqpia + \underset{[2.10]}{0.41}\, lrpratio \qquad (A.6)$$

1971 - 1989; $\bar{R}^2 = 0.62$; D.W. = 1.94

where

apia = total area under pepper in hectares in India
pcia = f.o.b. price of black pepper in India in constant 1980 rupees
qpia = total production of pepper in India
rpratio = $rpsny/rpsny_{-1}$
t70 = linear trend starting in 1970: $t=t_{-1}+1$, in this case used to estimate technical progress or shift in cultivation.
xpia = total exports of pepper from India.

Indonesia

Data on aggregate area under pepper in Indonesia are very poor. They are shown in Figure 1.3. Official records claim that total area did not change from 1983 until 1987. Records for Lampung and Bangka show considerable changes over these years. Unfortunately the time series on area of Lampung and Bangka are still too short. Furthermore there is hardly any information on area in Kalimantan. Regional disaggregation of supply of Indonesia is one of the important items for future modelling research. Especially because of the special position of Bangka where only white pepper is produced. The area equation is again familiar, with only one new variable that needs explanation. That is the trend variable. It has been assumed that clearing of new land has been important and will continue to be important. Nowadays this clearing of new land predominantly takes place in Kalimantan and Sulawesi.

When looking at production, the current year's price performed better than last year's price, indicating that for Indonesia the influence of the price on stocks is more important than on maintenance. This is the opposite of the conclusion drawn in the case of India. Note, however, that the price effect is very modest.

A very straightforward relation was superimposed on exports. Although regression of exports with only production as explanatory variable gave a coefficient of 0.88, we decided to lower it a bit, based on information of exporters that some 15% of pepper was lost in grading. Any regression with price or price difference as explanatory variable resulted in a strong negative relation and was therefore rejected.

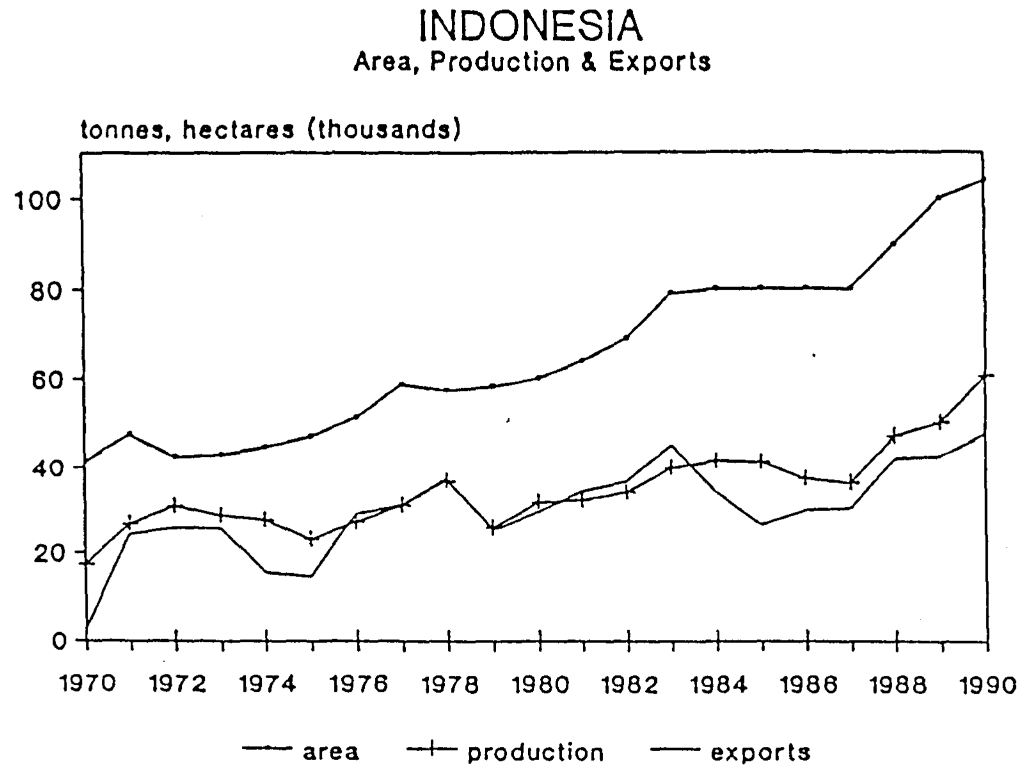


Figure 1.3

The resulting equations are:

$$lapio = 3.26 + 0.64\, lapio_{-1} + 0.055\, lpcio_{-3} + 0.18\, lt70 \qquad (A.7)$$
$$[1.59]\ [3.33] \qquad [1.28] \qquad [2.28]$$

1973 - 1988; $\bar{R}^2 = 0.96$; D.W. = 1.69

$$lqpio = 0.65 + 0.82\, lapio + 0.09\, lpcio \qquad (A.8)$$
$$[.31]\ [5.63] \qquad [1.01]$$

1973 - 1988; $\bar{R}^2 = 0.74$; D.W. = 2.22

$$xpio = 0.85\, qpio \qquad (A.9)$$

1971 - 1989; D.W. = 1.03

where

apio = total area under pepper in hectares in Indonesia
pcio = f.o.b. price of black pepper in Indonesia in constant 1980 rupiahs.

qpio = total production of pepper in Indonesia
t70 = linear trend starting in 1970: $t=t_{-1}+1$, in this case used to estimate technical progress or shift in cultivation.
xpio = total exports of pepper from Indonesia

Malaysia

When looking at data of area and production in Malaysia or Sarawak one immediately becomes aware of the fact that either the data are wrong or yields are extremely volatile (cf Figure 1.4). Sources claim that both is the case. Yields are strongly influenced by foot-rot and data are unreliable as production is estimated on the basis of exports, whereas it is well known that the farmers in Sarawak are relatively rich and speculate with pepper as is also done by exporters. So there may be large differences between production and exports from time to time.

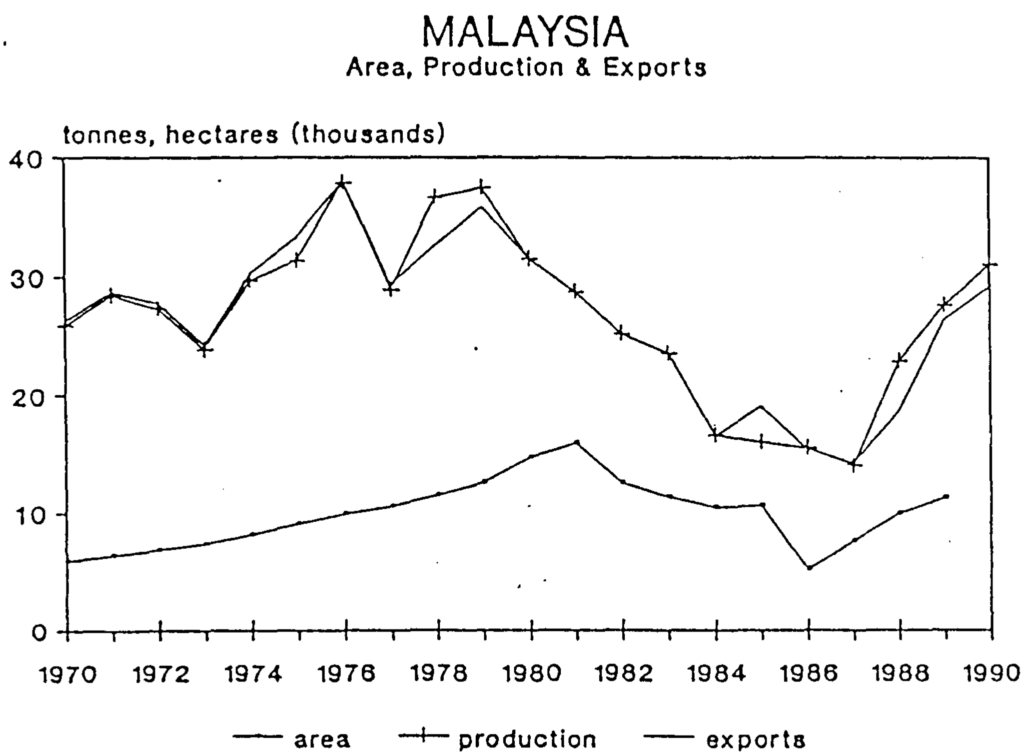


Figure 1.4

We tried to solve these data problems by using lagged variables and estimate production as well as exports. Instead of using the price of pepper two years ago as independent variable in an area equation we used it now to explain production, although it is clear that this influence can only materialize through new planting of vines. Of course one would also still expect the one year lagged price to have effect on maintanance and the current price or price change to affect stocks. Because of strong multicolinearity, however, it is not possible to put more than one price variable in the equation. Speculation was taken into account partly by taking current and last year's production as independent variables in the export regression.

The resulting equations are:

$$lqpml = \underset{[0.65]}{1.48} + \underset{[7.17]}{0.80}\, lqpml_{-1} + \underset{[3.09]}{0.33}\, lpcml_{-2} \qquad (A.11)$$

1972 - 1989; $\bar{R}^2 = 0.73$; D.W. = 2.68

$$lxpml = \underset{[0.44]}{0.24} + \underset{[9.89]}{0.79}\, lqpml + \underset{[2.29]}{0.18}\, lqpml_{-1} \qquad (A.12)$$

1971 - 1989; $\bar{R}^2 = 0.95$; D.W. = 1.98

where

pcml = f.o.b. price of pepper in Malaysia (Sarawak) in constant 1980 M$
qpml = total production of pepper in Malaysia (Sarawak)
xpml = total exports of pepper from Malaysia

Other countries

For the other producing countries, i.e. Madagascar, Sri Lanka, Thailand, Vietnam and the People's Republic of China graphs on exports are shown in Figures 1.5 and 1.6. Only an export equation was estimated or some crude assumption was made. To improve on this, longer time series and information on area and production as well as on internal markets and export possibilities are needed. It should be noted that scope for improvement is considerable with respect to this part of the model. The importance of the non-IPC member countries can be illustrated by the fact that the share of IPC-countries in total world exports fluctuates between 84% and 95%.

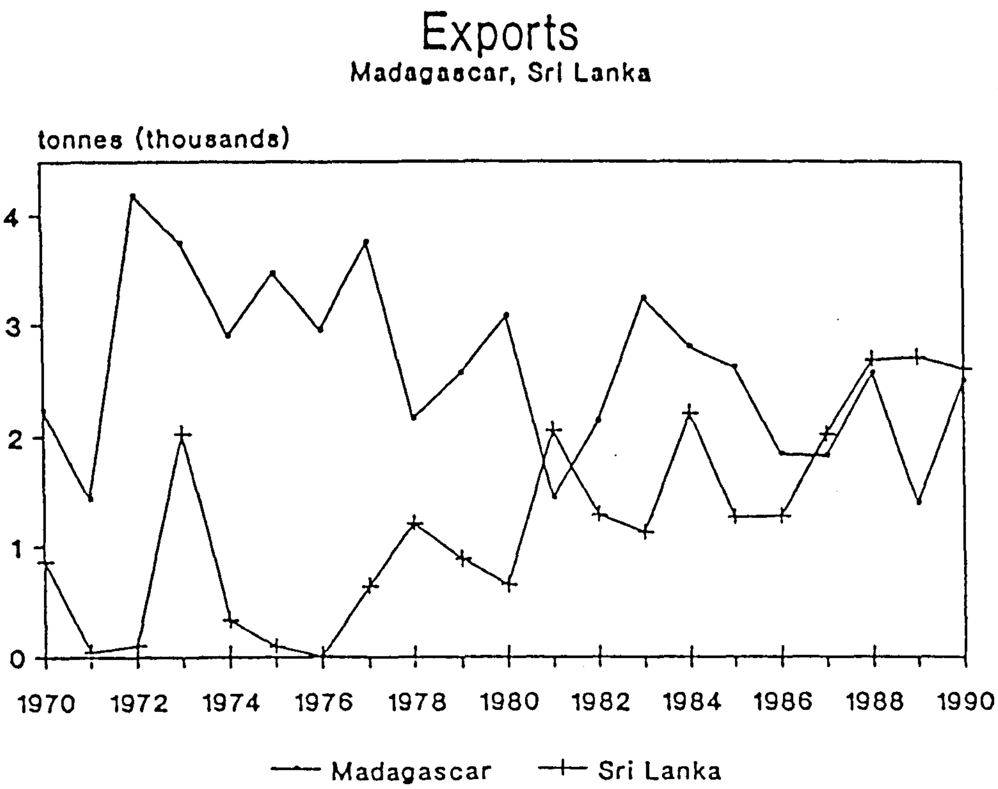


Figure 1.5

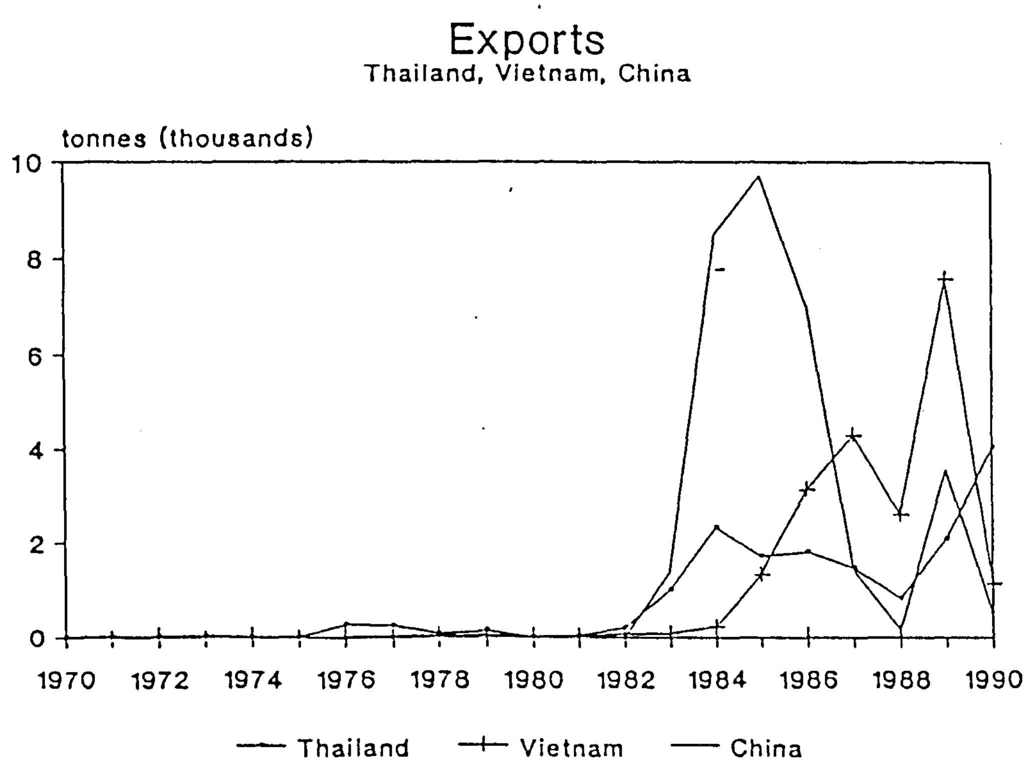


Figure 1.6

The models used are

Madagascar

forecasts:

$$xpmd = 2500 \text{ in } 1990 \qquad (A.15)$$

$$3000 \text{ in } 1991$$

$$3500 + 500 * (rpsny_{-5} - rpsny_{-6}) \text{ afterwards}$$

Sri Lanka

$$lxpsl = \underset{[4.78]}{3.80} + \underset{[3.47]}{1.27}\, lt71 \qquad (A.18)$$

1971 - 1988; $\bar{R}^2 = 0.39$; D.W. = 1.60

Thailand

$$lxpth = \underset{[13.56]}{5.78} + \underset{[3.72]}{1.02}\, lt82 + \underset{[1.60]}{1.05}\, lrpratio \qquad (A.21)$$

1982 - 1990 $\bar{R}^2 = 0.60$; D.W. = 1.32

Vietnam

$$lxpvm = \underset{[2.43]}{0.92} + \underset{[10.11]}{2.55}\, lt80 + \underset{[3.58]}{1.69}\, lrpsny \qquad (A.24)$$

1980 - 1989; $\bar{R}^2 = 0.96$; D.W. = 1.50

China (Hainan)

forecasting on the following basis:

$$xpch = \max(500, 2000*(rpsny-1.5)) \qquad (A.27)$$

where

rpratio = $rpsny/rpsny_{-1}$
rpsny = New York spot price of Lampung black pepper in $ct/kg in constant 1980 dollars.
t71 = linear trend starting in 1971: $t=t_{-1}+1$, in this case used to estimate technical progress or shift in cultivation.
t80 = linear trend starting in 1975: $t=t_{-1}+1$

t82 = linear trend starting in 1980: $t=t_{-1}+1$
xpch = total exports of pepper from China
xpmd = total exports of pepper from Madagascar
xpsl = total exports of pepper from Sri Lanka
xpth = total exports of pepper from Thailand
xpvm = total exports of pepper from Vietnam

Singapore

More needs to be said about the special position of Singapore as an entrepot for pepper and its consequences. We explain in Chapter 3 why and how we adjusted the data as import and export statistics revealed that exports exceeded imports by an average 10,000 tons a year. Although the importance of Singapore for Malaysia is decreasing, it is still important. We therefore used gross exports from Malaysia as independent variable. The estimation indicates that 69% of Malaysian pepper exports is shipped via Singapore. This could be slightly over-estimated especially for the future, as it is the concrete policy of the Pepper Marketing Board to encourage direct trade. The function of Singapore as an entrepot is accounted for by the variable total exports of producing countries minus estimated world consumption, which is merely our estimate of the change of stocks outside producing countries. Singapore is expected to import part of these stocks and keep the major part of it as carry over stocks. This is reflected by the negative sign in the export equation. Some part of pepper imports are of course consumed, but no statistics of pepper consumption in Singapore are available. If we assume that the change in stocks outside the producing countries has an expected value of zero, i.e. positive and negative changes balance, then consumption would be approximately 1% of imports. Finally, the significance of the price indicates that presumably pepper traders are more interested in trade if prices are high, which does not seem irrealistic as margins will probably be correllated with the height of the price.

The above has resulted in the following model:

$$\underset{}{\text{mpsp}} = \underset{[1.07]}{4268.46} + \underset{[6.11]}{0.70}\,\text{xgpml} + \underset{[2.21]}{2553.40}\,\text{rpsny} + \underset{[1.58]}{0.18}\,(\text{xprw}-\text{cpw}) \qquad (A.28)$$

$$1975 - 1989; \quad \bar{R}^2 = 0.82\ ; \quad D.W. = 1.85$$

$$xpsp = 0.99\ mpsp - 0.14\ (xprw - cpw) \quad \text{(A.29)}$$
$$[35.47] \qquad [1.68]$$

1975 - 1989; D.W. = 1.85

$$\Delta zpsp = \hat{mpsp} - \hat{xpsp} \quad \text{(A.30)}$$

where

cpw = total world consumption of pepper
mpsp = total imports into Singapore and Hong Kong
rpsny = New York spot price of Lampung black pepper in $ct/kg in constant 1980 dollars.
xgpml = total gross exports of pepper from Malaysia
xpsp = total net exports from Singapore and Hong Kong
xprw = total world exports of producing countries
zpsp = stocks in Singapore

1.2 Prices

About prices we can be relatively brief. To model the differences in f.o.b. prices and prices in final markets correctly one would have to look at costs of freight and insurance. The precision of an exercise like that would however be in sharp contrast with the crudeness of the rest of the model and add little to the accuracy of price forecasts and simulation results. In our modelling exercise we have chosen to take a constant difference between the price in New York and the price in a producing country converted into US$ (cf Figure 1.7). For reasons of comparison we took only black pepper prices. For the IPC member countries this resulted in the regression equations presented below. Along with these some definitions of other prices are given, that are straightforward and take account of inflation and depreciation effects.

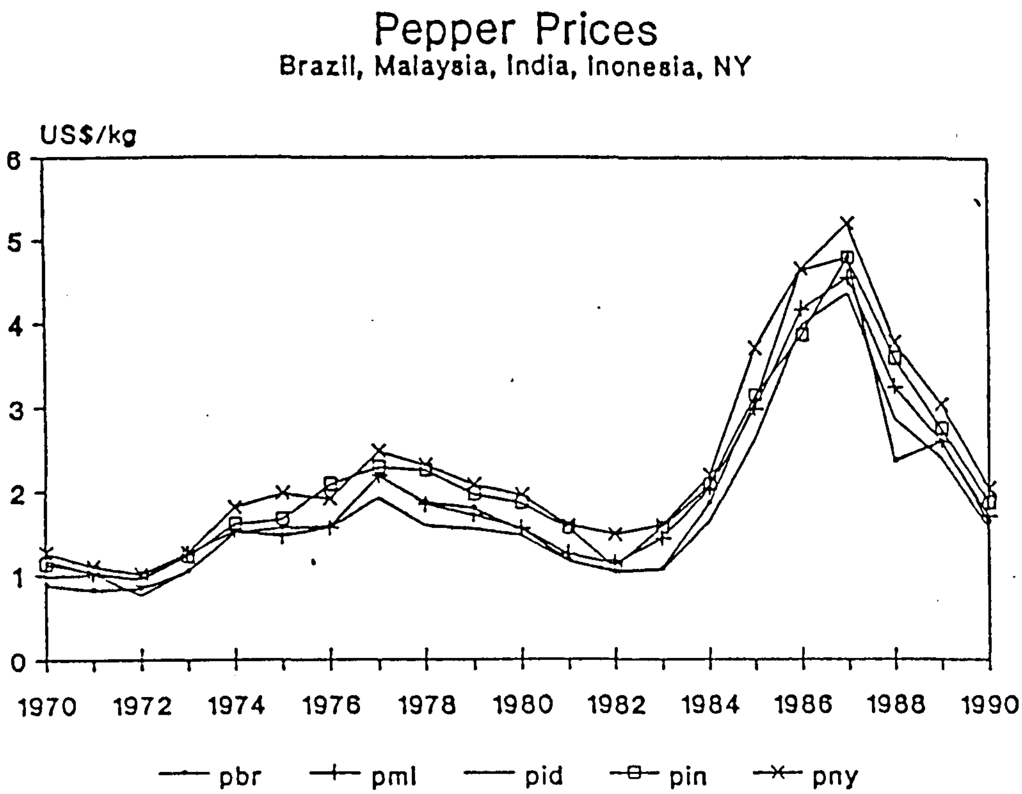


Figure 1.7

Brazil

$$p\$br = -0.27 + 0.94\ psny \qquad (A.31)$$
$$[1.95]\ [17.27]$$

1970 - 1988; $\bar{R}^2 = 0.94$; D.W. = 1.52

pcbr = p$br/pius * 100

pius = 1.04 $pius_{-1}$ from '90 onwards

India

$$p\$ia = 0.10 + 0.87\ psny \qquad (A.32)$$
$$[1.25]\ [27.40]$$

1970 - 1988; $\bar{R}^2 = 0.98$; D.W. = 1.99

pcia = (p$ia * eria)/piia * 100

$piia = 1.08\ piia_{-1}$ from '89 onwards

$eria = 1.05\ eria_{-1}$ from '90 onwards

Indonesia

$$p\$io = -0.10 + 0.82\ psny \qquad (A.33)$$
$$[1.28]\ [27.02]$$

1970 - 1988; $\bar{R}^2 = 0.97$; D.W. = 1.54

$pcio = (p\$io * erio)/piio * 100$

$piio = 1.08\ piio_{-1}$ from '89 onwards

$erio = 1.0847\ erio_{-1}$ from '90 onwards

Malaysia

$$p\$ml = -0.06 + 0.88\ psny \qquad (A.34)$$
$$[.98]\ [34.71]$$

1970 - 1988; $\bar{R}^2 = 0.98$; D.W. = 1.93

$pcml = (p\$ml * erml)/piml * 100$

$piml = 1.04\ piml_{-1}$ from '89 onwards

$erml = eria_{-1}$ from '90 onwards

explanation of variable abbreviations:

eria = exchange rate of India (rupees per US dollar)
eria = exchange rate of Indonesia (rupiahs per US dollar)
erml = exchange rate of Malaysia (Malaysian dollars per US dollar)
p$br = f.o.b. price of black pepper in Brazil in current dollars
p$ia = f.o.b. price of black pepper in India in current US dollars
p$io = f.o.b. price of black pepper in Indonesia in current US dollars
p$ml = f.o.b. price of pepper in Malaysia (Sarawak) in current US dollars
pcbr = f.o.b. price of black pepper in Brazil in constant 1980 dollars
pcia = f.o.b. price of black pepper in India in constant 1980 rupees

pcio = f.o.b. price of black pepper in Indonesia in constant 1980 rupiahs
pcml = f.o.b. price of pepper in Malaysia (Sarawak) in constant 1980 M$
piia = consumer price index of India
piio = consumer price index of Indonesia
piml = consumer price index of Malaysia
pius = consumer price index of the US
psny = New York spot price of Lampung black pepper in $/kg

1.3 Import, consumption and stocks

Modelling demand for pepper is proposed to be based on imports consisting of consumption and changes in stocks. Lack of data on end-use of pepper forced us to use general variables as income and/or population as explanatory variables for consumption. A more sophisticated modelling approach of demand, including a differentiation of pepper use in food industries, institutional catering and household consumption must be considered almost impossible at the moment as there are only rough estimates of shares available, but nothing on changes in these percentages. More important and useful would it be if the market for black and white pepper could be modelled separately. For this it is only needed that import statistics distinguish them.

As far as aggregation of consuming countries or regions is concerned, the European Community could be taken as one region or as several separate countries or regions; the first option was chosen, although there are marked differences in the development of demand over time, especially between Northern and Southern European countries. The same applies for the other European groupings: The countries united in the European Free Trade Association (EFTA) and Eastern Europe in combination with the USSR. It may be argued that after the falling apart of the communist block in 1989 there is not much reason left to take the USSR and the Eastern European Countries together. However as trade channels have not changed much since and for reasons of consistency in the analysis, they will still be taken together. Even the reunion of the two Germanies has not been incorporated as it would only disturb the time series and add no explanatory power. It should be stressed that pepper consumption will increase in Eastern Europe and the USSR only after political and economic reforms have been succesful and income starts to rise. For the moment we can only fear a dramatic fall in income. The Middle East, where growth in consumption is high, but imported quantities are still small in absolute terms was treated separately as was China, where, although statistical information is lacking, consumption as well as production is said to increase rapidly. Some other groupings are obvious such as the United States & Canada, Japan, Latin America (except Brazil), Australia & New Zealand and the rest of the world (divided in African and Asian countries).

To estimate consumption we sometimes used Gross Domestic Product as independent variable and sometimes population size. The effect of changes in income need some explanation. In some countries a rise in income leads to more meat consumption as people can afford to buy more and as a result particularly household use of pepper increases. In very rich countries, such as the U.S. or the countries of the E.C. a rise in income leads to more outdoor fast and/or ready-made food consumption as well as to a greater variety in food choice, including exotic, spicy dishes. The increase in the use of pepper is concentrated in the institutional catering and food processing. A somewhat different story applies to Japan, where growth of GDP is related to openness of the country and this openness is correllated with changing patterns in food consumption and taste. Here household consumption of pepper and other uses are equally affected.

The estimation of changes in stocks was not an easy task. We will give comments whenever necessary. For some regions it was not possible to estimate the change in stocks, so we applied another approach. We estimated imports with the price of pepper as explanatory variable and without. The estimates based on the equation without the price variable we then called consumption, as consumption is assumed to be very price inelastic. This procedure was followed in the case of the EFTA, Latin America and the rest of Africa where stocks are very small anyway. In the cases of Asia and the Pacific and the Middle East and Northern Africa, it was not possible to model stock changes.

European Community (E.C.)

To get estimates of consumption we started with a regression of per capita imports on per capita income and a constant term. We then assumed the residuals to be equal to the changes in stock. So we estimated consumption to be the estimated per capita import times the population size.

Europe is price concious, as far as stock formation is concerned, which is revealed by the fact that changes in stocks depend on the change in the change of price. So if prices go up rapidly so will stocks, but if there is a constant increase in prices it will not influence stocks. It should be stressed however that in general stocks in consuming countries are not very large and that there is a tendancy towards smaller stocks as means of transport and communication improve.

$$lmppcec = \underset{[18.10]}{2.91} + \underset{[10.04]}{0.95}\ lypcec \qquad (A.41)$$

1971 - 1989; $\bar{R}^2 = 0.85$; D.W. = 1.47

$$cpec = nec * \hat{mppcec} \qquad (A.42)$$

$$\Delta zpec = \underset{[2.35]}{1229.87}\ \Delta(\Delta rpsdr) + \underset{[2.88]}{0.09}\ (xprw - cpw) \qquad (A.43)$$

1975 - 1989; D.W. = 1.84

The above equations yield estimates which then for the future add up to mpec:

$$mpec = \hat{cpec} + \Delta\hat{zpec} \qquad (A.44)$$

Figure 3.1 illustrates consumption and imports of pepper of the European Community.

xprw = total net exports of pepper producing countries.
xpw = world net exports = xprw + Δzpsp.
Δzp = (assumed) change of carry-over stocks

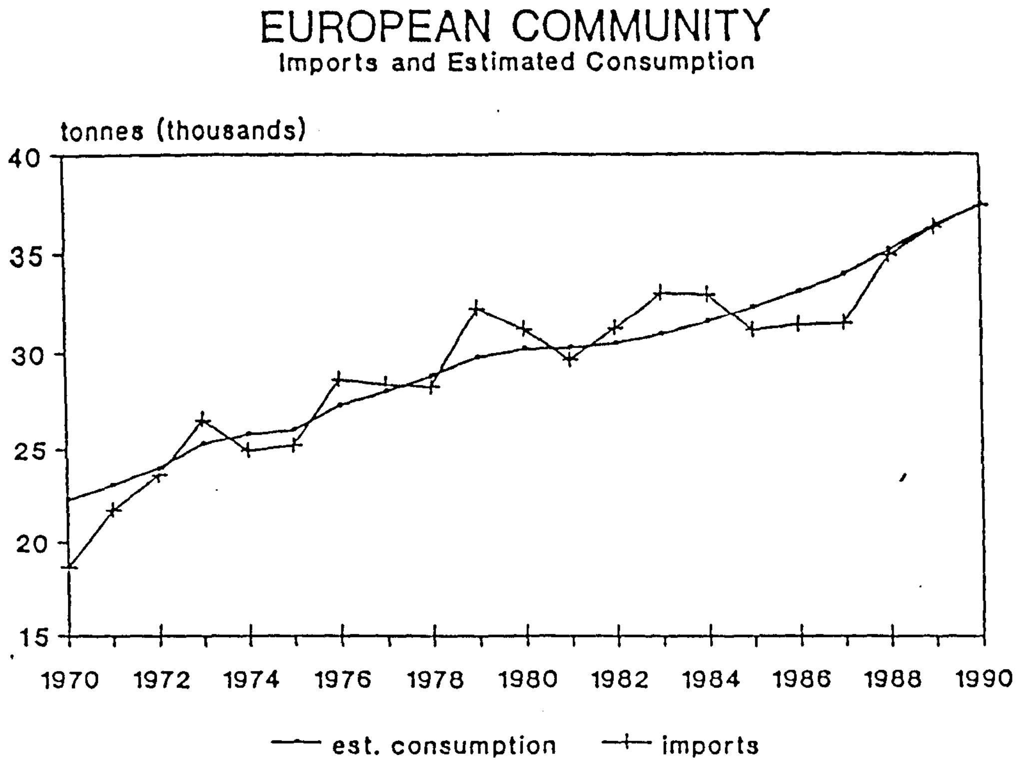


Figure 1.8

North America (U.S.A. and Canada)

Modelling concumption and stocks in North America proved to be extremely difficult. One of the problems is probably the availability of ASTA quality. If bad weather conditions limit supply of pepper, supply of ASTA quality is limited even more. Another feature to keep in mind is that a large amount of Brazilian pepper is shipped to the U.S. unsold. Consumption was estimated in exactly the same manner as consumption of the E.C. The basic idea behind the stock equation is that stock changes are influenced by relative abundance of good quality pepper or by naive price expectations. This latter means that when prices are rising they are expected to continue going up and that when they are falling they are expected to drop further. The result of this kind of expectations is a positive correlation between stocks and price changes. Figure 1.9 shows consumption and imports of pepper of

North America.

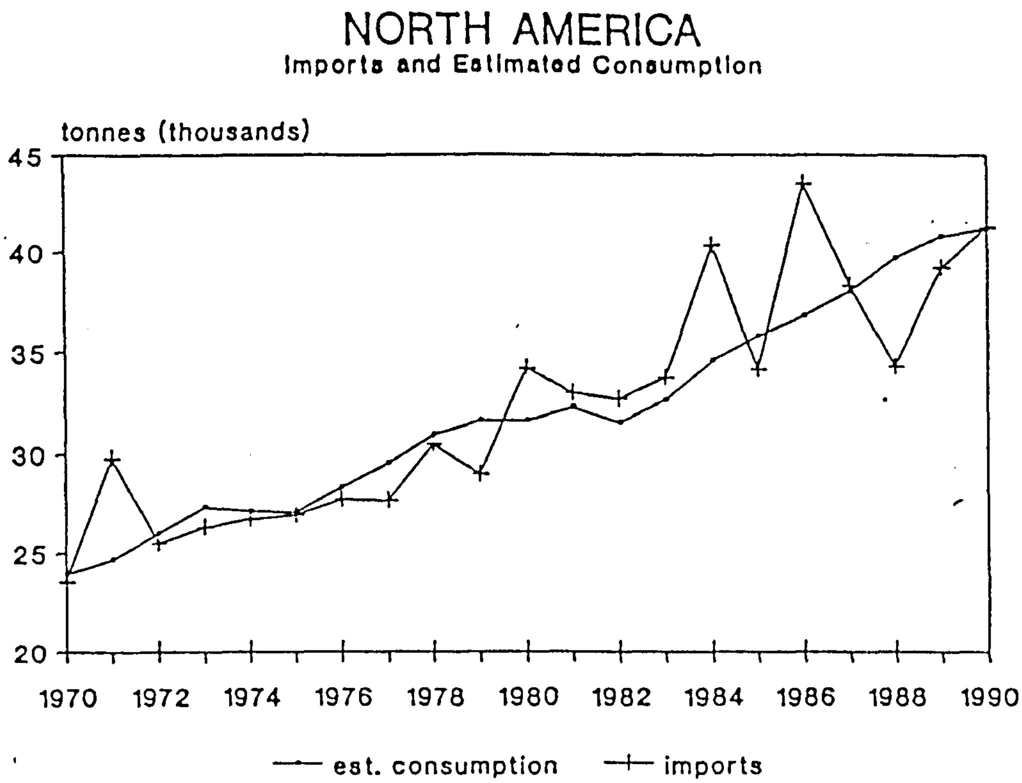


Figure 1.9

The resulting model for North America is

$$\text{lmppcna} = \underset{[7.05]}{2.93} + \underset{[4.60]}{0.92}\ \text{lypcna} \qquad \text{(A.45)}$$

$$1972 - 1989; \quad \bar{R}^2 = 0.54\ ; \quad D.W. = 2.02$$

$$\text{cpna} = \text{nna} * \widehat{\text{mppcna}} \qquad \text{(A.46)}$$

$$\Delta\text{zpna} = \underset{[1.62]}{0.14}\ \Delta\text{xpbr} + \underset{[1.86]}{0.14}\ (\text{xprw} - \text{cpw}) + \underset{[3.23]}{4147.02}\ \Delta\text{rpsny} \qquad \text{(A.47)}$$

$$1975 - 1989; \quad D.W. = 1.49$$

$$\text{mpna} = \widehat{\text{cpna}} + \widehat{\Delta\text{zpna}} \qquad \text{(A.48)}$$

where

- the last two characters of a name in general indicate the region, while w indicates world

cp = consumption of pepper
mp = net imports of pepper
mppc = net imports per capita
n = population size
psny = yearly average New York spot price of Lampong black pepper in \$ct/kg.
rpsdr = yearly average spot price of black Lampung in New York in constant 1980 special drawing rights per kg.
rpsny = yearly average spot price of black Lampung in New York in constant 1980 US dollar cents per kg.
y = Gross Domestic Product (GDP)
ypc = GDP per capita
xprw = total net exports of pepper producing countries.
xpw = world net exports = xprw + Δzpsp.
Δzp = (assumed) change of carry-over stocks

Japan

We mentioned already that demand in Japan depends on G.D.P. in more than one way. A change to more outdoor and ready-made food is important to get to know Western food, but the general cultural change towards more openness that goes along with a rising G.D.P. is far more important and leads to changes in taste. A straightforward explanation of imports by G.D.P. and a constant term was therefore chosen. For Japan the change in stocks was modelled to depend only on the change in price. Again the relation is found to be positive as was also the case for North America. For a graphic presentation see Figure 1.10. The model results are

$$\text{lcpjp} = \underset{[3.89]}{2.09} + \underset{[11.72]}{0.98}\ \text{lyjp} \tag{A.49}$$

1970 - 1989; $\bar{R}^2 = 0.88$; D.W. = 1.72

$$\Delta\text{zpjp} = \underset{[1.67]}{263.78}\ \Delta\text{rpsdr} \tag{A.50}$$

1975 - 1989; D.W. = 1.96

$$\text{mpjp} = \widehat{\text{cpjp}} + \Delta\widehat{\text{zpjp}} \tag{A.51}$$

where

the last two characters of a name in general indicate the region, while w indicates world

cp	=	consumption of pepper
mp	=	net imports of pepper
mppc	=	net imports per capita
n	=	population size
psny	=	yearly average New York spot price of Lampong black pepper in $ct/kg.
rpsdr	=	yearly average spot price of black Lampung in New York in constant 1980 special drawing rights per kg.
rpsny	=	yearly average spot price of black Lampung in New York in constant 1980 US dollar cents per kg.
y	=	Gross Domestic Product (GDP)
ypc	=	GDP per capita
xprw	=	total net exports of pepper producing countries.
xpw	=	world net exports = xprw + Δzpsp.
Δzp	=	(assumed) change of carry-over stocks

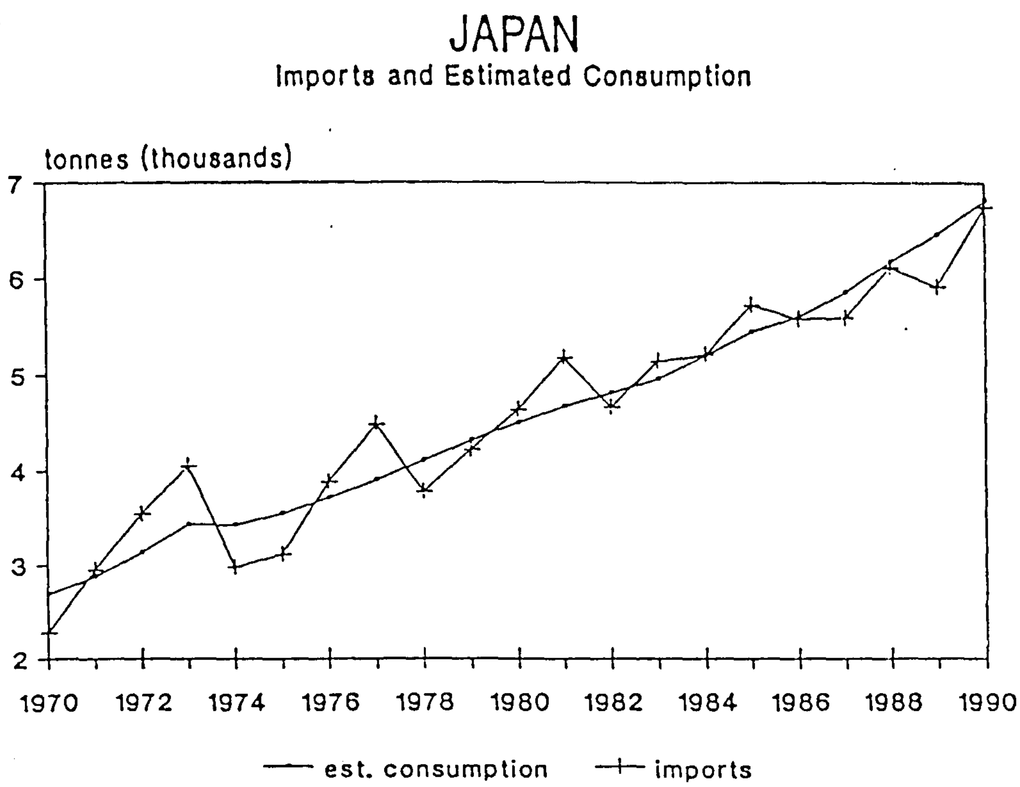


Figure 1.10

Rest of Western Europe, EFTA and Eastern Europe and USSR

From 1988 onwards Switzerland presents import data on pure pepper, whereas until then these figures also included pimento and capsicum. Therefore a dummy variable was introduced. For Eastern Europe and the USSR the relation between income and food consumption is very direct. More income means more meat and sausages, with a direct link to more use of pepper. Note further that we find a negative sign here when looking at the influence of price changes on stocks (although not significant), suggesting that we are at the lower end of the market, where pepper is dumped when there is oversupply and prices are falling. For results see also Figure 1.11.

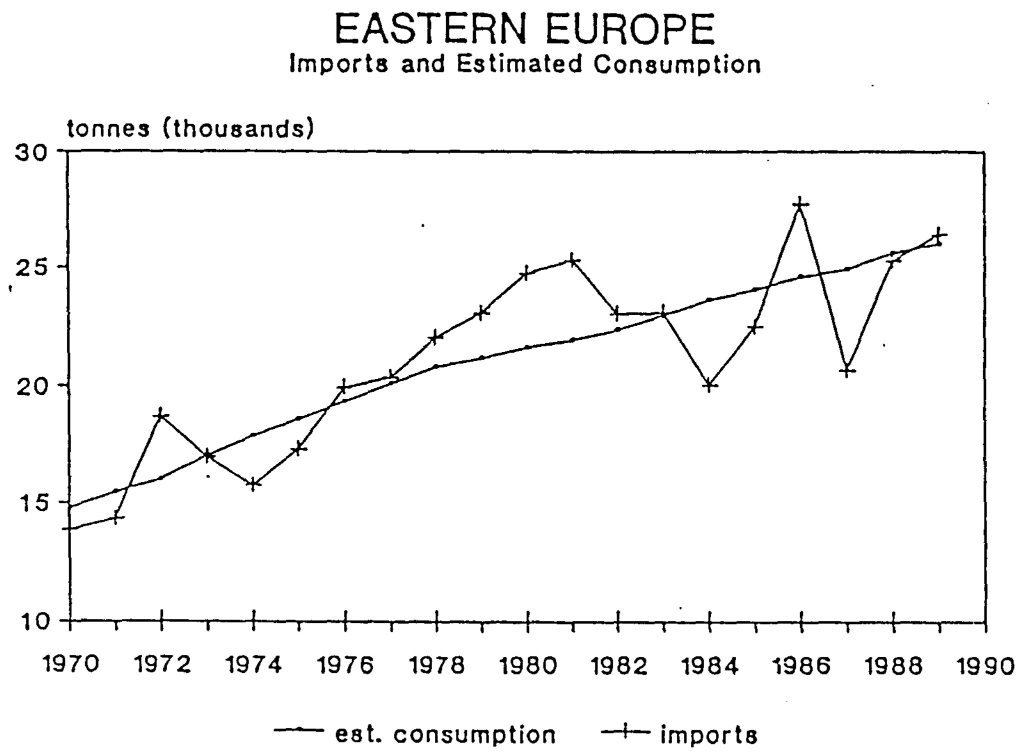


Figure 1.11

The model results are for Rest of Western Europe, EFTA

$$lcpre = \underset{[3.40]}{1.81} - \underset{[7.33]}{0.30}\, dsw88 + \underset{[11.84]}{1.15}\, lyre \qquad (A.65)$$

1971 - 1989; $\bar{R}^2 = 0.89$; D.W. = 1.40

$$lmpre = 1.89 - 0.31\ dsw88 + 1.14\ lyre - 0.07\ lrpsdr \quad (A.66)$$
$$[3.86] \quad [8.19] \quad [12.89] \quad [2.04]$$

$$1971 - 1989; \quad \bar{R}^2 = 0.91 \ ; \quad D.W. = 1.54$$

$$\Delta zpre = \hat{mpre} - \hat{cpre} \quad (A.67)$$

and for Eastern Europe and USSR

$$lcpee = 4.89 + 0.74\ lyee \quad (A.57)$$
$$[6.64] \quad [0.84]$$

$$1970 - 1988; \quad \bar{R}^2 = 0.72 \ ; \quad D.W. = 1.73$$

$$\Delta zpee = 0.08\ (xprw - cpw) - 1158.51\ \Delta rpsdr \quad (A.58)$$
$$[1.49] \quad [1.08]$$

$$1971 - 1988; \quad D.W. = 1.72$$

$$mpee = \hat{cpee} + \hat{\Delta zpee} \quad (A.59)$$

where

the last two characters of a name in general indicate the region, while w indicates world

cp = consumption of pepper
mp = net imports of pepper
mppc = net imports per capita
n = population size
psny = yearly average New York spot price of Lampong black pepper in $ct/kg.
rpsdr = yearly average spot price of black Lampung in New York in constant 1980 special drawing rights per kg.
rpsny = yearly average spot price of black Lampung in New York in constant 1980 US dollar cents per kg.
y = Gross Domestic Product (GDP)
ypc = GDP per capita
xprw = total net exports of pepper producing countries.
xpw = world net exports = xprw + Δzpsp.
Δzp = (assumed) change of carry-over stocks

Middle East and North Africa

For the model for this region, a dummy for the years 1980 - 1983 was introduced as there was a peak in oil income in those years, which did not affect food consumption proportionally.

$$lcpmn = 1.66 + 1.37\ lymn + 0.39\ d8083 \qquad (A.52)$$
$$\quad [2.40]\ [11.11] \qquad [5.39]$$

1970 - 1988; $\bar{R}^2 = 0.92$; D.W. = 2.16

$$mpmn = \hat{cpmn} \qquad (A.53)$$

For the other regions, <u>Australia and New Zealand</u>, <u>Asia and Pacific, excl. China, prod.countries, Singapore, Australia and New Zealand</u>, <u>Latin America</u> and <u>Rest of Africa</u> the modelling approach follows the lines of other regions:

<u>Australia and New Zealand</u>

$$lcpaz = 0.94 + 2.21\ lnaz \qquad (A.54)$$
$$\quad [1.67]\ [11.26]$$

1970 - 1989; $\bar{R}^2 = 0.87$; D.W. = 1.88

$$\Delta zpaz = 83.28\ \Delta rpsdr \qquad (A.55)$$
$$\quad [1.97]$$

1975 - 1989; D.W. = 1.15

$$mpaz = \hat{cpaz} + \Delta \hat{zpaz} \qquad (A.56)$$

<u>Asia and Pacific, excl. China, prod.countries, Singapore, Australia and New Zealand</u>

$$lcpap = 1.13 + 0.38\ lyap + 0.64\ lmpap_{-1} \qquad (A.60)$$
$$\quad [1.01]\ [0.82] \qquad [3.16]$$

1972 - 1988; $\bar{R}^2 = 0.81$; D.W. = 2.46

$$cmap = \hat{cpap} \qquad (A.61)$$

<u>China</u>

mpch = 0 from '83 onwards (A.62)

Latin America

$$lcpla = \underset{[2.12]}{4.86} + \underset{[1.32]}{0.30}\ lxpbr \qquad (A.68)$$

1970 - 1988; $\bar{R}^2 = 0.04$; D.W. = 1.87

$$lmpla = \underset{[2.15]}{4.97} + \underset{[1.37]}{0.32}\ lxpbr - \underset{[2.88]}{0.48}\ l((p\$br+p\$br_{-1})/2) \qquad (A.69)$$

1971 - 1988; $\bar{R}^2 = 0.30$; D.W. = 2.86

$$\Delta zpla = \hat{mpla} - \hat{cpla} \qquad (A.70)$$

Rest of Africa

$$lcprf = \underset{[1.67]}{2.74} + \underset{[2.68]}{0.88}\ lyrf \qquad (A.71)$$

1970 - 1988; $\bar{R}^2 = 0.26$; D.W. = 1.67

$$lmprf = \underset{[2.14]}{3.18} + \underset{[2.86]}{0.84}\ lyrf - \underset{[2.24]}{0.31}\ lrpsny \qquad (A.72)$$

1970 - 1988; $\bar{R}^2 = 0.40$; D.W. = 2.03

$$\Delta zprf = \hat{mprf} - \hat{cprf} \qquad (A.73)$$

where

the last two characters of a name in general indicate the region, while w indicates world

cp = consumption of pepper
mp = net imports of pepper
mppc = net imports per capita
n = population size
p$ = price in US$
psny = yearly average New York spot price of Lampong black pepper in $ct/kg.
rpsdr = yearly average spot price of black Lampung in New York in constant 1980 special drawing rights per kg.
rpsny = yearly average spot price of black Lampung in New York in constant 1980 US dollar cents per kg.
y = Gross Domestic Product (GDP)

ypc = GDP per capita
xpbr = total exports of pepper from Brazil.
xprw = total net exports of pepper producing countries.
xpw = world net exports = xprw + Δzpsp.
Δzp = (assumed) change of carry-over stocks

The model is then closed with the following <u>identities</u>:

$$cpw = cpec + cpna + cpjp + cpmn + cpee + cpap + cpaz + cpre + cpla + cprf \quad (A.81)$$

$$mpw = mpec + mpan + mpjp + mpmn + mpee + mpap + mpaz + mpre + mpla + mprf \quad (A.82)$$

$$xprw = xpbr + xpia + xpio + xpml + xpmd + xpsl + xpth + xpvm + xpch \quad (A.83)$$

$$xpw = xprw + \Delta zpsp \quad (A.84)$$

$$mpw = xpw \quad (A.85)$$

mpw = total world net imports

xpw = total world net exports

Finally the model is solved by deriving a level of the price that clears the market:

rpsny = clearing price (A.91)

2. Projections of the pepper economy and assessment of selected policy measures

2.1 Introduction

Price instability of pepper is very high and arises mainly due to fluctuations of supply, as demand in the short-term is quite price-inelastic and stable. Figure 2.1 illustrates this. The cyclical movement of the prices with on average four years up and four years down, already indicates that supply reactions on prices are the main causes of price instability.

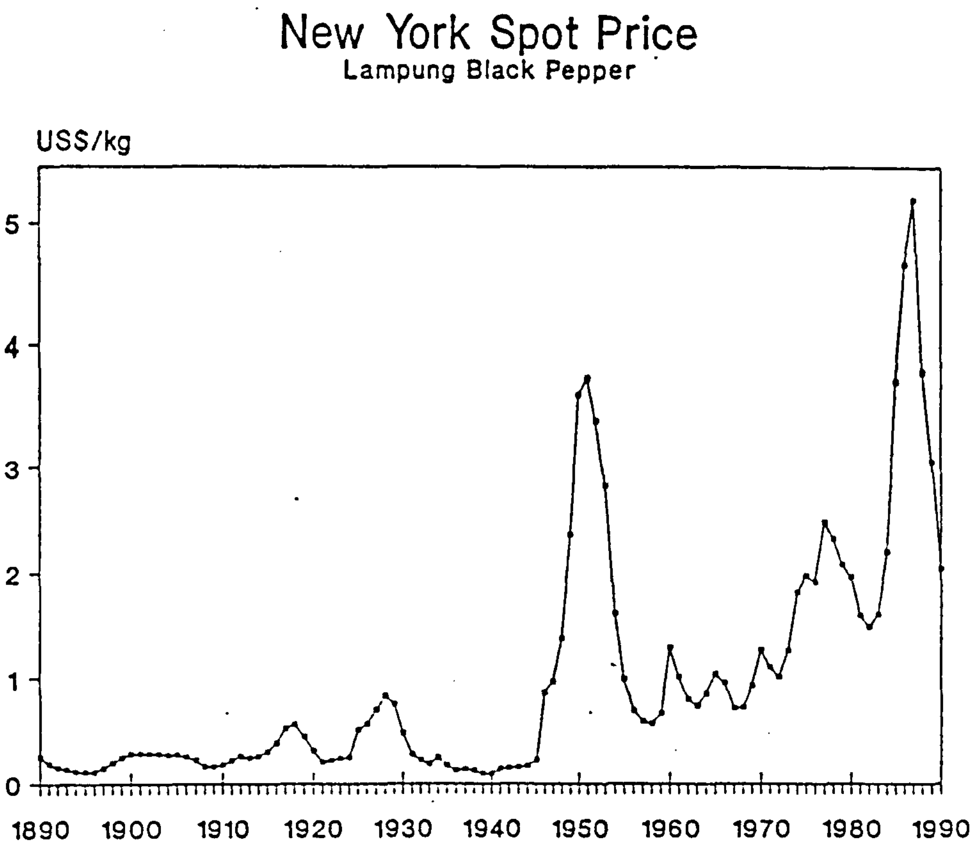


Figure 2.1

It is the purpose of this chapter to draw a picture of the future of the pepper economy using the model that was presented in Chapter 1 and to broadly assess policy measures particularly referring to the problem of price instability and supply management. First some recent developments are shown and a reference scenario is developed, which will be sketched in the next section. Afterwards, in section 2.3, some alternative scenarios of economic growth are shown. The chapter concludes with sections on policy formulation and evaluation and on a review of the need for further work.

2.2 Standard scenario: outlook to the year 2020

Before embarking on the presentation of figures for likely future developments, it needs to be stressed again, that the results in this chapter are preliminary, since it has not been possible within this project to devote sufficient time to obtain more solid results. In interaction with country experts and on the basis of discussions of the current model and additional data, considerable improvements are expected to be possible. One of the aspects not yet sufficiently captured is e.g. the size of the Indian supply responses to price fluctuations. The investment side is not yet represented adequately for long-term analyses. Stock formation at various levels need further work as well. In this way a list of necessary activities can be formulated, depending of the concrete policy question at hand: an investment policy question requires elaboration in a different direction than a question about the feasibility of a buffer stock. Nevertheless, the figures may in due course turn out to have been accurate predictions or at least accurate indicators of moments and directions of changes.

Two earlier sets of projections were derived. The first one in late 1990 and presented in a paper called "Modelling the pepper market" to the International Workshop on "Cooperation among the IPC member countries in the development and use of a computer simulation model for forecasting supply, demand and prices of pepper", Jakarta, 12 - 21 March 1991. At that time our projections indicated a slight recovery in prices in 1991, compared to 1990. In a paper "The pepper economy- present and future -", prepared for the International Workshop on the Progress and Development in the Control of Pepper Diseases in the Producing Countries, Lampung, Indonesia, 3 - 5 December 1991, the forecasts were based on the same model but including all available new information and data. The model indeed projects lower prices in 1991 but higher prices in 1992. All this refers to real prices, obtained as nominal prices deflated with a price index. Figure 2.2 shows the two cases: the oldest forecast, called the reference price, and the latter one, called price scenario.

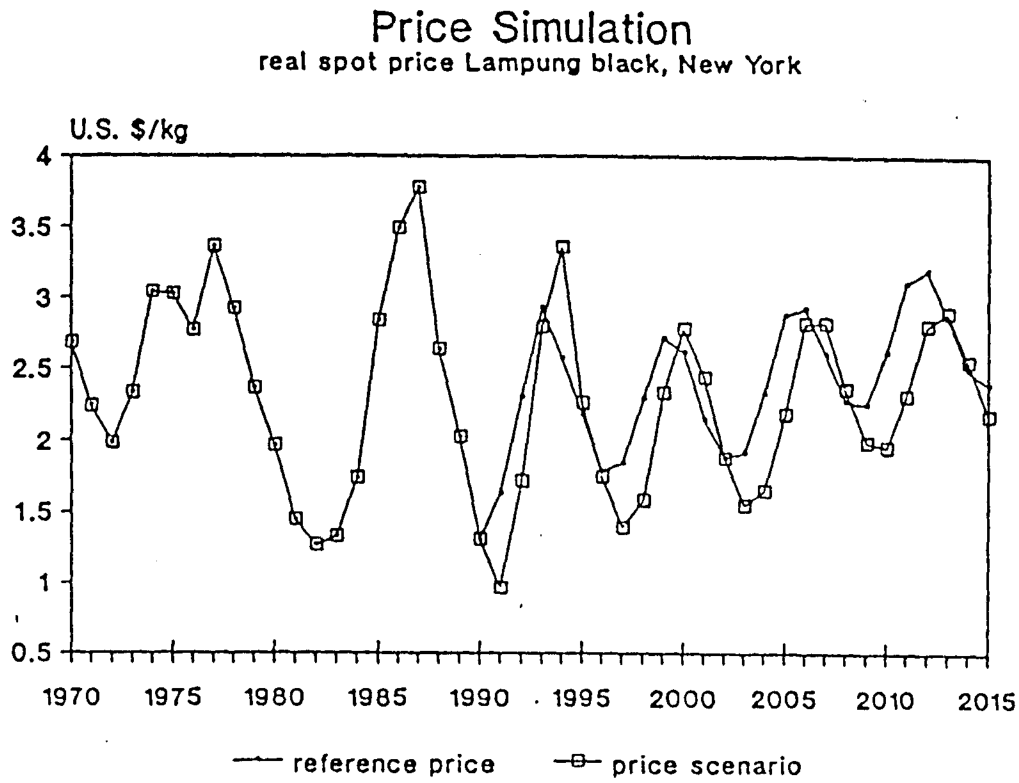


Figure 2.2

Obviously, data on the price in 1991 are available now. It has not been possible at this juncture to update the rest of the database referring to area, production, export, import, consumption and stocks. The only new figure is the 1991 price. However, for the future new scenarios for GDP have been used. In this chapter we use scenarios as prepared by FAO. For the full period 1990 - 2020 the FAO scenario predicts a world economic growth of over 3.7%. We find that quite optimistic and we therefore call this scenario the "optimistic scenario" or the "high growth scenario" (GDP3). From this we have derived a "standard scenario" (GDP2) by taking 70% of the growth rate of each individual country in case of positive growth rates and we increase the possible negative growth rates in absolute terms. Next to that we define a "pessimistic scenario" or a "low growth scenario" (GDP1) in a similar way but taking 40% in stead of 70%.

Figure 2.3 now shows both the latter forecast "price scenario" in Figure 2.2 and the new forecast called "reference price", which now is the reference price for the new standard GDP scenario: GDP2. The two are very close especially during the earlier part of the forecasting period. The new forecast is a bit higher owing to somewhat higher GDP growth assumptions. Projections for the four major producing countries are shown in Figures 2.4 to 2.7. The results are self explanatory. On the consumption side results for four regions are depicted: the EC, North America and Japan show a steady growth (Figures 2.8 to 2.10). Important are developments in Eastern Europe. Figure 2.11 shows the result for Eastern European, with a serious decline in the current years. To complete the picture projections for the price are shown in Figure 2.12, both in real and in nominal terms.

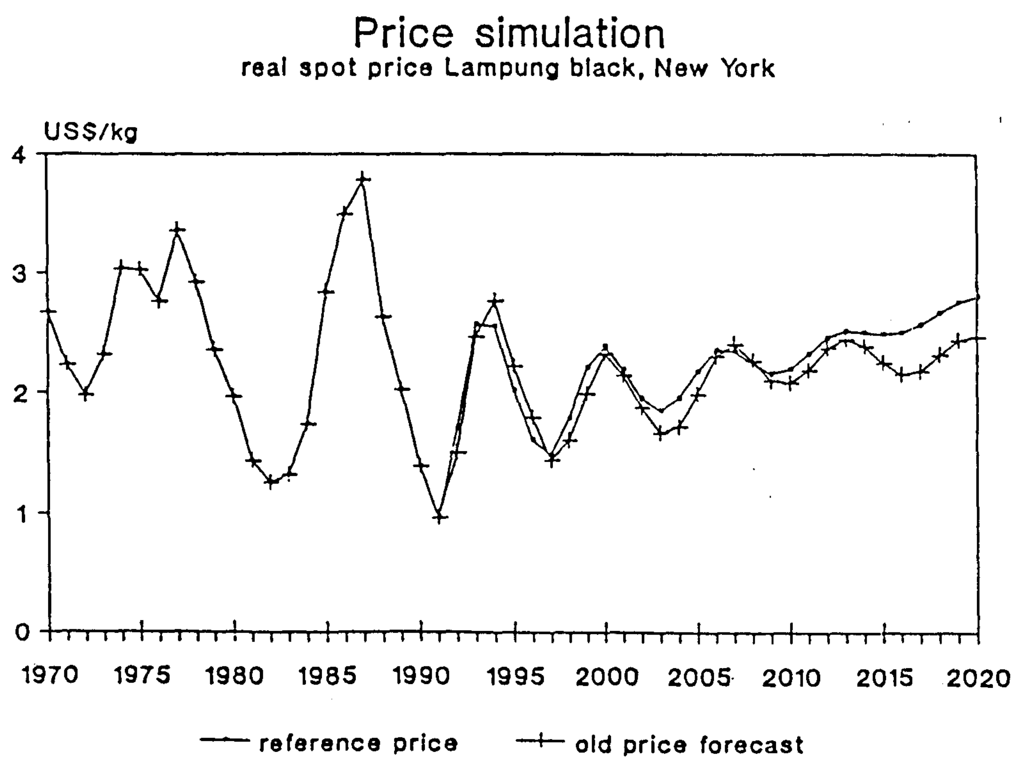


Figure 2.3

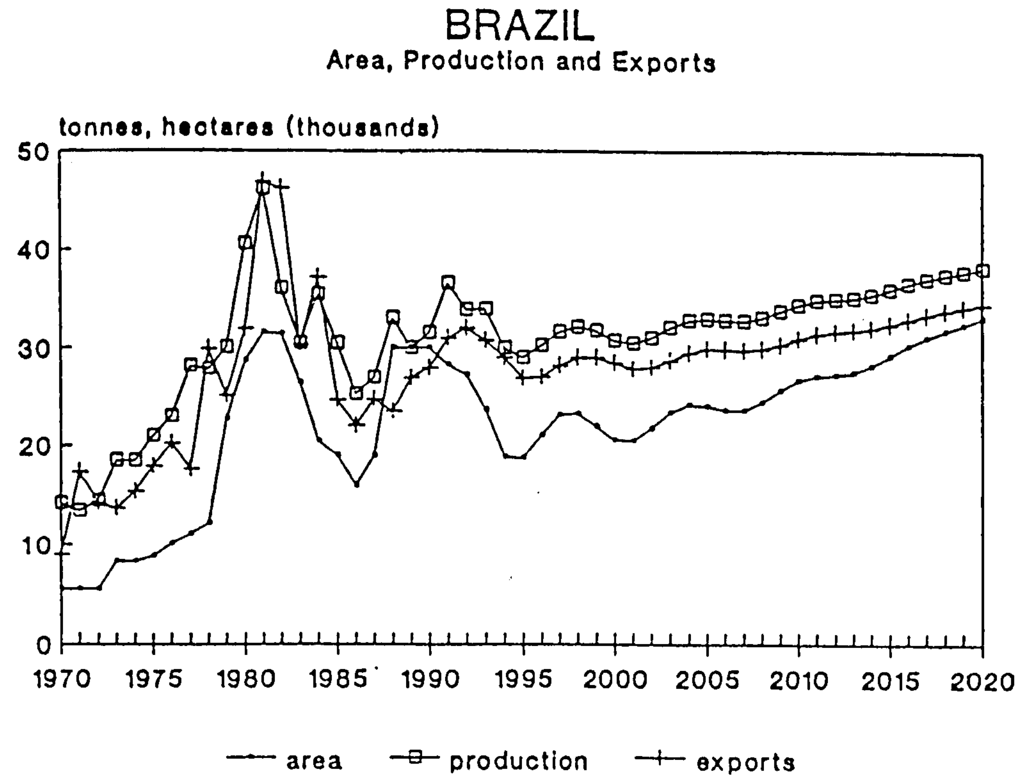


Figure 2.4

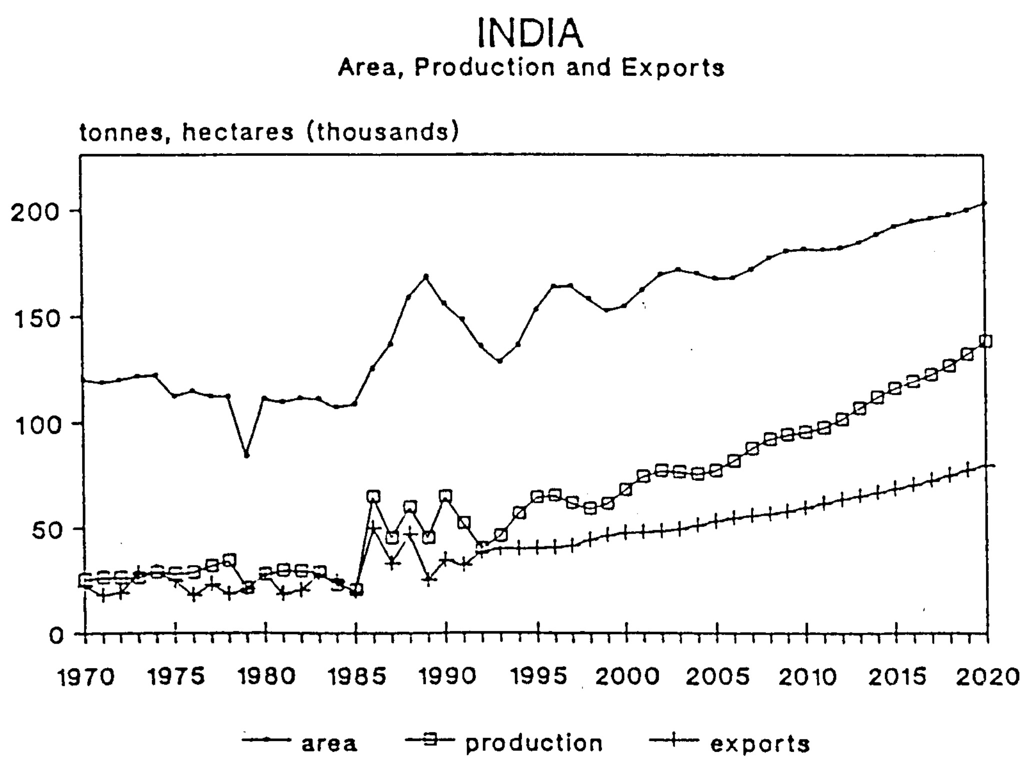


Figure 2.5

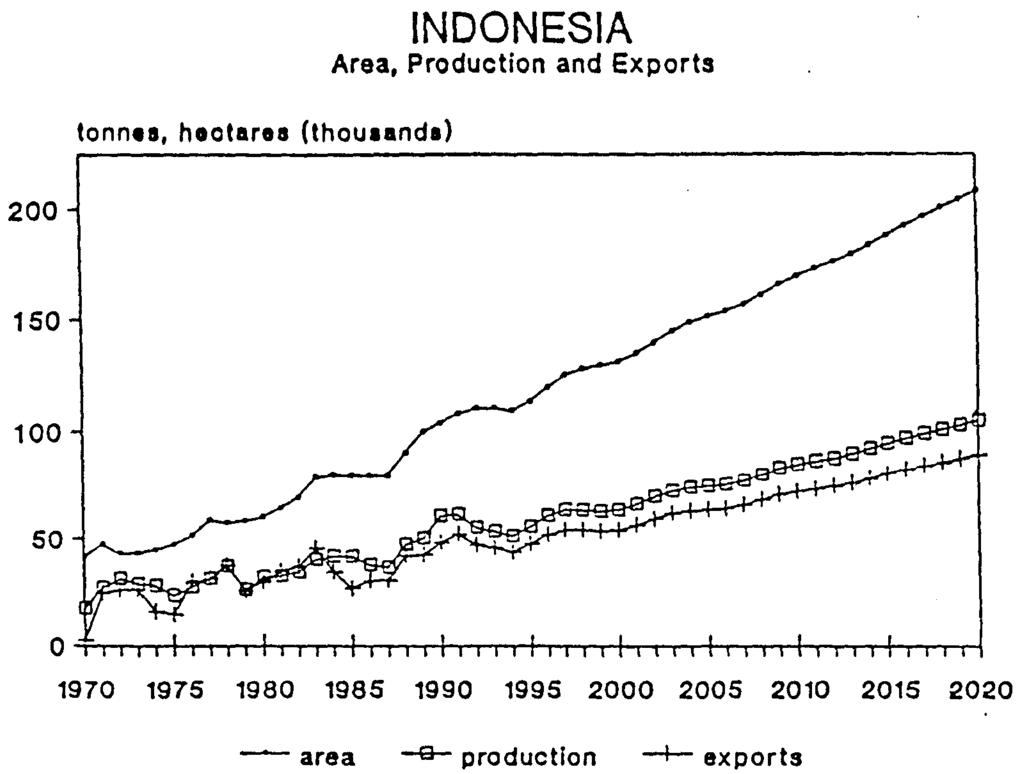


Figure 2.6

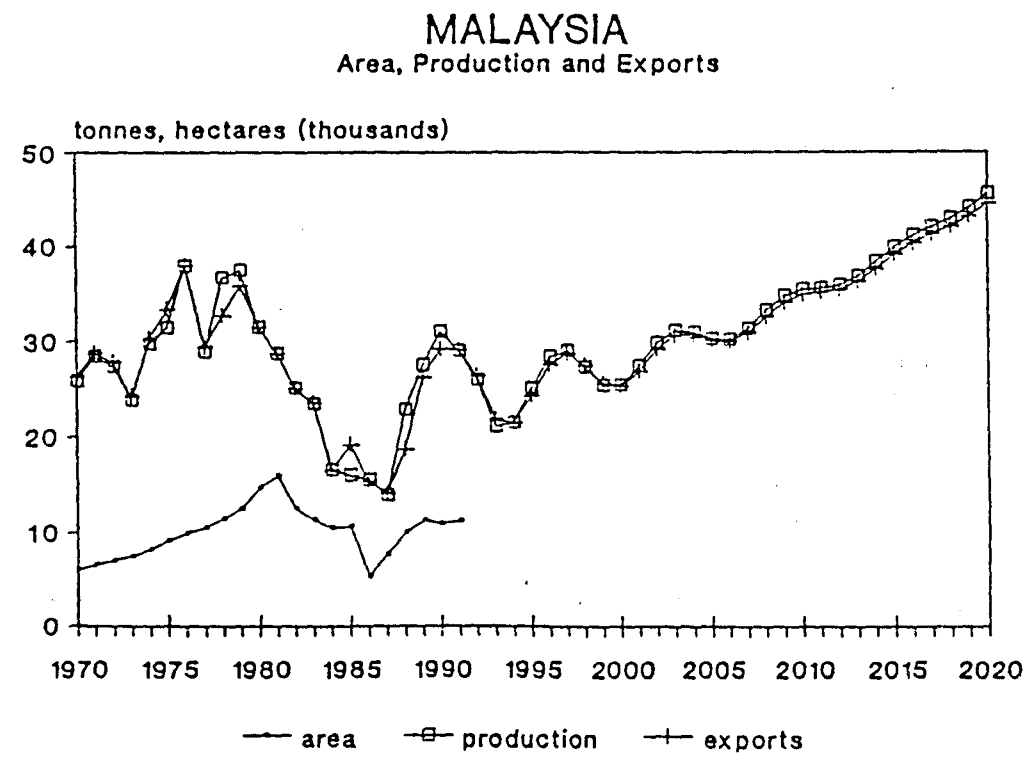


Figure 2.7

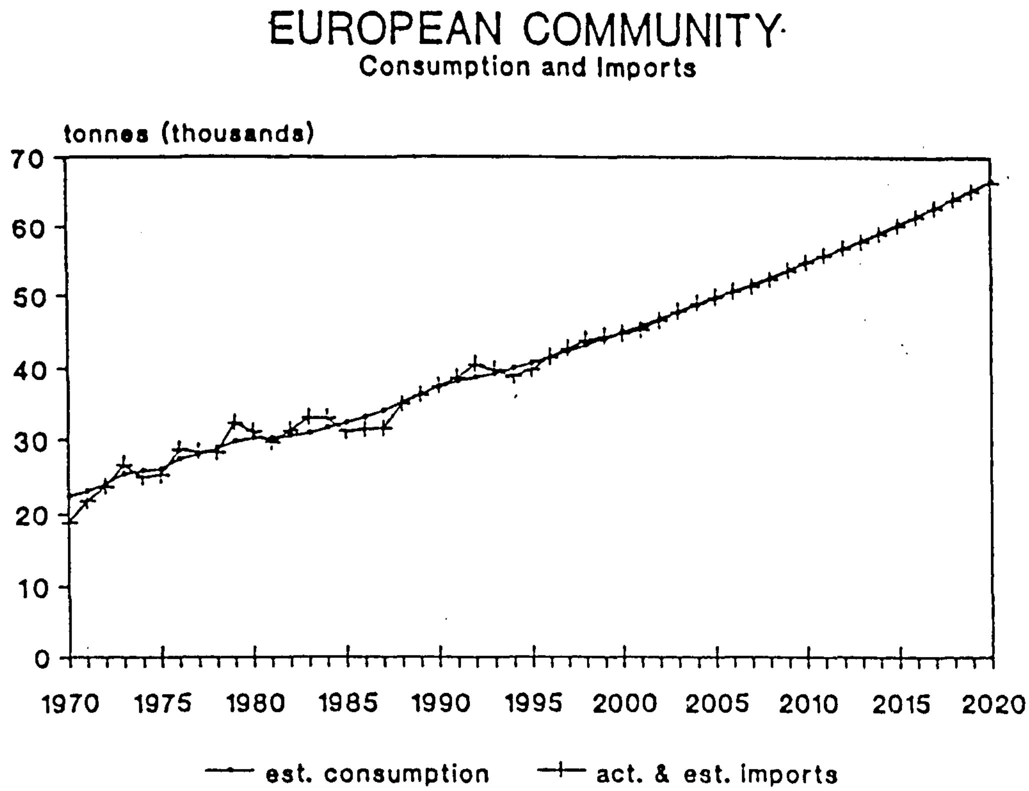


Figure 2.8

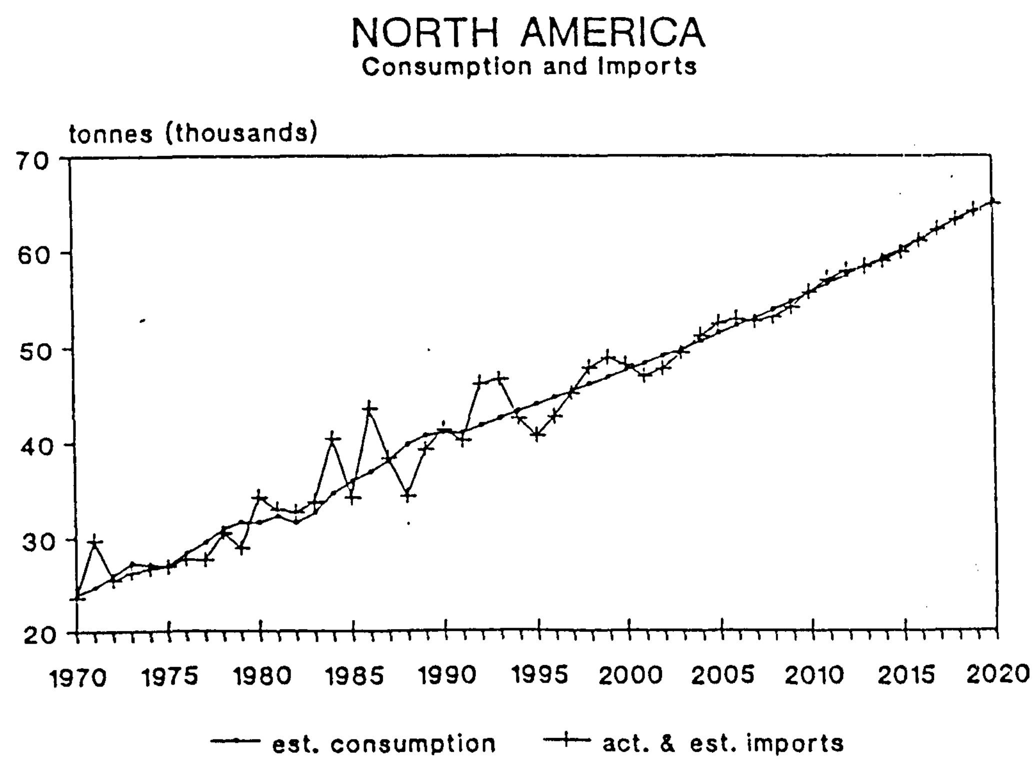


Figure 2.9

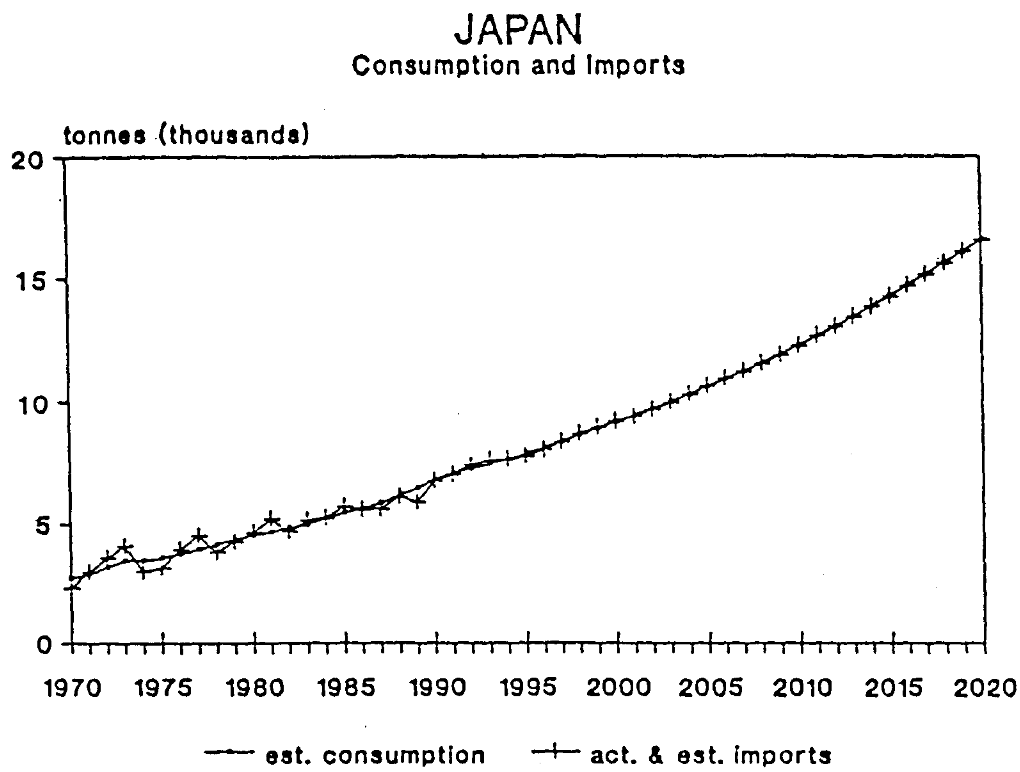


Figure 2.10

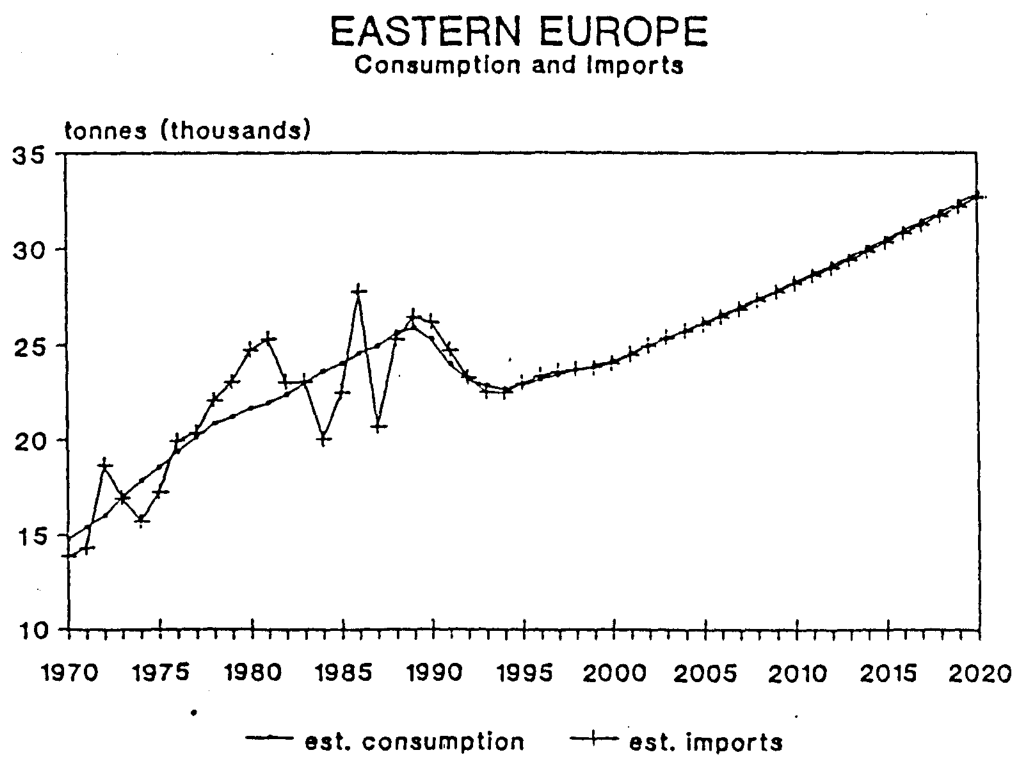


Figure 2.11

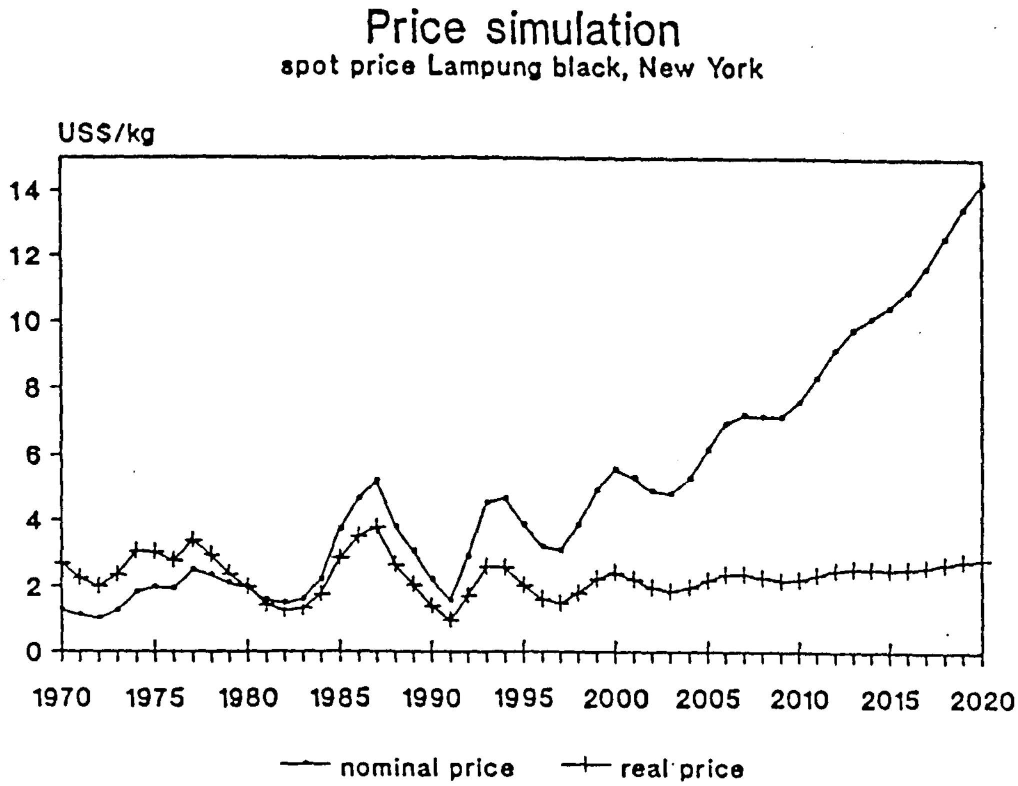


Figure 2.12

2.3 Alternative scenarios of economic growth

For the purpose of evaluation of alternative policies, the standard GDP scenario (GDP2) acts as a reference base. Two alternative growth paths were described so in section 2.2: a pessimistic and an optimistic scenario. The corresponding simulation results are presented below for selected cases and only in graphical form.

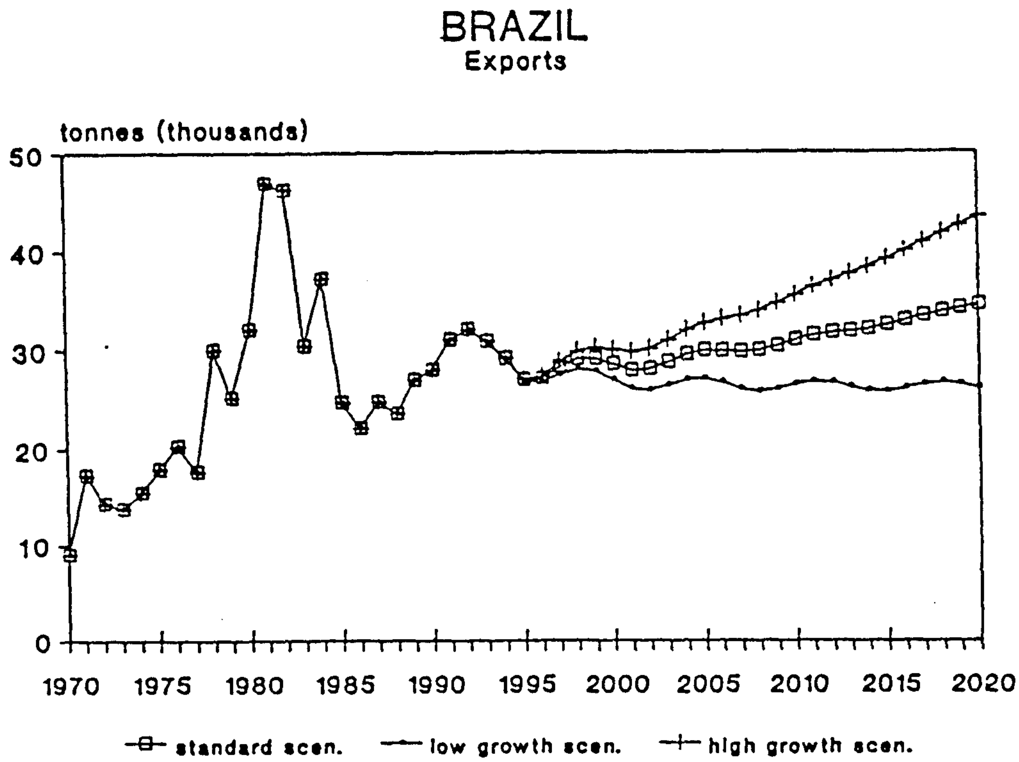


Figure 2.13

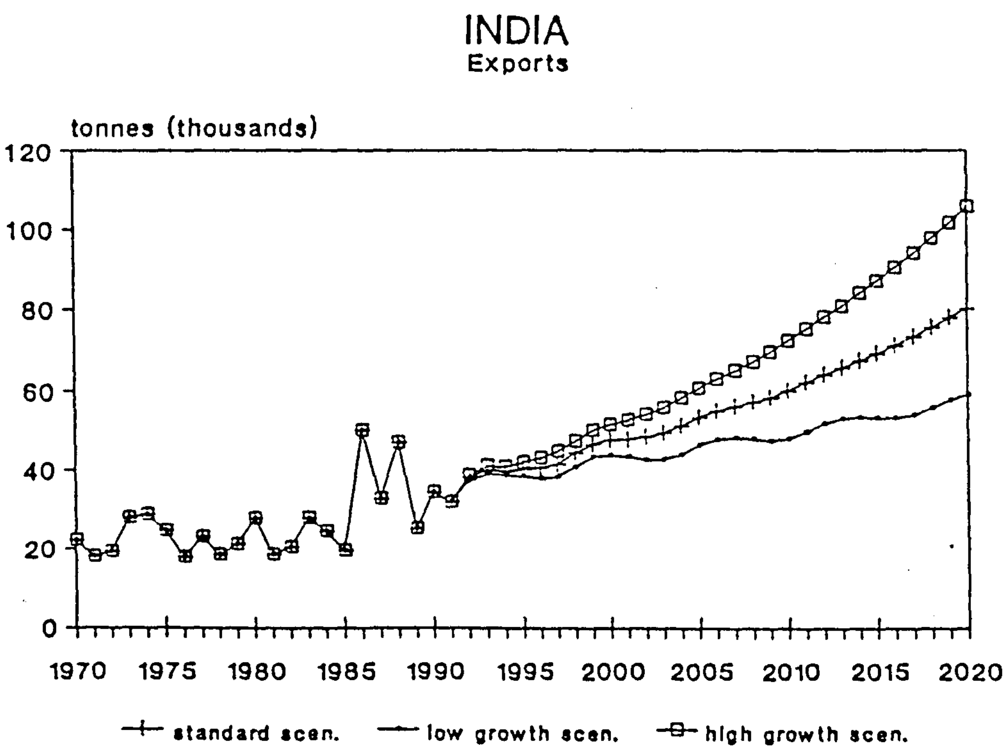


Figure 2.14

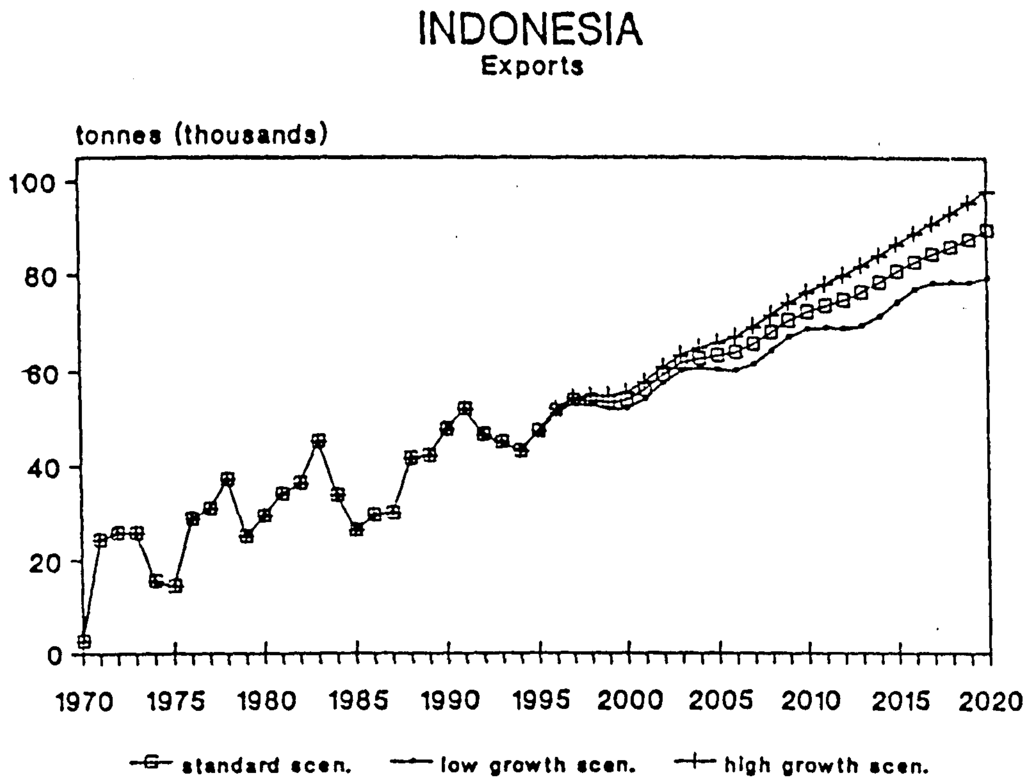


Figure 2.15

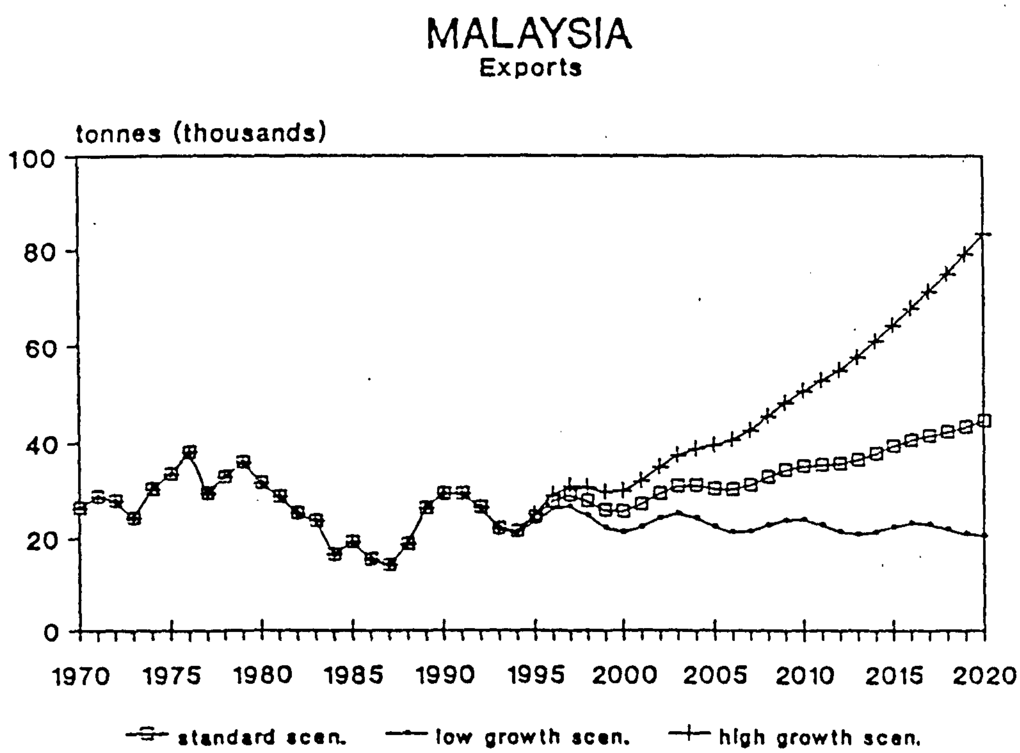


Figure 2.16

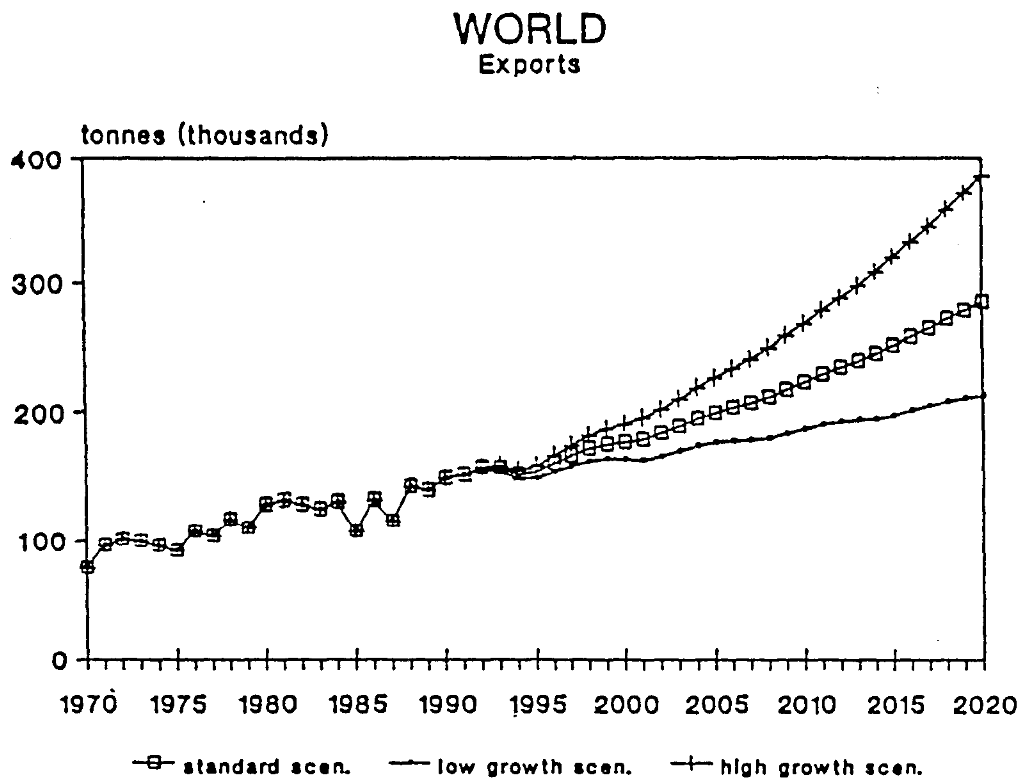


Figure 2.17

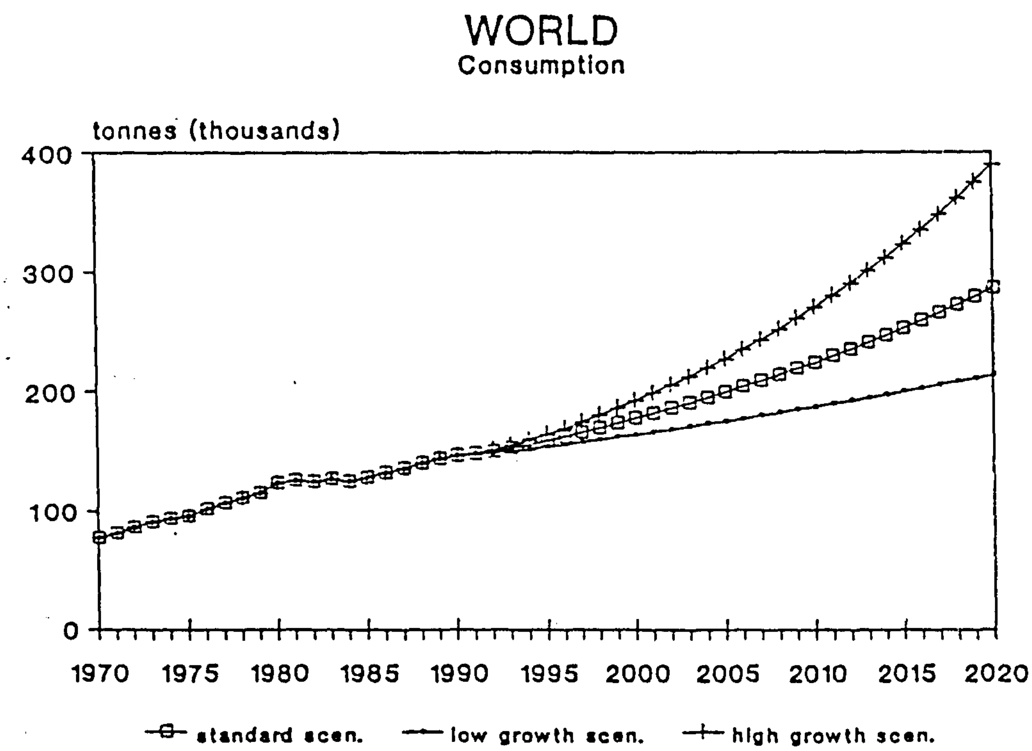


Figure 2.18

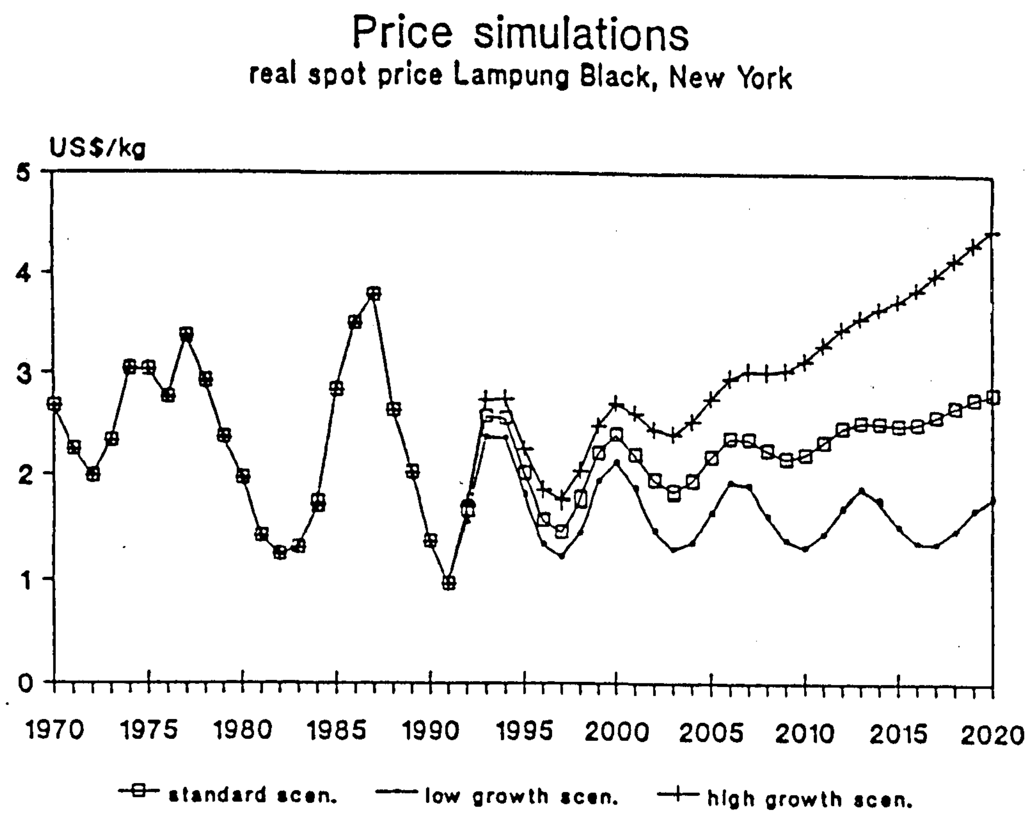


Figure 2.19

2.4 Evaluation of selected policy measures

Planting/investment policies

The degree of success of this type of policies in the case of pepper will depend on the effectiveness of the programmes. A discouragement of pepper planting can only be successful if there are alternative crops. Subsidizing and stimulating other crops seems to be the best way to reduce pepper planting. In countries where the life cycle of pepper vines is short, e.g. Malaysia and Brazil, the effects will be larger than in India and Lampung, where an investment decision involves the next ten to twenty years. However in India and Lampung there seem to be more alternative crops. In the past there have often been programmes to encourage the cultivation of pepper or to improve production methods. From evaluations of these programmes it can be learnt that they were quite successful. International coordination of stimulation programmes is needed on the one hand to avoid overshooting (stimulation in all producing countries could easily lead to oversupply) and on the other hand to make sure prices will not reach the level where other countries will take up production and enter the market. There seems to be little reason to fear for substitution on the demand side at high price levels, although some irreversible loss could be the result of the development of new spice mixtures (only partly consisting of pepper) as an alternative for pepper. The model presented in Chapter 1 is not yet elaborate enough to simulate the effects of planting policies. Developing the model in such a way that it can be used for this purpose is one of the most important recommendations for further work.

Production/harvesting/exploitation policies

The production of first grade qualities of pepper depends not only on the number of vines and the weather. The amount of inputs, like time spent on weeding, pruning, remounding and taking care of ill vines to prevent a spread of disease as well as the amount of fertilizer and pesticide is very important and so is the number of pickings in the harvest time. Especially to farmers with different crops or with alternatives to earn a living, the allocation of time and money will be an optimization process. This will add to stability, as inputs will be higher when prices are higher and vice versa. The only possible management of the amount of inputs seems to be to use credit facilities and/or the price of fertilizer as instruments. This will, however, not only affect pepper production, but agricultural production in general and hence cannot be regarded as an easy policy option.

Export quotas

When discussing export quotas, there are two different situations that have to be considered; a system of export quotas with a central stockpiling agency and a system without organized national stocks. The first system, that will be further discussed in the next paragraph, need not have any influence on production. It could just simply be meant to stabilize the price at a minimum level and then it does not induce smuggling as long as the agency purchases at the market price. The second system however is much more restrictive and will create oversupply on the local markets in producing countries, leading to a drop in price and production. The main concern of this second system is only to stabilize export earnings at a minimum level. Smuggling can be very profitable in such a situation and hard to avoid. There also is no direct incentive for countries to prevent smuggling (the free rider problem).

For pepper producing countries export earning from pepper are very small when related to total export earnings. Therefore the second system is not a likely alternative.

National stockpiling

In his report, ESCAP (1979), on stabilization of export earnings Pande recommended so called price-supply management schemes for the main producing countries. The calculations of Pande to estimate the costs and benefits of such a stabilization programme are very straightforward. He had to make strong assumptions. Furthermore he could not take into account the effects of price stabilization on supply and he did not make any assumptions on the effects these schemes could have on the level of the stocks that are held by farmers and exporters. However, it is an interesting illustration of how national stockpiling can be organized. It is important to know how long the pepper has to be kept in stock as it is impossible to support a situation of structural oversupply for a longer period. In the case of pepper, national stocks could be used for temporary adjustments when the general planting policies fail. This could e.g. happen in the case of an exceptionally good crop. A combination of stockpiling and planting management should however always be regarded as a necessity.

Minimum export price

The concept of a minimum export price (m.e.p.) is a simple one. If all exporters stick to a minimum price and do not sell below that price, they can effectively avoid a drop in prices. However, because the internationally arranged minimum export price is likely to become effective only in times of oversupply, stocks in producing countries will grow. This then leads to the same choices that had to be made in the case of export quotas; either no regulated stocks in combination with lower farm prices and an incentive for smuggling and avoidance of the m.e.p. or regulated stock keeping with the problems mentioned in the above paragraph to be solved. Commodities for which the price elasticity of demand is low are most suitable for m.e.p.-schemes as for these a small difference between supply and demand can result in a large fall in prices. Pepper seems excellent to benefit from m.e.p.-schemes and for a couple of years there was a minimum price, set by the IPC at the regular Pepper Exporters' Meetings. However, these arrangements failed to be effective, because it was to easy for exporters to avoid the m.e.p.. Again the message is that m.e.p. schemes need to be combined with supportive planting management and planning.

International buffer stock

To illustrate the effects of an international buffer stock the model can be used. This was in the report referred to previously. However, because we do not feel comfortable with some aspects of the model in this respect, in particular such items as the effect of an international buffer stock on private stocks, we do not reproduce results here. The assumption was made that nothing would change in the policies of private stockholders and producers, which is not realistic: studies for other commodities indicate the opposite (Burger and Smit (1989), Herrmann, Burger and Smit (1990)).

2.5 Need for further work

The model that has been used for the simulations, as presented in this chapter, is in its current state not elaborate enough for sound policy advise. There is a need for a set of models that can be used for all kinds of simulations and especially for planting policies and price stabilization analyses. For that purpose more analysis of production and better data on area and planting density is needed. Some experimented production analysis on very short time series of production area, weather and prices showed that there is scope for considerable improvement. Once there have been developed such elaborate models, crop forecasting becomes feasable and the combination of regional production models will lead to better forecasts of developments in the world market.

A good model is needed to quantify and forecast the effects of all kinds of international coordinated supply policies. However, it should be stressed that it is equally important that expertise be developed by the governments and policy makers in producing countries to use this kind of simulation model to evaluate different policies and types of supply policies and monitor and adjust them on a regular basis.

3. Data availability and requirements

3.1 Introduction

The International Pepper Community (IPC) has played a significant role in the collection and dissemination of information by starting a series of Pepper Statistics and Pepper Statistical Yearbooks in 1980. However, as the Executive Director of the IPC already acknowledged in the introduction to the 1989 edition, there is still scope for further improvement. In chapter 5 of Bade and Smit (1991) an overview of the existing pepper statistics is given and shortcomings in data availability are discussed. They are summarized here.

3.2 Data on area and supply

With respect to the supply of pepper the yearbooks of the I.P.C. give series on area and production. These are obtained from various sources in the producing countries.

As is often the case with statistics, these figures are not very accurate and also not always comparable. There is e.g. some confusion on the definition of "area". While in most countries area applies to planted area, the data of Brazil at least for some years refer to harvested area. Mostly it is not very clear in what way the area data are estimated and whether production figures are derived from export data or are also based on other information (e.g. data on area under pepper cultivation and average yields). To improve the accuracy of the analysis it would also be helpful to have more information on the quantity of immature vines, the density of vines, the average age structure of the vines, the effect of age on yield (the so-called yield profile), the number of farms and their sizes and the extent of pruning, weeding, remounding and fertilizer application. To get an impression of medium and long-term price-elasticity of pepper supply and the relative profitability of pepper in comparison with other crops, data on the costs of production are needed. Since short-term variation of production seems to be mainly the result of fluctuations in weather conditions and the effects of diseases (which is related to maintenance), data on rainfall (as given in the last two country reports of Malaysia) and data on the number of vines damaged by diseases might be helpful.

3.3 Data on prices

All the important price quotations in New York, London and Singapore are reported by IPC in the statistical yearbooks. Furthermore they present a price series of monthly average FOB prices in Sarawak. Publication of series of market prices in the major producing and consuming countries would be very relevant. Collecting national FOB price series and average farm gate prices in the major pepper growing districts would be very good activities as all prices paid, especially farmer prices are very important. Unfortunately the word producer price is often somewhat confusing as this could refer to the price paid by exporters to middlemen or to the actual farm gate price.

3.4 Data on stocks

On this subject one can be very brief as no data series on stocks could be traced. As pepper has low storage costs and can be stored for a long period without much deterioration, there might be considerable stocks from time to time, held by farmers and exporters as well as by importers, grinders and food industries.

3.5 Data on trade

Data on exports, imports and re-exports of pepper are supplied by the IPC in the statistical yearbooks and by the FAO. Export data concerning black and white unground pepper for Brazil were supplied by CACEX, which is the name of the Foreign Trade Department of the Bank of Brazil. The Spices Board of India gave more disaggregated figures regarding black, white, green dehydrated, green canned unground pepper as well as pepper oil and oleoresin. The Indonesian Central Bureau of Statistics supplied export quantities and values of black and white unground whereas the Pepper Marketing Board of Malaysia in addition reported on oil, ground and green unground pepper exports. Black and green unground pepper exports are registered by Le Directeur General de la Banque Donnees de L'Etat of Madagascar while no break-down in different products appear in the statistics of the Department of Census and Statistics of Sri Lanka and the Department of Customs of Thailand.

For most importing countries there are only import figures on pepper as an aggregate or on pepper and ground pepper. For some countries black, white and sometimes green pepper and oleoresin imports are distinguished or difference is made between imports for industrial manufacturing of essential oils or resinoids and other imports. Almost all data were obtained from the various national bureaus on (trade) statistics. With respect to re-exports one gets the same picture: pepper is taken as an aggregate. Even for countries with large re-exports as the Fed. Rep. of Germany, the Netherlands and the United Kingdom there seem to be no data which are more disaggregated. Only for Singapore and the U.S.A. the difference between black pepper and white pepper is made.

3.6 Data on demand

The only statistics available are on aggregate imports as reported above. A study of the International Trade Centre UNCTAD/GATT gives a lot of information on market characteristics in the major consuming countries. Estimates of the industrial shares of consumption and the ratio of black and white pepper used are presented in this survey that was published in 1982 and may need some updating. Addresses of spice traders organizations and other important organizations in the consuming countries are provided.

Bibliography

Bade, J. and Hidde P. Smit (1988): Co-operation among the IPC member countries in the development and use of a computer simulation model for forecasting supply and demand of pepper and pepper products, Report for UNCTAD and the International Pepper Community, Economic and Social Institute, Free University, Amsterdam.

Bade, J. and Hidde P. Smit (1991): Modelling and policy formulation for commodity markets, Paper prepared for the International Workshop on Cooperation among the IPC member countries in the development and use of a computer simulation model for forecasting supply, demand and prices of pepper, Jakarta, 12 - 21 March 1991, Economic and Social Institute, Free University, Amsterdam.

Burger, K. and Smit, H.P. (1989), Long-term and short-term analysis of the natural rubber market, Weltwirtschaftliches Archiv, Vol. 125(4), pp. 718-747.

ESCAP (1978): An Examination of the Pepper Economy in Brazil and Madagascar, Consultants' report of the Royal Tropical Institute Amsterdam by dr.ir. P.W.F. de Waard and ir. C.B. Houtman, ESCAP, Bangkok, Thailand.

ESCAP (1979): Study on the Stabilization of Export Earnings from Pepper, by Pande, V.C., ESCAP, Bangkok, Thailand.

ESCAP (1981a): Report on a Socio-economic Study on Production and Productivity of Pepper Holdings in India, by George, C.K. and Lakshmanachar, M.S., ESCAP, Bangkok, Thailand.

ESCAP (1981b): Report on a Socio-economic Study on Production and Productivity of Pepper Holdings in Indonesia, by Sjamsu Ckeng and Nasution, A.G., ESCAP, Bangkok, Thailand.

ESCAP (1981c): Report on a Socio-economic Study on Production and Productivity of Pepper Holdings in Malaysia, by Wong Ting Hung and Chua Teck Kheng, ESCAP, Bangkok, Thailand.

ESCAP (1981d): Report on a Socio-economic Study on Production and Productivity of Pepper Holdings in India, Indonesia and Malaysia, ESCAP, Bangkok, Thailand.

ESCAP (1983): A Consolidated Study Report on Determination of Remunerative Price Levels of Pepper in India, Indonesia and Malaysia, by M. Balaraman Nair, H. Soedarno, S. Haji Abdullah and J. Lau Lik Chu, ESCAP, Bangkok, Thailand.

ESCAP (1984): Market Study to determine the Demand Prospects of Pepper in Selected Countries of the Escap Region, Escap, Bangkok, Thailand.

Food and Agriculture Organization (1986): The World Pepper Economy: Projections of Supply, Demand and Trade to 1990 and 1995, F.A.O., Rome, Italy.

Food and Agriculture Organization - Regional Office for Asia and the Pacific (1988): A Study of Possible New Low-cost Approaches to Small-holder Tree Crop Development, 2 volumes, draft report AG TCP/INS/6654 by R. Cambell, Pasril Wahid, D.P. Tarigans, Mudrig Yahmadi. Arifin Sultoni and A.F. Fulliott, F.A.O., Bangkok, Thailand.

Herrmann, R., Burger, K. and Smit, H.P. (1990), Commodity policy: price stabilisation versus financing, in: L.A. Winters and D. Sapsford (eds.), Primary Commodity Prices: Economic Models and Economic Policy, Cambridge University Press, Cambridge.

International Pepper Community (1980, 1982): Pepper Statistics, I.P.C., Jakarta, Indonesia.

International Pepper Community (1984, 1985, 1986, 1987): Pepper Statistical Yearbooks, I.P.C., Jakarta, Indonesia.

International Pepper Community (1986): Report of the eleventh meeting of the permanent panel on techno-economic studies, I.P.C., Jakarta, Indonesia.

International Pepper Community (1990): Report of the fifteenth meeting of the permanent panel on techno-economic studies in London, I.P.C., Jakarta, Indonesia.

International Pepper Community (1988): Report of the thirteenth meeting of the permanent panel on techno-economic studies, I.P.C., Jakarta, Indonesia.

International Trade Centre UNCTAD/GATT (1982): Spices, a survey of the world market, 2 volumes, ITC UNCTAD/GATT, Geneva, Switzerland.

International Trade Centre UNCTAD/GATT (1988): A Note on the Development of Restructured Pepper or "Plus Pepper", prepared for the 13th meeting of the International Pepper Community, ITC UNCTAD/GATT, Geneva, Switzerland.

Nasution, A.G., Intensification Project of Pepper in Indonesia during PELITA II and Programme for PELITA III, Directorate General of Plantations, Jakarta, Indonesia.

Purseglove, P.W., Brown, E.G. Green, C.L. and Robbins, S.R.J. (1981): Spices, Longman, London, United Kingdom.

Raja Sekhar, S. (1982), A Study of Pepper Growers, interim report no. 12 of the Indo-Dutch Kerala Research Project on Labour and Poverty in India and the Philippines, University of Amsterdam, Amsterdam, The Netherlands.

Tropical Products Institute (1980): A Technical and Economic Study to Assess and Evaluate the Prospects for Pepper Processing in the Countries of the Pepper Community, final report to UNIDO by Walters, P.R. and Smith, A.E., TPI, London, United Kingdom.

Tropical Products Institute (1980): Report of a Study of Primary Processing, Handling and Grading of Pepper (Piper nigrum) in Member Countries of the International Pepper Community, part I: Black Pepper in India, by F.V. Robinson , TPI, London, United Kingdom.

Tropical Products Institute (1981): Report of a Study of Primary Processing, Handling and Grading of Pepper (Piper nigrum) in Member Countries of the International Pepper Community, part II: Black and White Pepper in Malaysia, by F.V. Robinson , TPI, London, United Kingdom.

Tropical Products Institute (1981): Report of a Study of Primary Processing, Handling and Grading of Pepper (Piper nigrum) in Member Countries of the International Pepper Community, part III: Black and White Pepper in Indonesia, by F.V. Robinson , TPI, London, United Kingdom.

Tropical Products Institute (1981): Report of a Study of Primary Processing, Handling and Grading of Pepper (Piper nigrum) in India, Malaysia and Indonesia, Member Countries of the International Pepper Community, part IV, final report by F.V. Robinson and C.L. Green, TPI, London, United Kingdom.

Wahid, P. (1986): Rainfed Resource Development Project in Bicol Region, The Republic of Philippines, consultant's report, Research Institute for Spices and Medicinal Crops, Bogor, Indonesia.

World Bank (1984): Madagascar, Export Crops Sub-sector Review, report No. 5097-MAG, World Bank, Washington, U.S.A.

APPENDIX

The structural pepper model in mathematical notation

All quantities of pepper are in tonnes unless stated otherwise. An explanation of the used abbreviated variables can be found at the end of each paragraph. An "l" before a variable name means that its natural logarithm was taken. Absolute t-values are presented in parentheses.

Supply side

Brazil

$$\text{lapbr} = \underset{[2.35]}{1.81} + \underset{[10.11]}{0.81}\ \text{lapbr}_{-1} + \underset{[2.47]}{0.27}\ \text{lpcbr}_{-3} \quad \text{(A.1)}$$

1973 - 1990; $\bar{R}^2 = 0.87$; D.W. = 1.75

$$\text{lqpbr} = \underset{[9.59]}{5.60} + \underset{[7.93]}{0.47}\ \text{lapbr} + \underset{[.56]}{0.06}\ \text{l}(\text{pcbr}_{-1}/\text{pcbr}_{-2}) \quad \text{(A.2)}$$

1972 - 1990; $\bar{R}^2 = 0.79$; D.W. = 1.04

$$\text{lxpbr} = \underset{[0.13]}{0.15} + \underset{[9.02]}{0.98}\ \text{l}((\text{qpbr}_{-1} + \text{qpbr})/2) \quad \text{(A.3)}$$

1971 - 1990; $\bar{R}^2 = 0.81$; D.W. = 1.79

India

$$\text{lapia} = \underset{[2.74]}{4.16} + \underset{[4.46]}{0.60}\ \text{lapia}_{-1} + \underset{[3.66]}{0.18}\ \text{lpcia}_{-2} - \underset{[5.90]}{0.39}\ \text{d79} \quad \text{(A.4)}$$

1972 - 1989; $\bar{R}^2 = 0.84$; D.W. = 1.53

$$\text{lqpia} = \underset{[0.59]}{-2.29} + (\underset{[2.83]}{0.99} + \underset{[1.61]}{0.001}\ \text{t70})\ \text{lapia} + \underset{[2.36]}{0.33}\ \text{lpcia}_{-1} \quad \text{(A.5)}$$

1971 - 1989; $\bar{R}^2 = 0.66$; D.W. = 2.50

$$\text{lxpia} = \underset{[1.39]}{2.05} + \underset{[5.49]}{0.78}\ \text{lqpia} + \underset{[2.10]}{0.41}\ \text{lrpratio} \quad \text{(A.6)}$$

1971 - 1989; $\bar{R}^2 = 0.62$; D.W. = 1.94

Indonesia

$$lapio = \underset{[1.59]}{3.26} + \underset{[3.33]}{0.64}\ lapio_{-1} + \underset{[1.28]}{0.055}\ lpcio_{-3} + \underset{[2.28]}{0.18}\ lt70 \qquad (A.7)$$

1973 - 1988; $\bar{R}^2 = 0.96$; D.W. = 1.69

$$lqpio = \underset{[.31]}{0.65} + \underset{[5.63]}{0.82}\ lapio + \underset{[1.01]}{0.09}\ lpcio \qquad (A.8)$$

1973 - 1988; $\bar{R}^2 = 0.74$; D.W. = 2.22

$$xpio = 0.85\ qpio \qquad (A.9)$$

1971 - 1989; D.W. = 1.03

Malaysia

$$lqpml = \underset{[0.65]}{1.48} + \underset{[7.17]}{0.80}\ lqpml_{-1} + \underset{[3.09]}{0.33}\ lpcml_{-2} \qquad (A.11)$$

1972 - 1989; $\bar{R}^2 = 0.73$; D.W. = 2.68

$$lxpml = \underset{[0.44]}{0.24} + \underset{[9.89]}{0.79}\ lqpml + \underset{[2.29]}{0.18}\ lqpml_{-1} \qquad (A.12)$$

1971 - 1989; $\bar{R}^2 = 0.95$; D.W. = 1.98

Madagascar

forecasts:

xpmd = 2500 in 1990 (A.15)
3000 in 1991
$3500 + 500 * (rpsny_{-5} - rpsny_{-6})$ afterwards

Sri Lanka

$$lxpsl = \underset{[4.78]}{3.80} + \underset{[3.47]}{1.27}\ lt71 \qquad (A.18)$$

1971 - 1988; $\bar{R}^2 = 0.39$; D.W. = 1.60

Thailand

$$lxpth = \underset{[13.56]}{5.78} + \underset{[3.72]}{1.02}\,lt82 + \underset{[1.60]}{1.05}\,lrpratio \qquad (A.21)$$

1982 - 1990 $\bar{R}^2 = 0.60$; D.W. = 1.32

Vietnam

$$lxpvm = \underset{[2.43]}{0.92} + \underset{[10.11]}{2.55}\,lt80 + \underset{[3.58]}{1.69}\,lrpsny \qquad (A.24)$$

1980 - 1989; $\bar{R}^2 = 0.96$; D.W. = 1.50

China (Hainan)

forecasting on the following basis:

$$xpch = \max(500,\ 2000*(rpsny-1.5)) \qquad (A.27)$$

Singapore

$$mpsp = \underset{[1.07]}{4268.46} + \underset{[6.11]}{0.70}\,xgpml + \underset{[2.21]}{2553.40}\,rpsny + \underset{[1.58]}{0.18}\,(xprw-cpw) \qquad (A.28)$$

1975 - 1989; $\bar{R}^2 = 0.82$; D.W. = 1.85

$$xpsp = \underset{[35.47]}{0.99}\,mpsp - \underset{[1.68]}{0.14}\,(xprw - cpw) \qquad (A.29)$$

1975 - 1989; D.W. = 1.85

$$\Delta zpsp = \hat{mpsp} - \hat{xpsp} \qquad (A.30)$$

explanation of variable abreviations:

apbr = total area under pepper in hectares in Brazil
apia = total area under pepper in hectares in India
apio = total area under pepper in hectares in Indonesia
pcbr = f.o.b. price of black pepper in Brazil in constant 1980 dollars
pcia = f.o.b. price of black pepper in India in constant 1980 rupees
pcio = f.o.b. price of black pepper in Indonesia in constant 1980 rupiahs.
pcml = f.o.b. price of pepper in Malaysia (Sarawak) in constant 1980 M$

psny = New York spot price of Lampung black pepper in \$ct/kg
qpbr = total production of pepper in Brazil
qpia = total production of pepper in India
qpio = total production of pepper in Indonesia
qpml = total production of pepper in Malaysia (Sarawak)
rpratio = $rpsny/rpsny_{-1}$
rpsny = New York spot price of Lampung black pepper in \$ct/kg in constant 1980 dollars.
t70 = linear trend starting in 1970: $t=t_{-1}+1$, in this case used to estimate technical progress or shift in cultivation.
t75 = linear trend starting in 1975: $t=t_{-1}+1$
t80 = linear trend starting in 1980: $t=t_{-1}+1$
xpbr = total exports of pepper from Brazil
xpia = total exports of pepper from India
xpio = total exports of pepper from Indonesia
xpma = total exports of pepper from Malaysia
xpmd = total exports of pepper from Madagascar
xpsp = total net exports from Singapore and Hong Kong
xpsl = total exports of pepper from Sri Lanka
xpth = total exports of pepper from Thailand
xprw = total world exports of producing countries
zpsp = stocks in Singapore

Prices

Brazil

$$p\$br = \underset{[1.95]}{-0.27} + \underset{[17.27]}{0.94}\, psny \qquad (A.31)$$

1970 - 1988; $\bar{R}^2 = 0.94$; D.W. = 1.52

$$pcbr = p\$br/pius * 100$$

$pius = 1.04\, pius_{-1}$ from '90 onwards

India

$$p\$ia = \underset{[1.25]}{0.10} + \underset{[27.40]}{0.87}\, psny \qquad (A.32)$$

1970 - 1988; $\bar{R}^2 = 0.98$; D.W. = 1.99

$$pcia = (p\$ia * eria)/piia * 100$$

$piia = 1.08\, piia_{-1}$ from '89 onwards

eria = 1.05 $eria_{-1}$ from '90 onwards

Indonesia

p$io = -0.10 + 0.82 psny (A.33)
[1.28] [27.02]

1970 - 1988; $\bar{R}^2$ = 0.97 ; D.W. = 1.54

pcio = (p$io * erio)/piio * 100

piio = 1.08 $piio_{-1}$ from '89 onwards

erio = 1.0847 $erio_{-1}$ from '90 onwards

Malaysia

p$ml = -0.06 + 0.88 psny (A.34)
[.98] [34.71]

1970 - 1988; $\bar{R}^2$ = 0.98 ; D.W. = 1.93

pcml = (p$ml * erml)/piml * 100

piml = 1.04 $piml_{-1}$ from '89 onwards

erml = $eria_{-1}$ from '90 onwards

explanation of variable abbreviations:

eria = exchange rate of India (rupees per US dollar)
eria = exchange rate of Indonesia (rupiahs per US dollar)
erml = exchange rate of Malaysia (Malaysian dollars per US dollar)
p$br = f.o.b. price of black pepper in Brazil in current dollars
p$ia = f.o.b. price of black pepper in India in current US dollars
p$io = f.o.b. price of black pepper in Indonesia in current US dollars
p$ml = f.o.b. price of pepper in Malaysia (Sarawak) in current US dollars
pcbr = f.o.b. price of black pepper in Brazil in constant 1980 dollars
pcia = f.o.b. price of black pepper in India in constant 1980 rupees
pcio = f.o.b. price of black pepper in Indonesia in constant 1980 rupiahs

pcml = f.o.b. price of pepper in Malaysia (Sarawak) in constant 1980 M$
piia = consumer price index of India
piio = consumer price index of Indonesia
piml = consumer price index of Malaysia
pius = consumer price index of the US
psny = New York spot price of Lampung black pepper in $/kg

Demand side

European Community (E.C.)

$$lmppcec = 2.92 + 0.95\ lypcec \qquad (A.41)$$
$$[18.10]\ [10.04]$$

$$1971 - 1989;\ \bar{R}^2 = 0.85;\ D.W. = 1.47$$

$$cpec = nec * \widehat{mppcec} \qquad (A.42)$$

$$\Delta zpec = 1229.87\ \Delta(\Delta rpsdr) + 0.09\ (xprw - cpw) \qquad (A.43)$$
$$[2.35] \qquad [2.88]$$

$$1975 - 1989;\ D.W. = 1.84$$

$$mpec = \widehat{cpec} + \Delta \widehat{zpec} \qquad (A.44)$$

North America (U.S.A. and Canada)

$$lmppcna = 2.93 + 0.92\ lypcna \qquad (A.45)$$
$$[7.05]\ [4.60]$$

$$1972 - 1989;\ \bar{R}^2 = 0.54;\ D.W. = 2.02$$

$$cpna = nna * \widehat{mppcna} \qquad (A.46)$$

$$\Delta zpna = 0.14\ \Delta xpbr + 0.14\ (xprw - cpw) + 4147.02\ \Delta rpsny \qquad (A.47)$$
$$[1.62] \qquad [1.86] \qquad [3.23]$$

$$1975 - 1989;\ D.W. = 1.49$$

$$mpna = \widehat{cpna} + \Delta \widehat{zpna} \qquad (A.48)$$

Japan

$$lcpjp = \underset{[3.89]}{2.09} + \underset{[11.72]}{0.98}\, lyjp \qquad (A.49)$$

1970 - 1989; $\bar{R}^2 = 0.88$; D.W. = 1.72

$$\Delta zpjp = \underset{[1.67]}{263.78}\, \Delta rpsdr \qquad (A.50)$$

1975 - 1989; D.W. = 1.96

$$mpjp = \widehat{cpjp} + \widehat{\Delta zpjp} \qquad (A.51)$$

Middle East and North Africa

$$lcpmn = \underset{[2.40]}{1.66} + \underset{[11.11]}{1.37}\, lymn + \underset{[5.39]}{0.39}\, d8083 \qquad (A.52)$$

1970 - 1988; $\bar{R}^2 = 0.92$; D.W. = 2.16

$$mpmn = \widehat{cpmn} \qquad (A.53)$$

Australia and New Zealand

$$lcpaz = \underset{[1.67]}{0.94} + \underset{[11.26]}{2.21}\, lnaz \qquad (A.54)$$

1970 - 1989; $\bar{R}^2 = 0.87$; D.W. = 1.88

$$\Delta zpaz = \underset{[1.97]}{83.28}\, \Delta rpsdr \qquad (A.55)$$

1975 - 1989; D.W. = 1.15

$$mpaz = \widehat{cpaz} + \widehat{\Delta zpaz} \qquad (A.56)$$

Eastern Europe and USSR

$$lcpee = \underset{[6.64]}{4.89} + \underset{[0.84]}{0.74}\, lyee \qquad (A.57)$$

1970 - 1988; $\bar{R}^2 = 0.72$; D.W. = 1.73

$$\Delta zpee = \underset{[1.49]}{0.08}\,(xprw - cpw) - \underset{[1.08]}{1158.51}\,\Delta rpsdr \qquad (A.58)$$

1971 - 1988; D.W. = 1.72

$$mpee = \widehat{cpee} + \widehat{\Delta zpee} \qquad (A.59)$$

Asia and Pacific, excl. China, prod.countries, Singapore, Australia and New Zealand

$$lcpap = \underset{[1.01]}{1.13} + \underset{[0.82]}{0.38}\, lyap + \underset{[3.16]}{0.64}\, lmpap_{-1} \qquad (A.60)$$

1972 - 1988; $\bar{R}^2 = 0.81$; D.W. = 2.46

$$cmap = \widehat{cpap} \qquad (A.61)$$

China

$$mpch = 0 \text{ from '83 onwards} \qquad (A.62)$$

Rest of Western Europe, EFTA

$$lcpre = \underset{[3.40]}{1.81} - \underset{[7.33]}{0.30}\, dsw88 + \underset{[11.84]}{1.15}\, lyre \qquad (A.65)$$

1971 - 1989; $\bar{R}^2 = 0.89$; D.W. = 1.40

$$lmpre = \underset{[3.86]}{1.89} - \underset{[8.19]}{0.31}\, dsw88 + \underset{[12.89]}{1.14}\, lyre - \underset{[2.04]}{0.07}\, lrpsdr \qquad (A.66)$$

1971 - 1989; $\bar{R}^2 = 0.91$; D.W. = 1.54

$\wedge \qquad \wedge$

$$\Delta zpre = mpre - cpre \qquad (A.67)$$

Latin America

$$lcpla = \underset{[2.12]}{4.86} + \underset{[1.32]}{0.30}\ lxpbr \qquad (A.68)$$

1970 - 1988; $\bar{R}^2 = 0.04$; D.W. = 1.87

$$lmpla = \underset{[2.15]}{4.97} + \underset{[1.37]}{0.32}\ lxpbr - \underset{[2.88]}{0.48}\ l((p\$br+p\$br_{-1})/2) \qquad (A.69)$$

1971 - 1988; $\bar{R}^2 = 0.30$; D.W. = 2.86

$$\Delta zpla = \hat{mpla} - \hat{cpla} \qquad (A.70)$$

Rest of Africa

$$lcprf = \underset{[1.67]}{2.74} + \underset{[2.68]}{0.88}\ lyrf \qquad (A.71)$$

1970 - 1988; $\bar{R}^2 = 0.26$; D.W. = 1.67

$$lmprf = \underset{[2.14]}{3.18} + \underset{[2.86]}{0.84}\ lyrf - \underset{[2.24]}{0.31}\ lrpsny \qquad (A.72)$$

1970 - 1988; $\bar{R}^2 = 0.40$; D.W. = 2.03

$$\Delta zprf = \hat{mprf} - \hat{cprf} \qquad (A.73)$$

explanation of variable abreviations:

Consumption, imports exports and stocks of pepper are measured in tonnes, GDP in millions of constant 1975 US dollars and population in millions of people.

cpap = consumption of pepper by Asia and the Pacific excl. China, prod. countries, Australia and New Zealand.
cpaz = consumption of pepper by Australia and New Zealand
cpec = consumption of pepper by the European Community.
cpee = consumption of pepper by Eastern Europe and the USSR.
cpjp = consumption of pepper by Japan.
cpla = consumption of pepper by Latin America (Brazil excl.)
cpmn = consumption of pepper by the Middle East and North Africa.
cpna = consumption of pepper by North America.

cpre = consumption of pepper by the EFTA-countries.

cprf = consumption of pepper by the rest of Africa.

cpw = world consumption of pepper of non-producing countries

d8083 = dummy variable, having the value one in 1980 - 1983 and zero in other years.

dsw88 = dummy variable, having the value one since 1988 and zero before 1988.

mpap = net imports of pepper by Asia and the Pacific excl. China, prod. countries, Australia and New Zealand.

mpaz = net imports of pepper by Australia and New Zealand.

mpch = net imports of pepper by the People's Rep. of China

mpec = net imports of pepper by the European Community.

mpee = net imports of pepper by Eastern Europe and the USSR.

mpjp = net imports of pepper by Japan.

mpla = net imports of pepper by Latin America (Brazil excl.).

mpmn = net imports of pepper by the Middle East and North Africa.

mpna = net imports of pepper by North America.

mpre = net imports of pepper by the EFTA-countries.

mprf = net imports of pepper by the rest of Africa.

naz = population size of Australia and New Zealand

nec = population size of the European Community.

nee = population size of Eastern Europe and the USSR.

nna = population size of North America.

nre = population size of the EFTA-countries.

p$br = f.o.b. price of black pepper in Brazil in current dollars

psny = yearly average New York spot price of Lampong black pepper in $ct/kg.

rpsdr = yearly average spot price of black Lampung in New York in constant 1980 special drawing rights per kg.

rpsny = yearly average spot price of black Lampung in New York in constant 1980 US dollar cents per kg.

yap = Gross Domestic Product of Asia and the Pacific excl. China, prod. countries, Australia and New Zealand.

yee = Gross Domestic Product of Eastern Europe and the USSR.

yjp = Gross Domestic Product of Japan.

ymn = Gross Domestic Product of the Middle East and North Africa.

yre = Gross Domestic Product of the EFTA-countries.

yrf = Gross Domestic Product of the rest of Africa.

xpbr = total exports of pepper from Brazil.

xprw = total net exports of pepper producing countries.

xpw = world net exports = xprw + Δzpsp.

Δzpaz = assumed change of carry-over stocks in Australia and New Zealand.

Δzpec = assumed change of carry-over stocks in the E.C.

Δzpee = assumed change of carry-over stocks in Eastern Europe and the USSR.

Δzpjp = assumed change of carry-over stocks in Japan.

Δzpla = assumed change of carry-over stocks in Latin America (Brazil excl.).

Δzpna = assumed change of carry-over stocks in North America.

Δzpre = assumed change of carry-over stocks in the EFTA.

Δzprf = assumed change of carry-over stocks in the rest of Africa.

Identities

$$cpw = cpec + cpna + cpjp + cpmn + cpee + cpap + cpaz + cpre + cpla + cprf \quad (A.81)$$

$$mpw = mpec + mpan + mpjp + mpmn + mpee + mpap + mpaz + mpre + mpla + mprf \quad (A.82)$$

$$xprw = xpbr + xpia + xpio + xpml + xpmd + xpsl + xpth + xpvm + xpch \quad (A.83)$$

$$xpw = xprw + \Delta zpsp \quad (A.84)$$

$$mpw = xpw \quad (A.85)$$

mpw = total world net imports

xpw = total world net exports

rpsny = clearing price (A.91)

ANNEX-7

UPDATED ESTIMATES OF
THE WORLD PEPPER ECONOMY

UPDATED ESTIMATES OF THE WORLD PEPPER ECONOMY

Dr. Kaman Nainggolan

Workshop
The Development and Use of Computer Simulation Model for Forecasting Supply, Demand, and Prices of Agricultural Commodities in ASEAN Countries

August 4 - 15, 1993
Ciawi - Bogor, INDONESIA

A. REGRESSION ESTIMATES FOR AREA, PRODUCTION, AND EXPORT

1. BRAZIL

1.1. AREA

LS // Dependent Variable is LAPBR
Date: 6-23-1993 / Time: 9:40
SMPL range: 1972 - 1991
Number of observations: 20

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	0.4351845	0.6237006	0.6977459	0.495
LAPBR(-1)	0.9429044	0.0624265	15.104241	0.000
LPCBR(-2)	0.3321294	0.0896693	3.7039370	0.002

R-squared	0.930955	Mean of dependent var	9.755319
Adjusted R-squared	0.922832	S.D. of dependent var	0.545003
S.E. of regression	0.151397	Sum of squared resid	0.389657
Durbin-Watson stat	2.310100	F-statistic	114.6086
Log likelihood	11.00344		

1.2. PRODUCTION

LS // Dependent Variable is LQPBR
Date: 6-23-1993 / Time: 10:15
SMPL range: 1972 - 1991
Number of observations: 20

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	5.0876637	0.6354551	8.0063304	0.000
LAPBR	0.5304862	0.0652602	8.1287912	0.000
LRPCBR(-1)	0.1112735	0.1133139	0.9819934	0.340

R-squared	0.817268	Mean of dependent var	10.25864
Adjusted R-squared	0.795770	S.D. of dependent var	0.303795
S.E. of regression	0.137290	Sum of squared resid	0.320427
Durbin-Watson stat	1.618697	F-statistic	38.01628
Log likelihood	12.95957		

1.3. EXPORT

LS // Dependent Variable is LXPBR
Date: 4-15-1993 / Time: 5:39
SMPL range: 1971 - 1991
Number of observations: 21

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.3549315	1.1136135	-0.3187206	0.753
LQXPBR	1.0279431	0.1091424	9.4183654	0.000

R-squared	0.823593	Mean of dependent var	10.12820
Adjusted R-squared	0.814309	S.D. of dependent var	0.375875
S.E. of regression	0.161972	Sum of squared resid	0.498463
Durbin-Watson stat	1.703781	F-statistic	88.70561
Log likelihood	9.480150		

2. INDIA

2.1. AREA

LS // Dependent Variable is LAPIA
Date: 6-23-1993 / Time: 10:25
SMPL range: 1972 - 1991
Number of observations: 20

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	4.0928131	1.1320333	3.6154530	0.002
LAPIA(-1)	0.6077278	0.1023469	5.9379224	0.000
LPCIA(-2)	0.1820250	0.0477670	3.8106831	0.002
D79	-0.3934878	0.0642156	-6.1276094	0.000

R-squared	0.896089	Mean of dependent var	11.70579
Adjusted R-squared	0.876606	S.D. of dependent var	0.170079
S.E. of regression	0.059745	Sum of squared resid	0.057111
Durbin-Watson stat	1.631417	F-statistic	45.99260
Log likelihood	30.20616		

2.2. PRODUCTION

LS // Dependent Variable is LQPIA
Date: 6-23-1993 / Time: 10:26
SMPL range: 1971 - 1991
Number of observations: 21

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-3.9081720	3.5315463	-1.1066461	0.284
LAPIA	1.1314648	0.3141637	3.6015131	0.002
T70LAPIA	0.0014277	0.0006701	2.1304218	0.048
LPCIA(-1)	0.3023058	0.1298242	2.3285787	0.032

R-squared	0.787485	Mean of dependent var	10.41028
Adjusted R-squared	0.749982	S.D. of dependent var	0.358620
S.E. of regression	0.179317	Sum of squared resid	0.546626
Durbin-Watson stat	2.646993	F-statistic	20.99807
Log likelihood	8.511680		

2.3. EXPORT

LS // Dependent Variable is LXPIA
Date: 6-23-1993 / Time: 10:27
SMPL range: 1971 - 1990
Number of observations: 20

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	2.2931115	1.3276870	1.7271477	0.102
LQPIA	0.7563733	0.1279926	5.9095098	0.000
LRPRATIO	0.4242008	0.1869596	2.2689440	0.037

R-squared	0.672806	Mean of dependent var	10.13429
Adjusted R-squared	0.634313	S.D. of dependent var	0.300445
S.E. of regression	0.181685	Sum of squared resid	0.561163
Durbin-Watson stat	1.959966	F-statistic	17.47847
Log likelihood	7.355988		

3. INDONESIA

3.1. AREA

LS // Dependent Variable is LAPIO
Date: 6-23-1993 / Time: 10:30
SMPL range: 1973 - 1991
Number of observations: 19

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	2.9205969	1.1488715	2.5421441	0.023
LAPIO(-1)	0.6485361	0.1221630	5.3087763	0.000
LPCIO(-3)	0.0804213	0.0225946	3.5593137	0.003
LT71	0.1919619	0.0630511	3.0445456	0.008

R-squared	0.982927	Mean of dependent var	11.14670
Adjusted R-squared	0.979513	S.D. of dependent var	0.304124
S.E. of regression	0.043530	Sum of squared resid	0.028423
Durbin-Watson stat	1.777901	F-statistic	287.8664
Log likelihood	34.83753		

3.2. PRODUCTION

LS // Dependent Variable is LQPIO
Date: 6-23-1993 / Time: 10:31
SMPL range: 1971 - 1991
Number of observations: 21

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	1.9819399	0.8854106	2.2384415	0.038
LAPIO	0.7417747	0.0766785	9.6738312	0.000
LPCIO(-1)	0.0335897	0.0495552	0.6778244	0.507

R-squared	0.843250	Mean of dependent var	10.46248
Adjusted R-squared	0.825833	S.D. of dependent var	0.259076
S.E. of regression	0.108121	Sum of squared resid	0.210423
Durbin-Watson stat	1.902037	F-statistic	48.41623
Log likelihood	18.53545		

3.3. EXPORT

LS // Dependent Variable is XPIO
Date: 6-23-1993 / Time: 10:33
SMPL range: 1970 - 1991
Number of observations: 22

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
QPIO	0.8739674	0.0324640	26.921135	0.000

R-squared	0.749471	Mean of dependent var	30697.04
Adjusted R-squared	0.749471	S.D. of dependent var	11180.84
S.E. of regression	5596.332	Sum of squared resid	6.58E+08
Durbin-Watson stat	1.134131	Log likelihood	-220.5620

4. MALAYSIA

4.1. PRODUCTION

LS // Dependent Variable is LQPML
Date: 6-23-1993 / Time: 10:37
SMPL range: 1972 - 1991
Number of observations: 20

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	1.9579276	1.3083231	1.4965168	0.153
LQPML(-1)	0.7711061	0.1286195	5.9952487	0.000
LPCML(-2)	0.2321873	0.0915544	2.5360594	0.021

R-squared	0.720019	Mean of dependent var	10.15354
Adjusted R-squared	0.687080	S.D. of dependent var	0.296867
S.E. of regression	0.166065	Sum of squared resid	0.468820
Durbin-Watson stat	2.343494	F-statistic	21.85916
Log likelihood	9.153918		

4.2. EXPORT

LS // Dependent Variable is LXPML
Date: 6-23-1993 / Time: 10:38
SMPL range: 1971 - 1991
Number of observations: 21

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	0.4500441	0.5856376	0.7684685	0.452
LQPML	0.7816034	0.0870779	8.9759128	0.000
LQPML(-1)	0.1726294	0.0874483	1.9740741	0.064

R-squared	0.941276	Mean of dependent var	10.14255
Adjusted R-squared	0.934751	S.D. of dependent var	0.275850
S.E. of regression	0.070463	Sum of squared resid	0.089370
Durbin-Watson stat	1.550582	F-statistic	144.2593
Log likelihood	27.52697		

5. SRILANKA

5.1. EXPORT

LS // Dependent Variable is LXPSL
Date: 6-23-1993 / Time: 10:55
SMPL range: 1971 - 1991
Number of observations: 21

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	3.8023371	0.7030285	5.4085102	0.000
LT71	1.2750163	0.3051926	4.1777434	0.001

R-squared	0.478789	Mean of dependent var	6.557595
Adjusted R-squared	0.451356	S.D. of dependent var	1.506546
S.E. of regression	1.115906	Sum of squared resid	23.65968
Durbin-Watson stat	1.629785	F-statistic	17.45354
Log likelihood	-31.04983		

6. THAILAND

6.1. EXPORT

LS // Dependent Variable is LXPTH
Date: 6-23-1993 / Time: 10:55
SMPL range: 1982 - 1990
Number of observations: 9

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	5.7768452	0.4241978	13.618283	0.000
LT82	1.0160387	0.2720685	3.7344960	0.010
LRPRATIO	1.0469462	0.6530596	1.6031402	0.160

R-squared	0.702420	Mean of dependent var	7.218244
Adjusted R-squared	0.603226	S.D. of dependent var	0.835134
S.E. of regression	0.526051	Sum of squared resid	1.660378
Durbin-Watson stat	1.320999	F-statistic	7.081308
Log likelihood	-5.164640		

7. VIETNAM

7.1. EXPORT

LS // Dependent Variable is LXPVM
Date: 6-23-1993 / Time: 10:57
SMPL range: 1980 - 1991
Number of observations: 12

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	1.0677463	0.6433678	1.6596204	0.131
LT80	2.8922790	0.3198483	9.0426591	0.000
LRPSNY	0.8525513	0.5602650	1.5216930	0.162

R-squared	0.908617	Mean of dependent var	6.433252
Adjusted R-squared	0.888309	S.D. of dependent var	2.376853
S.E. of regression	0.794347	Sum of squared resid	5.678891
Durbin-Watson stat	2.226919	F-statistic	44.74320
Log likelihood	-12.53836		

8. SINGAPORE

8.1. IMPORT

LS // Dependent Variable is MPSP
Date: 6-23-1993 / Time: 13:34
SMPL range: 1975 - 1989
Number of observations: 15

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	3453.3867	3669.6761	0.9410604	0.367
XGPML	0.6936665	0.1010811	6.8624778	0.000
RPSNY	2819.3072	994.50995	2.8348708	0.016
XPRWCPW	0.1776626	0.0823849	2.1564937	0.054

R-squared	0.884756	Mean of dependent var	28154.43
Adjusted R-squared	0.853326	S.D. of dependent var	7454.488
S.E. of regression	2854.924	Sum of squared resid	89656532
Durbin-Watson stat	1.789088	F-statistic	28.14989
Log likelihood	-138.3099		

8.2. EXPORT

LS // Dependent Variable is XPSPTOT
Date: 7-05-1993 / Time: 10:34
SMPL range: 1975 - 1991
Number of observations: 17

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
MPSP	0.9798451	0.0292981	33.444025	0.000
XPRWCPW	-0.2169314	0.0816217	-2.6577653	0.018

R-squared	0.742834	Mean of dependent var	29837.99
Adjusted R-squared	0.725690	S.D. of dependent var	6907.409
S.E. of regression	3617.731	Sum of squared resid	1.96E+08
Durbin-Watson stat	2.393667	F-statistic	43.32812
Log likelihood	-162.3493		

B. REGRESSION ESTIMATES FOR PRICES

1. BRAZIL

LS // Dependent Variable is PBR
Date: 6-23-1993 / Time: 13:38
SMPL range: 1970 - 1991
Number of observations: 22

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.2950057	0.1620273	-1.8207158	0.084
PSNY	0.9213315	0.0639129	14.415413	0.000

R-squared	0.912205	Mean of dependent var	1.806686
Adjusted R-squared	0.907816	S.D. of dependent var	1.092009
S.E. of regression	0.331555	Sum of squared resid	2.198571
Durbin-Watson stat	1.076029	F-statistic	207.8041
Log likelihood	-5.881064		

2. INDIA

LS // Dependent Variable is PIA
Date: 6-23-1993 / Time: 13:40
SMPL range: 1970 - 1991
Number of observations: 22

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	0.1132527	0.0847776	1.3358806	0.197
PSNY	0.8765777	0.0334412	26.212531	0.000

R-squared	0.971715	Mean of dependent var	2.112854
Adjusted R-squared	0.970301	S.D. of dependent var	1.006648
S.E. of regression	0.173479	Sum of squared resid	0.601902
Durbin-Watson stat	1.866543	F-statistic	687.0968
Log likelihood	8.369087		

3. INDONESIA

LS // Dependent Variable is PIO
Date: 6-23-1993 / Time: 13:43
SMPL range: 1970 - 1991
Number of observations: 22

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.0758782	0.0768556	-0.9872829	0.335
PSNY	0.8140438	0.0303163	26.851694	0.000

R-squared	0.973010	Mean of dependent var	1.781074
Adjusted R-squared	0.971660	S.D. of dependent var	0.934213
S.E. of regression	0.157269	Sum of squared resid	0.494669
Durbin-Watson stat	1.503982	F-statistic	721.0134
Log likelihood	10.52734		

4. MALAYSIA

LS // Dependent Variable is PML
Date: 7-05-1993 / Time: 12:00
SMPL range: 1970 - 1991
Number of observations: 22

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.0799416	0.0806681	-0.9909948	0.334
PSNY	0.8618836	0.0318201	27.086094	0.000

R-squared	0.973463	Mean of dependent var	1.886140
Adjusted R-squared	0.972136	S.D. of dependent var	0.988885
S.E. of regression	0.165070	Sum of squared resid	0.544963
Durbin-Watson stat	1.229560	F-statistic	733.6565
Log likelihood	9.462224		

C. REGRESSION ESTIMATES FOR CONSUMPTIONS, IMPORTS, AND STOCKS

1. EUROPEAN COMMUNITY (E.C)

1.1. CONSUMPTION

LS // Dependent Variable is LCPPCEC
Date: 7-01-1993 / Time: 10:58
SMPL range: 1971 - 1991
Number of observations: 21

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	2.8077033	0.1327711	21.146949	0.000
LYPCEC	1.0193645	0.0771279	13.216549	0.000

R-squared	0.901899	Mean of dependent var	4.557672
Adjusted R-squared	0.896735	S.D. of dependent var	0.140046
S.E. of regression	0.045003	Sum of squared resid	0.038481
Durbin-Watson stat	1.438035	F-statistic	174.6772
Log likelihood	36.37451		

1.2. STOCK

LS // Dependent Variable is DZEC1
Date: 7-01-1993 / Time: 11:02
SMPL range: 1972 - 1991
Number of observations: 20

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
DDRPSDR	1315.9936	460.70925	2.8564515	0.010
XPRWCPW1	0.0725822	0.0236029	3.0751308	0.007

R-squared	0.460155	Mean of dependent var	82.46187
Adjusted R-squared	0.430164	S.D. of dependent var	1357.115
S.E. of regression	1024.452	Sum of squared resid	18891029
Durbin-Watson stat	1.836725	F-statistic	15.34292
Log likelihood	-165.9634		

2. NORTH AMERICA

2.1. CONSUMPTION

LS // Dependent Variable is LCPPCNA
Date: 7-07-1993 / Time: 14:23
SMPL range: 1970 - 1991
Number of observations: 22

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	3.0270854	0.3253253	9.3047968	0.000
LYPCNA	0.8763931	0.1557793	5.6258645	0.000

R-squared	0.612781	Mean of dependent var	4.854467
Adjusted R-squared	0.593420	S.D. of dependent var	0.133603
S.E. of regression	0.085190	Sum of squared resid	0.145148
Durbin-Watson stat	2.070101	F-statistic	31.65035
Log likelihood	24.01485		

2.2. STOCK

LS // Dependent Variable is DZNA1
Date: 7-07-1993 / Time: 14:33
SMPL range: 1975 - 1991
Number of observations: 17

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
DXPBR	0.1618457	0.0762014	2.1239201	0.052
XPRWCPW1	0.1087103	0.0639909	1.6988385	0.111
DRPSNY	3662.6210	1193.5254	3.0687417	0.008

R-squared	0.467830	Mean of dependent var	507.9524
Adjusted R-squared	0.391806	S.D. of dependent var	3083.776
S.E. of regression	2404.938	Sum of squared resid	80972180
Durbin-Watson stat	1.433486	F-statistic	6.153697
Log likelihood	-154.8214		

3. JAPAN

3.1. CONSUMPTION

LS // Dependent Variable is LCPJP
Date: 6-30-1993 / Time: 12:33
SMPL range: 1970 - 1991
Number of observations: 22

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	2.3706801	0.4697918	5.0462354	0.000
LYJP	0.9346606	0.0727174	12.853334	0.000

R-squared	0.892013	Mean of dependent var	8.403379
Adjusted R-squared	0.886614	S.D. of dependent var	0.284061
S.E. of regression	0.095651	Sum of squared resid	0.182984
Durbin-Watson stat	1.696311	F-statistic	165.2082
Log likelihood	21.46674		

3.2. STOCK

LS // Dependent Variable is DZJP1
Date: 4-13-1993 / Time: 3:04
SMPL range: 1975 - 1991
Number of observations: 17

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
DRPSDR	266.16537	171.62225	1.5508791	0.140

R-squared	0.130300	Mean of dependent var	7.419566
Adjusted R-squared	0.130300	S.D. of dependent var	365.0108
S.E. of regression	340.4007	Sum of squared resid	1853963.
Durbin-Watson stat	2.021644	Log likelihood	-122.7187

4. REST OF WESTERN EUROPE, EFTA

4.1. CONSUMPTION

LS // Dependent Variable is LCPRE
Date: 6-30-1993 / Time: 12:57
SMPL range: 1970 - 1991
Number of observations: 22

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	1.0127054	0.6630495	1.5273450	0.143
DSW88	-0.2286093	0.0473755	-4.8254768	0.000
LYRE	1.2928845	0.1210950	10.676611	0.000

R-squared	0.868035	Mean of dependent var	8.111003
Adjusted R-squared	0.854144	S.D. of dependent var	0.164605
S.E. of regression	0.062864	Sum of squared resid	0.075087
Durbin-Watson stat	1.220898	F-statistic	62.48889
Log likelihood	31.26503		

4.2. IMPORT

LS // Dependent Variable is LMPRE
Date: 6-30-1993 / Time: 12:54
SMPL range: 1970 - 1991
Number of observations: 22

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	1.2983086	0.5909012	2.1971669	0.041
DSW88	-0.2678157	0.0441354	-6.0680507	0.000
LYRE	1.2531876	0.1071328	11.697519	0.000
LRPSDR	-0.0947804	0.0364080	-2.6032858	0.018

R-squared	0.904131	Mean of dependent var	8.111003
Adjusted R-squared	0.888152	S.D. of dependent var	0.164605
S.E. of regression	0.055050	Sum of squared resid	0.054549
Durbin-Watson stat	1.472170	F-statistic	56.58511
Log likelihood	34.78006		

5. EASTERN EUROPE

5.1. CONSUMPTION

LS // Dependent Variable is LCPEE
Date: 6-30-1993 / Time: 13:08
SMPL range: 1970 - 1991
Number of observations: 22

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	5.4910292	0.7777769	7.0599021	0.000
LYEE	0.6483017	0.1134799	5.7129222	0.000

R-squared	0.620043	Mean of dependent var	9.931904
Adjusted R-squared	0.601045	S.D. of dependent var	0.193891
S.E. of regression	0.122467	Sum of squared resid	0.299963
Durbin-Watson stat	1.316021	F-statistic	32.63748
Log likelihood	16.02987		

5.2. STOCK

LS // Dependent Variable is DZEE1
Date: 4-13-1993 / Time: 3:07
SMPL range: 1971 - 1989
Number of observations: 19

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
XPRWCPW1	0.0503410	0.0527042	0.9551607	0.353
DRPSDR	-1793.3481	1076.3990	-1.6660626	0.114

R-squared	0.169750	Mean of dependent var	702.2753
Adjusted R-squared	0.120911	S.D. of dependent var	2183.722
S.E. of regression	2047.452	Sum of squared resid	71265020
Durbin-Watson stat	1.657924	F-statistic	3.475753
Log likelihood	-170.7659		

6. MIDDLE EAST AND NORTH AFRICA

6.1. CONSUMPTION

LS // Dependent Variable is LCPMN
Date: 6-30-1993 / Time: 13:18
SMPL range: 1970 - 1991
Number of observations: 22

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	0.9878466	0.6427483	1.5369104	0.141
LYMN	1.4968942	0.1136199	13.174575	0.000
D8083	0.3489105	0.0744038	4.6894201	0.000

R-squared	0.921480	Mean of dependent var	9.539467
Adjusted R-squared	0.913215	S.D. of dependent var	0.450269
S.E. of regression	0.132646	Sum of squared resid	0.334304
Durbin-Watson stat	1.690380	F-statistic	111.4888
Log likelihood	14.83757		

7. AUSTRALIA AND NEW ZEALAND

7.1. CONSUMPTION

LS // Dependent Variable is LCPAZ
Date: 4-13-1993 / Time: 3:07
SMPL range: 1970 - 1991
Number of observations: 22

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	0.5872957	0.5556407	1.0569703	0.303
LNAZ	2.3298522	0.1924515	12.106176	0.000

R-squared	0.879923	Mean of dependent var	7.311743
Adjusted R-squared	0.873919	S.D. of dependent var	0.189244
S.E. of regression	0.067196	Sum of squared resid	0.090307
Durbin-Watson stat	1.780934	F-statistic	146.5595
Log likelihood	29.23473		

7.2. STOCK

LS // Dependent Variable is DZAZ1
Date: 4-13-1993 / Time: 3:30
SMPL range: 1971 - 1990
Number of observations: 20

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
DRPSDR	80.897402	36.327700	2.2268793	0.038

R-squared	0.180135	Mean of dependent var	-15.32966
Adjusted R-squared	0.180135	S.D. of dependent var	85.48557
S.E. of regression	77.40412	Sum of squared resid	113836.5
Durbin-Watson stat	1.719102	Log likelihood	-114.8466

8. ASIA PACIFIC, EXCL. CHINA, PROD. COUNTRIES, SINGAPORE, AUSTRALIA AND NEW ZEALAND

8.1. CONSUMPTION

LS // Dependent Variable is LCPAP
Date: 6-30-1993 / Time: 13:33
SMPL range: 1971 - 1991
Number of observations: 21

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	0.8284698	0.8494426	0.9753098	0.342
LMPAP(-1)	0.2627691	0.0759876	3.4580527	0.003
LYAP	1.0684923	0.2452242	4.3572055	0.000

R-squared	0.878420	Mean of dependent var	8.212689
Adjusted R-squared	0.864912	S.D. of dependent var	0.697460
S.E. of regression	0.256347	Sum of squared resid	1.182848
Durbin-Watson stat	1.412324	F-statistic	65.02557
Log likelihood	0.406564		

9. LATIN AMERICA

9.1. CONSUMPTION

LS // Dependent Variable is LCPLA
Date: 4-13-1993 / Time: 3:32
SMPL range: 1970 - 1988
Number of observations: 19

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	4.8636197	2.2883118	2.1254183	0.049
LXPBR	0.3005060	0.2279694	1.3181854	0.205

R-squared	0.092734	Mean of dependent var	7.877482
Adjusted R-squared	0.039365	S.D. of dependent var	0.418970
S.E. of regression	0.410641	Sum of squared resid	2.866638
Durbin-Watson stat	1.874428	F-statistic	1.737613
Log likelihood	-8.992492		

8.2. IMPORT

LS // Dependent Variable is LMPLA
Date: 4-13-1993 / Time: 3:32
SMPL range: 1971 - 1988
Number of observations: 18

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	4.9661720	2.3030262	2.1563680	0.048
LXPBR	0.3154243	0.2293315	1.3754077	0.189
LPBRL.5	-0.4814393	0.1674028	-2.8759331	0.012

R-squared	0.381220	Mean of dependent var	7.903165
Adjusted R-squared	0.298715	S.D. of dependent var	0.415440
S.E. of regression	0.347901	Sum of squared resid	1.815529
Durbin-Watson stat	2.856673	F-statistic	4.620615
Log likelihood	-4.894939		

10. REST OF AFRICA

10.1. CONSUMPTION

LS // Dependent Variable is LCPRF
Date: 6-30-1993 / Time: 13:43
SMPL range: 1970 - 1991
Number of observations: 22

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	0.5528394	1.5126783	0.3654706	0.719
LYRF	1.3211123	0.2996164	4.4093460	0.000

R-squared	0.492931	Mean of dependent var	7.219111
Adjusted R-squared	0.467577	S.D. of dependent var	0.321677
S.E. of regression	0.234719	Sum of squared resid	1.101858
Durbin-Watson stat	1.367563	F-statistic	19.44233
Log likelihood	1.717846		

8.2. IMPORT

LS // Dependent Variable is LMPRF
Date: 6-30-1993 / Time: 13:43
SMPL range: 1970 - 1991
Number of observations: 22

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	2.4593659	1.3182026	1.8656965	0.078
LYRF	1.0085960	0.2541677	3.9682301	0.001
LRPSNY	-0.4163791	0.1173661	-3.5476948	0.002

R-squared	0.694983	Mean of dependent var	7.219111
Adjusted R-squared	0.662876	S.D. of dependent var	0.321677
S.E. of regression	0.186773	Sum of squared resid	0.662800
Durbin-Watson stat	1.884853	F-statistic	21.64577
Log likelihood	7.308920		

ANNEX-8

GUIDE TO THE WORKSHEET ESIPEP.WK1

Economic and Social Institute (ESI-VU)

Date	Your letter dated	Telefax	Enclosure(s)
8 July 1993	30 June 1993	31-20-644 4057	
Our reference	Your reference	Telephone	
HPS/JvW A 013		31-20-548 4915	

Mailing address: De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands

Dr. Ruyat Wiratmadja,
head of Bureau for International Cooperation
Ministry of Agriculture
Jl. Harsono RM No. 3
Jakarta Selatan
Ragnunan Pasar Minggu   Indonesië

vrije Universiteit *amsterdam*

Re: pepper model

Dear Dr. Ruyat,

Thank you very much for your letter of 30 June 1993. Congratulations with your project "Development and use of a Computer Simulation Model for Forecasting Supply, Demand and Prices of Agricultural Commodities in ASEAN Countries". We agree that the pepper model is very well suited for an activity as you suggest. You are most welcome to use the material we presented during the June 1992 workshop in Jakarta. Proper reference to the authors and the ESI would be appreciated. The forecast resulting from the model are on the optimistic side because the forecasts for world income were to optimistic in retrospect. Some downward adjustment is in order. We are likely to do some update in the coming half a year. Please let me know when the seminar will be held and whether you would like to make use of an update should such become available.

Kind regards.

Sincerely Yours

i.a.

Dr. Hidde P. Smit,
Division Chief Economic Research

GUIDE TO THE WORKSHEET ESIPEP.WK1

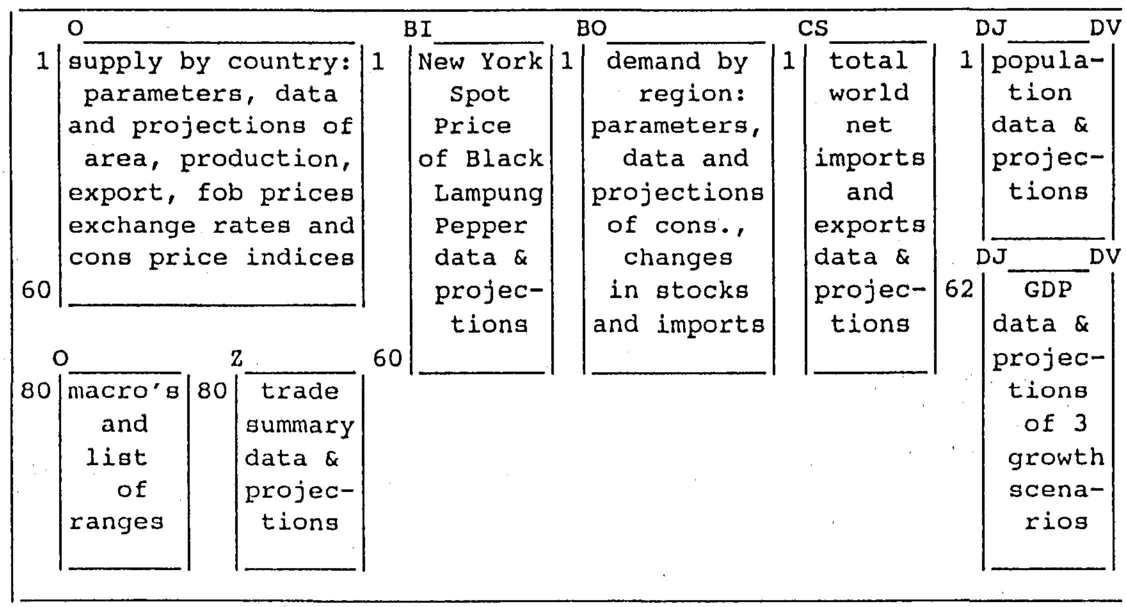
Jan Bade
Economic and Sosial Institute
Free University, P.O. Box 7161
1007 MC Amsterdam
Netherlands

Workshop
The Development and Use of Computer Simulation Model
for Forecasting Supply, Demand, and Prices of Agricultural Commodities
in ASEAN Countries

August 4 - 15, 1993
Ciawi - Bogor, INDONESIA

1. Introduction

Map of the worksheet:



This map gives an overview of the worksheet. It is a bit much to make a print-out of the 112 columns and 179 rows the actual worksheet consists of. The above map should however make it easier to find your way. In this guide a description of the worksheet is given on the basis of the map. We will work through the worksheet from left to right and end with the macro's and summary in the lower corner on the left. But first we will explain how the map can be found in the worksheet.

The above presented map of the worksheet can be found in the upper left corner of the worksheet. It can however only be reached after the "titles" that we have chosen have been cleared or circumvented. The title rows and the title column form boundaries one cannot cross by simply moving the cursor with the arrows of the keyboard. Titles can simply be avoided by using function key F5, the "go to key". After pressing F5, you type the name of the cell you want to go to. If you type A1 and then ENTER, you will see the map.

An easier way to have a look at the map is to use the macro command ALT-M (press the Alt-key and the m simultaneously). The macro that is invoked by ALT-M is the following:

```
/wtc{goto}a1~{?}{goto}O1~{goto}P5~/wtb
```

$$\ln(apbr) = 1.81 + 0.81 \ln(apbr_{-1}) + 0.27 \ln(pcbr_{-3})$$

Again written differently this means that

$$e^{\ln(apbr)} = e^{[1.81 + 0.81 \ln(apbr_{-1}) + 0.27 \ln(pcbr_{-3})]}$$
$$= e^{1.81} * e^{0.81 \ln(apbr_{-1})} * e^{0.27 \ln(pcbr_{-3})}$$

or, as $e^{x\ln(y)} = y^x$:

$$apbr = e^{1.81} * apbr_{-1}^{0.81} * pcbr_{-3}^{0.27}$$

In Lotus the number e (2.71828..) to the power x is calculated by using the mathematical function @EXP(x). To calculate any exponentiation the operator ^ is used;
so y^x is written as y^x.

When applying lotus language the equation becomes:

$$apbr = EXP(1.81) * (apbr_{-1})\text{^}0.81 * (pcbr_{-3})\text{^}0.27$$

As P6=1.81, P7=0.81 and P8=0.27 we can substitute the values by these cell names. In the same way we can say that if cell P31 contains apbr, cell P30 contains $apbr_{-1}$ and cell U28 contains $pcbr_{-3}$. So finally we can conclude that if @EXP(P6)*(P30^P7)*(U28^P8) is the contents of cell P29, that formula calculates an estimate of the area under pepper in Brazil on the basis of the regression analysis.

All the other regression equations were also transformed in such a way that the forecasts are a consistent continuation of the data series. The explanation of the variable names in row 4 and the relevant regression equations can be found in the paper "An annual model of the world pepper market". Going from left to right through the worksheet one will find the IPC countries first and then the other pepper producing countries. Finally comes Singapore, which, as in the already mentioned paper, was also taken under the heading of supply.

5. <u>Population and GDP block</u>

For the importing regions aggregate population figures and data on Gross Domestic Product are presented based on country data and projections of various national and international bodies. Data and projections of Gross Domestic Product are in constant 1975 US Dollars. Three different projections based on different growth rates are included in the worksheet. The projections start in 1992. GDP2 is the reference scenario which means that the most likely growth rates were used here. GDP1 represents a pessimistic scenario with lower growth rates, whereas GDP3 has higher rates and is therefore called optimistic.

6. <u>Macro's</u>

The main macro of the worksheet can be invoked by pressing the ALT-key simultaneously with "r", which stands for "run". As was mentioned in "How to find the map", a macro executes a number of lotus commands. The advantage of using a macro is that it saves a lot of typing and time. Let us now look at the main macro. The objective of it is to find production, export, import, consumption and an equilibrium price for each year of the projection period. This means that for each consecutive year a value for rpsny, the real price of pepper, is calculated in such a way that after the forecasting for all varibales has been done on the basis of this new price forecast, total net imports equal total net exports.

The macro looks like this:

```
\r      {indicate WAIT}
        {blank t80..t85}
        {getnumber "type starting year  ",t78}{recalc t79}
        {if t79<2}{branch p82}
        {goto}bk29~{down t79}{for t80,t79,30,1,p90}
        {calc}{panelon}{indicate}{goto}bk31~{quit}


\g      {recalc p91..p99}{down}
        {recalc yr"&@RIGHT(@STRING(1990+T80,0),4)&"}{panelon}
            {indicate "&@STRING(1990+T80,0)&"}{paneloff}
        {let t81,@index(wimp,0,t80)}
        {let t82,@index(wexp,0,t80)}
```

YR2016	P56..DE56
YR2017	P57..DE57
YR2018	P58..DE58
YR2019	P59..DE59
YR2020	P60..DE60
\G	P90
\M	P110
\R	P80

As you can see rpsny is the range with the real price, wexp refers to the column containing the world's total net exports and wimp the column with the world's total net imports. Then every year (YR) is a row and finally some ranges have a one letter name; these are macro names and the cell they contain is the first cell of the macro programme. If you look in the worksheet e.g. you will see that the text of the macro listed above starts in cell P80, which is the range \R. R because the macro can be invoked with ALT-R.

Let us return now to the text of the macro.

- {indicate WAIT} changes the indicator in the upper right corner of the screen in WAIT.
- {blank t80..t85} erases the contents of the range T80..T85.
- {getnumber "type starting year ",t78}{recalc t79} allows to enter any year where the forecasting period can start; t79 is then recalculated: T78-1990.
- {if t79<2}{branch p82} implies that if the request is to start forecasting for 1991 or earlier then the macro starts again {branch p82} and a new year can be typed.
- {goto}bk29~{down t79}{for t80,t79,30,1,p90}: the cursor is now moved to bk29, then down with the value of t79, and then a do-loop is carried out to repeat the macro subroutine that starts in cell P90. In T80 (the counter location) a counter counts the number of times the subroutine is executed. The counter starts with the value in cell T79 (the start number) and stops if it becomes more than 30 (the stop number). The counter goes up with the step-number, which is here chosen to be one.
- {calc}{panelon}{indicate}{goto}bk31~{quit} is the last line of the macro. This line will be executed after all the do-loops and sub-routines and after all the prices have been adjusted. The worksheet is recalculated by the command {calc}, which does the

(more than 10), T83 will be recalculated: {branch p92} (with the same price); if T83 has converged to a stable value the price can be adjusted on the basis of the value of T83. This is done in following way:

- {let t84,@index(rpsny,0,t80)} defines the contents of cell T84 to be the value of the real price in the year the macro is adjusting.

- {if @abs(t83)>t77}{branch p101} tells the macro to execute the subroutine in cell P101 if the absolute value of T83 is larger than T77; now the price is adjusted. The value in T77 can be changed to improve or relax the precision of the macro. It specifies the largest difference that is allowed between world exports and world imports in a certain year (pepper afloat and data errors).

- {recalc yr"&@RIGHT(@STRING(1990+T80,0),4)&"}{if @abs((@index (wimp,0,t80)-@index(wexp,0,t80))-t83)>.5}{branch p92}: by now T83 has a smaller value in absolute terms than the value specified in T77. To make sure that this will remain the case, recalculation of the difference between between world imports and world exports in absolute terms will continue until it has converged to a stable value. If necessary, i.e. if T83 exceeds T77 after recalclation, even the price will be adjusted again. Therefore the macro branches to p92 if the condition is violated: {branch p92}. If T83 has reached a stable value that is less than T77 (in absolute terms) then the equilibrium price has been approximated conform the set precision.

- {return} indicates the end of the subroutine that was called in the for-loop: {for t80,t79,30,1,p90}.

In P101, where the second subroutine starts the real price is adjusted. The bigger the difference between world imports and exports, the bigger the adjustment will be.

- {put rpsny,0,t80,t84+(t83/20000)} changes the value of rpsny in column BX in the year the macro is adjusting. The old value is (slightly) adjusted with the difference between world imports and world exports (T83) divided by 20000.

- {branch p91} takes the macro back to the first subroutine. Again the difference between total imports and exports will be calculated and if this difference is not almost equal to zero the

ANNEX-9

MODELLING AND POLICY FORMULATION FOR COMMODITY MARKETS

Economic and Social Institute (ESI-VU)

Date	Your letter dated	Telefax	Enclosure(s)
8 July 1993	30 June 1993	31-20-644 4057	
Our reference	**Your reference**	**Telephone**	
HPS/JvW A 013		31-20-548 4915	

Mailing address: De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands

Dr. Ruyat Wiratmadja,
head of Bureau for International Cooperation
Ministry of Agriculture
Jl. Harsono RM No. 3
Jakarta Selatan
Ragnunan Pasar Minggu   Indonesië

vrije Universiteit *amsterdam*

Re: pepper model

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Kind regards.

Sincerely Yours

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Dr. Hidde P. Smit,
Division Chief Economic Research

MODELLING AND POLICY FORMULATION FOR COMMODITY MARKETS

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Economic and Sosial Institute
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Workshop
The Development and Use of Computer Simulation Model
for Forecasting Supply, Demand, and Prices of Agricultural Commodities
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Introduction

This paper is meant to be a broad introduction into the use and development of commodity models for commodity policy formulation. First a very brief review is given of what may be considered as major commodities. Then possible commodity policies and policy instruments are discussed. Various approaches towards commodity modelling are indicated among which the econometric type of commodity models which are the topic of this paper. An essential element is the place where and the way in which policies and instruments are included in the analysis. All this leads to the need for tailor-made models, depending on the commodity and the objectives and policy instruments at stake. Chapter 1 then goes on with an indication of the steps to be taken when one is trying to build or adapt a model to formulate or, more likely, fine-tune policies for commodities. Chapter 1 is concluded with some organizational requirements of commodity policy analysis, formulation and implementation. This refers in particular to the qualifications required for the staff quantitatively analyzing commodity economies and building and applying models and to relationships of these commodity analysts with other divisions in particular those formulating and those implementing policies.

The focus of Chapters 2 and 3 is the specification of the model to be constructed and applied. An introductory example is used in Chapter 2 to define various concepts: different types of variables, equations, functions, parameters, scatter diagrams etc. In chapter 3 the basic parts of a model are elaborated upon, both in more theoretical terms as well as with the help of empirical examples. Elaborate attention is first paid to the supply side, both referring to the short-term aspects like harvest and exploitation as well as to the long-term side namely investment. For the demand side, the following major block, both the short-term and the long-term are discussed as well, be it rather briefly, since the orientation of this paper is on commodity modelling for policy formulation by producing countries in particular. Then the interaction between supply, demand and prices is elaborated upon with an extension in the next section to incorporate the intermediate or processing sector. Finally, special points of attention for various types of models are elaborated upon: models for annual crops, models for perennial crops, models for renewable exhaustible resources and models for non-renewable exhaustible resources.

In Chapter 4, estimation of coefficients in an equation is the main subject. First, some practical remarks are made concerning the problem of aggregation, over regions, time as well as over the different types of what is normally called one commodity. The question to what extent certain variables are representative is discussed as well, e.g. the choice of a world market price. Briefly discussed are the possibilities and problems for single equation models. For more information on econometrics there is a vast amount of basic texts available. Some examples are presented in this chapter. For more details of empirical models the reader is referred to the paper containing a description of the pepper model presented during the workshop.

1. Commodity policies and modelling approaches

1.1 Commodities

This section gives a review of the commodities which are important for developing countries. We concentrate on the national level and the most relevant commodities. The criterion is the position of each commodity in the international market as measured through the level and share of the amount exported as that aspect can be assessed relatively easily for many commodities using data from the UNCTAD Commodity Yearbook. For the purpose of providing such basic background information Table 1.1 lists the five major exporting countries for most of the relevant commodities. Those commodities are then selected with at least two developing countries among the major five exporters. For these commodities total world exports are presented in Table 1.2, together with the share of the five major exporters, be they developing country or not, the share of the five major LDC exporters and the share of the biggest LDC exporter. Obviously it would have been better to use net exports instead of gross exports. That would also eliminate entrepot centers like Singapore and Hong Kong, which do not produce these commodities. However, data on net exports are more difficult to obtain at adequate levels of accuracy. In Table 1.3 for the commodities as selected for Table 1.2 and for developing countries only, the share in total merchandise exports of the major exporting countries is given. Countries are listed in order of their share in world export of the commodity concerned. An important finding from the last Table is that some countries are major exporters of certain commodities which only comprise a small share of their total merchandise export e.g. sugar, cocoa and cocoa beans from Brazil and rice, cotton and jute from China.

Table 1.1 The five major exporters per commodity, ranked by value in US$ of exports (1985)

Export products	exporting countries				
	1	2	3	4	5
Animals and meat	Netherl.	France	Denmark	USA	Germ. FR.
- bovine meat	Australia	Germ. FR.	Netherl.	France	New Zeal.
Fishery commodities	Canada	USA	Denmark	Norway	Japan
Cereals	USA	France	Canada	Australia	Argentina
- wheat and wheat flour	USA	Canada	France	Australia	Argentina
- rice	Thailand	USA	Italy	China	Pakistan
- coarse grains	USA	France	Argentina	Australia	China
Bananas	Honduras	Costa R.	Ecuador	Colombia	Philipp.
Sugar, total raw and refined	Cuba	France	Australia	Brazil	Thailand
- sugar, raw (*)	Cuba	Australia	Thailand	Brazil	Dom.Rep.
- sugar, refined (*)	France	Brazil	Germ. FR.	Cuba	Belg+Lux.
Tropical beverages	Brazil	Colombia	Cote dIv.	Netherl.	India
- coffee	Brazil	Colombia	Cote dIv.	Indonesia	Mexico
- cocoa beans	Cote dIv.	Brazil	Ghana	Nigeria	Cameroon
- cocoa products	Netherl.	Brazil	Germ. FR.	Cote dIv.	Nigeria
- tea	India	S. Lanka	China	Kenya	UK
Spices	India	Indonesia	Singapore	Brazil	Madagask.
- pepper	Indonesia	Brazil	India	Malaysia	Thailand
Oilseeds, fats etc.	USA	Brazil	Argentina	Malaysia	Netherl.
- vegetable oilseeds & oils	USA	Malaysia	Argentina	Brazil	France
- groundnuts	USA	China	Argentina	India	Vietnam
- groundnut oils	Brazil	Senegal	China	Belg+Lux.	Netherl.
- soybeans	USA	Brazil	Argentina	China	Paraguay
- soybean oil	Brazil	USA	Argentina	Netherl.	Spain
- copra	Papua	Malaysia	Solomon I	Vanuatu	Singapore
- coconut oil	Philipp.	Indonesia	Singapore	Malaysia	S. Lanka
- palm nuts and kernels	Nigeria	Indonesia	Papua NG	S. Leone	Cameroon
- palm kernel oil	Malaysia	Indonesia	Netherl.	Singapore	Cote dIv.
- palm oil	Malaysia	Singapore	Indonesia	Netherl.	Guinea
Tobacco	USA	Brazil	Turkey	Zimbabwe	Bulgaria
Hides and skins	USA	UK	Denmark	France	Finland
Natural rubber	Malaysia	Indonesia	Thailand	S. Lanka	Liberia
Timber, non coniferous	Malaysia	Indonesia	USA	France	Singapore
Cotton	USA	USSR	Egypt	China	Pakistan
Cotton yarn (*)	China	Pakistan	Turkey	Brazil	Egypt
Jute	Banglad.	China	India	Hong Kong	Nepal
Jute goods (*)	Banglad.	India	Thailand	USSR	China
Hard fibers & manuf	Brazil	Philipp.	Mexico	Portugal	India
- hard fibers manuf. (*)	Brazil	Portugal	Philipp.	Mexico	Tanzania
Wool, greasy and degreased	Australia	New Zeal.	Argentina	France	UK
- wool, greasy (*)	Australia	New Zeal.	Argentina	France	Uruguay
- wool, degreased (*)	New Zeal.	Australia	Argentina	UK	USSR

Table 1.1 (continued)

Export products	exporting countries				
	1	2	3	4	5
Bauxite	Guinea	Guyana	Brazil	Jamaica	Australia
Alumina	Australia	Jamaica	Surinam	Germ. FR.	Guinea
Aluminium	Canada	Norway	Australia	USSR	USA
Copper ore	Canada	Chile	Papua NG	Mexico	USA
Blister copper	Chile	Zaire	Peru	Sweden	Namibia
Refined copper	Chile	Zambia	Canada	Belg+Lux.	Poland
Iron ore	Brazil	Australia	USSR	Canada	India
Lead ore	Australia	Peru	Morocco	Sweden	Canada
Lead metal	Australia	UK	Germ. FR.	Belg+Lux.	Canada
Manganese ore	Gabon	Australia	Brazil	USSR	India
Ferromanganese	France	Norway	USSR	Germ. FR.	Mexico
Nickel ore	N.Caledo.	Indonesia	Philipp.	Australia	Albania
Nickelterm. products	Canada	Australia	Indonesia	Cuba	Botswana
Nickel unwrought	Canada	USSR	Norway	N.Caledo.	Dom.Rep.
Phosphate rock	Morocco	USA	Jordan	USSR	Togo
Sulphur	Canada	Poland	USA	S. Arabia	Mexico
Tin ore	Singapore	Australia	Bolivia	UK	Peru
Tin metal	Malaysia	Indonesia	Brazil	Thailand	China
Tungsten ore	China	Canada	Australia	Portugal	Bolivia

Source: UNCTAD Commodity Yearbook 1987, Table 1.13
(*) = in 1000 tonnes

Table 1.2 World total exports, share of the largest LDC exporter and share of the five major (LDC) exporters (1985).

Export products	world exports (mln $)	share largest LDC exporter	share 5 major exporters	share 5 major LDC exporters
Cereals, -rice	3109.7	26.7	72.2	46.2
- coarse grains	13234.7	8.3	79.1	17.1
Bananas	1513.7	17.3	61.1	61.1
Sugar, raw and refined	8922.8	53.1	70.7	63.9
- sugar, raw (*)	18023.1	34.6	69.3	58.3
- sugar, refined (*)	9482.1	12.6	56.5	26.2
Tropical beverages	19696.3	17.3	44.3	43.9
- coffee	11468.0	20.7	51.1	51.1
- cocoa beans	2912.5	30.7	68.0	68.0
- cocoa products	1992.7	21.0	72.7	37.5
- tea	2376.1	24.3	72.9	71.4
Spices	1275.7	20.1	57.6	57.6
- pepper	299.0	26.2	93.0	93.0
Oilseeds, fats etc.	26102.2	10.9	58.0	33.1
- veg. oilseeds and oils	18541.8	10.2	59.7	35.1
- groundnut	541.0	20.5	77.4	40.8
- groundnut oils	294.9	22.2	70.3	61.3
- soybeans	5527.4	13.8	98.8	31.1
- soybean oil	2250.7	26.8	77.0	42.0
- copra	130.7	25.9	71.0	71.0
- coconut oil	727.8	47.7	79.8	79.8
- palm nuts and kernels	23.3	29.6	81.5	81.5
- palm kernel oil	337.6	64.1	89.8	86.4
- palm oil	2640.8	60.3	95.2	93.9
Tobacco	4054.7	11.1	66.5	24.4
Natural rubber	2783.0	41.6	91.5	91.5
Timber, non coniferous	7577.8	22.2	52.9	47.8
Cotton	6092.3	7.0	61.0	22.7
Cotton yarn (*)	997.4	15.5	52.5	49.2
Jute	194.2	76.3	94.7	94.7
Jute goods (*)	1037.3	43.0	87.6	83.1
Hard fibers & manuf.	361.0	21.6	61.5	58.8
- hard fibers manuf. (*)	241.0	43.4	77.8	69.6
Wool, greasy (*)	905.7	3.9	87.3	8.8
- wool, degreased (*)	394.6	6.5	76.4	14.5
Bauxite	931.8	41.9	80.3	75.5
Alumina	2445.1	8.5	68.2	24.0
Copper ore	1787.9	15.7	64.6	50.2
Blister copper	954.4	25.6	83.7	75.8
Refined copper	4542.2	27.2	64.2	57.6
Iron ore	6988.4	23.7	75.6	39.4
Lead ore	238.3	15.5	52.6	31.9
Manganese ore	414.7	28.2	58.0	46.4
Nickel ore	84.5	45.7	98.7	80.4
Nickel interm. products	868.8	13.4	95.3	37.7
Nickel unwrought	1977.5	8.3	55.9	25.7
Phosphate rock	1576.9	30.4	78.0	53.0
Sulphur	2107.1	7.4	85.0	14.7
Tin ore	279.8	27.8	79.4	61.7
Tin metal	1892.4	35.1	78.7	78.7
Tungsten ore	217.4	38.2	67.8	53.0

(*) = in 1000 tonnes

Table 1.3 Export-value percentage of total merchandise export (1985)

Export products	exporting countries 1	2	3	4	5
Rice	Thailand 11.6%	China 0.8%	Pakistan 8.1%	Uruguay 9.5%	Burma 25.3%
Coarse grains	Argentina 13.1%	China 2.8%	Thailand 4.5%	Singapore 0.2%	Zimbabwe 2.1%
Bananas	Honduras 33.6%	Costa R. 20.6%	Ecuador 6.7%	Colombia 4.5%	Philipp. 2.5%
Sugar, raw and refined	Cuba 55.3%	Brazil 1.4%	Thailand 3.2%	Mauritius 42.2%	Dom.Rep. 24.2%
Tropical beverages	Brazil 13.3%	Colombia 51.7%	Côte dIv. 61.9%	India 9.5%	Indonesia 4.2%
Coffee	Brazil 9.2%	Colombia 50.1%	Côte dIv. 20.7%	Indonesia 3.0%	Mexico 2.5%
Cocoa beans	Côte dIv. 30.4%	Brazil 1.4%	Ghana 53.5%	Nigeria 1.6%	Cameroon 26.6%
Cocoa products	Brazil 1.6%	Côte dIv. 4.9%	Nigeria 0.5%	Singapore 0.3%	Ecuador 2.0%
Tea	India 6.8%	S. Lanka 23.7%	China 1.1%	Kenya 24.4%	Indonesia 0.8%
Spices	India 3.0%	Indonesia 0.8%	Singapore 0.6%	Brazil 0.4%	Madagask. 32.4%
Pepper	Indonesia 0.4%	Brazil 0.3%	India 0.7%	Malaysia 0.4%	Thailand 0.7%
Oilseeds, fats etc.	Brazil 11.1%	Argentina 26.6%	Malaysia 13.2%	China 2.9%	Indonesia 3.3%
Vegetable oilseeds & oils	Malaysia 12.2%	Argentina 21.1%	Brazil 6.2%	Singapore 3.0%	China 2.1%
Groundnuts	China 0.4%	Argentina 0.6%	India 0.3%	Vietnam 5.3%	Brazil 0.0%
Groundnut oils	Brazil 0.3%	Senegal 10.8%	China 0.2%	Argentina 0.3%	Gambia 14.0%
Soybeans	Brazil 3.0%	Argentina 6.9%	China 1.0%	Paraguay 24.9%	Singapore 0.0%
Soybean oil	Brazil 2.3%	Argentina 3.7%	Malaysia 0.1%	Singapore 0.1%	Hong Kong 0.0%

Table 1.3 (continued)

Export products	exporting countries 1	2	3	4	5
Copra	Papua NG 3.7%	Malaysia 0.1%	Solomon I 22.6%	Vanuatu 42.3%	Singapore 0.1%
Coconut oil	Philipp. 7.6%	Indonesia 0.6%	Singapore 0.2%	Malaysia 0.2%	S. Lanka 1.9%
Palm nuts and kernels	Nigeria 0.1%	Indonesia 0.0%	Papua NG 0.4%	S. Leone 2.1%	Cameroon 0.2%
Palm kernel oil	Malaysia 1.4%	Indonesia 0.3%	Singapore 0.0%	Côte dIv. 0.3%	Zaire 1.3%
Palm oil	Malaysia 10.3%	Singapore 2.4%	Indonesia 1.3%	Guinea 14.1%	Côte dIv. 1.3%
Tobacco	Brazil 1.8%	Zimbabwe 21.3%	India 1.3%	Malawi 43.5%	Korea 7.6%
Natural rubber	Malaysia 7.5%	Indonesia 3.9%	Thailand 7.0%	S. Lanka 5.1%	Liberia 17.7%
Timber, non coniferous	Malaysia 10.9%	Indonesia 6.3%	Singapo. 1.4%	Côte dIv. 7.7%	Philipp. 4.9%
Cotton	Egypt 11.5%	China 1.3%	Pakistan 10.6%	Sudan 44.6%	Paraguay 35.2%
Jute	Banglad. 16.0%	China 0.1%	India 0.0%	Hong Kong 0.0%	Nepal 1.4%
Jute goods	Banglad. 34.0%	India 3.1%	Thailand 0.9%	China 0.2%	Nepal 7.1%
Hard fibers & manuf.	Brazil 0.3%	Philipp. 1.3%	Mexico 0.2%	India 0.3%	Kenya 1.9%
Bauxite	Guinea 90.7%	Guyana 48.1%	Brazil 0.4%	Jamaica 15.1%	Surinam 11.3%
Alumina	Jamaica 37.0%	Surinam 56.0%	Guinea 30.5%	Venezuela 0.8%	Brazil 0.0%
Copper ore	Chile 7.3%	Papua NG 29.7%	Mexico 0.7%	Indonesia 0.6%	Philipp. 1.9%
Blister copper	Chile 6.4%	Zaire 38.9%	Peru 5.7%	Namibia (1)	Zimbabwe 2.1%
Refined copper	Chile 32.3%	Zambia 134.0%	Zaire 43.3%	Peru 9.0%	Philipp. 3.5%

Table 1.3 (continued)

Export products	exporting countries 1	2	3	4	5
Iron ore	Brazil 6.5%	India 5.4%	Liberia 64.1%	Venezuela 2.8%	Mauritius 40.3%
Lead ore	Peru 1.4%	Morocco 0.7%	Thailand 0.1%	Mexico 0.0%	Honduras 0.9%
Manganese ore	Gabon 6.1%	Brazil 0.1%	India 0.2%	Mexico 0.0%	Ghana 1.5%
Nickel ore	N.Caledo. 14.2%	Indonesia 0.1%	Philipp. 0.3%	(2)	
Nickel interm. products	Indonesia 0.6%	Cuba 1.3%	Botswana 8.8%	N.Caledo. 11.6%	(2)
Nickel unwrought	N.Caledo. 60.9%	Dom.Rep. 16.1%	Cuba 1.4%	Colombia 1.5%	Zimbabwe 4.7%
Phosphate rock	Morocco 22.2%	Jordan 20.0%	Togo 48.8%	Senegal 12.6%	Nauru 45.3%
Sulphur	S. Arabia 0.5%	Mexico 0.5%	Iraq 0.3%	Iran 0.0%	Kuwait 0.0%
Tin ore	Singapore 0.3%	Bolivia 7.6%	Peru 0.7%	Zaire 2.2%	China 0.0%
Tin metal	Malaysia 4.3%	Indonesia 1.3%	Brazil 0.9%	Thailand 2.8%	China 0.6%
Tungsten ore	China 0.3%	Bolivia 1.4%	Burma 2.7%	Peru 0.3%	Hong Kong 0.0%

(1) no data on value of exports available
(2) no further exporting countries with significant export of this commodity

For reasons of policy formulation as well as to the type of modelling, it is important to distinguish broad categories of commodities as was already indicated in the Introduction. The reasons will be explained below as well as in Chapters 2 and 3. Here we only list the broad commodity groups:

- policies and models for annual crops,
- policies and models for perennial crops,
- policies and models for renewable exhaustible resources and

- policies and models for non-renewable exhaustible resources.

Which commodities belong to which group is obvious and does not need further elaboration at this stage.

1.2 Commodity policies and commodity policy instruments

Commodity policies are in general drawn up for the following aspects of the commodity economy:

(a) investment

(b) production

(c) processing

(d) domestic consumption

(e) exports

(f) national stocks

(g) imports

(f) the international market

Without trying to be exhaustive and rather for the purpose of giving examples, for each of these sectors some possible policies and corresponding instruments will be discussed.

(a) investment policies

In this connection one might think of (re)planting programs for perennial crops or programs for setting up mines. This is very much a medium- to long-term approach which requires, in order to be effective, that the producing country has a reasonable forecast of world and/or regional demand as well as future supply of each (competing) producer. Models are then needed to assess the future effect of existing and considered investment programs. This could best be done on a cooperative basis, where information about investment plans is exchanged and where preferably concerted action is undertaken, especially when outside loans are applied for. Possible instruments are replanting subsidies and investment permits, which have a rather direct and clear effect on replanting and investment. Less direct and presumably less effective are instruments in the area of price support or price stabilization methods for the product to be forthcoming from the investment considered.

(b) <u>production policies</u>

This applies to annual agricultural crops or the degree of exploitation of mines and the degree of capacity utilization of area under perennial crops. Production might e.g. be pushed downward in a period of sustained or expected low prices through a reduction in the availability of or a decrease in subsidies on seed. In a year of high prices government officials might discourage farmers to switch full swing to that high-priced crop so as to prevent oversupply in the year after.

Another road towards influencing farmers may be through government extension work, which may be used both to stimulate or to slow down production. A rather indirect method to affect production is through prices, in particular through duties and taxes. The outcome of such an approach may be more difficult to predict. In general, instruments should better be applied before the decision to grow the crop is made. Once an annual crop is in the ground, it is very difficult to prevent the farmers from harvesting, unless the price is so low that the costs are not covered combined with the assumption that the farmer has alternative opportunities for earning a living. This is equally so in the case of those perennial crops which are harvested during a short period of time. What is required anyway for such policies to be effective is that the government does have a sound idea what the price will be in the following year. Otherwise instability in prices might be the result and the government officials would lose their credibility. This again requires an analytical tool to predict prices in the ensuing year. The approach to reduce production through export quotas is discussed further down. Production quotas are only possible in the case of large scale enterprises and even then there are chances that a large amount will be put on the market illegally. Monitoring, and certainly policing, is the major problem. In the case of large scale enterprises, entrepreneurs might be persuaded to join for a short period if prices are very low and if the variable costs are hardly covered, if at all. The price mechanism e.g. through taxes may be the only way to achieve such measures.

(c) <u>processing policies</u>

There is an increasing tendency to do the processing in the producing country either for increasing value added or to reduce imports or to export final products. For some commodities like jute this has advanced very far already: from the main producing countries taken as a group, hardly any raw jute is exported. Required is technology to do so and, in many case, a sufficiently large domestic market or export capabilities. In those cases where the world market as a whole is affected, is a more detailed analysis in place. This may be the case when there is an increase in the domestic market or, more importantly, when a different mix of materials is used, thereby affecting the supply-demand balance of the individual composing raw material. An example is natural rubber, which is in many applications world-wide mixed with synthetic rubber. Increased production in natural rubber producing countries for the purpose of import substitution may lead to higher demand for natural rubber as the mix may be more directed towards natural rubber.

(d) <u>domestic consumption policies</u>

Normally policies concerning domestic consumption are rather general and rarely directed towards domestic consumption of particular commodities. An exception is food. However, the objectives are not to influence a particular commodity, but rather to improve living conditions of the people. Such policies and the attached instruments should be included in the analysis of any particular commodity, so as to obtain a complete picture thereby bringing various policies in line and making them consistent.

(e) <u>export policies</u>

The objectives of export policies may be to increase domestic earnings by increasing exports, to add to the government income by using export duties or to affect the international market and market price by applying export quotas. The instrument to increase exports may be export promotion when there is a demand problem or export subsidies, when supply is the bottle neck, which is rarely the case. The effect of export duties is a matter which requires careful analysis: does an increase in export duties mean less competitiveness, because the domestic price is fixed, then resulting in a decrease in the market share of the country. Or is the result of such an increase in the export duty a decrease of the domestic price and thus e.g. the farm gate price because the world market price is fixed. Or is there a combined result: the country becomes less competitive, produces less, what in turn leads to a reduction in world supply and an increase in world market price, making life easier again for the domestic industry.

The aspect of export quotas requires special attention as it is normally designed as a multi-country tool to stabilize or enhance world market prices. Export quota are somewhat easier to monitor and to police than restrictions on production. However, even then smuggling or other ways of avoiding quotas have been shown to be possible. A way of dealing with such undermining activities is to allow for national inventory formation, which is discussed below. The disadvantages of export quotas are well known from the experience with coffee: rigidity in allocating national quotas, the free rider problem and the two-tier market. Again, a forecasting device is indispensable. As long as there is a large overhanging stock, elimination is a straightforward first priority. After that policies need to be refined and forecasting is required.

(f) <u>national stocks policies</u>

National stocks may be held for security reasons e.g. for strategic purposes or for food security. Another reason is domestic market price stabilization. In all these cases normally the government directly or indirectly acts as the stockholder, purchase material and sells it or gives it away. A special case is when national stocks are built to support an international market policy e.g. when export quotas are applied and supply from the farmers has to be taken care of. In general the instruments are therefore rather straightforward and simple.

(g) <u>import policies</u>

Import policies are mostly import restrictions, drawn up to protect the domestic industry. The instruments may be physical restrictions which have the same problems as in the case of export quotas: smuggling and other ways of avoiding quotas have been shown to be possible. Or there may be an import duty so as to protect the domestic industry in particular from what is considered relatively low prices on the world market. An important danger is that imports are not available in time in adequate quantities either because of bureaucratic procedures or because future needs have not been analyzed well. Finally there is the well-known question: how long to protect an industry while avoiding inefficiencies.

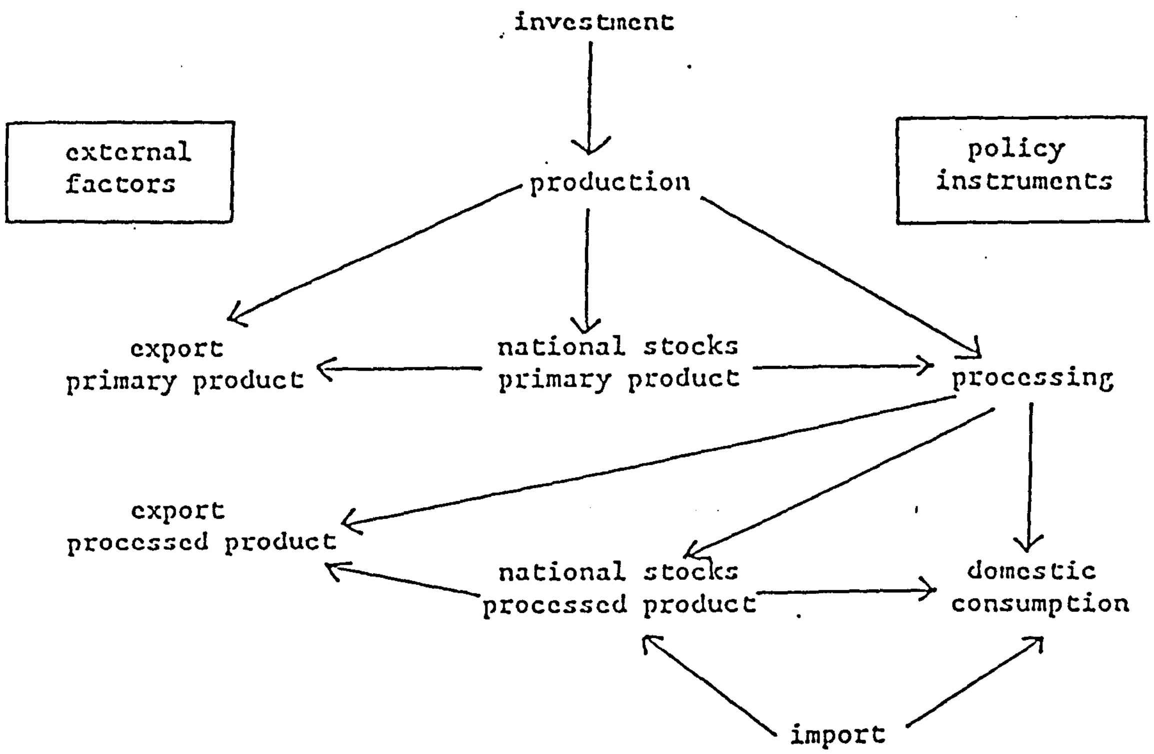
(h) <u>international market policies</u>

National stocks can play a proper role in eliminating imbalances between demand and supply on the world market, especially when coordinated internationally. However, this is only possible, from the financial point of view, if such inventory formation is for a short period. International funding of national stocks is not a very likely option. In order to be reasonably sure that such national stocks are required for a short period only, it is important to have a clear view on whether these stocks can be depleted again shortly. This also requires a forecasting tool.
An international bufferstock is not very different from the above internationally coordinated national stocks. Obtaining international finance may be easier, but the cost may be higher, in particular the cost of the administrative apparatus. Rules required for operation of an international bufferstock are much more complicated. However, it is easier to check whether the stock is managed properly and kept during the period agreed upon. A factor to be taken into account is to what extent such stocks might induce consumers to reduce their level of stocks.

1.3 The approach toward commodity modelling for policy formulation

In this paper the emphasis is on commodity models for commodity policy formulation. That implies that many types of modelling and forecasting techniques are not relevant, because policy instruments, policy variables and variables representing policy objectives need to be explicitly included in the analysis. Apart from these considerations behaviour of the various groups of participants in the market needs to be explicitly included and modelled. For these reasons the only suitable type of model is the econometric type of model where economic relations are represented in mathematical formulae and estimated with econometric and similar techniques.

The major sectors of the commodity economy as far as the producing country is concerned are presented in section 1.2. For each sector examples of possible policies and policy instruments were indicated as well. Schematically, they can be represented as follows:



Basis to this is the accounting identity:

$$q + m = d^c + d^i + e + dz \qquad (1.1)$$

where

q = production

d^i = processing

d^c = domestic consumption

e = exports

dz = national stock formation

m = imports

This accounting identity is approached at one aggregate level. In certain cases it may be useful to have two accounting identities: one at the level of the primary product and one for the processed good, with proper linkages. Several but not all variables in the above accounting identity must be explained using (behavioural) equations or can be fixed exogenously. For that purpose one can incorporate external factors as well as policy instruments. How to exactly incorporate policy instruments in commodity models depends on the type of commodity and the type of policy and policy instrument. This leads to the conclusion that there is a need for tailor-made commodity models so as to optimally include policies, instruments, objectives, commodity specific aspects, country specific aspects, appropriate time horizon etc. in the modelling process. The broad composing steps of such a modelling process are

(a) policy suggestions
- suggestions for policies
- suggestions for possible instruments

(b) the commodity economy
- description of the market structure
- determination of relevant aspects to be incorporated in a model

(c) the commodity model specification
- selection of variables to be explained
- selection of explanatory variables
- model specification

(d) model estimation and validation
- collection of data
- model estimation
- if necessary respecification, further data collection
- if necessary re-estimation
- model simulation and validation

(e) policy formulation and selection and quantification of instruments
- policy simulation over the past
- forecasting

- policy simulation over the future
- policy formulation and quantification of instruments

(f) policy implementation
- translation of instruments into day to day reality
- acquiring and allocating necessary financial means
- setting up rules and regulations
- implementation

Step (a) has been touched upon in section 1.2. Step (b) as well as possible policies will be elaborated upon for each commodity of which details are presented in separate papers. Step (c) is the topic of Chapters 2 and 3 and will be discussed in detail in the separate paper on the pepper model as well. Steps (d) and (e) are briefly introduced in Chapter 4 and extensively presented in the pepper model paper. Some organizational aspects of steps (a) to (f) are discussed below.

1.4 Some organizational requirements of commodity policy analysis, formulation and implementation

The title of this section indicates that there are three aspects:
a. commodity policy analysis,
b. commodity policy formulation and
c. commodity policy implementation.

For a. it is important to divide the analysis into
a1. commodity outlook regarding world demand, supply and prices and
a2. a more detailed analysis regarding the countries specific problems and possibilities.

Obviously a1. should come first. It is important for countries not to be only dependent on international bodies to tell them what will happen and what is good for them.

Regarding b. two parts can be considered:
b1. commodity specific policy formulation and
b2. macro policy planning;

If approached properly, the two should interact, so as to achieve that e.g. monetary and fiscal policy and commodity policy push in the same direction and do not annihilate one another.

With reference to policy formulation and implementation cooperation among various bodies concerned e.g. with different commodities is essential.

It is obvious that the aspects a, b and c will be the responsibility of different persons and most likely of different divisions or units. Reality is that in most cases there is a good link between b. and c. but there is hardly any link between a. and b.: policy formulation is done without a detailed analysis. Many reasons can be found for this. Among the most important are:

- the objectives of the policy maker are such that a detailed analysis of reality is not called for: e.g. for a small producing country incorporating the effect on the world market and the resulting profitability of the investment and the income for the farmers or the miners is not relevant or
- the policy analysis, the modelling procedure, has never led to such results that the policy maker would feel happy to rely upon it for policy formulation.

The above phenomena are a general problem of any analytical or advisory task be it in the case of government or industry: policy makers have their own assessment of future developments and of appropriate policies; if an advice does not coincide with such a perception, it is difficult to convince the policy maker. However, if the assessment of the future and the advice by the modelling analyst do not differ from what the policy maker would have expected and what he would have decided, then it appears that there is no use in having such a policy analyst. The above is particularly difficult when starting commodity policy analysis and setting up a unit for such an activity. Without support by the policy maker such an effort appears to be doomed to fail.

When considering starting commodity policy analysis, it is important to start from the notion that in the past there have been problems such as oversupply, low prices or too high a support price for a commodity leading to lack of funds. Problem prevention is better than problem solving. This requires, as has been stipulated above, tailor-made models, because each commodity is different. Besides, what has to be incorporated in detail are policy objectives and policy instruments. Since the commodity economy changes all the time and with it change policy objectives and instruments, it is extremely important to monitor the working of the model regularly and to update it from time to time.

The updating of the model is essential for keeping the model reliable; and reliability is the basis for acceptability. It is obvious that such an effort can only succeed in the case where the perceptions of the policy makers are known in detail, both regarding what they assess as the reality of the commodity and what they consider important objectives and feasible instruments.

The latter implies that regular and in-depth communication between the commodity policy analysis unit and both the commodity policy formulation unit and the commodity policy implementation unit(s) is indispensable. Prior to this should be good communication and decision making among the various ministries and divisions and the Central Bureau of Statistics on the relevant statistics. Together with the aspect of constructing a reliable and acceptable model, keeping it in shape through regular adjustment and updating puts a number of requirements to the commodity policy analysis unit:

- the unit should be close to the policy makers, both organizationally and physically, in order to guarantee interaction and to enhance mutual trust;
- staff members of the unit should be given sufficient time for analysis, should not be asked to cover many commodities and should not be heavily involved in writing policy papers;
- the unit should have regular communication with the policy implementation units in order to receive feed-back on policy advises given;
- the unit should have regular exchanges with the relevant staff members at the statistical divisions so that necessary data can be collected and the derivation of existing data can be known and improved upon;
- staff members of the unit should be analysis and reality oriented and should have or obtain knowledge and experience on the following subjects
  - economics,
  - relevant commodities,
  - statistics,
  - mathematics for model specification,
  - basic econometrics,
  - personal computers and relevant software,

- policy formulation and implementation;
- staff members should have regular exchanges with colleagues in their own country covering other commodities;
- the staff members should have regular exchanges with colleagues in other countries covering the same commodities, either organized bilaterally or through a commodity or producers association or through another international body;
- the staff members should have exchanges with commodity modelling experts and, if necessary, should follow in-depth training.

Obviously the above depicts only a broad framework and is meant to indicate a number of essential aspects. For each country and for each commodity the problems may be different, the existing organizational set-up may be different and the possibilities may be different. Implementation of the above suggestions requires therefore adaptation to local circumstances.

2. The basic elements and structure of a commodity model

2.1 An introductory example

As an introduction to the use of commodity models, an example of a model will be presented which will be used as a tool for clarifying various elements of such models. The model introduced here, can be considered as a hypothetical and very simple model of an agricultural commodity market. It specifies the causes of the quantity of supply and of demand and it finally determines the price-level on the commodity market concerned.

2.2 An introductory example: the supply side

A commodity is supplied to the market in quantity s_t. The aim of this section is to derive a model explaining supply in terms of various explanatory variables. Let us start with something simple: The quantity s_t is only determined by a_t, the area planted in period t under the crop, and gives 0.5 tonnes per thousand ha. In mathematical terms:

$$s_t = 0.5a_t \qquad (2.1)$$

Using area data from table 2.1, for each of the years values for s_t can be derived. The resulting figures can be found in the first column of Table 2.2. Graphically the area data are shown in Figure 2.1, while the relationship (2.1) is found in Figure 2.2, with the <u>dependent variable</u> s_t on the vertical axis and the <u>explanatory variable</u> a_t on the horizontal axis. The slope of the linear curve through the squares is 0.5, the coefficient of a_t, implying that each additional 1000 ha will provide 500 tonnes more supply. Such a diagram is called a scatter diagram, from which the kind of relationship between the two variables can be seen. The variable s_t is a function of a_t, which is written as

$$s_t = f(a_t) \qquad (2.1a)$$

Obviously this relationship is linear, because that is the way equation (2.1) was formulated and the figures for s_t were derived. Equation (2.1) can be put in more general terms:

$$s_t = \beta_2 a_t \qquad (2.1a)$$

where the coefficient β_2 is called a parameter. Parameters are often represented by Greek letters α (alpha), β (beta), γ (gamma) and δ (delta) to which is added a sub-script to indicate which parameter is meant in that particular equation. Suppose the data on s_t and a_t are available, then the scatter diagram can be drawn and the parameter β_2 can be estimated at 0.5. We will come back to the estimation problem of parameters in chapter 4.

Table 2.1 Some basic data

Year	area a_t	price p_t	rain r_t	sub-optimal rainfall	income y_t
0	280.0	1.00	50	2	1000
1	212.5	1.34	55	3	1020
2	249.5	1.36	40	12	1060
3	252.1	1.68	20	32	1080
4	287.6	1.03	50	2	1090
5	216.3	1.33	55	3	1090
6	251.3	1.35	40	12	1110
7	255.0	1.73	20	32	1150
8	298.4	1.08	50	2	1170
9	228.9	1.41	55	3	1180
10	268.3	1.33	40	12	1180
11	262.5	1.66	20	32	1200
12	302.1	1.10	50	2	1240
13	243.2	1.43	55	3	1260
14	282.9	1.39	40	12	1270
15	281.9	1.62	20	32	1270
16	311.4	1.02	50	2	1290
17	248.7	1.44	55	3	1330
18	298.8	1.39	40	12	1350
19	297.9	1.66	20	32	1360
20	332.1	0.97	50	2	1360
21	259.3	1.34	55	3	1380
22	305.[illegible]	1.39	40	12	1420
23	314.7	1.66	20	32	1440
24	349.0	1.00	50	2	1450
25	280.7	1.28	55	3	1450
26	316.6	1.29	40	12	1470
27	322.0	1.65	20	32	1510
28	360.4	0.99	50	2	1530
29	298.2	1.31	55	3	1540
30	338.5	1.22	40	12	1540

<u>Table 2.2</u> Some derived figures for supply s_t

Year	resulting s_t based on equation			
	(2.1)	(2.2)	(2.3)	(2.4)
1	106.25	101.69	122.00	104.94
2	124.74	101.81	113.00	119.55
3	126.03	103.41	93.00	107.44
4	143.82	100.14	123.00	156.96
5	108.14	101.66	122.00	126.80
6	125.66	101.75	113.00	140.41
7	127.52	103.63	93.00	129.15
8	149.18	100.39	123.00	182.57
9	114.47	102.05	122.00	153.52
10	134.16	101.66	113.00	168.82
11	131.26	103.32	93.00	152.58
12	151.04	100.51	123.00	204.55
13	121.61	102.15	122.00	180.76
14	141.47	101.94	113.00	196.41
15	140.93	103.11	93.00	182.04
16	155.71	100.10	123.00	228.81
17	124.37	102.18	122.00	203.55
18	149.40	101.96	113.00	224.36
19	148.96	103.32	93.00	210.29
20	166.03	99.83	123.00	258.86
21	129.63	101.72	122.00	228.34
22	152.69	101.94	113.00	247.63
23	157.37	103.30	93.00	238.67
24	174.50	100.00	123.00	287.50
25	140.34	101.41	122.00	258.75
26	158.31	101.44	113.00	272.75
27	160.99	103.25	93.00	262.24
28	183.20	99.95	123.00	316.15
29	149.08	101.55	122.00	287.63
30	169.26	101.12	113.00	303.38

Another variable possibly influencing supply is the price. The data for this example are given in Table 2.1 and shown in Figure 2.3. As an example, the following equation is postulated

$$s_t = 95 + 5p_t \tag{2.2}$$

An increase of 1 in the price will lead to an increase of 5 in supply. In this equation a constant term of 95 is assumed. The figures for s_t resulting from equation (2.2) are shown in Table 2.2 in the column with the heading (2.2). The scatter diagram is given in Figure 2.4.

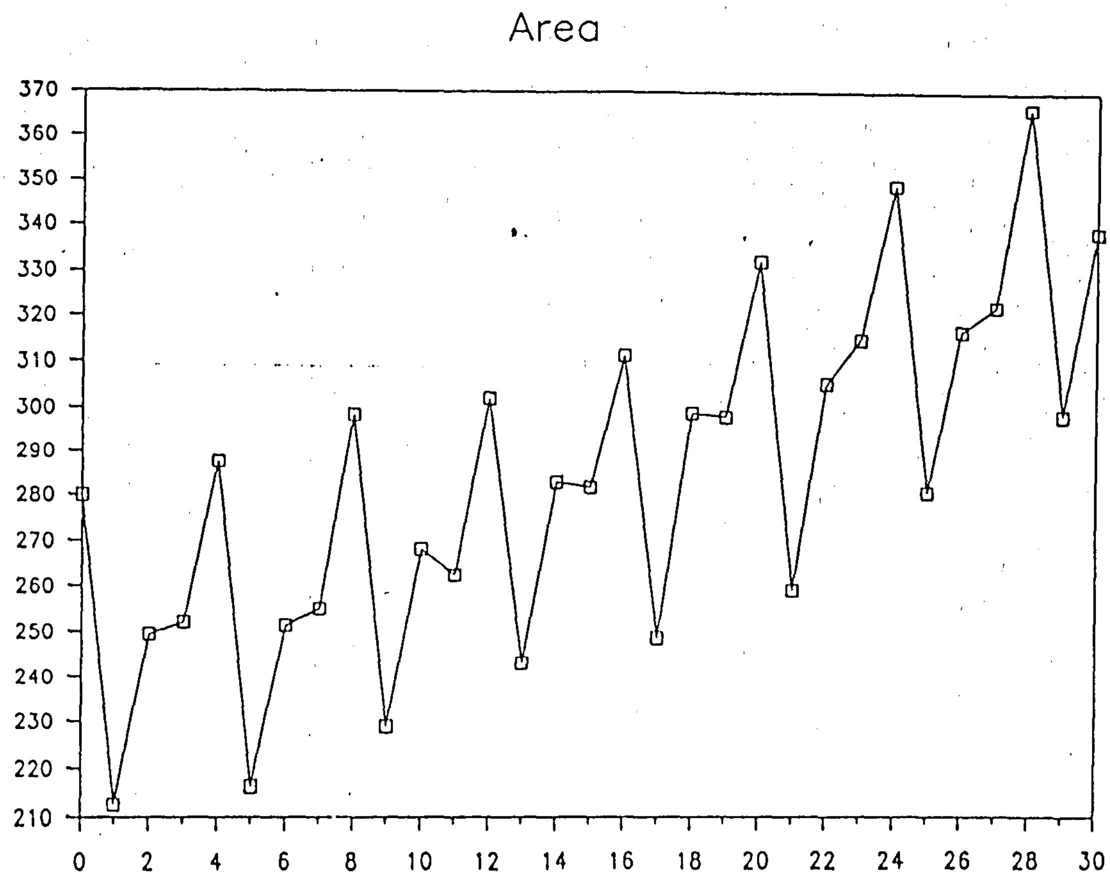


Figure 2.1

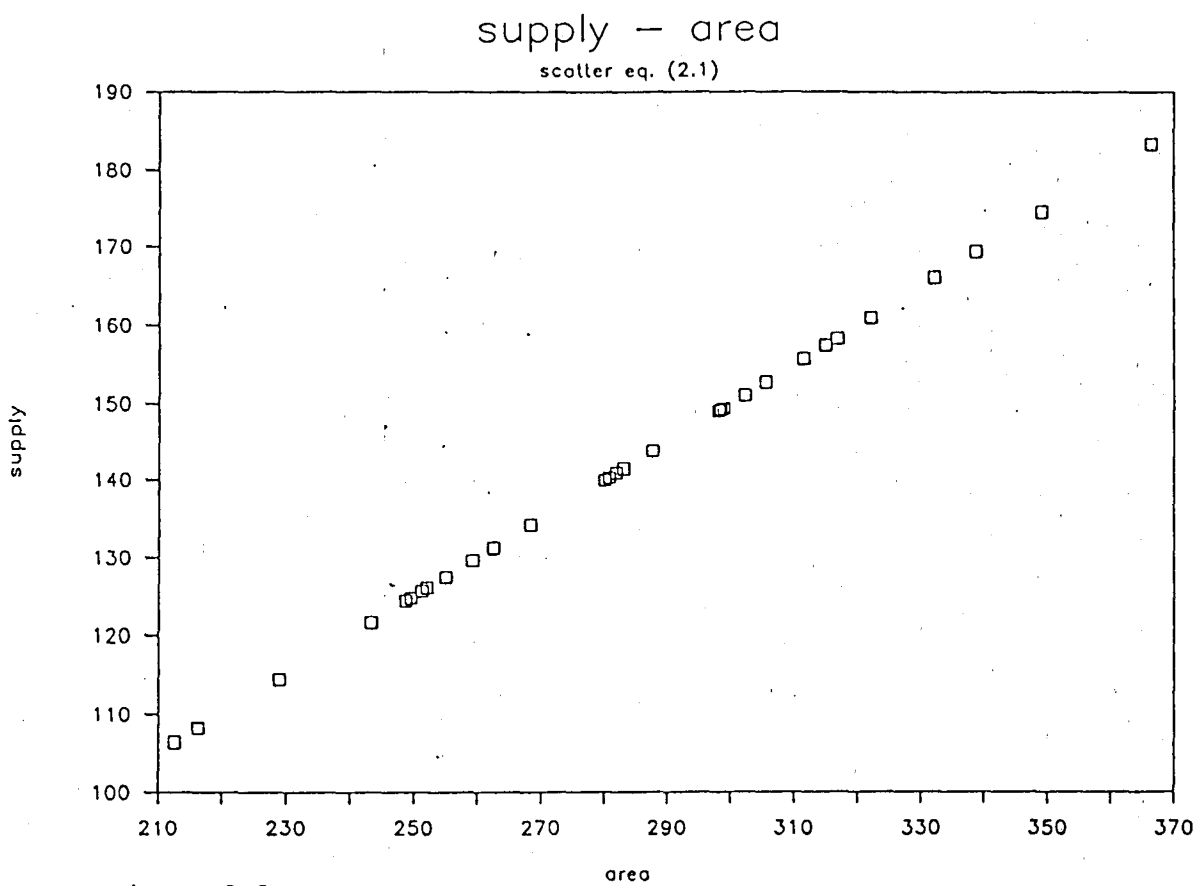


Figure 2.2

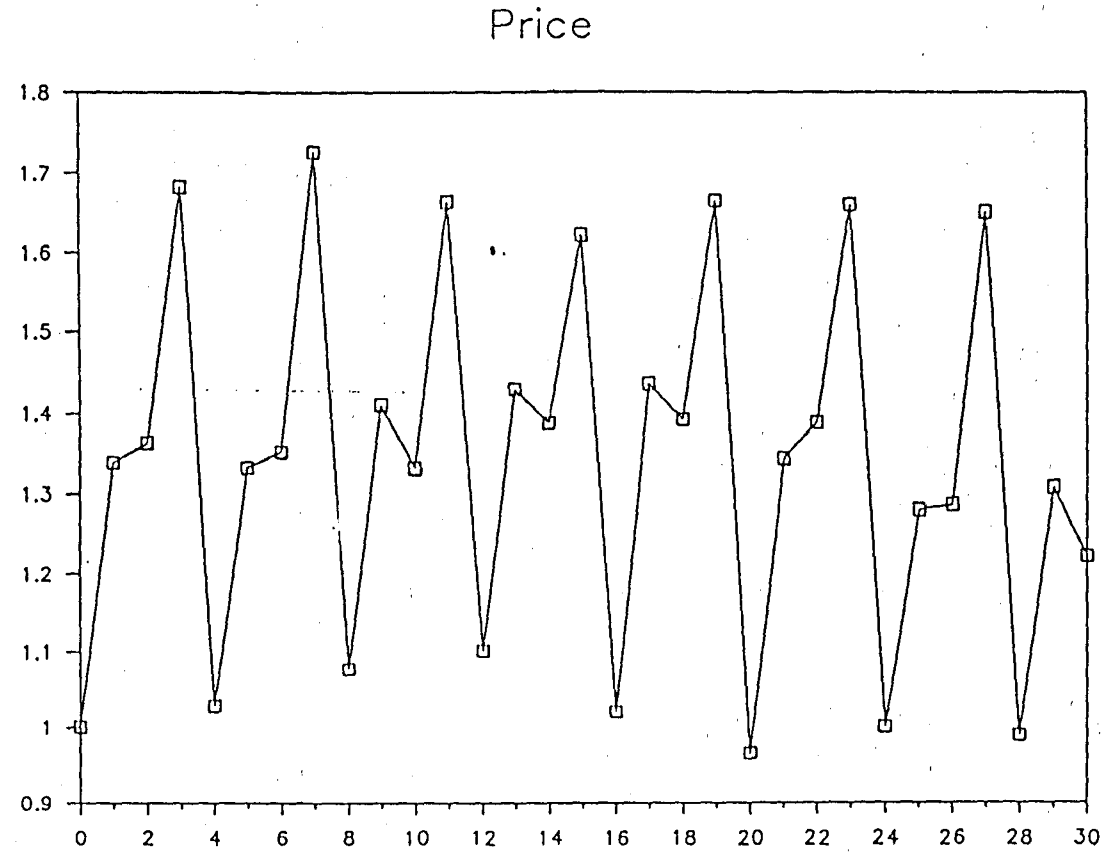


Figure 2.3

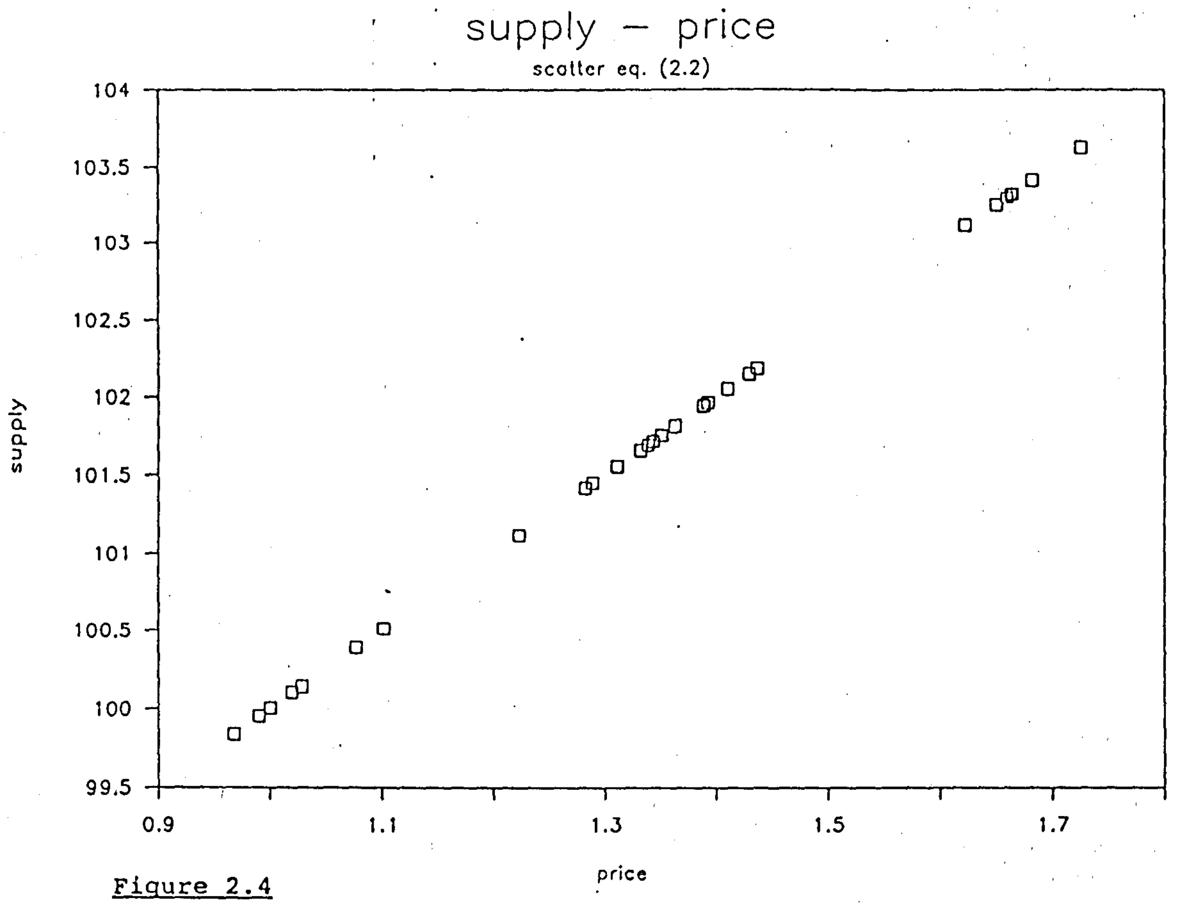


Figure 2.4

In general terms the supply-price relationship, if assumed linear in the variables and the parameters, can be formulated as

$$s_t = \beta_0 + \beta_2 p_t \qquad (2.2a)$$

The third variable in Table 2.1 is rainfall. We have assumed rainfall with a regular pattern 50, 55, 40, 20. This is done for the purpose of later-on more easily showing the effects of rainfall on the market. For many agricultural commodities, it is clear that much rain is not good and little rain is not good either. Suppose that the optimal amount of rain is 52 and that we specify the influence of rain on supply by using the absolute value of the difference between the actual and the optimal amount. This series is given in the fourth column of Table 2.1. This deviation in absolute terms is called rso_t in this model and must have a negative influence on supply: the greater the difference between actual and optimal, the lower will be supply. As an example we take

$$s_t = \beta_0 + \beta_4 rso_t \qquad (2.3)$$

with β_0 = 125 and β_4 = -1. The results are shown in Table 2.2 under the heading for equation (2.3) and obviously show the same regular pattern as was the case for rainfall. A scatter diagram can be found in Figure 2.5.

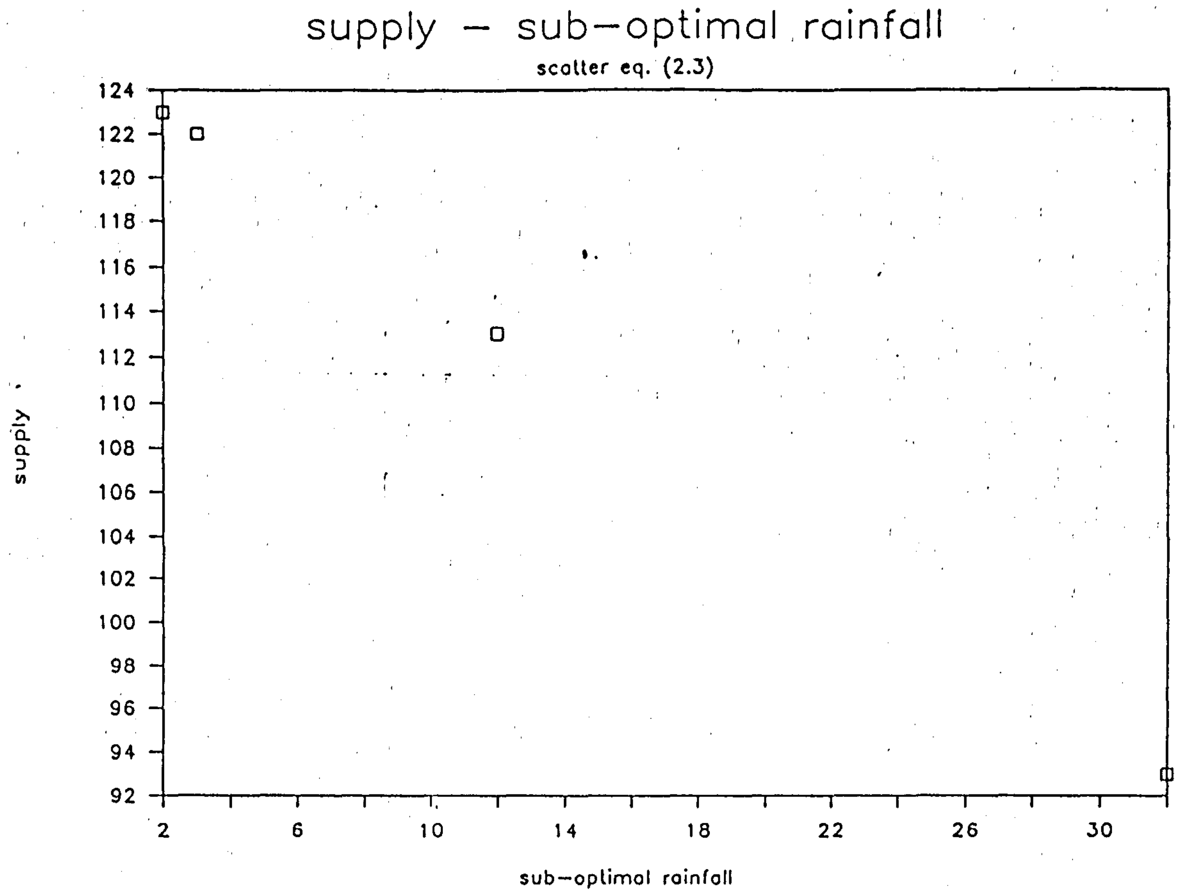


Figure 2.5

There are many variable which in principle can be put in the equation. In the following chapter some considerations and requirements in this area will be presented. Here we now present a very general formulation also including a time trend t representing technical progress: t has the value of the number of the year, so t = 0,1,2,...,30. The full equation then is

$$s_t = \beta_0 + \beta_1 a_t + \beta_2 p_t + \beta_3 t + \beta_4 rso_t \qquad (2.4)$$

with the following values for the coefficients: β_0 = -10, β_1 = 0.5, β_2 = 5.0, β_3 = 5.0 and β_4 = -1. The derived results for s_t are given in the last column of Table 2.2. This gives the graph in Figure 2.6. Note that the trend is largely determined by the trends in a_t and t.

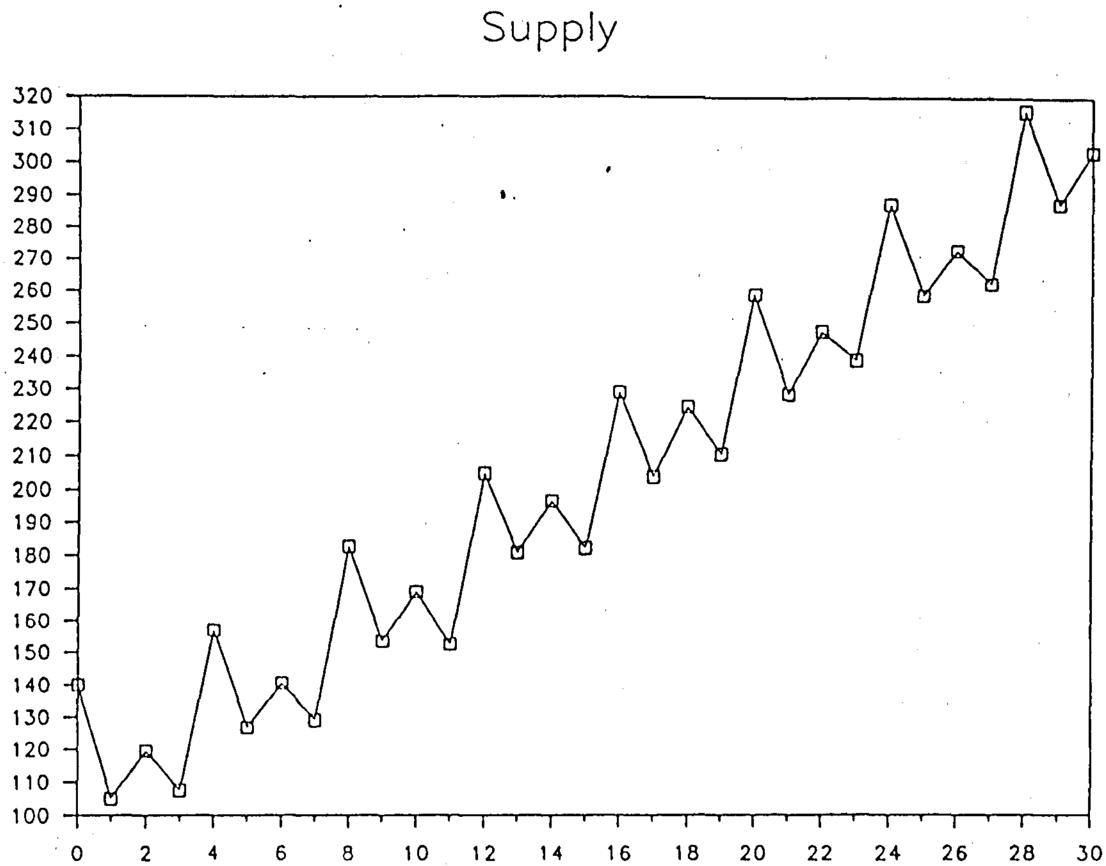


Figure 2.6

It is interesting to look at some scatter diagrams now that all influences on s_t have been included in the derived figures for s_t. First we present in Figure 2.7 the new version of Figure 2.2. Inclusion of all other influences on s_t means that the nice straight relationship is now somewhat diluted: the other variables cause some dispersion. The situation is far worse in Figure 2.8, which is the new version of Figure 2.4. No relationship seems to be present, which reflects that other variables appear to be much more important for the determination of s_t than p_t. This implies that an assessment of a possible influence of a variable (such as p_t here) on another variable (s_t in this example) can never really be derived from looking at (partial) scatter diagrams: one would conclude to no relationship at all, while the relationship was explicitly included in the equation.

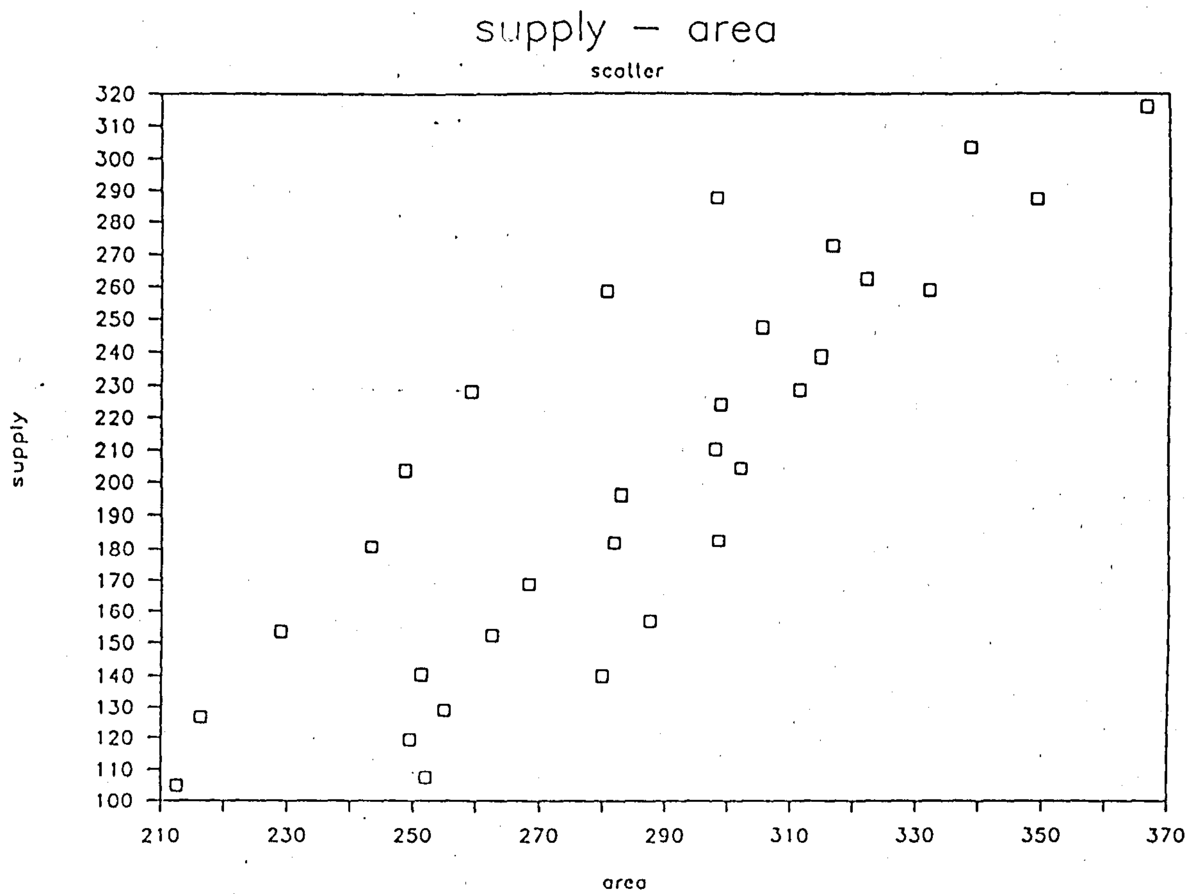


Figure 2.7

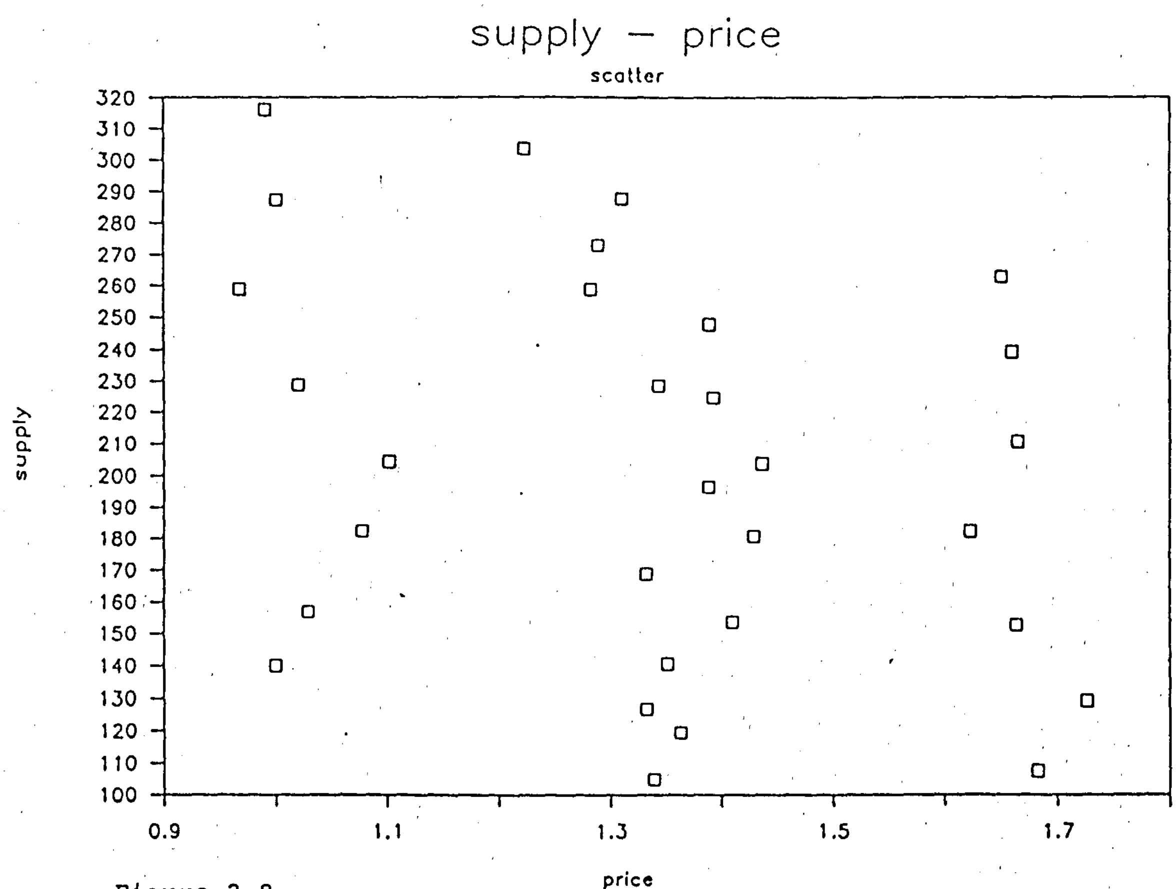


Figure 2.8

A beautiful picture emerges when a scatter is shown between s_t and rso_t: Figure 2.9. The shifting upwards of s_t by other factors seemingly dilutes the influence of rain, when comparing this to Figure 2.5.

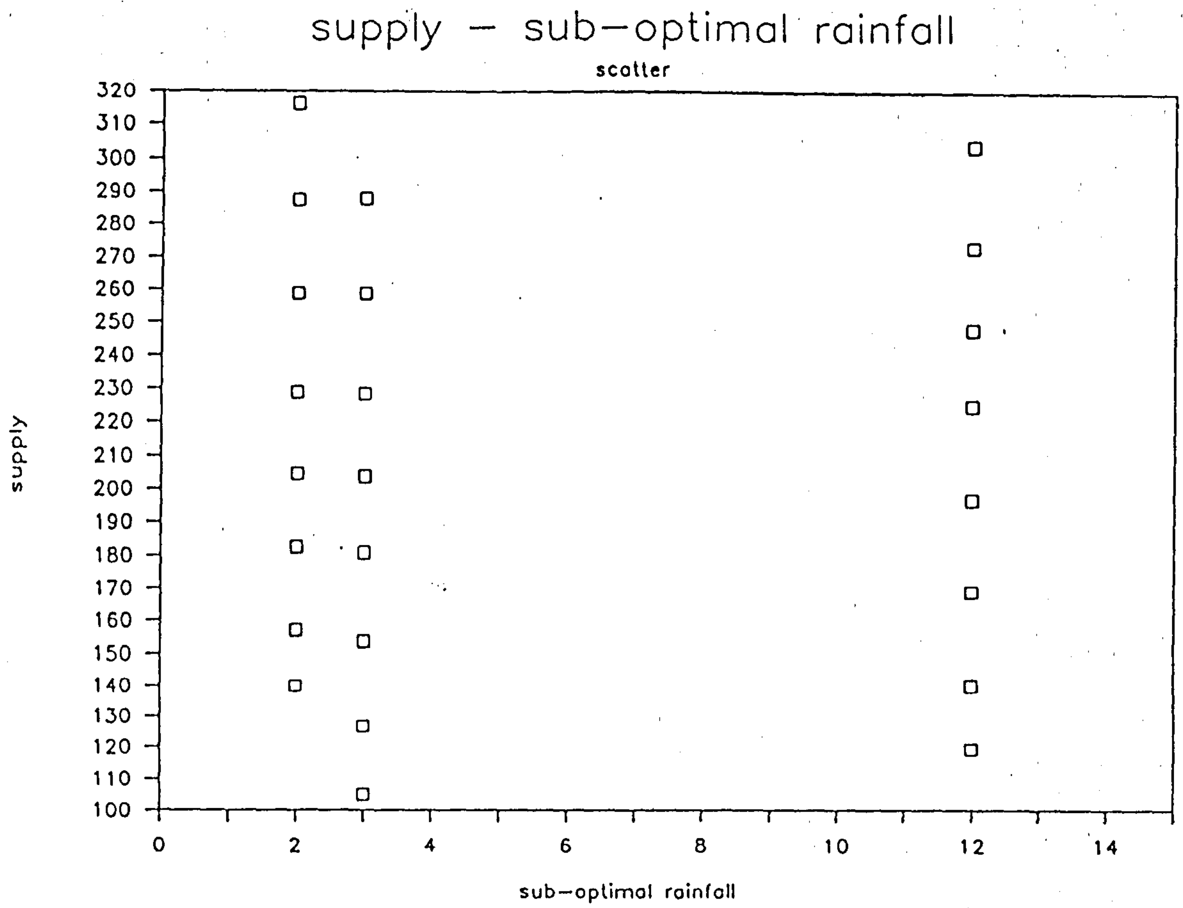


Figure 2.9

Because rso_t and t are determined independently, they are fixed outside the model and are therefore called exogenous variables. The endogenous variable in this equation, meaning that its value is determined within the model, is s_t. The variable s_{t-1} is called the lagged endogenous variable. The exogenous variables together with the lagged endogenous variables are called the predetermined variables. Two variables have not been allocated yet: a_t and p_t. First an equation for a_t is presented, followed later on by an equation for p_t. This means that the model is extended to containing more equations and that a_t and p_t are then endogenous as well.

2.3 An introductory example: explaining area under the crop

The allocation of area to various crops is a decision which has to be taken before the price is known and must therefore fully be based on information available from the previous crop year. Without going through all the detailed steps, a possible specification is presented right-away. Explanatory variables in equation (2.5) are lagged area, representing rigidity in farming practices, prices and a trend indicating autonomous influences towards more or less area.

$$a_t = \alpha_0 + \alpha_1 a_{t-1} + \alpha_2 p_{t-1} + \alpha_3 (p_{t-1} - p_{t-2}) + \alpha_4 t \qquad (2.5)$$

In this example the following values have been used for the coefficients: $\alpha_0 = 10$, $\alpha_1 = 0.9$, $\alpha_2 = 10$, $\alpha_3 = 100$ and $\alpha_4 = 0.5$. The resulting figures for a_t based on this equation were already presented in Table 2.1, because this equation was used to generate the data as presented there. The rigidity in the area allocation is strong: a coefficient of 0.9. The reaction to price changes in the previous period is much bigger than to price levels. In fact this part can be written as $110p_{t-1} - 100p_{t-2}$, as show Figure 2.10 and 2.11. This implies a negative influence of p_{t-2} on a_t. The scatter between a_t and t in Figure 2.12 obviously is similar to Figure 2.1, but without connecting lines.

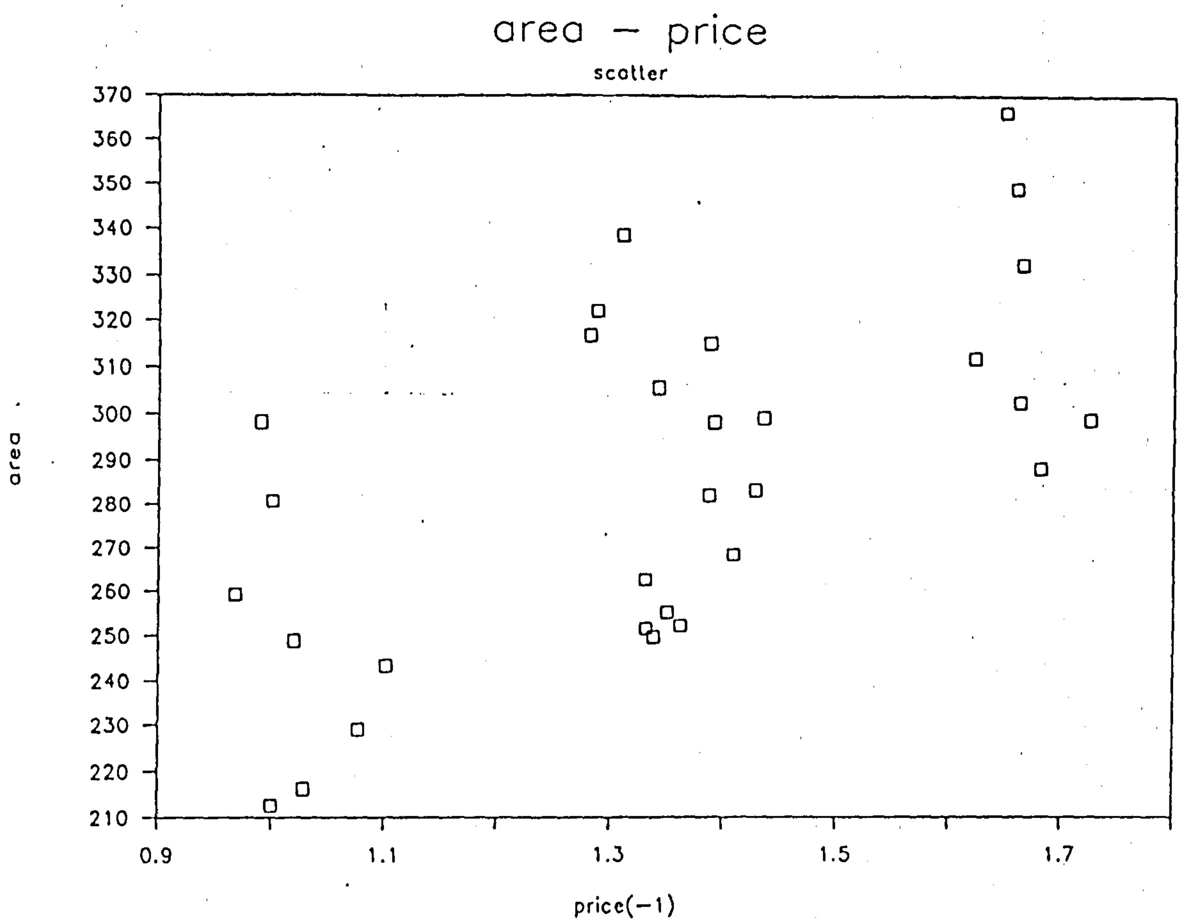


Figure 2.10

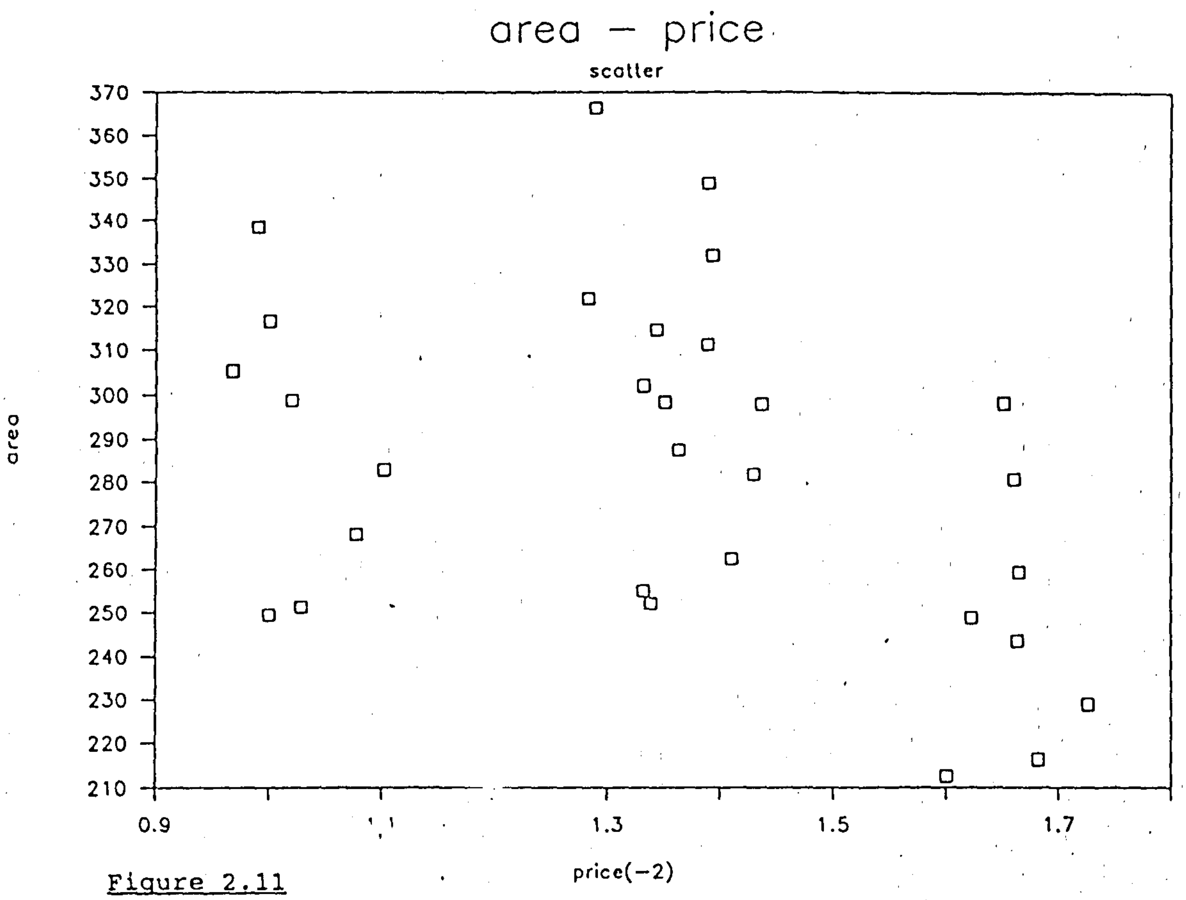


Figure 2.11

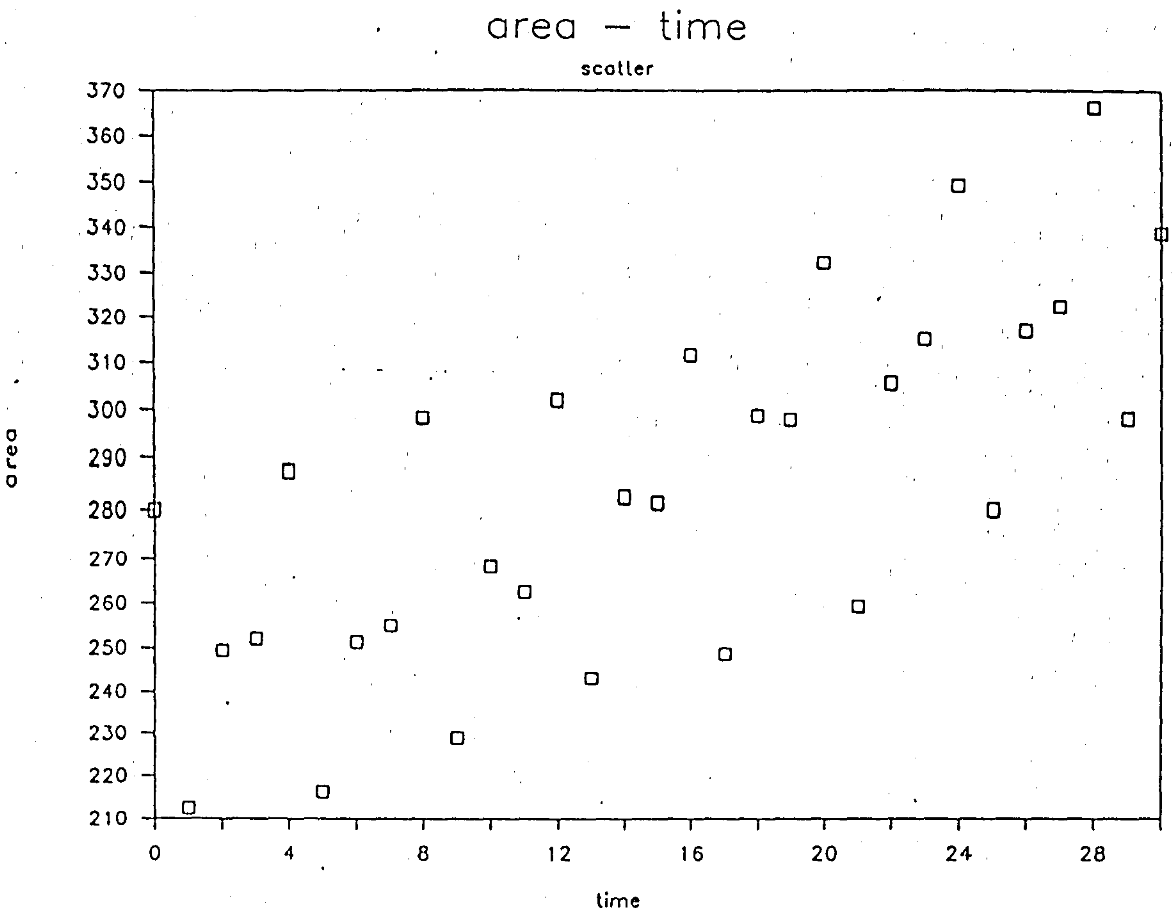

area — time
scatter
370
360
350
340
330
320
310
300
290
280
270
260
250
240
230
220
210
area
0
4
8
12
16
20
24
28
time

Figure 2.12

2.4 An introductory example: the demand side

Equation (2.6) specifies the determination of demand (d_t) dependent on rigidity in demand (as represented by d_{t-1}), the level of income (y_t), where y_t is included as an indicator for the need in the production process and there is the time trend representing possible autonomous demand shifts. Further p_{t-1} is the price in the previous period, which influences this year's demand. This so called one-year lagged influence of the price seems realistic, as processing industries will only slowly adjust their demand. The variable p_t is included as well to include possible more rapid reactions of demand to prices. The demand equation in a linear specification then is

$$d_t = \delta_0 + \delta_1 d_{t-1} + \delta_2 y_t + \delta_3 p_{t-1} + \delta_4 p_t + \delta_5 t \qquad (2.6)$$

The coefficients have the following values: $\delta_0 = -110$, $\delta_1 = 0.15$, $\delta_2 = 0.25$, $\delta_3 = -30$, $\delta_4 = -10$ and $\delta_5 = 1$. Using the data for income from Table 2.1, the graph for income is shown in Figure 2.13.

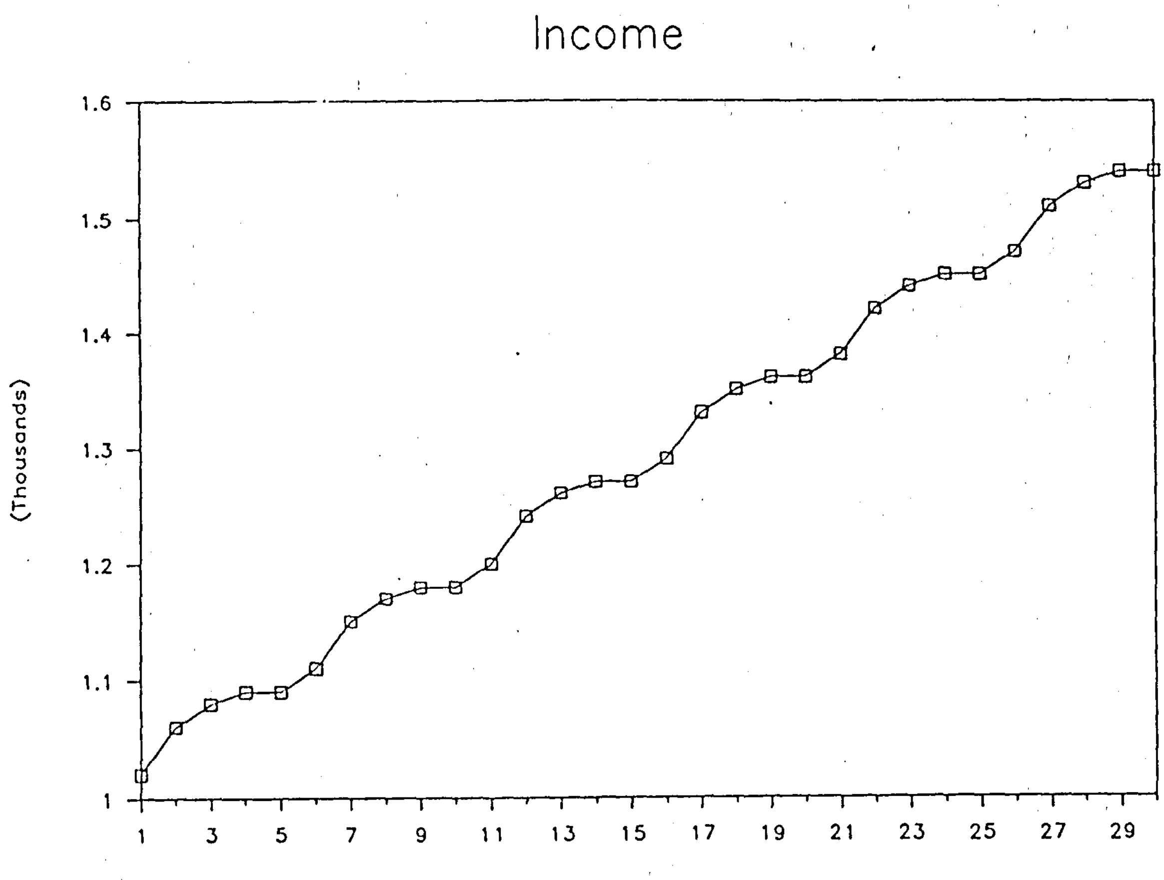


Figure 2.13

Note that income has a 5-year cycle. Using the equation and the data on prices, d_t can be calculated (Table 2.3). Figure 2.14 shows that this 5-year cycle disappears, as it is over-ruled by the other variables. In particular the 4-year cycle in p_t appears. The trend is caused by the further pushing by lagged demand, income and time. In Figure 2.15 this trend appears clearly and can only partly be attributed to y_t: the 5-year cycle only shows in groups of 5 squares in the diagram. For the scatter between demand and price, the same can be said as in the case of supply and area: little relationship is revealed (see Figure 2.16).

Table 2.3

Year	demand d_t	Year	demand d_t	Year	demand d_t
1	107.0	11	170.9	21	232.4
2	110.9	12	175.7	22	233.5
3	124.9	13	185.7	23	249.2
4	125.3	14	182.0	24	249.3
5	131.8	15	194.5	25	256.3
6	130.3	16	196.8	26	254.9
7	150.1	17	211.2	27	274.9
8	150.5	18	207.9	28	275.4
9	160.0	19	223.1	29	285.1
10	153.6	20	220.6	30	278.8

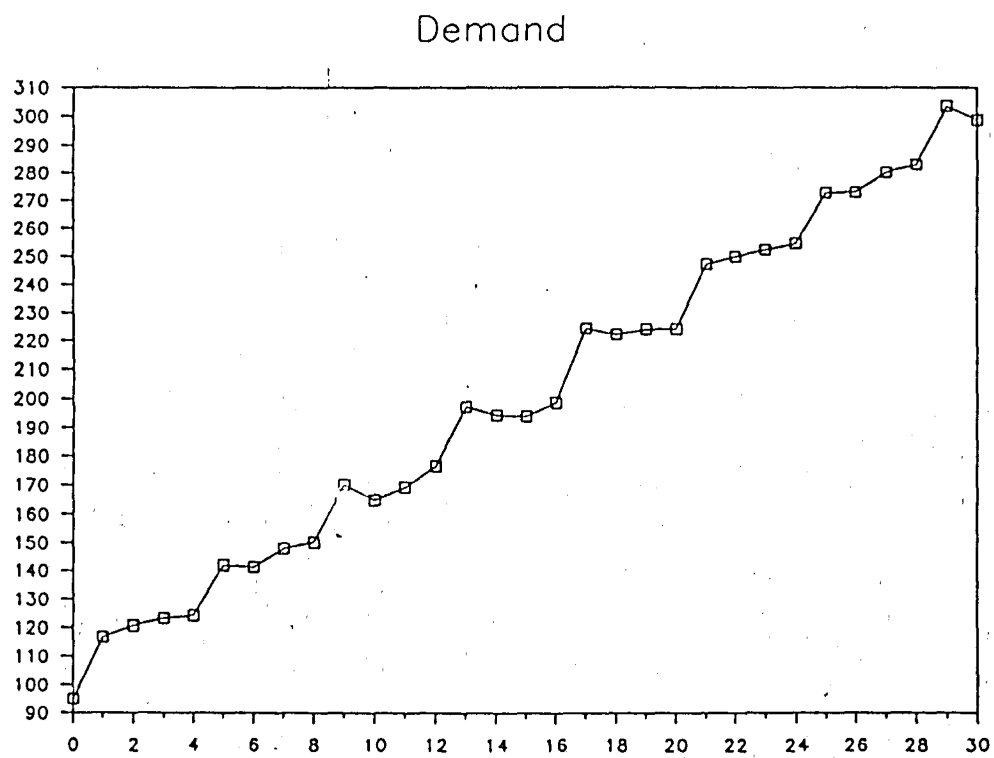


Figure 2.14

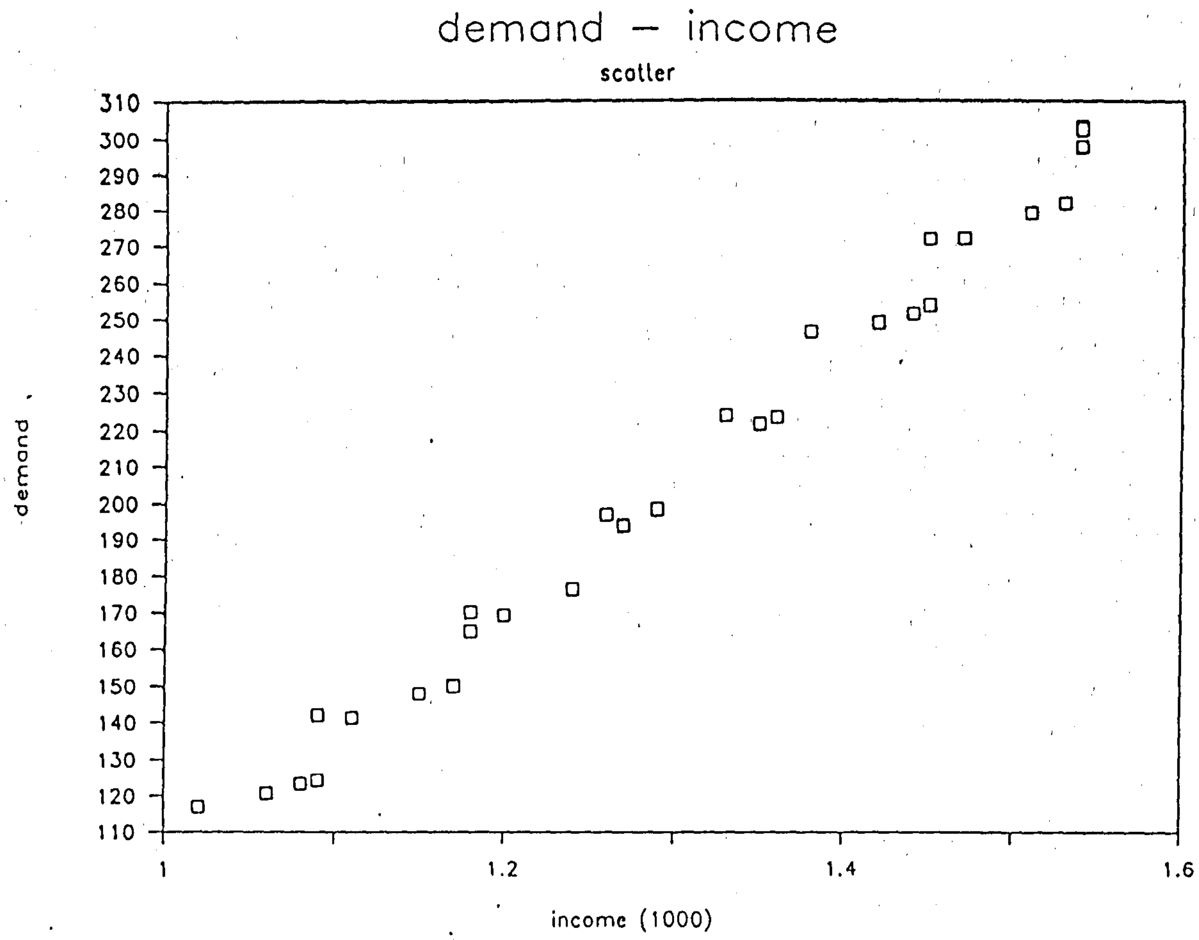


Figure 2.15

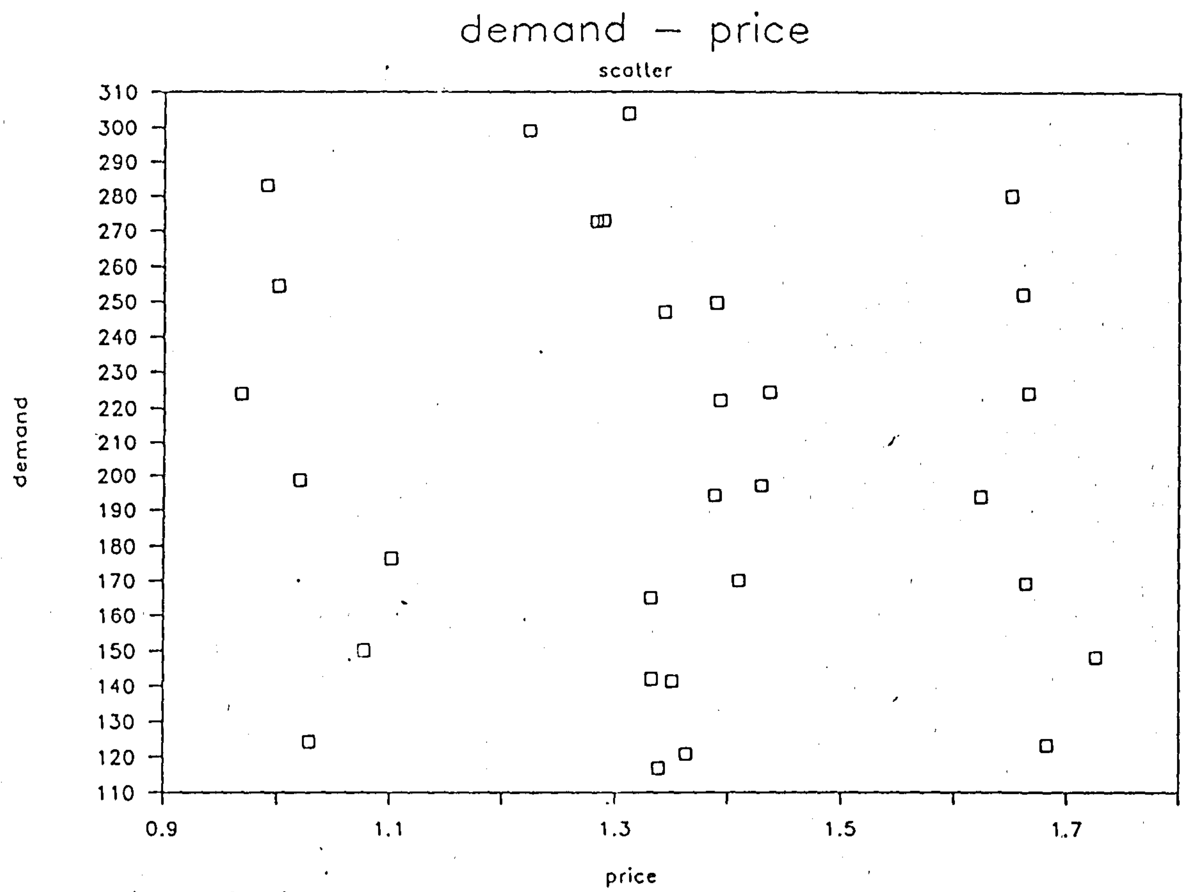


Figure 2.16

2.5 An introductory example: closure as a dis-equilibrium model

There are two more important variables in the model which have not yet been discussed in detail: stocks and prices. The way these variables are treated should reflect the way the market works. The first possibility follows the way of thinking of a dis-equilibrium model. This says that the balance between supply and demand goes into stocks, so end-of-year's stocks equal end-of-last-year's stocks plus supply minus demand. This leads to a definitional equation for z_t:

$$z_t = z_{t-1} + s_t - d_t \qquad (2.7)$$

The tendency to accumulate stocks during a year has a negative influence on prices, while lower stocks will have an influence in the upward direction. Therefore the following behavioural equation might be formulated:

$$p_t = \gamma_0 + \gamma_1 z_t \qquad (2.8)$$

with $\gamma_1 < 0$. During the year, the physical balance between production, consumption and stocks obviously will be fulfilled. The disequilibrium part is that it is assumed that stock holders do not have their own objective function and therefore there is no behavioural equation for z_t.

The price in this situation cannot be derived directly as was done above in the case of supply and demand, where the price was assumed fixed. By adding equations (2.7) and (2.8) to the model, we cannot anymore assume p_t to be fixed: p_t has become an endogenous variable in equation (2.8) with z_t as explanatory variable. However, z_t in turn also is endogenous in equation (2.7), depending on the already discussed endogenous variables s_t and d_t, and the latter ones again depend on p_t. So there is a circle and such a model is called a simultaneous model. To solve it a bit of algebra is applied: the variables z_t, s_t and d_t are subsequently substituted and one equation results from which p_t can be derived, after which the other three can be determined. First, substitute z_t using (2.7) into (2.8), so

$$p_t = \gamma_0 + \gamma_1 z_{t-1} + \gamma_1(s_t - d_t) \quad (2.8a)$$

In this bit of calculations we concentrate on those variables which are mutually dependent. The variable a_t comes from equation (2.5) only using predetermined (exogenous or lagged endogenous) variables. In the equations for s_t and d_t most of the elements are predetermined as well. Taking all such elements per equation together as $\underline{s}_t$ and $\underline{d}_t$ respectively, which can be calculated straightforwardly, allows us to write equations (2.4) and (2.6) as

$$s_t = \underline{s}_t + \beta_2 p_t \quad (2.9)$$

and

$$d_t = \underline{d}_t + \delta_4 p_t \quad (2.10)$$

These equations can then be substituted into (2.8a):

$$\begin{aligned} p_t &= \gamma_0 + \gamma_1 z_{t-1} + \gamma_1(\underline{s}_t + \beta_2 p_t - \underline{d}_t - \delta_4 p_t) \\ &= \gamma_0 + \gamma_1(z_{t-1} + \underline{s}_t - \underline{d}_t) + \gamma_1(\beta_2 - \delta_4)p_t \end{aligned}$$

so

$$(1 - \gamma_1(\beta_2 - \delta_4))p_t = \gamma_0 + \gamma_1(z_{t-1} + \underline{s}_t - \underline{d}_t)$$

and

$$p_t = (1/(1 - \gamma_1(\beta_2 - \delta_4)))*(\gamma_0 + \gamma_1(z_{t-1} + \underline{s}_t - \underline{d}_t)) \quad (2.11)$$

The resulting prices in each period can then be substituted in (2.9) and (2.10) to determine s_t and d_t which in turn lead to z_t. All figures are given in Table 2.4. The resulting prices equal those given in Table 2.1, because in that way these prices were derived. The figures for z_t and the relationship between the thus determined data for p_t and z_t are shown in Figures 2.17 and 2.18.

It is important to note that if β_2 and δ_4 are equal to zero, the simultaneity in the model disappears: both producers and consumers only react to pre-determined variables. Now p_t can also be derived directly. Such a model is called a recursive model: each variable can be determined recursively and (2.11) becomes

$$p_t = \gamma_0 + \gamma_1(z_{t-1} + \underline{s}_t - \underline{d}_t) \quad (2.11a)$$

Table 2.4

Year	supply s_t	demand d_t	stocks z_t	price p_t	$\underline{s}_t$	$\underline{d}_t$
1	104.94	116.87	33.08	1.34	98.25	130.25
2	119.55	120.75	31.88	1.36	112.74	134.38
3	107.44	123.42	15.90	1.68	99.03	140.24
4	156.96	124.27	48.59	1.03	151.82	134.55
5	126.80	141.97	33.41	1.33	120.14	155.29
6	140.41	141.34	32.48	1.35	133.66	154.84
7	129.15	147.93	13.70	1.73	120.52	165.19
8	182.57	150.14	46.13	1.08	177.18	160.91
9	153.52	170.11	29.54	1.41	146.47	184.20
10	168.82	164.93	33.43	1.33	162.16	178.24
11	152.58	169.17	16.84	1.66	144.26	185.80
12	204.55	176.46	44.92	1.10	199.04	187.48
13	180.76	197.13	28.55	1.43	173.61	211.42
14	196.41	194.32	30.63	1.39	189.47	208.20
15	182.04	193.80	18.87	1.62	173.93	210.03
16	228.81	198.69	48.99	1.02	223.71	208.89
17	203.55	224.34	28.20	1.44	196.37	238.70
18	224.36	222.15	30.41	1.39	217.40	236.07
19	210.29	223.92	16.77	1.66	201.96	240.57
20	258.86	223.98	51.65	0.97	254.03	233.65
21	228.34	247.16	32.84	1.34	221.63	260.59
22	247.63	249.89	30.58	1.39	240.69	263.78
23	238.67	252.24	17.02	1.66	230.37	268.83
24	287.50	254.54	49.98	1.00	282.50	264.55
25	258.75	272.84	35.89	1.28	252.34	285.67
26	272.75	273.07	35.57	1.29	266.31	285.96
27	262.24	280.30	17.51	1.65	253.99	296.80
28	316.15	283.15	50.51	0.99	311.20	293.05
29	287.63	303.67	34.47	1.31	281.08	316.78
30	303.38	299.00	38.85	1.22	297.26	311.23

It has been concluded that s_t, d_t, z_t and p_t are the endogenous variables of the model. The <u>number of equations</u> in a model has to equal the <u>number of endogenous variables</u> to be explained by the model, otherwise the model system cannot be solved for the values of the variables.

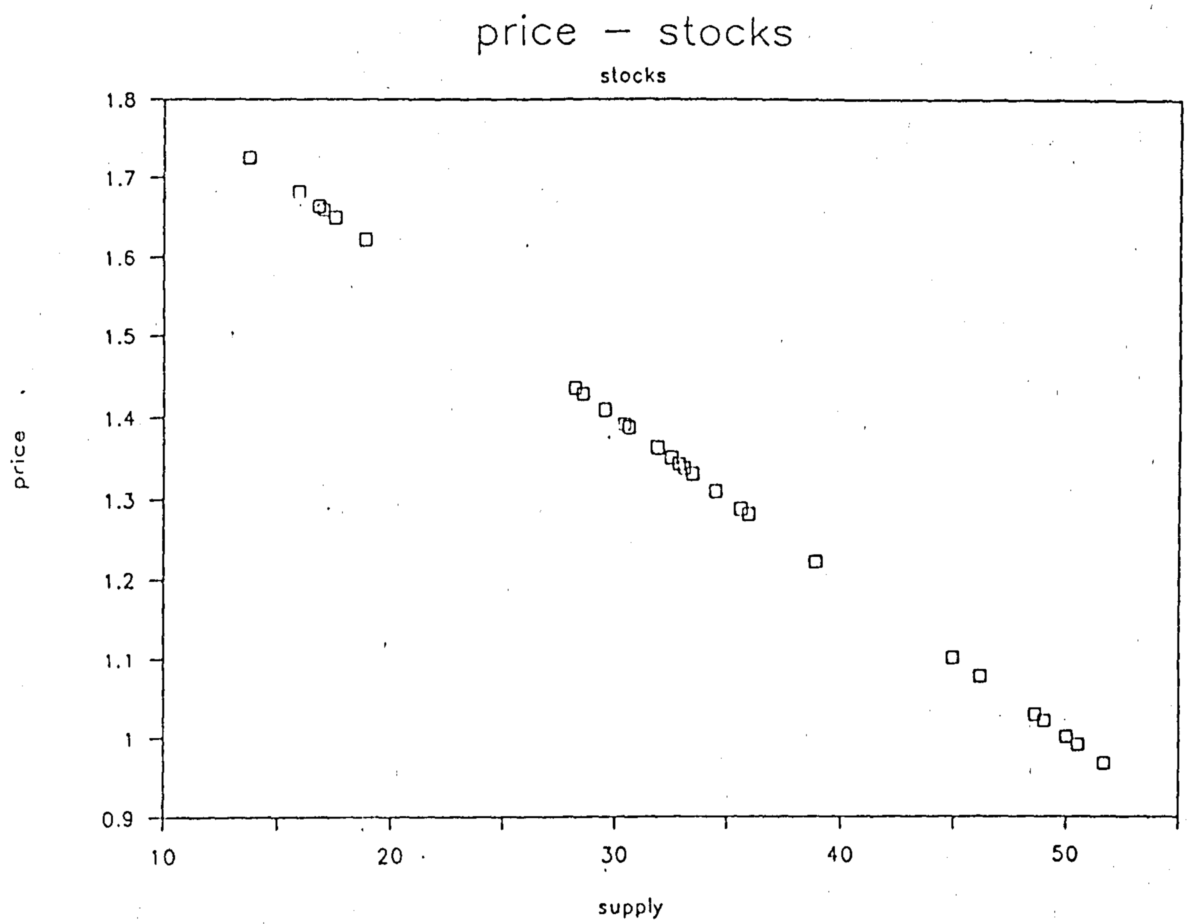


Figure 2.17

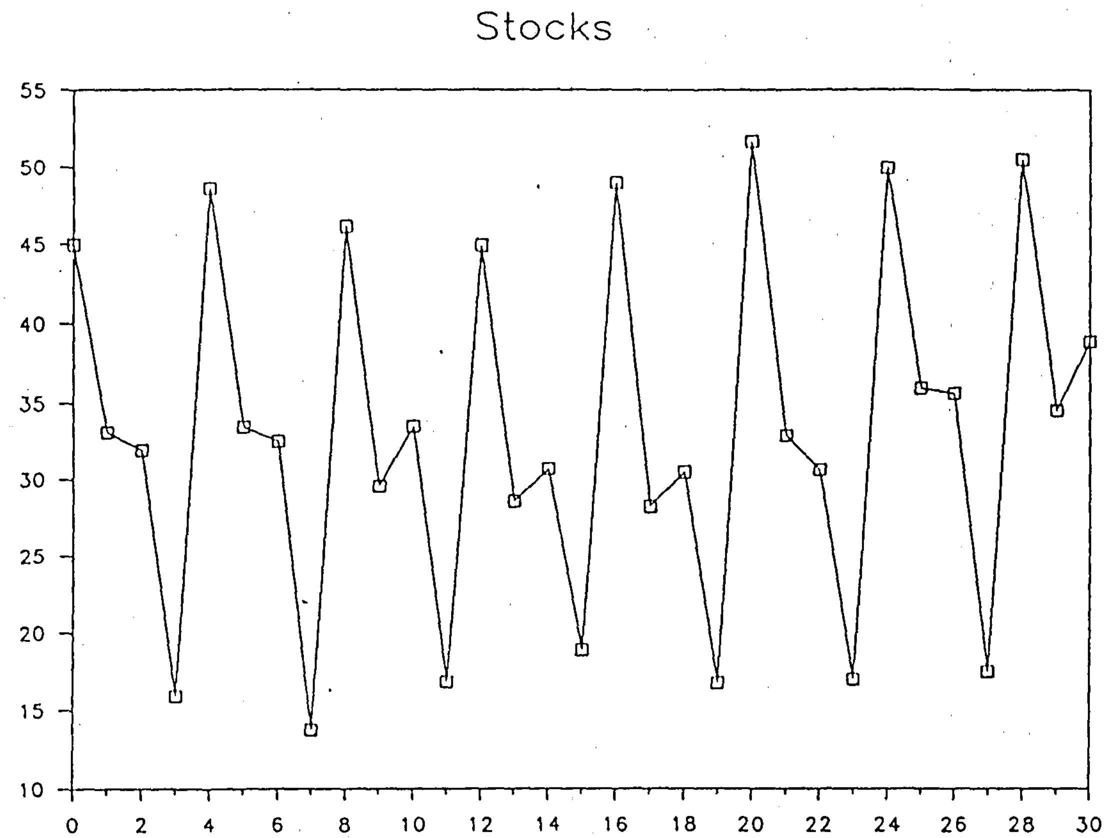


Figure 2.18

2.6 An introductory example: closure as an equilibrium model

If we want to describe the market of this example using an equilibrium model, the price has to be determined in such a way that

$$z_t + d_t = z_{t-1} + s_t \qquad (2.12)$$

while there is e.g. the following behavioural equation for stockholders:

$$z_t = \gamma_2 + \underbrace{\gamma_3}_{< 0} p_t \qquad (2.13)$$

Note that (2.12) appears to be the same equation as (2.7). However, (2.12) is an equilibrium equation while (2.7) was a definitional equation. Similarly, in this simple model (2.13) can be rewritten as (2.8) with $\gamma_0 = -\gamma_2/\gamma_3$ and $\gamma_1 = 1/\gamma_3$. In more complicated models such a simple reformulation may be difficult.

2.7 An introductory example: some simulations

In this section some calculations with the model are shown for the purpose of revealing some of the sensitivities and dynamics.

Scen. A: A first simulation is done with a lower value of β_3, putting it at 3 instead of 5. This means less autonomous increase in supply, yielding a higher price. The results are shown in Figure 2.19.

Scen. B: Contrary to the above, a higher value for β_3, namely 7 increases s_t to the extent that prices show a declining trend (Figure 2.20)

Scen. C: The main reason for the volatility in prices (4-year pattern) is rainfall. Putting rainfall at 50 throughout makes the 5-year pattern visible as it is caused by the income pattern.

Scen. D: If the income pattern would be eliminated as well, using an increase of 18 per year, prices become smooth after the initial fluctuations disappear.

Scen. E: Increase in income of 90 in years 3, 8, 13 etc. and 0 in the other years. The results are given in Figures 2.23 and 2.24.

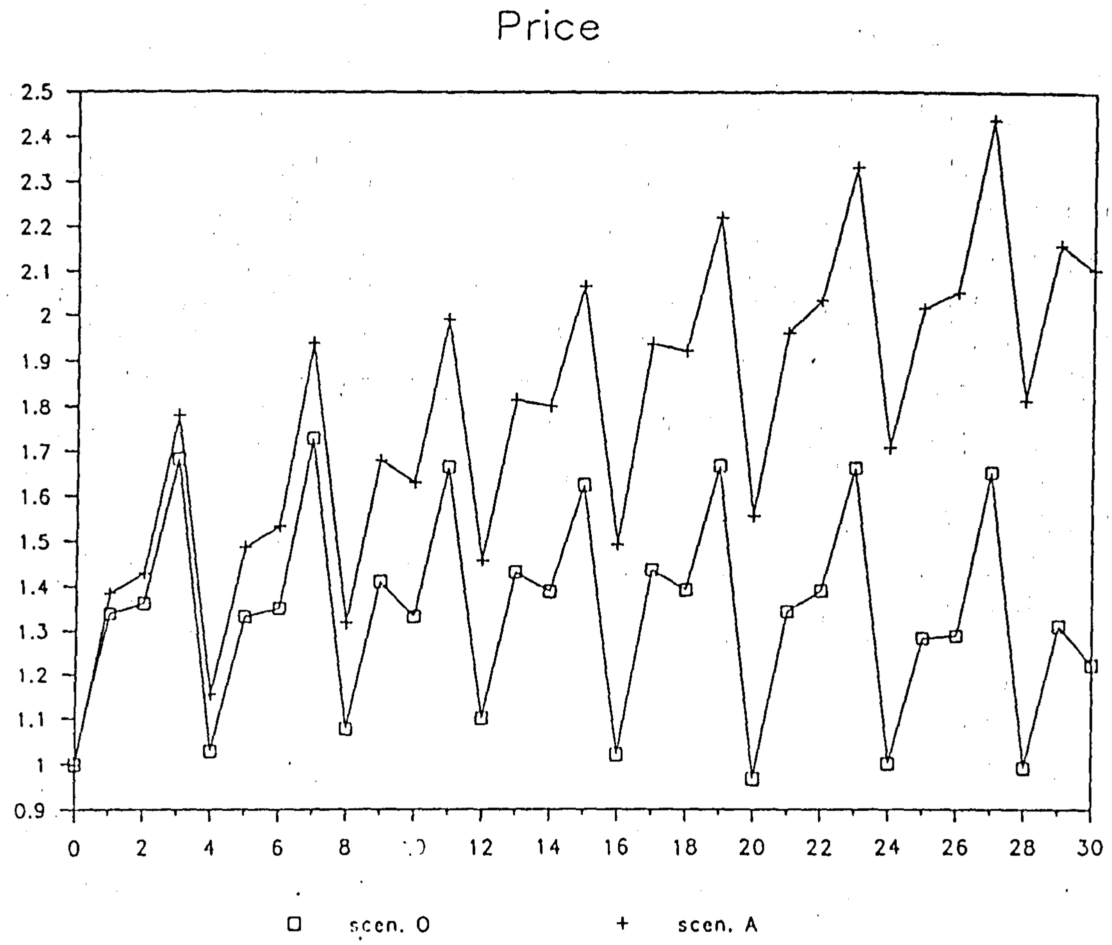


Figure 2.19

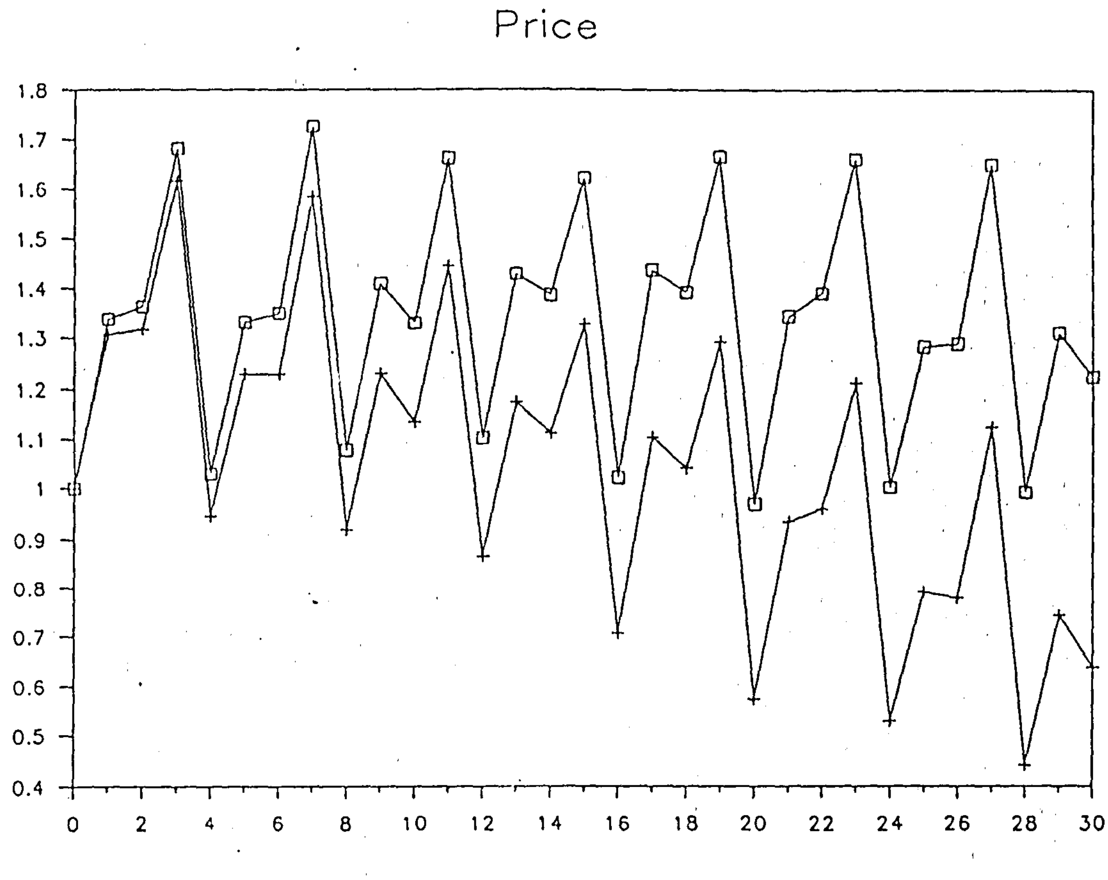


Figure 2.20

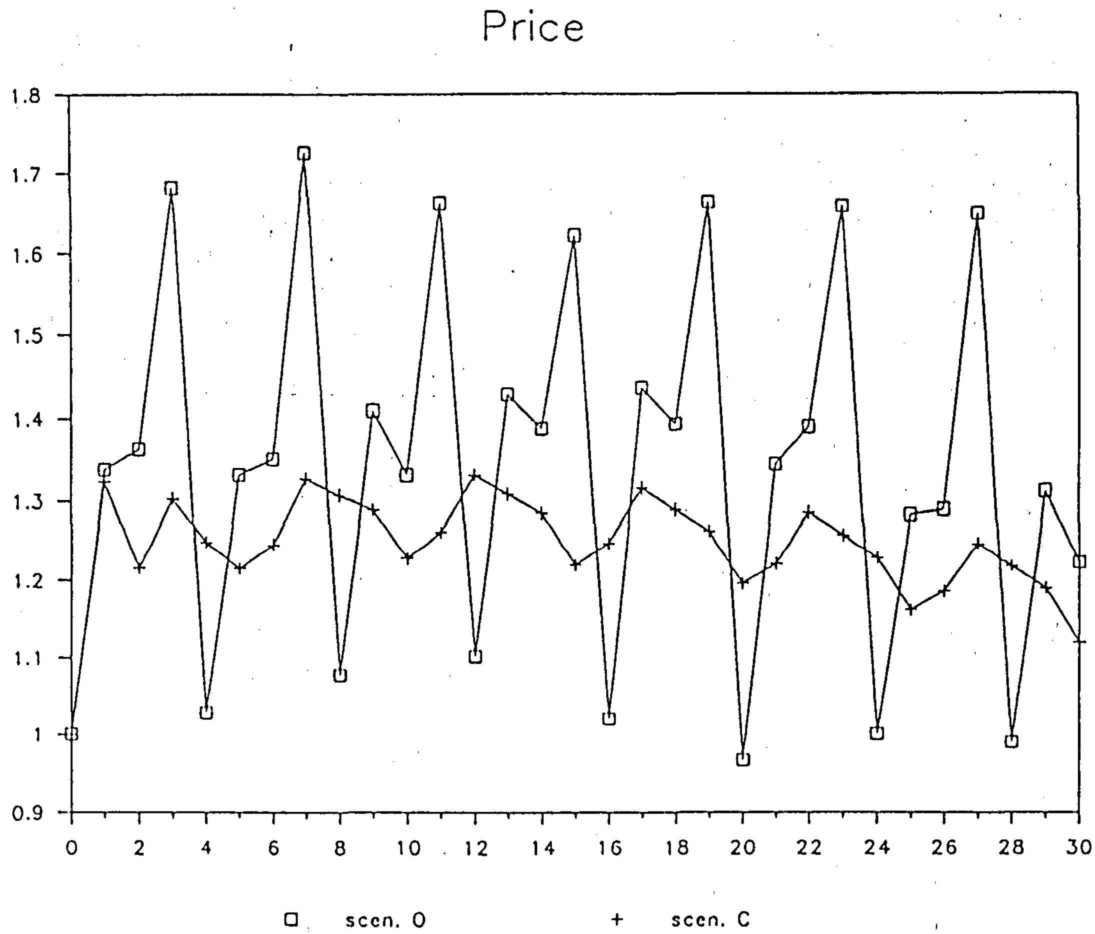


Figure 2.21

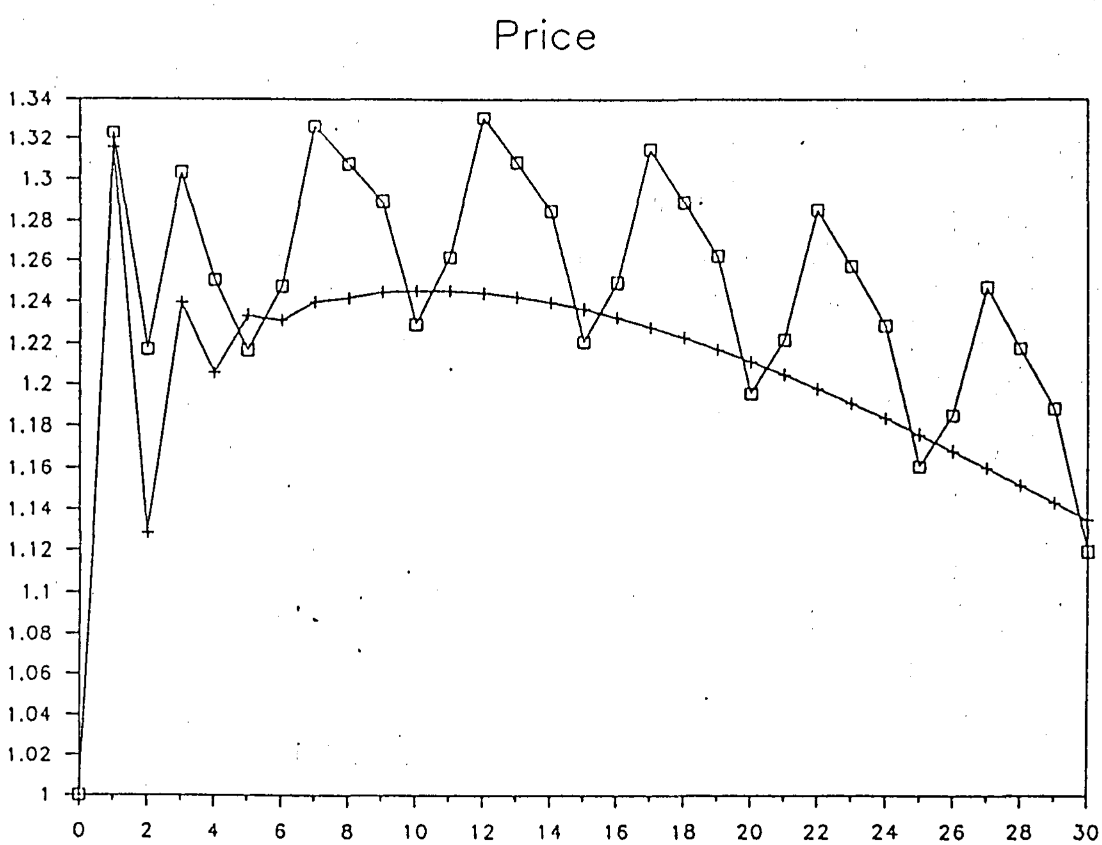


Figure 2.22

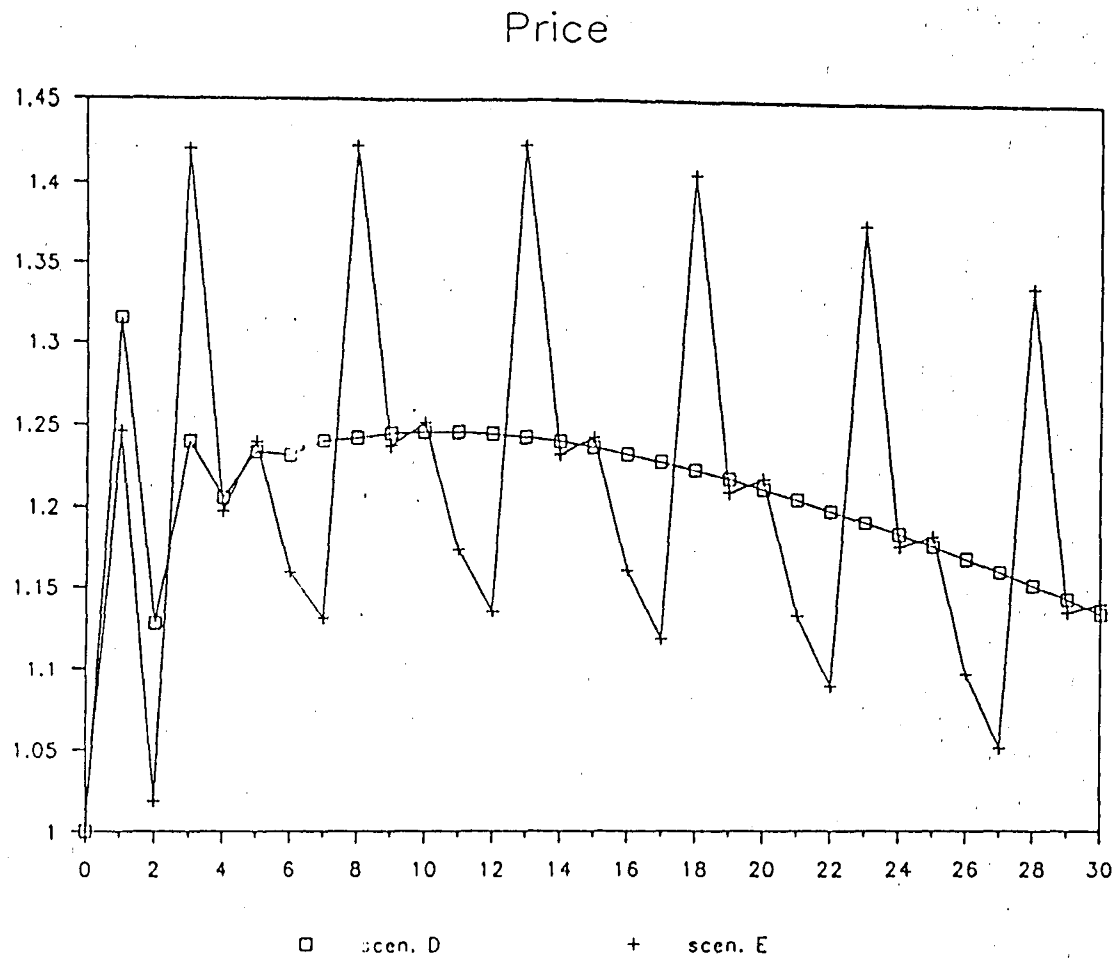


Figure 2.23

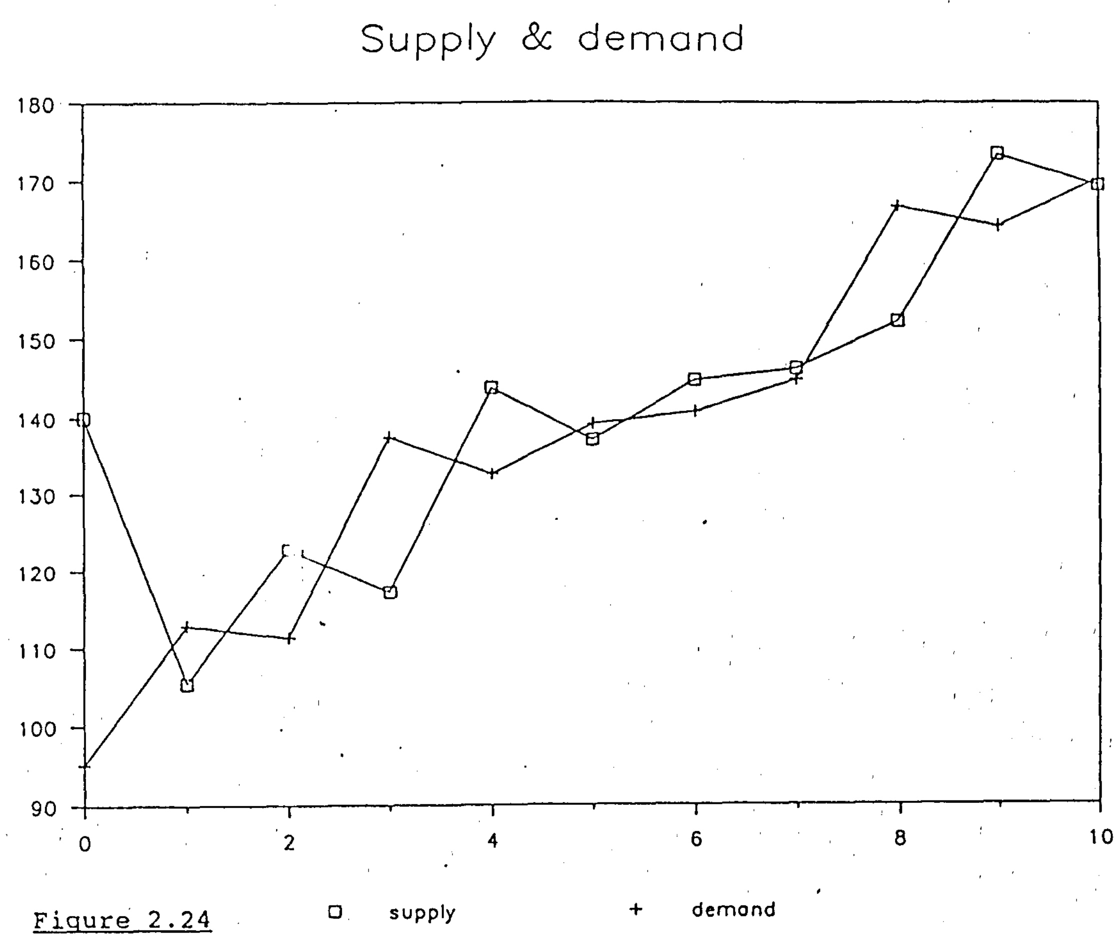


Figure 2.24

3. Commodity model specification

3.1 Introduction

This chapter is written for the purpose of deriving a proper specification for the commodity model. It requires in some cases a better understanding of mathematics than was needed for the previous chapter. However, many of such sections can also be read skipping the more difficult mathematics. A proper specification is based on the following requirements:

(a) the model should represent micro-economic behaviour of actors in the market,

(b) the model should include the objectives of policy formulation or appropriate proxies,

(c) the model should incorporate the major policy instruments or their proxies, and

(d) the model should be so designed that the necessary data are available and that parameters can be estimated.

For the purpose of fulfilling requirement (a) various items of commodity models are described in this chapter. Such items and their resulting description of the various types of commodity markets as well as the appropriateness of the inclusion of policy objectives (b) and policy instruments (c) are assessed. Aspect (d) concerning estimation, simulation and forecasting is treated in Chapter 4.

3.2 A short-term analysis of the supply side

In this section the production function will be introduced. This is, together with e.g. profit maximization, the basis for the supply function.

Production functions

In many models of firm behaviour, be it farms, mines of others, one assumes that the technology can be represented by a production function. The produced quantity of the output of one or more commodities is a function of the quantities of the production factors of inputs used in the production process. At present, we limit ourselves to models for one output, which we denote by q, and n inputs denoted by x_i, $i = 1,2,\ldots,n$. The production function is written as:

$$q = f\ (x_1,x_2,\ldots,x_n) \tag{3.1}$$

Technological progress can be modelled as a shift over time of the production function. With a given combination of inputs, it becomes possible to produce a larger output.

An example is the well-known Cobb-Douglas production function proposed in 1928 by the mathematician Cobb and the economist Douglas. We assume that two production factors, labour ℓ and capital k, are needed to produce a commodity q. The Cobb-Douglas production function

$$q = A\ \ell^{\alpha}\ k^{\beta}\ ,\ A > 0\ , \tag{3.2}$$

is a multiplicative function with $0 < \alpha$ and $0 < \beta$ and $\alpha + \beta < 1$. Expression (3.2) can also be written as a log-linear relationship. The marginal productivity of labour and capital, resp. $\partial f/\partial \ell = \alpha(q/\ell) > 0$, $\partial f/\partial k = \beta(q/k) > 0$, is proportional to the average productivity. The marginal productivity is a decreasing function of ℓ and k. The elasticities of production with respect to ℓ and k equal α and β resp., so that $\alpha + \beta$ is the percentage change in production caused by a one percent change of the inputs ℓ and k. The sum $\alpha + \beta$ is the degree of homogeneity of the production function, with $\alpha + \beta$ being smaller than, equal to or greater than 1 corresponding to respectively decreasing, constant or increasing returns to scale.

Supply functions

As assumed above a firm produces a commodity q for which the technology can be characterized by the production function (3.1). The firm chooses the inputs so as to maximize profits subject to the production function and given prices for the inputs, w_i, and for the output, p. Profit Π equals revenues R (= pq) minus costs C

$$\Pi = R - C = p\ f(x_1,\ldots,x_n) - \sum_{i=1}^{n} w_i x_i \tag{3.3}$$

The first order conditions for profit maximization are

$$p \frac{\partial f}{\partial x_i} - w_i = 0 \quad , \quad i = 1,\ldots,n \quad , \tag{3.4}$$

where $(\partial f/\partial x_i)$ is the marginal productivity of input i. The solution of (3.4) in terms of x_i as functions of p and the w_i's is the system of input demand functions

$$x_i = x_i(p, w_1,\ldots,w_n) \; , \; i = 1,\ldots,n \; , \tag{3.5}$$

Substitution of (3.5) into the production function leads to:

$$q = f(x_i(p,w_1,\ldots,w_n)) \; , \; i = 1,\ldots,n \tag{3.6}$$

which is the <u>supply function</u> of the firm under consideration. It gives the optimal output as a function of the prices on the output market and the input markets.

In summary, a production function represents a technical relationship between inputs and output. Therefore no prices are included. Prices come in because of the optimizing behaviour by producers under the restriction of the production function. This then leads to the supply function in which there will be prices if prices are relevant in the optimization approach of the producer.

It is important to note that in practical analyses, normally only supply functions can be generated as an ex-post realization of production. In general only in laboratory like situations can a production function be derived. In practical cases, however, it is only the supply function which is relevant. Some possible extensions of the above model are given in section 3.3. One such amendment is the derivation of a supply function based on utility maximization rather than profit maximization, an example of which is given in section 3.5.

3.3 Relevance and extensions of the simple short-term supply model

There are a number of aspects of the above discussed model of production and supply, which need further discussion:

(a) how realistic is such a production function,

(b) how realistic is the assumption of profit maximization,

(c) is it appropriate to use only one output commodity,

(d) where can policy objectives and policy instruments come in.

Each item is briefly discussed below.

(a) Constant technical coefficients

In the models discussed in section 3.2, the production function is assumed to be given and known. Moreover, it is assumed that the production function is a well behaved continuous function of the inputs. In practice, however, the best production process or the best combination of production process is not always known. In addition, at a micro-economic level the assumption of constant technical coefficients is often more realistic than that of a continuous production function. Such a production process is described below.

A production process or method in this approach is characterized by a set of technical coefficients. Each process is characterized by constant input-output ratios or constant technical coefficients d_j. The production function is defined by:

$$q = \min_j \left(\frac{x_j}{d_j} \quad j=1,\ldots n\right) \qquad (3.7)$$

The technical coefficient d_j is the number of units of input j per unit of output. Inputs are strictly complementary. Output can be increased only by augmenting all inputs in the proportions required. Returns to scale are constant. In the short-run in most industries, substitution between factors is indeed almost impossible. Only when several processes are available, substitution becomes feasible through combining these processes.

In its ultimate form this may lead to a production function where one production factor is the bottle neck and thus the only determinant.

This is the case for the production of many agricultural commodities in many developing countries where land is the determining factor and labour is relatively abundant. The supply function may then turn into an area allocation function followed by a yield function with little or no price influence. An example of such a situation is given below.

(b) Alternatives to profit maximization

Is it realistic for a small farmer or miner to consider profit maximization as the guiding principle for production and input decisions? In many cases the answer is no. Consider the case of a rubber smallholder, who has little alternative then to tap his rubber trees or to do some odd jobs here and there and to grow his own food. There are at least two reasons why profit maximization does not apply here. First, the cost of input in particular labour and land cannot be defined, because of the irrelevance of the wage concept and because the land with the trees is there and it is just a matter of to tap or not to tap. Secondly, the criterion is much more the choice between labour and leisure and leads therefore to utility maximization rather than profit maximization. An example is given in section 3.5. A similar story can be told for the case of a small tin miner in Thailand, going to sea with his former fishing boat, or his colleague who still goes fishing. In the short-term many of them do not have a substantial alternative source of income and therefore the choice is largely technically determined and for the rest depends on the utility choice: to work or not to work.

(c) Profit maximization in case of more than one commodity

In the case described in section 3.2 only one good is produced and all inputs are freely available. Such, however, is not very realistic in reality. First, normally, farmers etc. have more commodities they produce and, secondly, they face constraints on inputs. This implies that there are production functions for each commodity e.g. jute and rice for a Bangladeshi jute farmer. So profit maximization as in (3.3) should incorporate both or all commodities, adding up in this case profits on jute and profits on rice. Then there are constraints e.g. on land and on manpower: the farmer has to allocate land to the crops and has to divide family labour and possibly hired labour to the various crops depending on the sowing season, the maintenance season and the harvesting season. In empirical modelling of an individual farmer, such an approach can be followed in detail if data permit. If country-wide modelling is aimed at for national policy formulation, one cannot incorporate individual farmers constraints. The best approach is then to use as much as possible micro-behaviour of the farmers and translate that into a national supply function. For the Bangladeshi jute farmer this may then result in a supply function for jute where the price of rice, the yield of rice and the area under rice are determining factors next to more jute related variables. For details, see the example below.

(d) <u>Inclusion of policy objectives and policy instruments</u>

Policy objectives and policy instruments need to be specified first before they can be incorporated. The easiest is when the two sides can be translated into normal modelling variables. Let us take the Bangladeshi jute farmers as an example. Suppose the objective of the government is to increase jute supply in Bangladesh in 1990 by 10% compared to 1989. Such a variable is relatively easy to incorporate into a model. Then the policy instruments. One may think of price related instruments such as duties, subsidies and minimum prices for jute or physical instruments such as subsidies on seeds availability of seeds. Incorporating these instruments normally requires elaborate modelling of domestic price developments. In order to derive an optimal policy mix, it is useful to first try to calculate how much would be supplied if no change of policy would be adopted. Such a calculation could then act as a reference base, a standard scenario. In that context it is important to incorporate likely developments and policies for competing crops. After that the effect of policy changes in the jute field can be better assessed.

<u>Example 3.1</u>

Below a possible supply function for raw jute is given. In this case, the supply equation is split into two parts: an area equation and a yield equation.

Farmers base their jute acreage decision on expected prices for jute and competing products. As proxies for these, last year's average farm-gate prices have been taken. As a measure of expected yields in the supply relationship, last year's yields were used in the regression. Farmers may expect yields and prices more 'rationally' than only on the basis of last year's yield, but as a first proxy this appears to do quite well. Once area is fixed based on "last-years" information, no price influence could be established for harvest or yield.

Bangladesh acreage of jute (estimation period: 1974-1988):

$$lajb_t = 5.407 + 0.514 \ln(pjb*yjb/prb)_{t-1} - 1.213\ lyrb_{t-1} \quad (3.8)$$

Bangladesh yield of jute (estimation period: 1973-1988):

$$yjb_t = 1.03 + 0.019\ trend + 0.29\ d80 \quad (3.9)$$

Supply of jute is then arrived at by multiplying acreage and yield:

$$sjb_t = ajb_t * yjb_t \quad (3.10)$$

Definitions of the variables used for the supply relationships:
when the letter l is mentioned before a variable name, this means that the natural logarithm of the variable is taken; sjb refers to the production of raw jute in tonnes in Bangladesh; ajb refers to the area under jute in thousand ha.; pjb and prb refer to (proxies) of farm-gate price of jute and rice in local currency (Taka); pjb is an average farmer's price; "loose jute at grower's level in Taka per maund (1 maund = 37.324 kg.)"; prb is a grower's price for rice in Bangladesh in Taka per maund; yjb and yrb are yields in thousand kg. per ha. for jute and in tonnes per acre for rice respectively; d80 is a dummy for year 1980, taking the value 1 in year 80 and 0 otherwise; trend is a variable taking the value 1 in 1961, 2 for 1962 and so on, up to 28 in 1988. Agricultural data on acreage, yield, production and grower's prices before 1979 were taken from publication of the Bangladesh Bureau of Statistics, Monthly Bulletins and Yearbooks, unless stated otherwise. Since 1979 they were taken from FAO Quarterly Statistics on Jute, Kenaf and Allied Fibres.

3.4 Long-term supply: the investment side

In the previous section, supply by e.g. farmers was analyzed, assuming that there was full flexibility in allocating area to crops. This was particularly explicit in the example, where the supply decision in fact was an area allocation decision, super-imposed on which was an equation estimating yield, after which basically the whole possible production was put on the market without any influence of current prices.

For perennial crops and mines, however, supply is largely determined by investment decisions in the past while actual supply may be interpreted rather as a decision on the utilization of capacity. Such capacity is often estimated in industry as the maximum possible production, whereby a normal level of capacity utilization may be around 75%. In our approach we rather prefer to start from such a "normal" level of capacity utilization in view of an optimal long-term rate of exploitation of trees and mines. Such a level of production will be called "normal production".

To quantify the concept "normal production", it is defined as that level of production in a certain year, which would have been realized had there been no price influence. The reason for employing such a concept is that for real developments in the market, only the short-term price effect then needs to be superimposed. If prices are low, actual production will be below normal production. This may mean that there is a proportional reduction in production for the whole area or for all mines. However, another way to look at it is that less productive areas or mines will not be ("fully") exploited. If prices are high, even those areas or mines which are not profitable at average price levels will come back into production. In this section, we will broadly describe how normal production can be estimated in relationship to other variables. This is done as an example for natural rubber which is a perennial crop. However, the approach can easily be transposed in terms of the mining industry.

In analyzing production of natural rubber (NR) the following elements are essential: planted area, new planting, replanting, uprooting for replanting with other crops or for other purposes, the age of the area and the yield profiles, technical progress, other factors influencing normal production and prices. The reason for such an approach is that a hypothetical hectare of rubber trees planted in 1955 provides rubber starting from the 1960s onwards and declining in the 1970s. When the age of the tree is between 25 and 35, a decision about replanting or uprooting must be made, because, otherwise, production from that hypothetical area of trees will decline to very low levels in the years after (the yield profile). If this hectare is uprooted (not replanted with NR), the reduction of NR production potential depends on the yield profile and the age of the trees on that hectare at the time of uprooting. If the hectare is replanted with NR, this implies no NR production during the immaturity period. Afterwards production starts, following a yield profile. However the yield profile to be followed, will be considerably higher than the old one because of technical progress. Finally, the intensity at which tapping is carried out will depend on prices and labour availability.

Estimation of normal production therefore requires answers to the following questions:

(i) what is the composition of the total area for NR according to the year of planting (the vintages);

(ii) which percentage is uprooted or replanted because of age, disease or damage (the discarding system);

(iii) what is the average yield profile for a hectare of rubber during its life (the yield profile);

(iv) how does technical progress in quality of clones affect yield profiles of hectares planted in various years;

(v) what is the influence of other exogenous factors influencing normal production, e.g. weather and slaughter tapping.

For the mining case this would mean: what is the composition of the total of mines being actually exploited or not, what is the potential to open up new mines, what is the exploitation profile in relation to the age of the mine, what is technical progress in exploitation methods leading to more output from a new mine and, finally, what other variables influence actual output as against normal production.

Turning back to NR, it will be clear to anybody familiar with NR statistics, that data to do such an analysis are not available. Below will be shown the methodology to include all relevant variables in the analysis and how the data base and the relationships have been developed. For further details see Smit (1984).

<u>Area distribution by vintages and discarding systems</u>

It is clear that an essential element in analyzing NR production is total area divided by age groups, by vintages. A vintage of year t is the area planted in year t e.g. t = 1955. As the years pass by, the 1955 vintage will reduce in size owing to uprooting or replanting. Data on area planted per year are reasonably accurate for many years. Other data available include total acreage under rubber and areas discarded per year.

A huge problem arises in determining area distribution by vintages, i.e. the number of hectares planted in year t and still existing in the year of tapping, year t, which is the year of analysis. Discarding of area, meaning uprooting for other crops or replanting by rubber, can be derived for total area, but cannot be split up according to vintages. In other words, it is not known how much of the 1955 vintage is discarded in 1956, 1957 and soon. However, one may assume that in the first few years little will be discarded; then, when the tree becomes less productive, discarding will increase.

If the distribution of the area by vintage would be known in a certain year t-1, e.g. 1959, thus splitting the area up in area planted 1 year ago, 2 years ago and so on, and if one would know the discarding percentage p_1, p_2, for age 1, 2 etc., then it would be easy to calculate how much would be left for each vintage in year 1960. Using the same percentages one could then carry on and calculate the area distribution for 1961, 1962, etc. One does not know the p_k exactly, but one may assume that the shape of the p_k can be approximated by a sigmoid curve. By summing all discarded areas over the vintages in 1960, one obtains total discarded area in 1960 and similarly for the years after. The p_k must be chosen in such a way that the calculated discarded area in each year equals the actual discarded area in each year. This implies for each year a specific point of inflection shifting the sigmoid curve to the left when there was a lot of replanting and uprooting and shifting it to the right if discarding was more limited.

Yield profiles and technical progress

All NR clones follow a general yield curve over time, from the first year of tapping onwards, which resembles a skewed bell-shaped curve, increasing steeply first and, later-on, declining slowly. Because of the large degree of aggregation that is inevitable in the set-up of this study, an average of the various yield profiles has been used. The actual (commercial) yield profile will be lower than the ideal yield profile. The ideal yield profile therefore needs to be multiplied with a certain factor, in order to reduce the ideal yield profile to actual levels. This multiplication factor will be different for different countries, and, within countries, for estates and smallholdings. A reason may be the selection of clones. This selection of clones of which a certain vintage is composed is fixed once a vintage is in the ground. However the composition of different vintages (so different planting years) may vary over time, implying that the multiplication factor may need to increase over time in view of embodied technical progress. The assumption now is that each vintage will have an average yield profile, which is a constant fraction of the ideal yield profile: if a yield profile is estimated to be for example 0.3 times the ideal yield profile, then the profile is suppressed to 30% of the original shape. Of course, later vintages may be composed of better clones, thus increasing average yield. In the example, the fraction of 0.3 may become 0.4 for the vintage planted a number of years later. The fractions are estimated per vintage by relating area and ideal yield profile to production and then deriving the fractions which create actual yield profiles that are consistent with area composition and production.

Specification of a normal-production function

Above we have discussed composing elements for normal production: vintages, discarding systems, yield profiles and technical progress. Add to this a number of factors such as labour availability and the picture is complete. Of course no data on normal production are available. The approach we used is to explain actual production in terms of prices and the various elements of normal production. Having simultaneously allocated the price influence and the other influences using regression analysis the latter group is defined as normal production.

The normal production function may be specified mathematically as

$$\bar{q}_t = \sum_{\tau} f(\tau) y_{t-\tau} a_{t\tau} \qquad (3.11)$$

with $\bar{q}_t$ = normal production of NR

τ = year of planting

t = year of tapping

$f(\tau)$ = embodied technical progress function

$y_{t-\tau}$ = ideal yield profile, age = $t-\tau$

$a_{t\tau}$ = area of vintage τ still remaining in year t.

This in fact is the 'capital side' of the normal production function.

The ideal yield profile is adjusted for the length of the immaturity period, which may vary around 6 years. There are many possible specifications for $f(\tau)$ of which linear functions are easiest to apply. To (3.11) may be added the influence of other exogenous factors, such as weather. All factors discussed so far are either exogenous or predetermined.

3.5 Combining long-term and short-term supply

Actual production q_t may differ from $\bar{q}_t$ because of different input of labour, assumed to be caused by developments in the price of NR. For the derivation of such supply functions the above normal production function needs to be combined with labour input and profit maximization. The relationship between ℓ_t (labour input) and q_t may be specified as

$$\ell_t = \alpha\bar{q}_t \left[\frac{q_t}{\bar{q}_t}\right]^\beta, \qquad \beta > 1 \tag{3.12}$$

with $\bar{\ell}_t = \alpha\bar{q}_t$ is 'normal labour input', while $\beta > 1$ implies decreasing labour productivity. This may be rewritten as a Cobb-Douglas production function, with normal production $\bar{q}_t$ representing fixed inputs such as area,

$$q_t = \alpha^{-\frac{1}{\beta}} (\bar{q}_t)^{\frac{\beta-1}{\beta}} \cdot (\ell_t)^{\frac{1}{\beta}} \tag{3.13}$$

This is therefore in fact a short-term production function. Using p_t, w_t and C_t for the price of NR, the wage level and fixed production costs respectively, profit Π_t is defined as

$$\Pi_t = p_t q_t - w_t \ell_t - C_t. \tag{3.14}$$

Substituting ℓ_t from (3.12) and maximizing Π_t gives

$$q_t = \bar{q}_t \cdot (\alpha\beta w_t)^{\frac{1}{1-\beta}} \cdot (p_t)^{\frac{1}{\beta-1}} \tag{3.15}$$

showing a price elasticity less than unity and

$$\ell_t = \alpha\bar{q}_t \cdot (\alpha\beta w_t)^{\frac{\beta}{1-\beta}} \cdot (p_t)^{\frac{\beta}{\beta-1}} \tag{3.16}$$

with a price elasticity greater than unity.

In many cases, in particular on estates, labour input is not flexible in the short term owing to such factors as:
- workers under contract
- unavailability of skilled workers (e.g. tappers).

Further, good husbandry with respect to treatment of the trees may lead to the need to fix q_t as closely to $\bar{q}_t$ as possible. In such cases (3.12) may be replaced by

$$\ell_t = \bar{\ell}_t = \alpha q_t, \quad q_t = \bar{q}_t \tag{3.17}$$

Now variations in profit and loss are determined in the short term by variations in p_t only, while production is fixed.

Very important is the situation where a holding is run e.g. by a family. This holds among others for smallholdings. The number of workers is fixed and there is mostly no substantial alternative use for labour and source of income. A wage rate as a price actually paid for labour is an insignificant concept. Profit maximization therefore is not a useful approach and is better replaced by utility maximization where utility is a function of what can be bought for revenues from NR and how many hours per worker are needed as an input.

The model can be defined as

$$\max u_t = f\ (c_t, m_t) \tag{3.18}$$

$$\text{subject to } \ell_t = \alpha \bar{q}_t \left[\frac{q_t}{\bar{q}_t}\right]^{\beta} \tag{3.12}$$

$$p_t^c c_t = p_t q_t \tag{3.19}$$

$$m_t = \ell_t / \bar{\ell}_t \tag{3.20}$$

with c_t = consumption in constant prices, p_t^c = general price index, m_t = degree of utilization of labour.

The specification of the utility function is an essential element in deriving the supply function. The first part is some function of aggregate consumption in constant prices. An increase in production will positively affect consumption possibilities but will have a negative effect on utility originating from labour input per worker, m_t. The utility function might e.g. be specified as:

$$u_t = \gamma_1 \left(\frac{c_t}{c_{t-1}}\right)^{\gamma_2} - \delta_1 {m_t}^{\delta_2} \ . \tag{3.21}$$

The supply function can now be derived by substituting (3.12), (2,27) and (3.20) into (3.21) and making the first derivative with respect to q_t equal to zero.

This leads to

$$q_t = \alpha_0 \bar{q}_t \left[\frac{p_t^r \bar{q}_t}{p_{t-1}^r q_{t-1}} \right]^{\alpha_1} \qquad (3.22)$$

with

$$\alpha_0 = \left[\frac{\beta \delta_1 \delta_2}{\gamma_1 \gamma_2} \right]^{\frac{1}{\gamma_2 - \beta \delta_2}} \quad \text{and} \quad \alpha_1 = \frac{-\gamma_2}{\gamma_2 - \beta \delta_2} \qquad (3.23)$$

One could argue that a decision criterion based on the ratio of $p_t^r \bar{q}_t$ and $p_{t-1}^r q_{t-1}$ is a too refined approach for a natural rubber farmer. He might not be too interested in or aware of the above difference between $\bar{q}_t$ and q_{t-1}. In that case supply would be a function of p_t^r / p_{t-1}^r instead. This might be presented as

$$q_t = \alpha_0 \bar{q}_t \left[\frac{p_t^r}{p_{t-1}^r} \right]^{\alpha_1} \qquad (3.24)$$

Obviously, different choices of utility functions (3.21) would lead to different specifications of (3.22) or (3.24) e.g. with p_t^r or p_t or p_t/p_{t-1} as explanatory variable.

Example of a supply equation

A quarterly supply equation for Thailand's NR supply was estimated, based on 'normal' production levels. These normal production levels are derived on a yearly basis as in the above description, where only one type of farm was considered and were then converted into quarterly figures. Consequently, quarterly supply behaviour refers to tapping only and does not need to distinguish between utilization and change of production capacity. As dependent variable in the short-run supply equations, using equation (3.24) and moving normal production to the left, the ratio of actual and normal production was taken. A double log specification related this ratio to seasonal dummies and to the ratio of the Singapore price of NR, converted into local currency and adjusted for export duties and the consumer prices. The estimation period was 1976.1-1987.4.

$$lqqt_t = -0.891 + 0.163\ d_1 - 0.167\ d_2 + 0.171\ lprt_t \qquad (3.25)$$

These results imply that prices do influence production with an elasticity of 0.171. Note that this is a short-term elasticity. The effect of prices on the medium- to long-term levels of production should be analyzed through the effect of prices on new planting, replanting and uprooting. Afterwards the vintage model can be used to determine normal production, which is the denominator of qqtt of which the natural logarithm is taken in the left-hand side of (3.25).

3.6 The demand side

In economic models for consumption analysis, one usually assumes that a consumer can choose among different amounts of n divisible commodities. The consumer is assumed to order the different bundles according to his preferences. Further we assume that the preferences of the consumer can be represented by a utility function

$$U = U(q_1, q_2, \ldots, q_n) \qquad (3.26)$$

of the commodity bundles where q_i denotes the quantity of good i. The existence of a function U is based on the rational behaviour of the consumer. In the present context, the utility function is an ordinal measure and not a cardinal measure of utility. The marginal utility is positive:

$$\frac{\partial U}{\partial q_i} > 0 , \quad i=1,\ldots,n.$$

In the static model, we assume that a rational consumer maximizes utility U given the budget restriction $Z = \Sigma\ p_i q_i$, where Z is the income of the consumer and p_i is the price of the commodity i. The consumer cannot influence the price level and takes it as a given exogenous variable. The income Z is also assumed to be given. The model discussed in this section is at best a crude approximation for consumer behaviour in real life. For instance, savings are not included in the model. Inter-temporal aspects of decision making are ignored. Many of these aspects can be taken into account later when empirically modelling consumer behaviour.

Utility maximization given the budget restriction leads to an optimization problem. The solution gives the optimal quantities q_i as a function of prices p_i and income Z. The set of functions for the q_i's is called the system of demand equations

$$q_i = q_i(p_1, p_2, \ldots, p_n, Z), \quad i=1,\ldots,n, \tag{3.27}$$

A demand equation is a behavioural equation for a consumer who maximizes his utility subject to the budget restriction. It can be used to study the effect of variations in price or income on the choice of the consumer. The functions q_i very often express demand in terms of ratios of prices, so called relative prices.

Above only static demand equations have been presented, without paying attention to consumer decision making with an inter-temporal character. The case of durable goods poses quite a number of problems resulting from the very nature of durable goods. First, of course, utility resulting from a purchase in year t will be positive during many years after. Replacement of a durable may be decided upon in view of economic developments but may become close to compulsory once a durable breaks down. For this reason, demand should be split into new demand and replacement demand. Further, there is the discrete choice aspect: to buy one or to buy none. This is made more complex as in general, consumer durables are goods affected by strong waves of innovation. All these factors cause researchers to study a durable in detail by itself rather than including complete consumer demand systems.

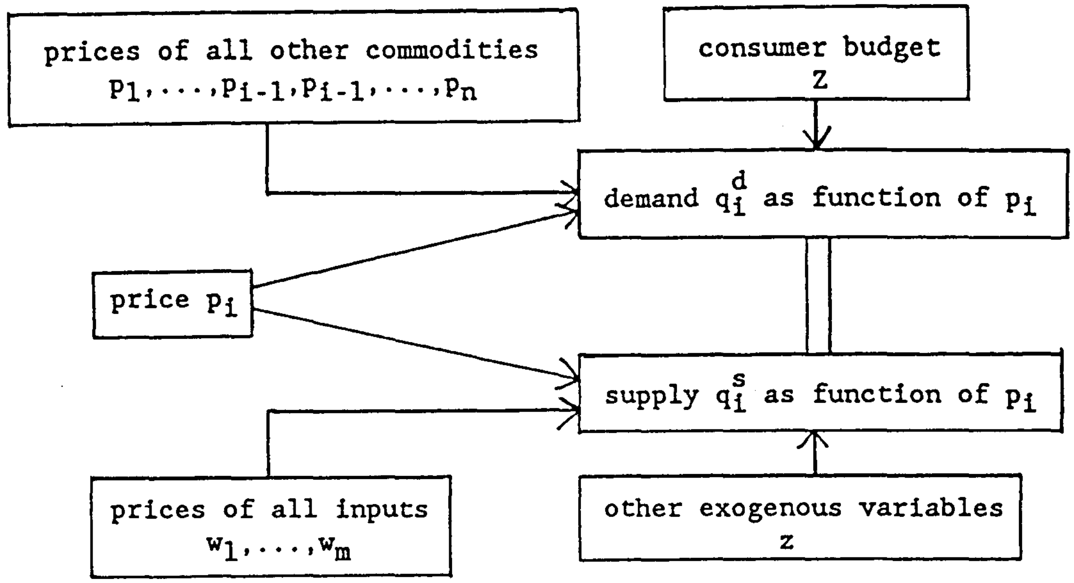
In the case of non-durable commodities, a number of serious problems arise as well, when one tries to apply classical consumer theory. The first problem is that in many cases the commodity is not used by consumers but by industry. It is therefore rather a matter of setting up an input-demand function as is discussed in section 3.8. Another problem is that for the few commodities going straight to the consumer, the share in total expenditure is so small that no utility maximization is required and a more simple approach could be applied. From classical consumer theory only broad specifications of demand equations can then be derived. In doing it is very important to distinguish between short-term and long-term developments. The commodities, which are the topic of the analysis in this paper are largely used in some kind of industrial, technical process, where some rigidity is built into the system: it is not attractive to change the technical parameters of a production process for cost and/or quality reasons. In the short-term, price developments may not have much influence for that reason. However, in the long-term changes may be much greater. For the same reason, a lost market may be very difficult to recapture.

3.7 Supply-demand interactions and prices

In this section equilibrium on markets in the form of a general model for market equilibrium is presented. This model is then extended and somewhat more applied in section 3.8: a theoretical model for an agricultural commodity market, where intermediate supply and demand is included as well. Some more of the problems encountered when implementing this theoretical model in empirical analysis are illustrated in section 4.1. In the theory of consumers and producers a common assumption is that prices are given. Each individual consumer or producer is not able to influence the market in such a way that prices are affected. The market for a homogeneous good, as presented below is assumed to have the following characteristics:

- there is full competition
- prices on other markets are exogenous.

Below the various elements of the market are put together schematically:



Below the above scheme is put in mathematical terms. The standard approach is that utility maximization by consumers given a budget constraint leads to a system of demand equations for the n goods.
For consumer $\ell = 1,2,\dots,\bar{\ell}$ there is a demand function:

$$q^*_{i\ell} = q^*_{i\ell}(p_1, p_2, \dots, z_\ell), \tag{3.28}$$

where $q^*_{i\ell}$ is the optimal quantity demanded for good i ; $p_1,\dots,p_n$ are prices of the n goods and z_ℓ = income of consumer ℓ.
Total demand for good i is:

$$q^d_i = \sum_{\ell=1}^{\bar{\ell}} q^*_{i\ell}(p_1, p_2, \dots, p_n, z_\ell). \tag{3.29}$$

From (3.29) follows that demand for each good is a function of prices $p_1,\dots,p_n$ and income of the consumers and therefore depends on the income distribution between consumers.

In the theory of short-term producer behaviour, it is assumed that the producer maximizes his profit for given input prices, output price and production function. This leads to a supply function for output (cf. section 3.2).

For producer $j = 1,2,\dots,J$ producing good i, the supply function is:

$$q^*_{ij} = q^*_{ij}(p_i, w_1, \dots, w_m) . \tag{3.30}$$

where q_{ij}^{*} is the optimal quantity of output supplied, p is the price of output and $w_1, w_2, \ldots, w_m$ are the prices of the m inputs.
The aggregated supply function of good i is

$$q_i^s = \sum_{j=1}^{J} q_{ij}^{*} (p_i, w_1, \ldots, w_m) \tag{3.31}$$

which is a function of p_i and the prices of the m inputs.

The assumption that the p_j's, $j = 1,2,\ldots,n$, the z_ℓ's, $\ell = 1,2,\ldots,\bar{\ell}$, and the w_k's, $k = 1,2,\ldots,m$ are given (exogenous), implies that the aggregated demand for good i

$$q_i^d = q_i^d (p_i) \tag{3.32}$$

and the aggregated supply of good i

$$q_i^s = q_i^s (p_i) \tag{3.33}$$

are functions of p_i. Supply is a monotonously increasing function of p_i. A market equilibrium price (short term) is defined as the price p_i^{*} for which demand equals supply of good i (market-clearing condition)

$$q_i^d (p_i^{*}) = q_i^s (p_i^{*}) \tag{3.34}$$

This p_i^{*} determines the market equilibrium quantity.

The derivation of aggregate demand and supply functions often causes aggregation problems. The analytical form of individual demand- and supply-functions can be derived in most cases from assumptions about utility- and profit-maximization. However, it will be very difficult in general to obtain a simple analytical form for the implied aggregated functions. For this reason approximations of market demand- and supply-functions are often used. When aggregating, it is implicitly assumed, that utility and production levels of consumers and producers respectively are mutually independent, so that one can abstract from external effects. In section 3.8 an extension of this model is presented first, before embarking on aspects like realism and policy formulation.

3.8 The role of intermediate production in a theoretical model for an agricultural commodity market in equilibrium

In this section as an extension of the previous section, a purely competitive commodity market is considered. For the individual participant at the market prices are given. Equilibrium between total demand and total supply determines the price level. First a schematic representation is given, which can be read separately from the mathematical representation which appears afterwards.

A. A broad and schematic description

Producers supply

The basis for supply by each individual producer is the production function, where production is related to variable inputs x^a, fixed inputs here represented by the variable x^f, the state of technology (t^a) and weather conditions (r). Given such production functions, producers are assumed to maximize profits. Profit (Π^a) is then defined using the price of the commodity concerned (p^a), prices for the variable inputs (w^a) and the cost of fixed inputs C^a. Maximization of Π^a implies solving a system of equations. Using a factor z^a for fixed inputs, the state of technology and weather,

$$x^{ad} = x^{ad} (p^a, w^a, z^a) \qquad (3.35)$$

and substitution of the x^{ad} in the production function gives the supply q^{as} of the commodity

$$q^{as} = q^{as} (p^a, w^a, z^a) \qquad (3.36)$$

Note that the costs of fixed input C^a will not influence supply.

Intermediate demand and supply

In general, consumers do not directly buy agricultural commodities from the producers. Some intermediate processing is necessary. Again assuming pure competition, a similar approach as for primary product producers can be used. The agricultural commodity appears in quantity as variable input q^a in the production function. Other variables are variable inputs other than q^a (x^m) and fixed inputs and the state of technology combined in z^m. Intermediate production q^m follows a production function. Profit (Π^m) is then derived and maximized. This gives the optimal levels of variable inputs q^{ad} and x^{md}

$$q^{ad} = q^{ad}(p^m, p^a, w^m, z^m) \quad (3.37)$$

$$x^{md} = x^{md}(p^m, p^a, w^m, z^m) \quad (3.38)$$

Substituting q^{ad} and x^{md} in the production function gives that level of production which is defined as supply q^{ms}. This will then lead to the following general formulation of the supply function of processed goods

$$q^{ms} = q^{ms}(p^m, p^a, w^m, z^m) \quad (3.39)$$

Note that C^m does not appear in the above equations as it cannot influence short-term decisions on variable inputs and supply.

Final demand

Demand for final use of the commodity produced by the intermediary producers depends on the utility function of each consumer ℓ and on his budget constraint with x^c represents other commodities, goods and services with a price p^c and Z is the budget of the consumers. Utility maximization under the budget constraint leads to demand q^{md} for the processed commodity

$$q^{md} = q^{md}(p^m, p^c, Z) \quad (3.40)$$

Equilibrium

For the unprocessed commodity and for the unprocessed intermediate commodity different prices have been used: p^a and p^m respectively. If equilibrium on each of the two markets is assumed, p^a and p^m are determined by

$$q^{as} = q^{ad} \quad (3.41a)$$

and

$$q^{ms} = q^{md} \quad (3.41b)$$

Note that because of equilibrium at two levels, basically each variable affects any other variable. Suppose e.g. that there is a recession in consuming countries, so consumer budgets Z are going down. This implies a shift of the demand curve, leading to a lower q^{md} and a lower p^{m} as well as a lower level of supply q^{ms}. This is then passed on to lower input demand q^{ad}, which finally results in a lower price p^{a} and lower supply q^{as}.

The degree to which such an approach is applicable varies from commodity to commodity. A basic question is whether an equilibrium approach for demand and supply is the most useful way to model a particular market. In many cases other influences may better be captured in an equation explicitly explaining developments in prices. In such a case stocks need to be included and may play the role of accepting all surpluses or shortages of the market. Such levels of stocks may in turn play a role in explaining prices. Examples will be shown in models to presented for various commodities. In section 3.8 a further discussion is presented of various aspects and assumptions of the model of this section. Below, the above is put in more formal mathematical terms and can be skipped if so preferred.

B. A detailed, mathematical description

Producers supply

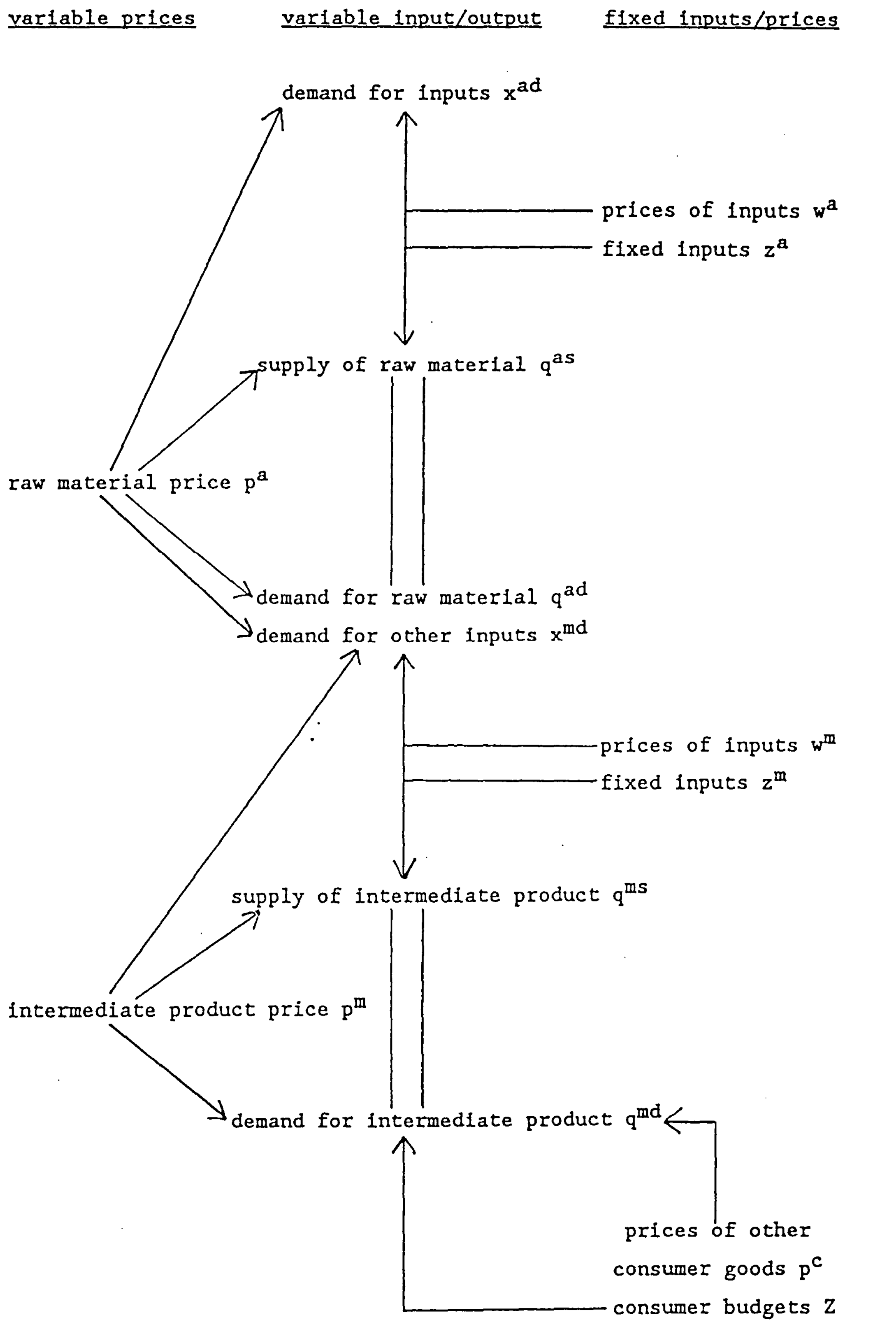
The basis for supply by each individual producer j is the production function, where production (q^{a}_{j}) is explained by n_j variable inputs (x^{a}_{ji} , $1=1,\ldots,n_j$), fixed inputs were represented by the variable x^{af}_{j}, the state of technology (t^{a}_{j}) and weather conditions (r_j):

$$q^{a}_{j} = q^{a}_{j}(x^{a}_{ji}, x^{af}_{j}, t^{a}_{j}, r_{j}) \qquad (3.42)$$

Given such production functions, producers are assumed to maximize profits. Profit (Π^{a}_{j}) is then defined using the price of the commodity concerned (p^{a}), prices for the variable inputs (w^{a}_{i}) and the cost of fixed inputs C^{a}_{j}

$$\Pi^{a}_{j} = p^{a}q^{a}_{j} - \sum_{i=1}^{n_j} w^{a}_{i}\, x^{a}_{ji} - C^{a}_{j} \qquad (3.43)$$

Note that inventory demand has been neglected. The full system can now be put into a scheme:



Note that prices are assumed to be the same for every producer j.

Maximization of Π^a_j implies

$$\frac{\partial \Pi^a_j}{\partial x^a_{ji}} = 0 \;,\; i=1,\ldots,n_j \tag{3.44}$$

Solving this system of equations using a factor z^a_j for all factors other than x^a_{ji} gives

$$x^{ad}_{ji} = x^{ad}_{ji}\,(p^a,\, w^a_i,\, z^a_j) \qquad i=1,\ldots,n_j \tag{3.45}$$

and substitution of the x^{ad}_{ji} in the production function gives the supply (q^{as}_j) of the commodity

$$q^{as}_j = q^{as}_j\,(p^a,\, w^a_i,\, z^a_j) \qquad i=1,\ldots,n_j \tag{3.46}$$

Note that the costs of fixed input C^a_j will not influence supply.

<u>Intermediate demand and supply</u>

In general, consumers do not directly buy agricultural commodities from the producers. Some intermediate processing is necessary. Again assuming pure competition, a similar approach as for primary product producers can be used. The agricultural commodity appears in quantity as variable input q^a_k in the production function. Other variables are other variable inputs (x^m_{ki}), and fixed inputs and the state of technology combined in z^m_k. Intermediate production q^m_k follows the production function

$$q^m_k = q^m_k(q^a_k,\, x^m_{ki},\, z^m_k) \tag{3.47}$$

Profit (Π^m_k) is then defined as

$$\Pi^m_k = p^m q^m_k - p^a q^a_k - \sum_{i=i}^{n_k} w^m_i\, x^m_{ki} - C^m_k \tag{3.48}$$

Maximization gives the optimal levels of variable inputs q^{ad}_k and x^{md}_{ki}

$$q^{ad}_k = q^{ad}_k(p^m,\, p^a,\, w^m_i,\, z^m_k) \qquad i=1,\ldots,n_k \tag{3.49}$$

$$x^{md} = x^{md}(p^m, p^a, w_i^m, z_k^m) \qquad i=1,\dots,n_k \qquad (3.50)$$

Substituting q_k^{ad} and x_{ki}^{md} in the production function gives that level of production which is defined as supply q_k^{ms}. This will then lead to the following general formulation of the supply function of processed goods

$$q_k^{ms} = q_k^{ms}(p^m, p^a, w_i^m, z_k^m) \qquad i=1,\dots,n_k \qquad (3.51)$$

Note that C_k^m does not appear in the above equations as it cannot influence short-term decisions on variable inputs and supply.

Final demand

Demand for final use of the commodity produced by the intermediary producers depends on the utility function of each consumer ℓ and on his budget constraint

$$\max u_\ell = u_\ell(q_\ell^m, x_\ell^c) \qquad (3.52)$$

$$\text{under } p^m q_\ell^m + p^c x_\ell^c = z_\ell \qquad (3.53)$$

with x_ℓ^c represents other commodities, goods and services with a price p^c and z_ℓ is the budget of this particular consumer ℓ. Maximization of the utility function under the budget constraint leads to demand q_ℓ^{md} for the processed commodity

$$q_\ell^{md} = q_\ell^{md}(p^m, p^c, z_\ell) \qquad (3.54)$$

Equilibrium

It was assumed that there are numerous participants on the markets concerned either functioning as

- a primary producer
- an intermediate consumer and producer
- a final consumer

with prices considered beyond influence by any of the participants.

For the unprocessed commodity and for the processed (intermediate) commodity different prices have been used: p^a and p^c respectively. If equilibrium on each of the two markets is assumed, p^a and p^m are determined by

$$\sum_j q^{as} = \sum_k q^{ad} \qquad (3.55)$$

and

$$\sum_{k} q^{ms} = \sum_{\ell} q^{md} \tag{3.56}$$

with j = individual primary producer

k = individual intermediate producer

ℓ = individual consumer.

Note that inventory demand has been neglected.

3.9 Modelling aspects for specific groups of commodities

In this section some special points of attention are mentioned when building or assessing a model for a specific commodity. The focus will thereby be on the supply side.

Models for annual crops

One of the main items is the short-term allocation of area and the decision process behind it. What are alternative crops and when are they sown and harvested? Which prices should be used for the analysis of this decision process? What is the influence of weather and other factors affecting the yield of the crop being analyzed and competing crops? Price expectations and other dynamic aspects are very important.

Models for perennial crops

As already indicated, the investment side and the short-term supply side need to be distinguished. Aspects of the long-term investment side have been discussed in section 3.4 while the short-term supply side has been treated briefly in both sections 3.2, 3.3 and 3.5. In general short-term supply elasticities will be relatively small as the investment has been made and the crop can be harvested generally with relatively little additional efforts.

Models for non-renewable exhaustible resources

For such commodities, it is important to estimate available resources and the cost at which they can be exploited. An approach along the lines of section 3.4 may be applied. Another item of importance is the pattern of exploration as this will influence supply as well as the price to be received for the commodity. Too high a price because of low supply will lead to market shares shrinking because of substitutes. Too low a price implies relative loss of income. In summary, there is an optimal pattern of exploration, conditional upon what other suppliers do and what long-term developments in demand will be. Aspects which may also be incorporated include risk aversion, cartels, international cooperation and multinational enterprises.

Models for renewable exhaustible resources

Commodities under this heading are in the field of forestry and fishery. The problems are obvious: exploitation at too high a level will lead to extinction. A detailed and partly multi-disciplinary analysis is called for. The approach may very much be long-term as in the case of forestry or short-term as in the case of fishery.

4. Commodity model estimation, simulation and forecasting

Before entering into estimation of parameters in equations some practical aspects of aggregation and selection of variables is discussed in section 4.1. It is beyond the scope of this document to write an elaborate story on regression analysis. Using examples from the model presented in chapter 2, the process of choosing a proper equation will be demonstrated in the following sections of this chapter. Simulation and forecasting can be found in detail in the paper describing the pepper economy and the pepper model.

4.1 Aggregation and representation: some practical aspects

In the section above a framework for a commodity model has been designed based on equilibrium in the market. Some modifications have been discussed and will be further elaborated upon below. However, it is useful to consider such a model as a starting point when specifying a model. This may e.g. prevent the model builder from trying to explain supply of raw jute from labour input. As can be seen in section 3.8 the two are both based on other factors. In this section the governing concept is the degree of aggregation.

Aggregation is a subject which is very important when setting up a model for a commodity market. The main types of aggregation where a choice has to be made are

(a) geographical
(b) type
(c) phase
(d) time
(d) markets
(e) rest of the economy

Each of these types of aggregation will be briefly discussed.

(a) The reasons for geographical aggregation are quite obvious. It is impossible in most cases to do any province or country separately. This may partly be caused by time constraints or data constraints. Important, however, is to decide at what level of geographical aggregation information is required for the kind of policy formulation to be decided upon. When considering export of a commodity by a country, it may be useful to analyze the important importing countries separately and to lump most of the others together in a few regions. When drawing up e.g. replanting programs for a perennial crop, regional disaggregation within that country may be needed if data permit. In general tailor-made models are called for. Otherwise too much work may generate too much information without sufficiently detailed emphasis on the topics asking for solutions.

(b) Aggregation by type of commodity is another choice to be made and, again, the questions to be answered should largely determine to what extent disaggregation is needed and aggregation is allowed. In some cases it may be necessary e.g. to distinguish the various types of natural rubber: Ribbed Smoked Sheets 1 up to 5 as well as latex and the various kinds of Technically Specified Rubbers. In other cases the whole may be aggregated to just Natural Rubber. The increase in the level of technology in many industries implies that grades of a commodity should be distinguished. Certain types are required by certain industries and cannot be substituted by other types including qualities from other countries. Unfortunately, in many cases, the availability of data does not permit such kind of disaggregation.

(c) Is it useful to distinguish various phases of a product separately? This again depends on the commodity and the kind of policies to be designed. For fibres like jute, the raw fibre may need to be treated differently from the processed material: yarn, hessian, sacking and other cloth. This is done in the study on jute presented separately. For pepper and natural rubber on the other hand, there is not much variation possible in the way the material is shipped to the final processing industry.

(d) Aggregation over time is another choice to be made: Do we use annual figures, quarterly figures or monthly figures. A first aspect is the time scope of the analysis. The natural rubber model by Burger and Smit, to be presented separately, is an interesting case in point: for long-term aspects like planting and production trends, annual figures are used and the analysis is taken up to the year 2020, because decisions on planting made nowadays influence production trends for the coming thirty years. For the analysis of prices, stocks, actual production and consumption, a quarterly analysis is applied. Using a monthly analysis perhaps would have been better, but would have required much more time and energy, while data are not readily available and are of lower quality in may cases. In general, in many cases data are checked for consistency e.g. on a yearly basis and adapted afterwards. The original monthly data may contain substantial inaccuracies. Another factor to be considered is that in many cases reactions take time. On a yearly basis e.g. rubber tappers act contemporaneously to changes in prices, while on a monthly basis, there may be a lag. Rigidities may lead away from equilibrium when a short period of time is used. Besides, on a yearly basis there may be no reaction noticeable, because all fluctuations have been netted out.

(e) Another problem of aggregation, or rather representation, is e.g. the choice of the representative price: which market, which currency, which type of the commodity, which deflator. Here again the choice will partly be determined by the availability of data and partly by the direction of the problem to be analyzed and solved.

(f) Finally there is the aspect of aggregation of the rest of the economy. Which competing crops e.g. have to be included? Is rice the only relevant alternative crop for a jute farmer in Bangladesh? And do we have to model the whole car, truck and tire market when trying to forecast natural rubber demand? All such questions have to be answered when starting to specify a model.

What are general guidelines for an optimal approach? Basically this is a matter of cost-benefit analysis. One has the following partly conflicting aspects:

- rather small and simple model is easier to build, understand and use;
- a more elaborate model will be needed in general to assess the effects of policy measures as policy instruments and/or policy objectives normally refer to rather detailed aspects of a commodity economy.

The level of aggregation of policy instruments and objectives is a good starting point in determining the optimal level of aggregation of the model. It is important then to consider the following aspects in the decision making process:

- model aggregation error
- data disaggregation error
- availability of data
- availability of model specialist
- availability of computing facilities
- availability of analytical commodity specialist
- availability of an existing model to be modified.

In each individual case a choice has to be made. A proper way of understanding how to make such a choice is going through a few hypothetical practical examples:

(i) proposed extension of natural rubber area to improve farmer income and environment;

(ii) proposed increase in export tax on Malaysian palm oil to increase government revenues;

(iii) stimulating former sugar cane farmers in the Philippines to cultivate shrimps;

(iv) proposed international buffer stock for pepper to stabilize earnings of the farmers;

(v) optimal stocking, production and export policies for tin in the post-crisis period and the policies of ATPC;

(vi) an optimal exploration pattern of iron ore in India

4.2 Estimating parameters in models: the method of ordinary least squares

In chapter 2 a model was developed for a hypothetical commodity economy. In that chapter, parameters in equations were given. Data for the exogenous variables were given as well. On that basis, the data for the endogenous variables a_t, s_t, d_t, z_t and p_t could be calculated. However, reality is different:

- parameters are not known,
- for all variables data are or should be available,
- the specification is not known exactly and
- the model will not fit perfectly, because
- some influences are not known
- the structure of the economy may vary over time
- the data are not sufficiently accurate

How to approach this? This is discussed below in very broad terms.

The first step is to derive a specification of the model based on theory, e.g. based on the theoretical considerations in chapter 3. This may e.g. lead to the conclusion that for the explanation of supply s_t the variables mentioned in section 2.2 are relevant: area, prices, a time trend and rainfall. As a first investigation draw graphs of the major variables to find out what trends and patterns are present, as was done in some graphs in section 2.2. Then draw some scatter diagrams to find out what relationships are strong, as was done in Figures 2.7 and further. In many cases a linear relationship would be acceptable.

Now it is time to estimate parameters. First the relationship must be specified e.g. equation (2.1a). The parameters are then estimated using the method of <u>least squares</u>. This method is based on the assumption that the best model, the best line through the scatter diagram of Figure 2.7 can be obtained by making the vertical distances between the points and the line as small as possible. This is illustrated in Figure 4.1, which is equal to Figure 2.7, but now a line is included, possibly representing the equation we are looking for. The distances between the line and the points are called the errors. In order to eliminate negative distances (for the points below the line) the distances are squared and all squared distances, the squared errors, are added: for that reason the method is called <u>least squares</u>. One can imagine that there is a line which is closest to all points, all observations in the above sense.

In general, start with a small number of variables to explain the dependent variable and use a regression method to estimate the parameters. In this chapter use is made of the software package TSP. Such a package requires data for all variables to be used as input. In our case all variables from chapter 2 are included. As a first example, the parameter in equation (2.1a) is estimated. How to use TSP is presented in a separate manual. Below we present the output of TSP indicated as Output 4.1. Such output contains more information than is used at this stage of modelling. Here we concentrate on the most important elements. Output 4.1 says that there are 30 observations, the sample SMPL runs from 1961 to 1990, which corresponds to the years 1 to

30 used in chapter 2.

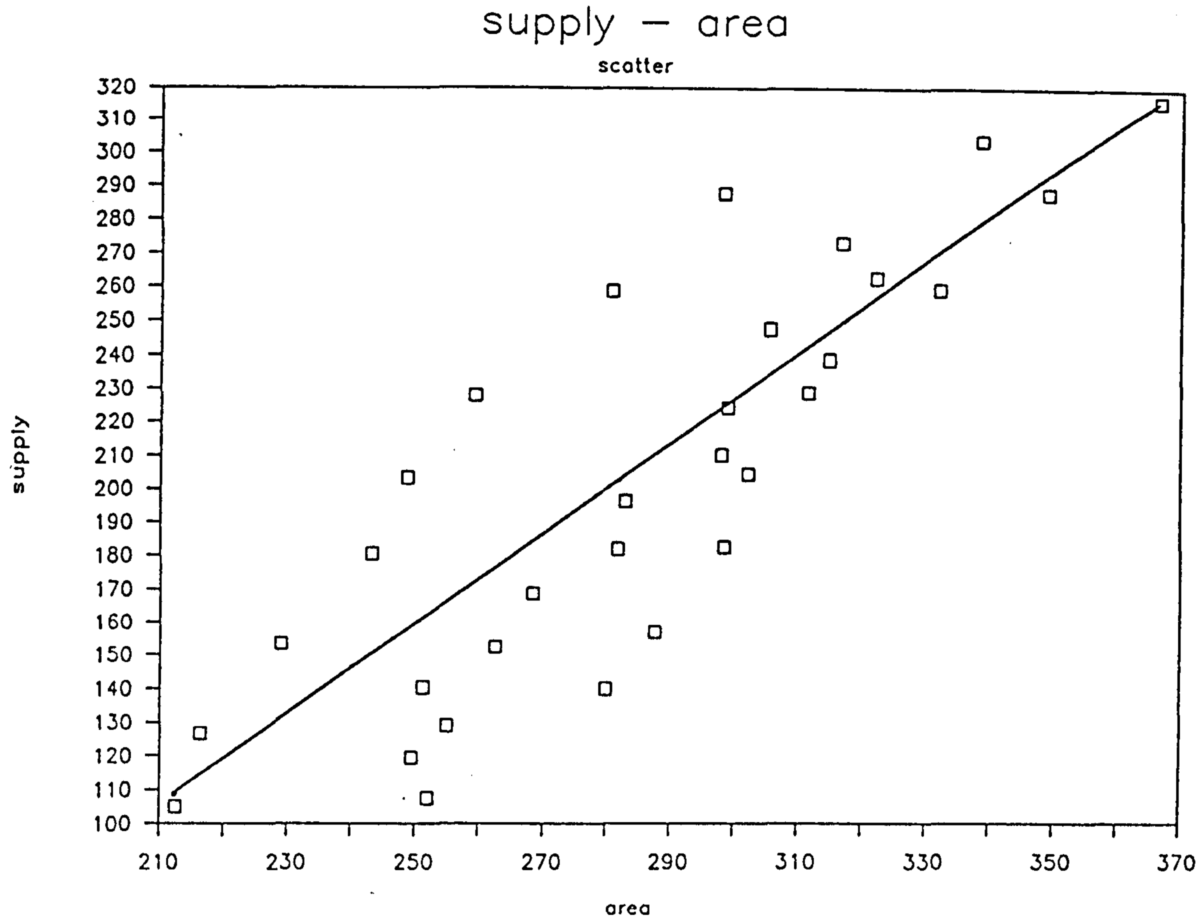


Figure 4.1

Then the output says that the dependent variable is s, leaving out the subscript t. In the model we used lower case letters, while in the computer output capitals are used. Below this a block follows with information on the coefficients of the explanatory variables. In this case only one variable is specified: a. Behind this variable follows the estimated coefficient 0.7301, rounding it a bit. This estimated coefficient is not quite equal to what has been used in the model, where 0.5 was applied. The reason is that for the data used ultimately, which were based on equation (2.4), more influences were included, which are as yet left out here. For this reason there is a bias, a level of uncertainty in the coefficient. For that reason an important figure in this block is the standard error, representing a measure for the uncertainty in the coefficient. This figure should be low, compared to the coefficient itself. A helpful figure in this respect is the next one, the t-statistic, which is the ratio of the coefficient and the standard error, thereby eliminating the problem of the size of the coefficient and the standard error. The t-statistic should be as big as possible, with a minimum of around 1 and preferably above 2. If a coefficient is negative, the t-statistic also has a negative sign and should then be less than -1 and preferably less than -2: the lower the better for a negative coefficient. The t-statistic of 28.89 is extremely big, implying a very significant influence of a_t on s_t.

How good is the fit of this equation? In the big block at the bottom of Output 4.1 the resulting FITTED figures, the levels of s_t for each a_t on the line, are shown in the last column. They are derived by substituting the values for a_t in the equation with the above estimated coefficient of 0.7301. Before that are mentioned the ACTUAL data for s_t. The differences are the errors, the vertical distances in Figure 4.1 between the points and the line. The column RESIDUALS shows these differences. It is clear that in the beginning there are many negative figures and in the second part there are many positive residuals. This indicates that the equation is not good: the line does not run nicely through the scatter diagram. Ideally the residuals should be randomly spread; no pattern should be present in the figures and in the graph in the left-side part of this block. Apart from visual inspection, a statistic is available, the Durbin-Watson statistic (DW), which should be as close as possible to 2. In this very bad case DW = 0.21.

The final figure to be discussed here is R^2, presented in the same block as DW. The higher R^2, the better. There is a maximum of 1 and a minimum of 0. Here $R^2 = 0.574$.

Output 4.1

LS // Dependent Variable is S
Date: 8-15-1991 / Time: 11:50
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
A	0.7300636	0.0252680	28.892830	0.000

R-squared	0.574069	Mean of dependent var	204.5134
Adjusted R-squared	0.574069	S.D. of dependent var	60.84649
S.E. of regression	39.71049	Sum of squared resid	45730.76
Durbin-Watson stat	0.213014	Log likelihood	-152.5081

```
            Residual Plot                 obs  RESIDUAL   ACTUAL    FITTED
=================================================================================
|       * :       |       :         | 1961 -50.1962   104.942   155.139
|     *   :       |       :         | 1962 -62.5842   119.553   182.137
|  *      :       |       :         | 1963 -76.5784   107.438   184.016
|       * :       |       :         | 1964 -53.0323   156.958   209.990
|         : *     |       :         | 1965 -31.0974   126.796   157.893
|         *       |       :         | 1966 -43.0678   140.412   183.480
|      *  :       |       :         | 1967 -57.0464   129.151   186.198
|         :*      |       :         | 1968 -35.2542   182.565   217.820
|         :    *  |       :         | 1969 -13.6246   153.516   167.140
|         :  *    |       :         | 1970 -27.0738   168.817   195.891
|         *       |       :         | 1971 -39.0804   152.576   191.656
|         :    *  |       :         | 1972 -15.9898   204.547   220.537
|         :       |*      :         | 1973   3.18918  180.756   177.566
|         :     * |       :         | 1974 -10.1584   196.409   206.567
|         :  *    |       :         | 1975 -23.7312   182.040   205.771
|         :       *       :         | 1976   1.45524  228.810   227.354
|         :       |   *   :         | 1977  21.9543   203.549   181.595
|         :       |*      :         | 1978   6.21595  224.360   218.144
|         :      *|       :         | 1979  -7.21900  210.286   217.505
|         :       |  *    :         | 1980  16.4420   258.861   242.419
|         :       |       *         | 1981  39.0702   228.345   189.275
|         :       |    *  :         | 1982  24.6838   247.635   222.951
|         :       | *     :         | 1983   8.88606  238.673   229.786
|         :       |     * :         | 1984  32.7107   287.501   254.790
|         :       |       :  *      | 1985  53.8365   258.753   204.916
|         :       |       *         | 1986  41.6003   272.754   231.153
|         :       |    *  :         | 1987  27.1734   262.240   235.067
|         :       |       : *       | 1988  48.6524   316.153   267.500
|         :       |       :     *   | 1989  69.9574   287.633   217.675
|         :       |       :  *      | 1990  56.2328   303.378   247.146
=================================================================================
```

For the purpose of showing some of the problems and possibilities in choosing the optimal equation in some part of a commodity model, some examples are presented in the following sections. They are based on the hypothetical model developed in chapter 2.

To summarize the estimation procedure: important is in the following order for evaluating the quality of regression results:

a. the sign and size of each coefficient;
b. the level of significance represented by the t-value; this figure can be found in the output and is put in brackets under each coefficient when the full equation is presented as in (2.4) with estimated coefficients in stead of the Greek letters; the figure should be around 2 and preferably higher: the higher the t-value, the more significant is the influence of the variable;
c. the Durbin-Watson statistic, indicating whether systematic patterns are left in the residuals, which should have been included in the model; the DW statistic should be around 2, while 1.5 in general is too low and 2.5 in general is too high;
d. the R^2, indicating the quality of the fit, the degree of explanation; R^2 is always less than unity; the higher R^2, the better is the fit.

4.3 Estimating parameters in the supply equation: some practical problems

In this section a number of regression analyses is presented, ultimately leading to equation (2.4). One of the basic problems in Output 4.1 is the extremely low DW. One reason for this is the absence of a constant term in the estimated equation: the estimated line is forced through the origin, because if $a_t = 0$ then $s_t = 0$. This of course appears obvious, but since so many variables were left out, it is better to include a constant term. This is done in Output 4.2. The coefficient of a_t now jumps to 1.3467, which shows that there is more to be included, but the DW is much better and, related to that, the residuals are somewhat scattered, although there is still some trend.

Output 4.2

LS // Dependent Variable is S
Date: 8-15-1991 / Time: 11:50
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-178.49631	44.432664	-4.0172319	0.000
A	1.3466913	0.1548561	8.6964038	0.000

R-squared	0.729801	Mean of dependent var	204.5134
Adjusted R-squared	0.720151	S.D. of dependent var	60.84649
S.E. of regression	32.18823	Sum of squared resid	29010.31
Durbin-Watson stat	1.426127	F-statistic	75.62744
Log likelihood	-145.6813		

```
             Residual Plot              obs  RESIDUAL   ACTUAL   FITTED
|          :     *|      :         | 1961 -2.73329  104.942  107.676
|        * :      |      :         | 1962 -37.9247  119.553  157.477
|     *    :      |      :         | 1963 -53.5062  107.438  160.944
|     *    :      |      :         | 1964 -51.8980  156.958  208.856
|          :      |  *   :         | 1965  14.0388  126.796  112.757
|          : *    |      :         | 1966 -19.5423  140.412  159.954
|         *:      |      :         | 1967 -35.8168  129.151  164.968
|        * :      |      :         | 1968 -40.7332  182.565  223.299
|          :      |     *:         | 1969  23.7013  153.516  129.815
|          :   *  |      :         | 1970 -14.0312  168.817  182.848
|          : *    |      :         | 1971 -22.4611  152.576  175.037
|          :*     |      :         | 1972 -23.7638  204.547  228.311
|          :      |      *         | 1973  31.7090  180.756  149.047
|          :     *|      :         | 1974 -6.13344  196.409  202.543
|          :  *   |      :         | 1975 -19.0337  182.040  201.074
|          :   *  |      :         | 1976 -12.0770  228.810  240.887
|          :      |      :   *     | 1977  47.0717  203.549  156.477
|          :      *      :         | 1978  0.46322  224.360  223.897
|          :   *  |      :         | 1979 -12.4319  210.286  222.718
|          :    * |      :         | 1980 -9.81389  258.861  268.675
|          :      |      :     *   | 1981  57.7011  228.345  170.644
|          :      |  *   :         | 1982  14.8708  247.635  232.764
|          :    * |      :         | 1983 -6.70034  238.673  245.373
|          :     *|      :         | 1984 -3.99460  287.501  291.496
|          :      |      :      *  | 1985  59.2559  258.753  199.497
|          :      |     *:         | 1986  24.8593  272.754  247.894
|          :      | *    :         | 1987  7.12731  262.240  255.113
|          :      *      :         | 1988  1.21222  316.153  314.940
|          :      |      :       * | 1989  64.6004  287.633  223.032
|          :      |     *:         | 1990  25.9845  303.378  277.394
```

If only p_t is used as explanatory variable, the regression results are very bad: Output 4.3. The coefficient of p_t has the wrong sign, it is not significant (t-stat = -2.20), the residuals show a very strong pattern (DW = 0.08) and little is explained (R^2 = 0.15).

Similar things happen to some extent when only rso_t is included (Output 4.4). The sign of rso_t is correct and the t-stat is not too bad, but the residuals, the DW and the R^2 are very poor.

Rather good results can be found in Output 4.5, where t is used as explanatory variable. All information appears to be very good: signs, t-statistics and R^2, except DW, which is too high. However, when looking at the residuals, patterns of 4 years can be recognized. Addding a_t in output in Output 4.6 improves the statistics, but does not eliminate the above problem. So there is still a pattern in the residuals, indicating that more variables need to be included. Since we know in this artificial example what the real model is, we know that this conclusion is correct. Such a situation will change later on (section 4.4).

Adding p_t in Output 4.7, however, helps a lot and including rso_t instead (Output 4.8) gives good results, because that variable was introduced with a four-period cycle. Now the DW drops to somewhat low levels. Excellent results of course are obtained when including all variables as in the original equation (Output 4.9), because that is the way s_t was calculated. Note that the estimated coefficients come out as they were included in equation (2.4) for the calculation of s_t.

<u>Output 4.3</u>

```
LS // Dependent Variable is S
Date: 8-15-1991 / Time: 11:52
SMPL range: 1961  -  1990
Number of observations: 30
```

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	343.02442	63.710835	5.3840829	0.000
P	-102.71050	46.605511	-2.2038273	0.036

R-squared	0.147819	Mean of dependent var	204.5134
Adjusted R-squared	0.117384	S.D. of dependent var	60.84649
S.E. of regression	57.16386	Sum of squared resid	91495.79
Durbin-Watson stat	0.076522	F-statistic	4.856855
Log likelihood	-162.9109		

```
           Residual Plot               obs RESIDUAL  ACTUAL   FITTED
|  *     :        |        :       | 1961 -100.608  104.942  205.550
|     *  :        |        :       | 1962 -83.5349  119.553  203.087
|        *        |        :       | 1963 -62.8212  107.438  170.259
|     *  :        |        :       | 1964 -80.4522  156.958  237.410
|     *  :        |        :       | 1965 -79.4354  126.796  206.231
|       *:        |        :       | 1966 -63.9176  140.412  204.329
|        :   *    |        :       | 1967 -36.6011  129.151  165.752
|        : *      |        :       | 1968 -49.8005  182.565  232.366
|        : *      |        :       | 1969 -44.7682  153.516  198.284
|        :  *     |        :       | 1970 -37.4600  168.817  206.277
|        :     *  |        :       | 1971 -19.6226  152.576  172.198
|        :    *   |        :       | 1972 -25.3395  204.547  229.887
|        :      * |        :       | 1973 -15.4879  180.756  196.244
|        :       *|        :       | 1974 -4.11757  196.409  200.527
|        :        |*       :       | 1975  5.67385  182.040  176.366
|        :       *|        :       | 1976 -9.42851  228.810  238.238
|        :        |*       :       | 1977  8.01458  203.549  195.534
|        :        |   *    :       | 1978  24.2920  224.360  200.068
|        :        |     *  :       | 1979  38.2298  210.286  172.056
|        :        | *      :       | 1980  15.1556  258.861  243.705
|        :        |  *     :       | 1981  23.2812  228.345  205.064
|        :        |      * :       | 1982  47.2112  247.635  200.423
|        :        |        :*      | 1983  66.1117  238.673  172.561
|        :        |      * :       | 1984  47.2340  287.501  240.267
|        :        |      * :       | 1985  47.4332  258.753  211.320
|        :        |        *       | 1986  62.0868  272.754  210.667
|        :        |        :   *   | 1987  88.6771  262.240  173.563
|        :        |        : *     | 1988  74.7956  316.153  241.357
|        :        |        :  *    | 1989  79.2218  287.633  208.411
|        :        |        :   *   | 1990  85.9765  303.378  217.402
```

Output 4.4

LS // Dependent Variable is S
Date: 8-15-1991 / Time: 11:52
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	216.58370	15.786349	13.719682	0.000
RSO	-1.0114738	0.9422937	-1.0734166	0.292

R-squared	0.039524	Mean of dependent var	204.5134
Adjusted R-squared	0.005222	S.D. of dependent var	60.84649
S.E. of regression	60.68742	Sum of squared resid	103123.0
Durbin-Watson stat	0.131895	F-statistic	1.152223
Log likelihood	-164.7054		

```
           Residual Plot               obs  RESIDUAL   ACTUAL   FITTED
|  *      :       |       :       | 1961 -108.607  104.942  213.549
|     *   :       |       :       | 1962 -84.8934  119.553  204.446
|      *  :       |       :       | 1963 -76.7787  107.438  184.217
|         *       |       :       | 1964 -57.6032  156.958  214.561
|     *   :       |       :       | 1965 -86.7535  126.796  213.549
|        *:       |       :       | 1966 -64.0343  140.412  204.446
|         *       |       :       | 1967 -55.0653  129.151  184.217
|         :   *   |       :       | 1968 -31.9953  182.565  214.561
|         *       |       :       | 1969 -60.0335  153.516  213.549
|         :  *    |       :       | 1970 -35.6289  168.817  204.446
|         :   *   |       :       | 1971 -31.6407  152.576  184.217
|         :      *|       :       | 1972 -10.0136  204.547  214.561
|         :  *    |       :       | 1973 -32.7936  180.756  213.549
|         :      *|       :       | 1974 -8.03692  196.409  204.446
|         :       *       :       | 1975 -2.17670  182.040  184.217
|         :       | *     :       | 1976  14.2490  228.810  214.561
|         :      *|       :       | 1977 -10.0002  203.549  213.549
|         :       |  *    :       | 1978  19.9137  224.360  204.446
|         :       |   *   :       | 1979  26.0691  210.286  184.217
|         :       |     * :       | 1980  44.2999  258.861  214.561
|         :       | *     :       | 1981  14.7956  228.345  213.549
|         :       |     * :       | 1982  43.1887  247.635  204.446
|         :       |       *       | 1983  54.4560  238.673  184.217
|         :       |       : *     | 1984  72.9403  287.501  214.561
|         :       |     * :       | 1985  45.2037  258.753  213.549
|         :       |       :*      | 1986  68.3077  272.754  204.446
|         :       |       :  *    | 1987  78.0234  262.240  184.217
|         :       |       :     * | 1988  101.592  316.153  214.561
|         :       |       : *     | 1989  74.0835  287.633  213.549
|         :       |       :     * | 1990  98.9324  303.378  204.446
```

Output 4.5

LS // Dependent Variable is S
Date: 8-15-1991 / Time: 11:53
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	101.26991	6.1902222	16.359656	0.000
T	6.6608734	0.3486873	19.102714	0.000

R-squared	0.928738	Mean of dependent var	204.5134
Adjusted R-squared	0.926192	S.D. of dependent var	60.84649
S.E. of regression	16.53050	Sum of squared resid	7651.207
Durbin-Watson stat	3.303516	F-statistic	364.9137
Log likelihood	-125.6895		

```
             Residual Plot                 obs  RESIDUAL   ACTUAL    FITTED
|        :      * |        :       |  1961  -2.98847   104.942   107.931
|        :        |  *     :       |  1962   4.96094   119.553   114.592
|        : *      |        :       |  1963  -13.8147   107.438   121.253
|        :        |        :     * |  1964   29.0441   156.958   127.913
|        :    *   |        :       |  1965  -7.77851   126.796   134.574
|        :        *        :       |  1966  -0.82343   140.412   141.235
|       *:        |        :       |  1967  -18.7448   129.151   147.896
|        :        |        :    *  |  1968   28.0086   182.565   154.557
|        :    *   |        :       |  1969  -7.70197   153.516   161.218
|        :        *        :       |  1970   0.93842   168.817   167.879
|      * :        |        :       |  1971  -21.9637   152.576   174.540
|        :        |        :  *    |  1972   23.3467   204.547   181.200
|        :    *   |        :       |  1973  -7.10561   180.756   187.861
|        :        |*       :       |  1974   1.88696   196.409   194.522
|       *:        |        :       |  1975  -19.1432   182.040   201.183
|        :        |        : *     |  1976   20.9659   228.810   207.844
|        :  *     |        :       |  1977  -10.9557   203.549   214.505
|        :        | *      :       |  1978   3.19412   224.360   221.166
|        *        |        :       |  1979  -17.5408   210.286   227.826
|        :        |        :   *   |  1980   24.3733   258.861   234.487
|        : *      |        :       |  1981  -12.8034   228.345   241.148
|        :        *        :       |  1982  -0.17440   247.635   247.809
|        :*       |        :       |  1983  -15.7974   238.673   254.470
|        :        |        :    *  |  1984   26.3702   287.501   261.131
|        :   *    |        :       |  1985  -9.03881   258.753   267.792
|        :       *|        :       |  1986  -1.69892   272.754   274.453
|       *:        |        :       |  1987  -18.8735   262.240   281.113
|        :        |        :     * |  1988   28.3782   316.153   287.774
|        :    *   |        :       |  1989  -6.80245   287.633   294.435
|        :        |*       :       |  1990   2.28234   303.378   301.096
```

Output 4.6

LS // Dependent Variable is S
Date: 8-15-1991 / Time: 11:53
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-8.3780000	19.867313	-0.4216977	0.677
A	0.4699905	0.0831713	5.6508726	0.000
T	5.1111215	0.3646637	14.015987	0.000

R-squared	0.967351	Mean of dependent var	204.5134
Adjusted R-squared	0.964932	S.D. of dependent var	60.84649
S.E. of regression	11.39431	Sum of squared resid	3505.418
Durbin-Watson stat	2.378383	F-statistic	399.9881
Log likelihood	-113.9812		

```
              Residual Plot              obs  RESIDUAL   ACTUAL    FITTED
|         :         |      *  :     | 1961   8.33619  104.942   96.6061
|         :         *         :     | 1962   0.45474  119.553   119.098
|   *     :         |         :     | 1963 -17.9810   107.438   125.419
|         :         |        *:     | 1964   9.70659  156.958   147.251
|         :         |     *   :     | 1965   7.97180  126.796   118.824
|         :         *         :     | 1966   0.00500  140.412   140.407
|  *      :         |         :     | 1967 -18.1165   129.151   147.268
|         :         |        *:     | 1968   9.82947  182.565   172.736
|         :         |      *  :     | 1969   8.29431  153.516   145.221
|         :         *         :     | 1970  -0.02413  168.817   168.841
|  *      :         |         :     | 1971 -18.6504   152.576   171.226
|         :         |        *:     | 1972   9.61737  204.547   194.930
|         :         |      *  :     | 1973   8.37771  180.756   172.378
|         :         *         :     | 1974   0.25017  196.409   196.159
|  *      :         |         :     | 1975 -18.7175   182.040   200.757
|         :         |      *  :     | 1976   9.04657  228.810   219.763
|         :         |      *  :     | 1977   8.13332  203.549   195.416
|         :         *         :     | 1978   0.30387  224.360   224.056
|  *      :         |         :     | 1979 -18.4699   210.286   228.756
|         :         |      *  :     | 1980   8.95519  258.861   249.906
|         :         |     *   :     | 1981   7.54064  228.345   220.804
|         :         *         :     | 1982   0.03967  247.635   247.595
|  *      :         |         :     | 1983 -18.4341   238.673   257.107
|         :         |      *  :     | 1984   9.18660  287.501   278.314
|         :         |     *   :     | 1985   7.43456  258.753   251.318
|         :         *         :     | 1986  -0.56631  272.754   273.320
|  *      :         |         :     | 1987 -18.7103   262.240   280.950
|         :         |      *  :     | 1988   9.21150  316.153   306.941
|         :         |     *   :     | 1989   7.65615  287.633   279.977
|         :        *|         :     | 1990  -0.68129  303.378   304.060
```

Output 4.7

LS // Dependent Variable is S
Date: 8-15-1991 / Time: 11:54
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	122.31924	7.7882734	15.705565	0.000
A	0.2366522	0.0227143	10.418655	0.000
P	-54.238510	2.5634945	-21.158036	0.000
T	5.6794939	0.0911143	62.333723	0.000

R-squared	0.998208	Mean of dependent var	204.5134
Adjusted R-squared	0.998001	S.D. of dependent var	60.84649
S.E. of regression	2.720417	Sum of squared resid	192.4173
Durbin-Watson stat	1.496337	F-statistic	4827.229
Log likelihood	-70.44519		

```
              Residual Plot             obs  RESIDUAL   ACTUAL   FITTED
|        :      * |        :       | 1961 -0.74886  104.942  105.691
|        :        | *      :       | 1962  0.73095  119.553  118.822
|        :       *|        :       | 1963 -0.33673  107.438  107.775
|        :       *|        :       | 1964 -0.37635  156.958  157.334
|        *        |        :       | 1965 -2.86583  126.796  129.662
|        : *      |        :       | 1966 -2.21894  140.412  142.631
|        :        |*       :       | 1967  0.33143  129.151  128.820
|        :        |        *       | 1968  2.63900  182.565  179.926
|        :        |       *:       | 1969  2.33542  153.516  151.180
|        :   *    |        :       | 1970 -1.58329  168.817  170.400
|   *    :        |        :       | 1971 -4.13537  152.576  156.711
|        :        |       *:       | 1972  2.33116  204.547  202.216
|        :        |        :     * | 1973  4.55513  180.756  176.201
|        :        |        *       | 1974  2.86654  196.409  193.543
|   *    :        |        :       | 1975 -4.16549  182.040  186.205
|        *        |        :       | 1976 -2.74440  228.810  231.554
|        :        |        :  *    | 1977  3.69921  203.549  199.850
|        :        |        :     * | 1978  4.58903  224.360  219.771
|        :       *|        :       | 1979 -0.16504  210.286  210.451
|       *:        |        :       | 1980 -3.18143  258.861  262.042
|        :  *     |        :       | 1981 -1.74448  228.345  230.089
|        :        |        : *     | 1982  3.39994  247.635  244.235
|        :        |   *    :       | 1983  1.25597  238.673  237.417
|        :        | *      :       | 1984  0.54619  287.501  286.955
|        :*       |        :       | 1985 -2.42840  258.753  261.181
|        : *      |        :       | 1986 -2.26717  272.754  275.021
|        :        *        :       | 1987 -0.13527  262.240  262.375
|        :        |     *  :       | 1988  1.78427  316.153  314.368
|        :        |   *    :       | 1989  1.13370  287.633  286.499
|       *:        |        :       | 1990 -3.10088  303.378  306.479
```

Output 4.8

LS // Dependent Variable is S
Date: 8-15-1991 / Time: 11:54
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	1.2092049	0.3926376	3.0796972	0.005
A	0.4778056	0.0016369	291.89006	0.000
T	5.0571224	0.0071789	704.44536	0.000
RSO	-0.9195143	0.0034829	-264.00589	0.000

R-squared	0.999988	Mean of dependent var	204.5134
Adjusted R-squared	0.999986	S.D. of dependent var	60.84649
S.E. of regression	0.224220	Sum of squared resid	1.307146
Durbin-Watson stat	1.422079	F-statistic	711855.6
Log likelihood	4.432117		

```
            Residual Plot               obs RESIDUAL  ACTUAL   FITTED

|        :    *   |        :        | 1961 -0.09916  104.942  105.041
|        :        | *      :        | 1962  0.06001  119.553  119.493
|        :        | *      :        | 1963  0.04842  107.438  107.389
|        :     *  |        :        | 1964 -0.07344  156.958  157.031
|      * :        |        :        | 1965 -0.27705  126.796  127.073
|        : *      |        :        | 1966 -0.18811  140.412  140.600
|        :        |   *    :        | 1967  0.10563  129.151  129.046
|        :        |      * :        | 1968  0.18162  182.565  182.384
|        :        |     *  :        | 1969  0.16247  153.516  153.353
|        :   *    |        :        | 1970 -0.13410  168.817  168.951
|       *:        |        :        | 1971 -0.27072  152.576  152.847
|        :        |     *  :        | 1972  0.15643  204.547  204.391
|        :        |        :    *   | 1973  0.35026  180.756  180.405
|        :        |        *        | 1974  0.24191  196.409  196.167
|      * :        |        :        | 1975 -0.27298  182.040  182.313
|       *:        |        :        | 1976 -0.27135  228.810  229.081
|        :        |        : *      | 1977  0.27875  203.549  203.270
|        :        |        :     *  | 1978  0.38769  224.360  223.972
|        :        |  *     :        | 1979  0.06507  210.286  210.221
|     *  :        |        :        | 1980 -0.30799  258.861  259.169
|        : *      |        :        | 1981 -0.18015  228.345  228.525
|        :        |        : *      | 1982  0.28802  247.635  247.347
|        :        |      * :        | 1983  0.18536  238.673  238.487
|        :        *        :        | 1984  0.00698  287.501  287.494
|        *        |        :        | 1985 -0.23767  258.753  258.991
|        : *      |        :        | 1986 -0.18977  272.754  272.943
|        :        |  *     :        | 1987  0.06862  262.240  262.171
|        :        |   *    :        | 1988  0.11182  316.153  316.041
|        :        | *      :        | 1989  0.06334  287.633  287.569
|       *:        |        :        | 1990 -0.25993  303.378  303.638
```

Output 4.9

LS // Dependent Variable is S
Date: 8-15-1991 / Time: 11:55
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-9.9999252	7.239E-05	-138131.84	0.000
A	0.4999999	1.508E-07	3316585.1	0.000
P	4.9999667	3.179E-05	157285.30	0.000
T	5.0000005	4.313E-07	11591640.	0.000
RSO	-0.9999996	5.240E-07	-1908307.0	0.000

R-squared	1.000000	Mean of dependent var	204.5134
Adjusted R-squared	1.000000	S.D. of dependent var	60.84649
S.E. of regression	7.27E-06	Sum of squared resid	1.32E-09
Durbin-Watson stat	1.859395	F-statistic	5.07E+14
Log likelihood	315.1235		

```
            Residual Plot                 obs RESIDUAL  ACTUAL   FITTED
|          :    * |      :         | 1961 -1.8E-06  104.942  104.942
|          :     *|      :         | 1962 -5.4E-07  119.553  119.553
|          :      |      :  *      | 1963  9.4E-06  107.438  107.438
|          :      |      *         | 1964  6.9E-06  156.958  156.958
|          :  *   |      :         | 1965 -3.7E-06  126.796  126.796
|          :      |   *  :         | 1966  4.2E-06  140.412  140.412
|          :   *  |      :         | 1967 -3.2E-06  129.151  129.151
|         *:      |      :         | 1968 -7.4E-06  182.565  182.565
|          :      |      :  *      | 1969  1.0E-05  153.516  153.516
|          :      |   *  :         | 1970  4.3E-06  168.817  168.817
|       *  :      |      :         | 1971 -1.0E-05  152.576  152.576
|        * :      |      :         | 1972 -9.4E-06  204.547  204.547
|          :      |  *   :         | 1973  2.5E-06  180.756  180.756
|          : *    |      :         | 1974 -4.5E-06  196.409  196.409
|          :      |  *   :         | 1975  2.8E-06  182.040  182.040
|          : *    |      :         | 1976 -5.3E-06  228.810  228.810
|          :   *  |      :         | 1977 -2.6E-06  203.549  203.549
|          :   *  |      :         | 1978 -3.3E-06  224.360  224.360
|          :      |      *         | 1979  7.3E-06  210.286  210.286
|          :      |      :   *     | 1980  9.7E-06  258.861  258.861
|          :    * |      :         | 1981 -1.8E-06  228.345  228.345
|         *:      |      :         | 1982 -8.1E-06  247.635  247.635
|          :   *  |      :         | 1983 -3.4E-06  238.673  238.673
|          :      |   *  :         | 1984  3.7E-06  287.501  287.501
|          :    * |      :         | 1985 -2.4E-06  258.753  258.753
|  *       :      |      :         | 1986 -1.5E-05  272.754  272.754
|          :      |    * :         | 1987  5.1E-06  262.240  262.240
|          :      |    * :         | 1988  5.2E-06  316.153  316.153
|          :      |      :      *  | 1989  1.3E-05  287.633  287.633
|          :    * |      :         | 1990 -1.9E-06  303.378  303.378
```

4.4 Estimating parameters and inclusion of disturbance terms

The data used in the above example were based on an exactly fitting model. For that reason t-statistics in many regression outputs were very high and so was the R^2 in many cases. In reality there are inaccuracies in the data, specification errors for the equations and problems in finding the proper estimation approach. To capture such aspects the usual approach is to add disturbance terms u_t to each of the equations. The model consisting of the equations of chapter 2 then becomes

$$a_t = \alpha_0 + \alpha_1 a_{t-1} + \alpha_2 p_{t-1} + \alpha_3 (p_{t-1} - p_{t-2}) + \alpha_4 t + u_{1t} \qquad (4.1)$$

$$s_t = \beta_0 + \beta_1 s_{t-1} + \beta_2 a_t + \beta_3 p_{t-1} + \beta_4 p_t + \beta_5 t + \beta_6 rso_t + u_{2t} \qquad (4.2)$$

$$d_t = \delta_0 + \delta_1 d_{t-1} + \delta_2 y_t + \delta_3 p_{t-1} + \delta_4 p_t + \delta_5 t + u_{3t} \qquad (4.3)$$

$$p_t = \gamma_0 + \gamma_1 z_t + u_{4t} \qquad (4.4)$$

Random values, normally distributed, have been drawn for the u_{it}, i = 1,2,3,4. On this basis disturbed data have been derived for the variables. In Figures 4.2 to 4.6 graphs are shown for the five variables area, supply, price, demand and stocks; in each case both the data as used in chapter 2, the deterministic data, and the above derived data, including the disturbance term, are presented. It is clear that the original regular pattern appears to some extent.

In this section we concentrate on the supply equation. Using the new data including the disturbance terms, new scatter diagrams can be drawn. Here we show the scatters for supply and area and for supply and price in Figures 4.7 and 4.8, which can be compared with Figures 2.2 and 2.4. It is also clear here that regular patterns have been removed to some extent.

The disturbed data are indicated in the TSP output by adding a letter u to the original variable. On this basis estimates for the parameters in the various equations could be derived.

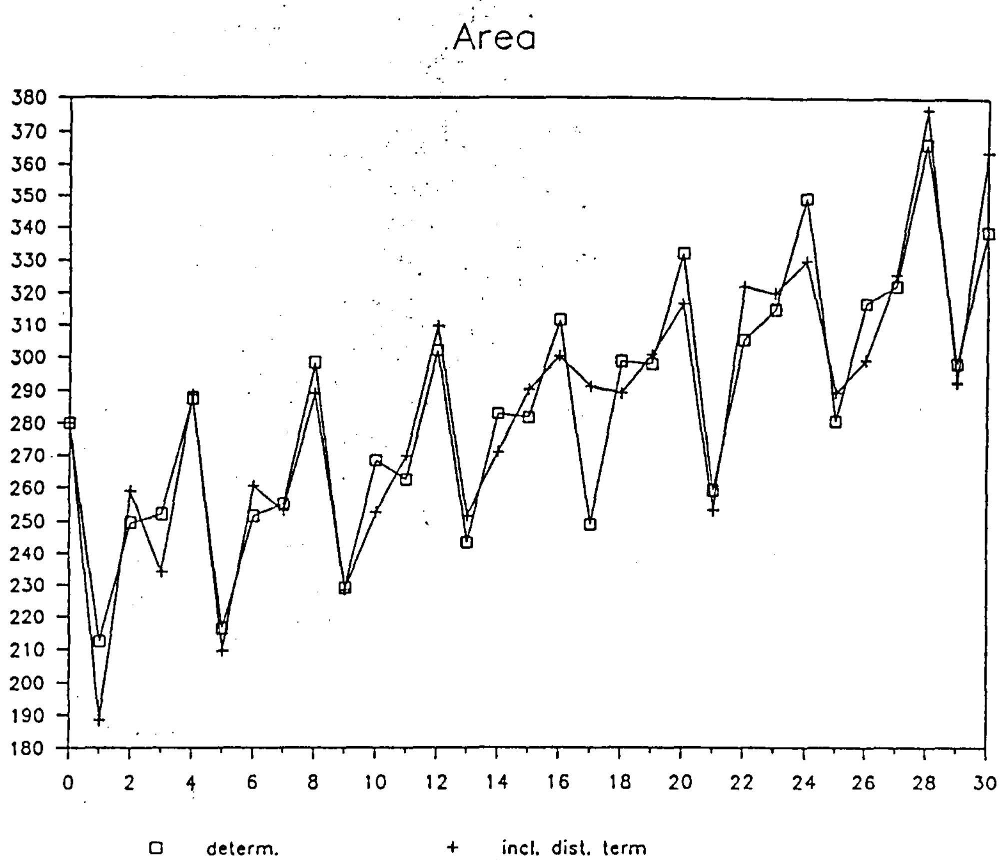


Figure 4.2

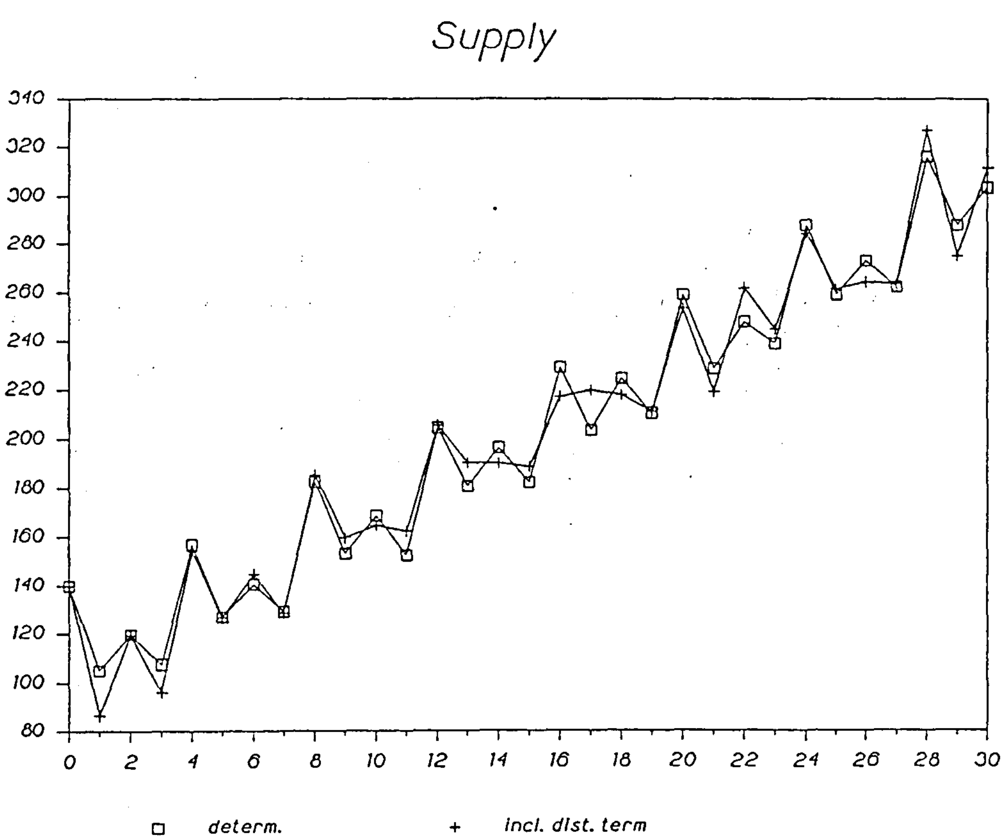


Figure 4.3

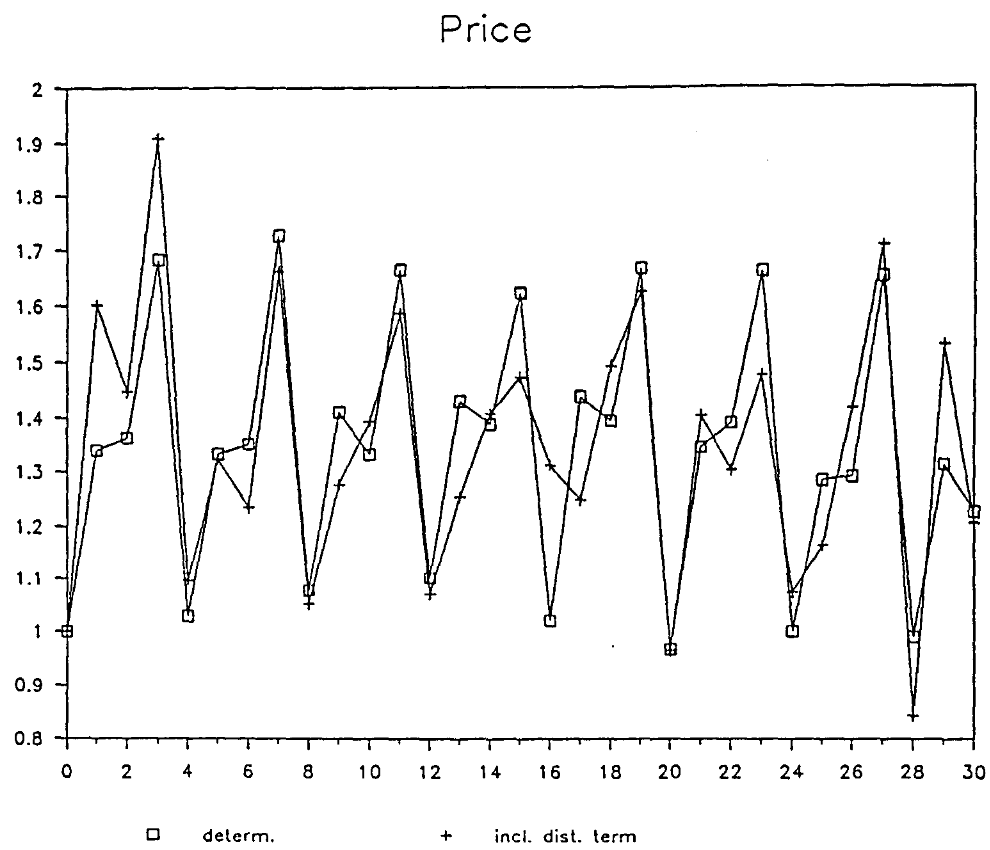


Figure 4.4

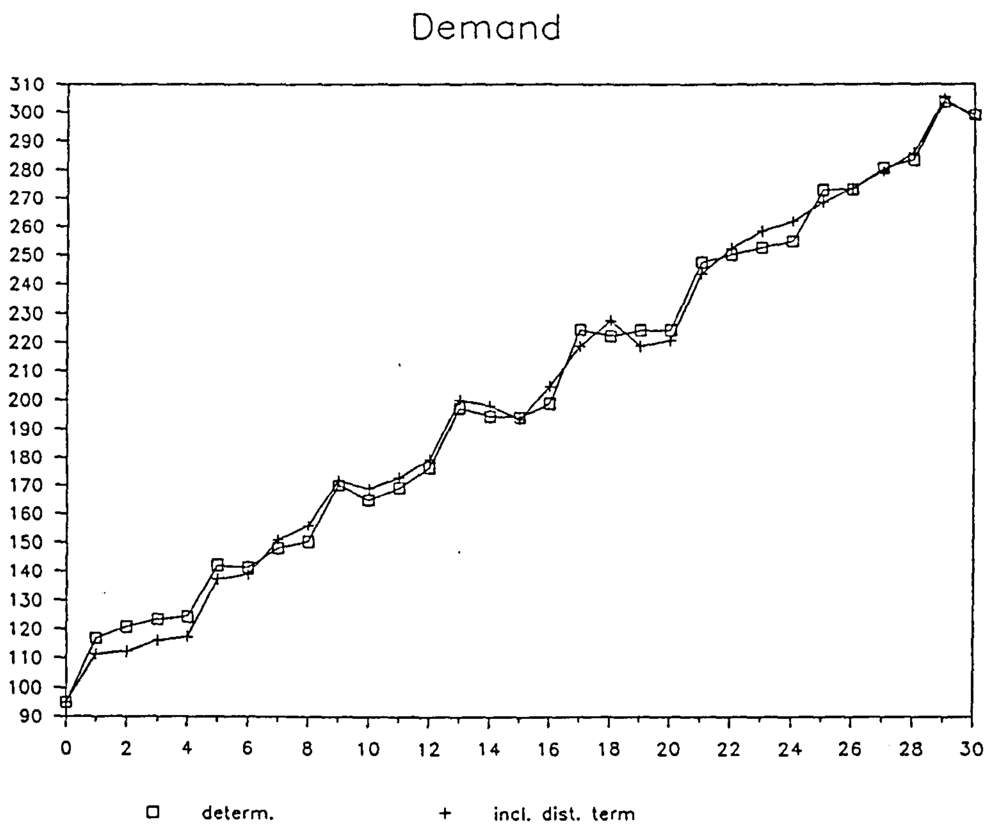


Figure 4.5

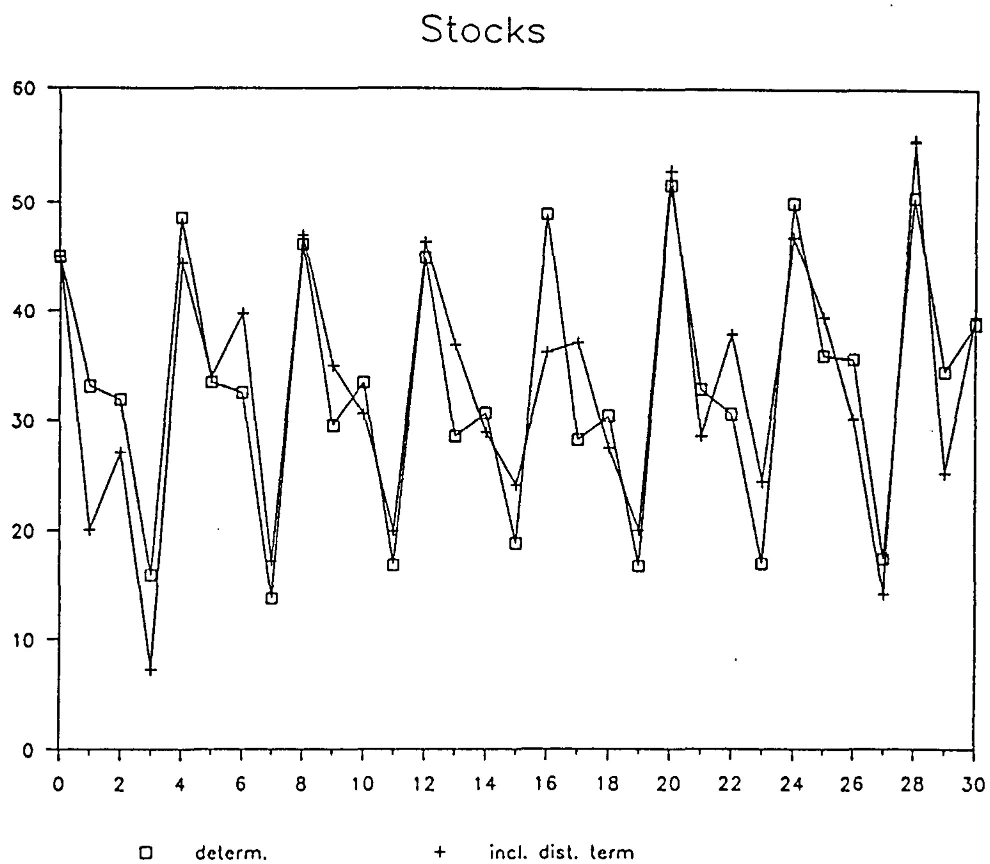


Figure 4.6

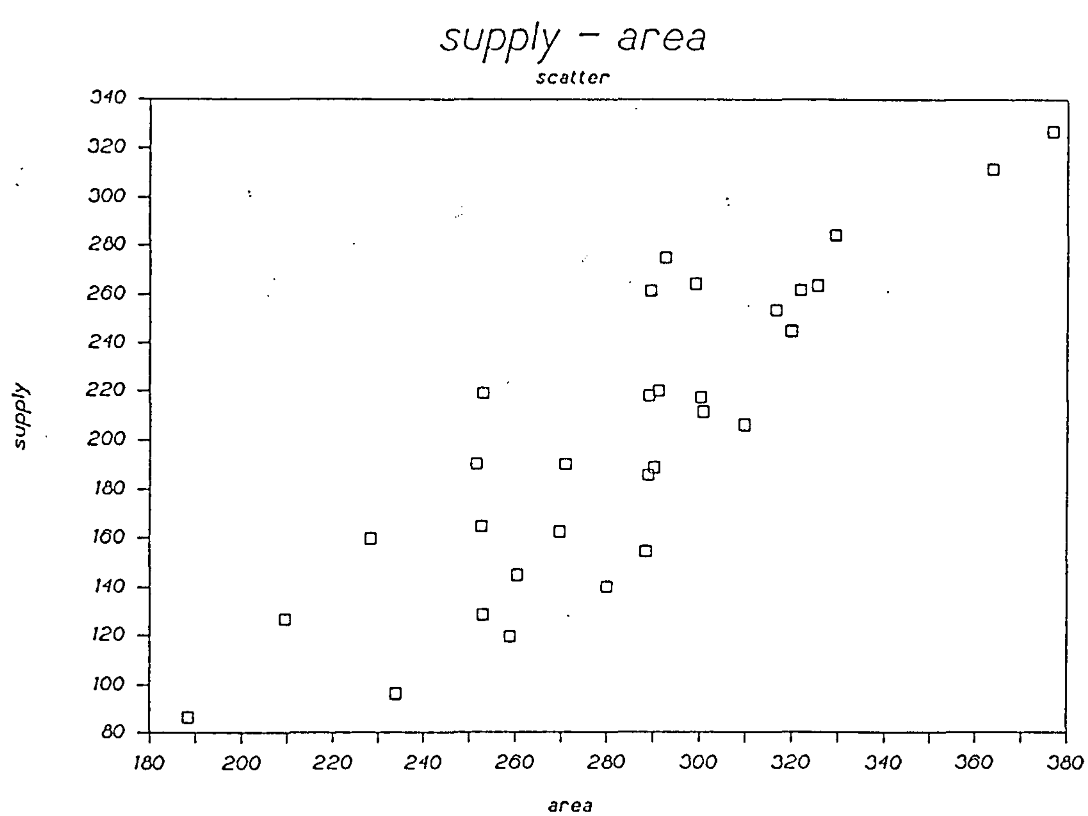


Figure 4.7

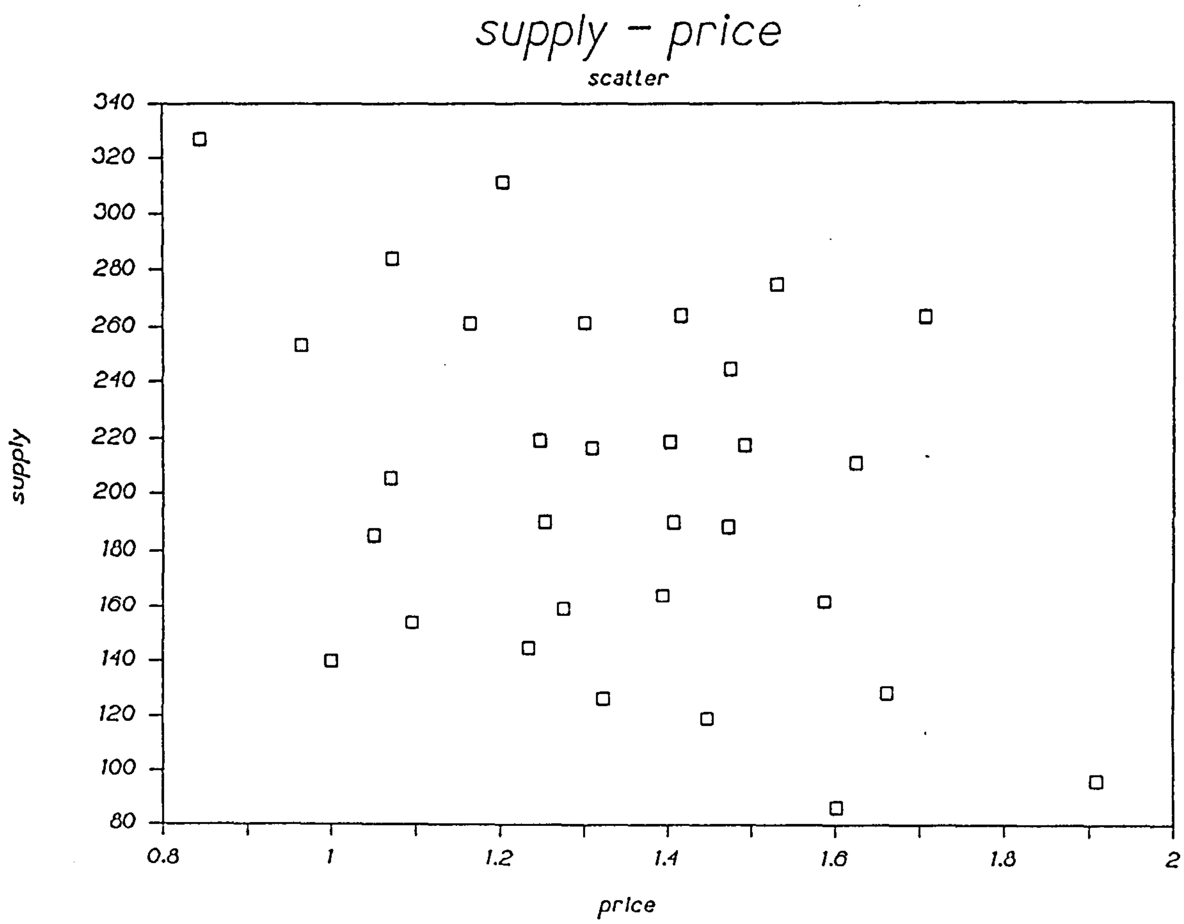


Figure 4.8

The estimation results for the supply equation are shown in reproduced output from TSP. The order is the same as in sections 4.2 and 4.3. A general conclusion is that estimation results are worse in most cases because of the disturbances partly disguising the real relationship. It is interesting to note that t-statistics in particular are almost always lower because of the additional uncertainty introduced by the disturbance term. And so is the R^2. In the final equation (Output 4.18) the estimated coefficients in some cases differ quite a bit from what was introduced originally and indeed resulted from Output 4.9: the coefficient of p_t even has the wrong sign.

Output 4.10

LS // Dependent Variable is SU
Date: 8-15-1991 / Time: 11:59
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
AU	0.7315099	0.0247172	29.595134	0.000

R-squared	0.613347	Mean of dependent var	204.4152
Adjusted R-squared	0.613347	S.D. of dependent var	62.50412
S.E. of regression	38.86593	Sum of squared resid	43806.26
Durbin-Watson stat	0.223835	Log likelihood	-151.8632

```
            Residual Plot               obs  RESIDUAL   ACTUAL   FITTED
|       * :       |       :        | 1961 -51.3986  86.4726  137.871
|   *     :       |       :        | 1962 -70.1312  119.243  189.375
|  *      :       |       :        | 1963 -74.9687  96.2045  171.173
|      *  :       |       :        | 1964 -56.7007  154.358  211.059
|         :  *    |       :        | 1965 -26.6474  126.643  153.291
|        *:       |       :        | 1966 -45.6487  144.831  190.479
|      *  :       |       :        | 1967 -56.5967  128.420  185.017
|         :  *    |       :        | 1968 -25.8967  185.488  211.385
|         :      *|       :        | 1969 -7.36124  159.724  167.085
|         :   *   |       :        | 1970 -20.1542  164.652  184.807
|         :*      |       :        | 1971 -35.0564  162.333  197.389
|         :   *   |       :        | 1972 -20.6910  205.830  226.521
|         :       |*      :        | 1973  6.35839  190.283  183.924
|         :     * |       :        | 1974 -8.32351  189.921  198.245
|         :  *    |       :        | 1975 -23.7578  188.562  212.319
|         :      *|       :        | 1976 -2.91156  216.814  219.726
|         :       |*      :        | 1977  6.40939  219.491  213.082
|         :       |*      :        | 1978  6.11770  217.667  211.549
|         :     * |       :        | 1979 -8.97482  211.089  220.064
|         :       |   *   :        | 1980  21.8510  253.417  231.566
|         :       |      *:        | 1981  33.5901  218.740  185.150
|         :       |    *  :        | 1982  26.0877  261.497  235.409
|         :       | *     :        | 1983  10.6178  244.656  234.038
|         :       |       :*       | 1984  42.9755  284.041  241.066
|         :       |       : *      | 1985  49.5063  261.256  211.750
|         :       |       :*       | 1986  45.2467  264.091  218.844
|         :       |    *  :        | 1987  25.1409  263.251  238.110
|         :       |       : *      | 1988  51.4010  327.014  275.613
|         :       |       :   *    | 1989  60.7131  274.741  214.028
|         :       |       :*       | 1990  45.6030  311.728  266.125
```

Output 4.11

LS // Dependent Variable is SU
Date: 8-15-1991 / Time: 12:00
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-170.63112	39.203786	-4.3524142	0.000
AU	1.3198247	0.1365587	9.6648878	0.000

R-squared	0.769377	Mean of dependent var	204.4152
Adjusted R-squared	0.761140	S.D. of dependent var	62.50412
S.E. of regression	30.54783	Sum of squared resid	26128.75
Durbin-Watson stat	1.447769	F-statistic	93.41006
Log likelihood	-144.1121		

```
            Residual Plot                obs  RESIDUAL   ACTUAL    FITTED
|         :       | *     :        | 1961   8.34993   86.4726   78.1227
|    *    :       |       :        | 1962 -51.8040   119.243   171.047
|      *  :       |       :        | 1963 -42.0032   96.2045   138.208
|   *     :       |       :        | 1964 -55.8129   154.358   210.171
|         :       |    *  :        | 1965  20.7001   126.643   105.943
|         :*      |       :        | 1966 -28.2100   144.831   173.041
|        *:       |       :        | 1967 -34.7648   128.420   163.185
|         : *     |       :        | 1968 -25.2714   185.488   210.760
|         :       |      *:        | 1969  28.8924   159.724   130.831
|         :       *       :        | 1970  1.84667   164.652   162.806
|         : *     |       :        | 1971 -23.1748   162.333   185.507
|         *       |       :        | 1972 -32.2390   205.830   238.069
|         :       |      *:        | 1973  29.0688   190.283   161.214
|         :       |*      :        | 1974  2.86964   189.921   187.052
|         : *     |       :        | 1975 -23.8839   188.562   212.445
|         :     * |       :        | 1976 -8.99409   216.814   225.808
|         :       |*      :        | 1977  5.67012   219.491   213.821
|         :       | *     :        | 1978  6.61081   217.667   211.056
|         :   *   |       :        | 1979 -15.3295   211.089   226.419
|         :       | *     :        | 1980  6.24603   253.417   247.171
|         :       |       :     *  | 1981  55.3152   218.740   163.424
|         :       | *     :        | 1982  7.39163   261.497   254.105
|         :     * |       :        | 1983 -6.97534   244.656   251.631
|         :       |    *  :        | 1984  19.7300   284.041   264.311
|         :       |       :    *   | 1985  49.8382   261.256   211.418
|         :       |       : *      | 1986  39.8730   264.091   224.218
|         :       |*      :        | 1987  4.27281   263.251   258.978
|         :       *       :        | 1988  0.37080   327.014   326.643
|         :       |       :      * | 1989  59.2129   274.741   215.528
|         :       |*      :        | 1990  2.20393   311.728   309.524
```

Output 4.12

LS // Dependent Variable is SU
Date: 8-15-1991 / Time: 12:01
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	361.73027	60.895443	5.9401863	0.000
PU	-116.45377	44.415292	-2.6219296	0.014

R-squared	0.197121	Mean of dependent var	204.4152
Adjusted R-squared	0.168447	S.D. of dependent var	62.50412
S.E. of regression	56.99720	Sum of squared resid	90963.08
Durbin-Watson stat	0.143087	F-statistic	6.874515
Log likelihood	-162.8233		

Output 4.13

LS // Dependent Variable is SU
Date: 8-15-1991 / Time: 12:01
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	215.36696	16.289600	13.221132	0.000
RSO	-0.9177411	0.9723329	-0.9438548	0.353

R-squared	0.030835	Mean of dependent var	204.4152
Adjusted R-squared	-0.003778	S.D. of dependent var	62.50412
S.E. of regression	62.62207	Sum of squared resid	109802.7
Durbin-Watson stat	0.164007	F-statistic	0.890862
Log likelihood	-165.6468		

Output 4.14

LS // Dependent Variable is SU
Date: 8-15-1991 / Time: 12:02
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	98.671655	6.5982529	14.954209	0.000
T	6.8221674	0.3716711	18.355387	0.000

R-squared	0.923271	Mean of dependent var	204.4152
Adjusted R-squared	0.920531	S.D. of dependent var	62.50412
S.E. of regression	17.62011	Sum of squared resid	8693.114
Durbin-Watson stat	3.096744	F-statistic	336.9202
Log likelihood	-127.6045		

Output 4.15

LS // Dependent Variable is SU
Date: 8-15-1991 / Time: 12:02
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-14.546448	19.505404	-0.7457650	0.462
AU	0.4978214	0.0835386	5.9591784	0.000
T	4.9999279	0.3941833	12.684271	0.000

R-squared	0.966859	Mean of dependent var	204.4152
Adjusted R-squared	0.964404	S.D. of dependent var	62.50412
S.E. of regression	11.79252	Sum of squared resid	3754.716
Durbin-Watson stat	2.317171	F-statistic	393.8540
Log likelihood	-115.0117		

Output 4.16

LS // Dependent Variable is SU
Date: 8-15-1991 / Time: 12:10
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	107.52534	11.743876	9.1558645	0.000
AU	0.2862628	0.0347406	8.2400025	0.000
PU	-51.385988	3.9092245	-13.144803	0.000
T	5.4813344	0.1498191	36.586361	0.000

R-squared	0.995665	Mean of dependent var	204.4152
Adjusted R-squared	0.995165	S.D. of dependent var	62.50412
S.E. of regression	4.346061	Sum of squared resid	491.0944
Durbin-Watson stat	2.505104	F-statistic	1990.746
Log likelihood	-84.49974		

```
           Residual Plot               obs  RESIDUAL   ACTUAL    FITTED
|         :       |  *    :        |  1961   1.78841  86.4726   84.6842
|         :       | *     :        |  1962   1.00550  119.243   118.238
|         :       |     * :        |  1963   3.31574  96.2045   92.8888
|         :     * |       :        |  1964  -1.36576  154.358   155.724
|         :      *|       :        |  1965  -0.30927  126.643   126.953
|     *   :       |       :        |  1966  -6.73273  144.831   151.563
|         *       |       :        |  1967  -4.53558  128.420   132.955
|         :       |       :*       |  1968   5.38834  185.488   180.100
|         :       |    *  :        |  1969   2.99741  159.724   156.726
|         :       |  *    :        |  1970   1.59071  164.652   163.062
|         :     * |       :        |  1971  -1.21725  162.333   163.550
|         :     * |       :        |  1972  -1.11137  205.830   206.942
|         :       |      *:        |  1973   3.89950  190.283   186.383
|         :       |*      :        |  1974   0.36796  189.921   189.553
|  *      :       |       :        |  1975  -8.63248  188.562   197.194
|         :       |    *  :        |  1976   2.92692  216.814   213.887
|         :      *|       :        |  1977  -0.55789  219.491   220.049
|         :       |       :*       |  1978   5.31640  217.667   212.351
|         : *     |       :        |  1979  -3.25849  211.089   214.348
|         *       |       :        |  1980  -4.79161  253.417   258.208
|         *       |       :        |  1981  -4.31897  218.740   223.059
|         :       |       :     *  |  1982   8.09066  261.497   253.406
|         *       |       :        |  1983  -4.75157  244.656   249.407
|         :       |       : *      |  1984   5.75703  284.041   278.284
|      *  :       |       :        |  1985  -6.30560  261.256   267.562
|         :       | *     :        |  1986   1.13645  264.091   262.954
|         :       |   *   :        |  1987   2.22955  263.251   261.021
|         :       |  *    :        |  1988   1.52076  327.014   325.494
|         :       |    *  :        |  1989   3.09447  274.741   271.647
|         :   *   |       :        |  1990  -2.53725  311.728   314.265
```

Output 4.17

```
LS // Dependent Variable is SU
Date: 8-15-1991 / Time: 12:10
SMPL range: 1961  -  1990
Number of observations: 30
```

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-9.1298942	7.9982320	-1.1414890	0.264
AU	0.5216427	0.0342583	15.226735	0.000
T	4.8859277	0.1616589	30.223683	0.000
RSO	-0.8730754	0.0751077	-11.624316	0.000

R-squared	0.994652	Mean of dependent var	204.4152
Adjusted R-squared	0.994035	S.D. of dependent var	62.50412
S.E. of regression	4.827335	Sum of squared resid	605.8822
Durbin-Watson stat	1.535472	F-statistic	1611.946
Log likelihood	-87.65048		

```
          Residual Plot               obs RESIDUAL  ACTUAL   FITTED

|        *        |        :       | 1961 -4.98073  86.4726  91.4534
|      * :        |        :       | 1962 -5.96550  119.243  125.209
|        :  *     |        :       | 1963 -3.44929  96.2045  99.6538
|        *        |        :       | 1964 -4.81657  154.358  159.174
|        :        |       *:       | 1965  4.65061  126.643  121.993
|        :       *|        :       | 1966 -0.70979  144.831  145.540
|        :       *|        :       | 1967 -0.64941  128.420  129.069
|        :        |        :  *    | 1968  6.53736  185.488  178.951
|        :        |        :     * | 1969  8.35047  159.724  151.373
|        :        |     *  :       | 1970  3.61361  164.652  161.039
|        :        |        *       | 1971  4.89679  162.333  157.436
|        :  *     |        :       | 1972 -3.45805  205.830  209.288
|        :        |        :   *   | 1973  7.35761  190.283  182.925
|        :        *        :       | 1974 -0.24404  189.921  190.165
|        :        | *      :       | 1975  0.93514  188.562  187.626
|    *   :        |        :       | 1976 -7.17202  216.814  223.986
|        : *      |        :       | 1977 -3.77000  219.491  223.261
|        :     *  |        :       | 1978 -1.52955  217.667  219.197
|        :     *  |        :       | 1979 -1.60370  211.089  212.693
|        :        |  *     :       | 1980  1.44370  253.417  251.973
|        : *      |        :       | 1981 -4.14661  218.740  222.886
|        :        |        :*      | 1982  5.74203  261.497  255.755
|        :        |   *    :       | 1983  2.45420  244.656  242.201
|        :        |        :*      | 1984  5.75010  284.041  278.291
|        :        *        :       | 1985 -0.14267  261.256  261.399
|        :        |*       :       | 1986  0.60486  264.091  263.486
|        :     *  |        :       | 1987 -1.39807  263.251  264.649
|        :        |       *:       | 1988  4.54334  327.014  322.471
|   *    :        |        :       | 1989 -7.82593  274.741  282.567
|        *        |        :       | 1990 -5.01790  311.728  316.746
```

Output 4.18

```
LS // Dependent Variable is SU
Date: 8-15-1991 / Time: 12:10
SMPL range: 1961  -  1990
Number of observations: 30
```

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	60.961873	15.809788	3.8559577	0.001
AU	0.3826504	0.0385239	9.9327986	0.000
PU	-30.707873	6.4265786	-4.7782615	0.000
T	5.2337512	0.1396578	37.475548	0.000
RSO	-0.4125013	0.1111634	-3.7107648	0.001

R-squared	0.997205	Mean of dependent var	204.4152
Adjusted R-squared	0.996758	S.D. of dependent var	62.50412
S.E. of regression	3.559064	Sum of squared resid	316.6735
Durbin-Watson stat	2.183221	F-statistic	2229.811
Log likelihood	-77.91826		

```
            Residual Plot                 obs RESIDUAL  ACTUAL   FITTED

|          :   *  |      :         | 1961 -1.43810  86.4726  87.9107
|          :  *   |      :         | 1962 -1.86124  119.243  121.105
|          :      |   *  :         | 1963  1.80479  96.2045  94.3997
|          *      |      :         | 1964 -3.46113  154.358  157.819
|          :      | *    :         | 1965  1.18084  126.643  125.463
|        * :      |      :         | 1966 -4.34118  144.831  149.172
|          :  *   |      :         | 1967 -1.76004  128.420  130.180
|          :      |      :   *     | 1968  5.17518  185.488  180.313
|          :      |      :  *      | 1969  4.64621  159.724  155.077
|          :      |    * :         | 1970  2.41751  164.652  162.235
|          :      |    * :         | 1971  2.45851  162.333  159.874
|          :*     |      :         | 1972 -2.73382  205.830  208.564
|          :      |      :  *      | 1973  4.77929  190.283  185.504
|          :      *      :         | 1974  0.13574  189.921  189.786
|          *      |      :         | 1975 -3.56909  188.562  192.131
|          :  *   |      :         | 1976 -1.76764  216.814  218.582
|          : *    |      :         | 1977 -2.39682  219.491  221.888
|          :      |    * :         | 1978  2.57718  217.667  215.090
|          :   *  |      :         | 1979 -1.36500  211.089  212.454
|          :*     |      :         | 1980 -2.90821  253.417  256.325
|       *  :      |      :         | 1981 -4.70029  218.740  223.440
|          :      |      :       * | 1982  7.13871  261.497  254.358
|          :     *|      :         | 1983 -0.62426  244.656  245.280
|          :      |      :   *     | 1984  5.13878  284.041  278.903
|        * :      |      :         | 1985 -4.30501  261.256  265.561
|          :      | *    :         | 1986  0.98544  264.091  263.105
|          :      |   *  :         | 1987  2.02008  263.251  261.231
|          :      |   *  :         | 1988  2.07473  327.014  324.940
|          :  *   |      :         | 1989 -1.75265  274.741  276.494
|          *      |      :         | 1990 -3.54850  311.728  315.276
```

4.5 Some further examples: the area equation

In this section estimation results for the area equation are shown, only presenting the realistic case with a disturbance term based on the model in equations (4.1) to (4.4). Scatter diagrams are presented in Figures 4.9 and 4.10. The residuals of the regression equations have not been reproduced to save space. The sign of au_{t-1} is wrong in Output 4.21. Note the similarities and differences Output 4.24 and Output 4.25: in Output 4.25 a variable dpu is defined as the first difference in prices: dp = p - p(-1) in TSP notation. The final results are shown in Output 4.27.

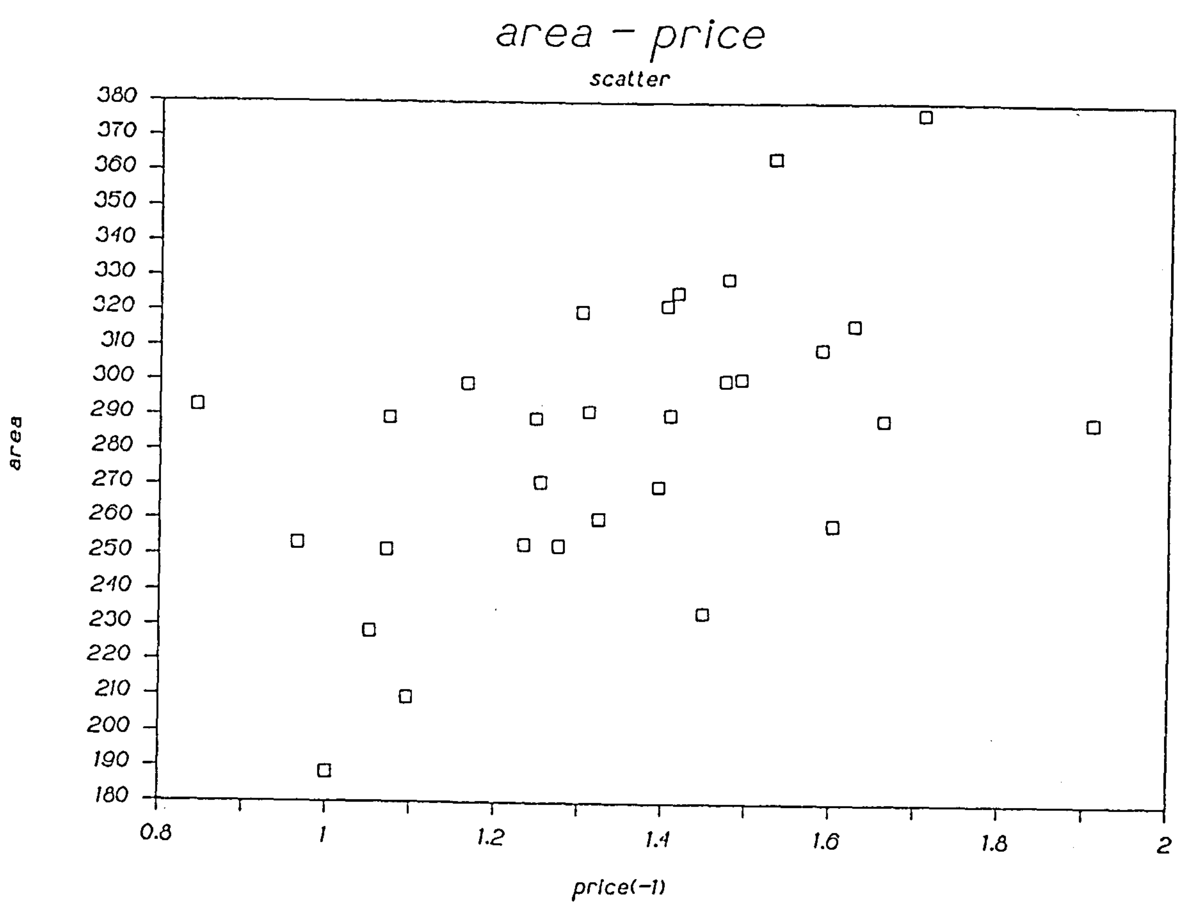


Figure 4.9

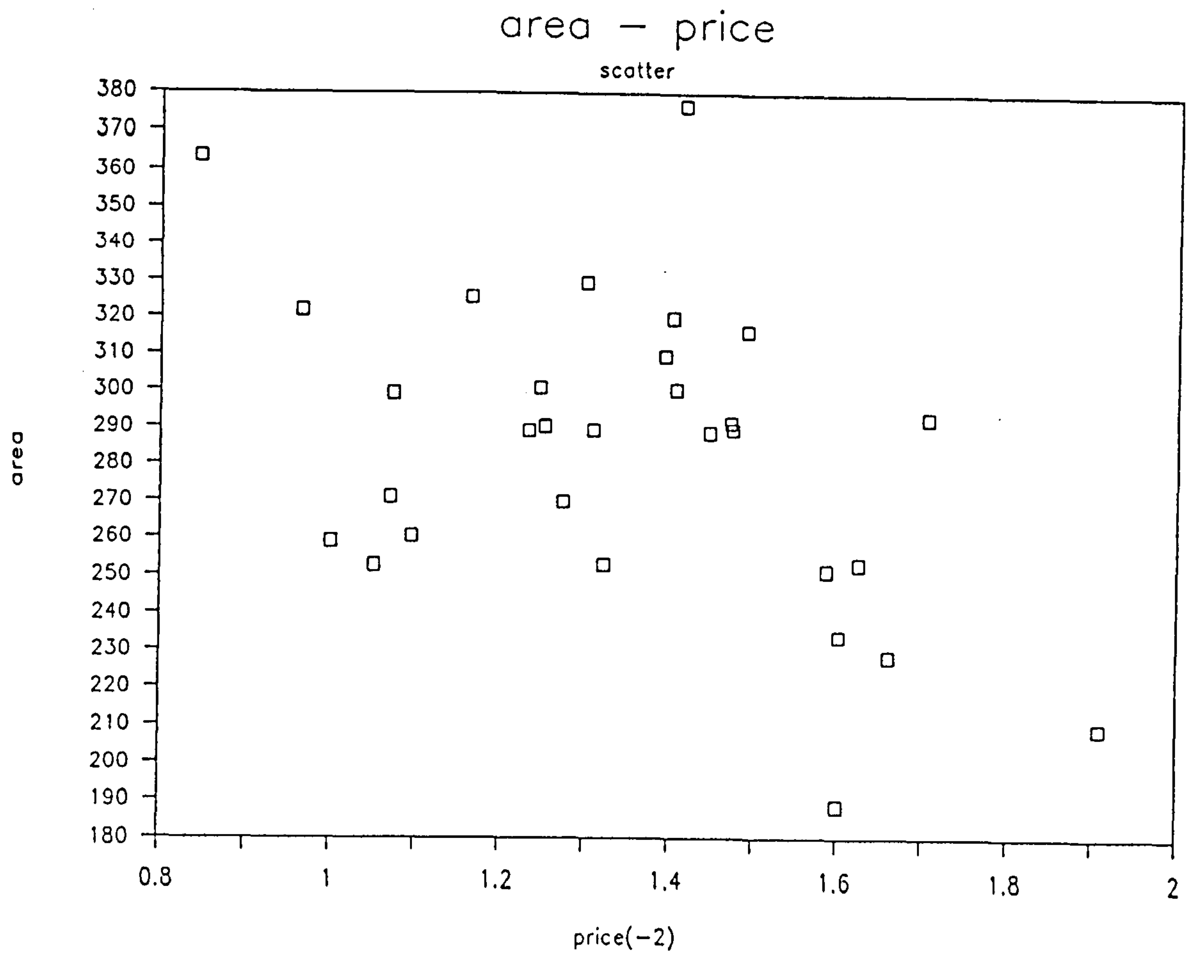


Figure 4.10

Output 4.19

LS // Dependent Variable is AU
Date: 8-15-1991 / Time: 12:55
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	187.82124	54.552693	3.4429325	0.002
AU(-1)	0.3424047	0.1921314	1.7821381	0.086

R-squared	0.101874	Mean of dependent var	284.1638
Adjusted R-squared	0.069798	S.D. of dependent var	41.53956
S.E. of regression	40.06366	Sum of squared resid	44942.70
Durbin-Watson stat	1.982933	F-statistic	3.176016
Log likelihood	-152.2474		

Output 4.20

LS // Dependent Variable is AU
Date: 8-15-1991 / Time: 12:55
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	227.42714	9.9898907	22.765729	0.000
T	3.6604280	0.5627177	6.5049097	0.000

R-squared	0.601785	Mean of dependent var	284.1638
Adjusted R-squared	0.587563	S.D. of dependent var	41.53956
S.E. of regression	26.67721	Sum of squared resid	19926.86
Durbin-Watson stat	2.745427	F-statistic	42.31385
Log likelihood	-140.0476		

Output 4.21

LS // Dependent Variable is AU
Date: 8-15-1991 / Time: 12:56
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	346.55328	37.699292	9.1925673	0.000
AU(-1)	-0.5118632	0.1576876	-3.2460594	0.003
T	5.2666859	0.6935852	7.5934236	0.000

R-squared	0.713567	Mean of dependent var	284.1638
Adjusted R-squared	0.692350	S.D. of dependent var	41.53956
S.E. of regression	23.04041	Sum of squared resid	14333.24
Durbin-Watson stat	2.103371	F-statistic	33.63150
Log likelihood	-135.1052		

Output 4.22

LS // Dependent Variable is AU
Date: 8-15-1991 / Time: 12:57
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	163.86358	37.072445	4.4200909	0.000
PU(-1)	89.502676	27.147670	3.2968824	0.003

R-squared	0.279640	Mean of dependent var	284.1638
Adjusted R-squared	0.253912	S.D. of dependent var	41.53956
S.E. of regression	35.88036	Sum of squared resid	36047.20
Durbin-Watson stat	0.119896	F-statistic	10.86943
Log likelihood	-148.9390		

Output 4.23

LS // Dependent Variable is AU
Date: 8-15-1991 / Time: 12:58
SMPL range: 1962 - 1990
Number of observations: 29

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	372.84612	36.661652	10.169921	0.000
PU(-2)	-63.827817	26.965399	-2.3670266	0.025

R-squared	0.171851	Mean of dependent var	287.4634
Adjusted R-squared	0.141178	S.D. of dependent var	38.06405
S.E. of regression	35.27496	Sum of squared resid	33596.71
Durbin-Watson stat	0.912668	F-statistic	5.602815
Log likelihood	-143.4451		

Output 4.24

LS // Dependent Variable is AU
Date: 8-15-1991 / Time: 12:58
SMPL range: 1962 - 1990
Number of observations: 29

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	263.88983	62.530606	4.2201707	0.000
PU(-1)	58.939217	28.187428	2.0909753	0.046
PU(-2)	-42.121239	27.462102	-1.5337951	0.137

R-squared	0.291066	Mean of dependent var	287.4634
Adjusted R-squared	0.236532	S.D. of dependent var	38.06405
S.E. of regression	33.25909	Sum of squared resid	28760.35
Durbin-Watson stat	0.279821	F-statistic	5.337379
Log likelihood	-141.1913		

Output 4.25

LS // Dependent Variable is AU
Date: 8-15-1991 / Time: 12:59
SMPL range: 1962 - 1990
Number of observations: 29

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	263.88983	62.530606	4.2201707	0.000
PU(-1)	16.817978	46.194479	0.3640690	0.719
DPU(-1)	42.121239	27.462102	1.5337951	0.137

R-squared	0.291066	Mean of dependent var	287.4634
Adjusted R-squared	0.236532	S.D. of dependent var	38.06405
S.E. of regression	33.25909	Sum of squared resid	28760.35
Durbin-Watson stat	0.279821	F-statistic	5.337379
Log likelihood	-141.1913		

Output 4.26

LS // Dependent Variable is AU
Date: 8-15-1991 / Time: 12:59
SMPL range: 1962 - 1990
Number of observations: 29

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	17.793488	23.543633	0.7557664	0.457
AU(-1)	0.9566453	0.0574265	16.658593	0.000
PU(-1)	-1.0739357	13.585302	-0.0790513	0.938
DPU(-1)	104.57370	8.8810940	11.774867	0.000

R-squared	0.941412	Mean of dependent var	287.4634
Adjusted R-squared	0.934382	S.D. of dependent var	38.06405
S.E. of regression	9.750528	Sum of squared resid	2376.820
Durbin-Watson stat	1.918082	F-statistic	133.9030
Log likelihood	-105.0394		

```
              Residual Plot              obs  RESIDUAL   ACTUAL   FITTED
|          :      *      :         |  1962  -0.35861   258.882  259.240
|       *  :      |      :         |  1963  -13.7851   234.000  247.785
|          :      |*     :         |  1964   0.67927   288.525  287.845
|          :      |*     :         |  1965   1.87566   209.554  207.678
|          :      |      :       * |  1966   19.8499   260.392  240.542
|          :   *  |      :         |  1967  -3.33410   252.924  256.258
|       *  :      |      :         |  1968  -13.6704   288.971  302.641
|          :     *|      :         |  1969  -0.90902   228.411  229.320
|          :  *   |      :         |  1970  -5.73710   252.637  258.374
|          :      *      :         |  1971  -0.51860   269.838  270.356
|          :      |      :    *    |  1972   15.2518   309.663  294.411
|          :*     |      :         |  1973  -7.50022   251.431  258.931
|          :  *   |      :         |  1974  -5.03965   271.008  276.048
|          :     *|      :         |  1975  -1.40104   290.248  291.649
|          :      *      :         |  1976  -0.31908   300.373  300.692
|          :      |  *   :         |  1977   4.47210   291.290  286.818
|          :      |*     :         |  1978   0.75518   289.196  288.440
|    *     :      |      :         |  1979  -17.6154   300.835  318.451
|          :     *|      :         |  1980  -1.15559   316.559  317.714
|          :      | *    :         |  1981   2.45861   253.106  250.647
|          :      |      :     *   |  1982   17.6705   321.813  304.142
|          :      |    * :         |  1983   6.25901   319.938  313.679
|         *:      |      :         |  1984  -10.9325   329.546  340.478
|          :      *      :         |  1985  -0.41507   289.469  289.884
|          :   *  |      :         |  1986  -3.92366   299.168  303.091
|          :    * |      :         |  1987  -3.14698   325.505  328.652
|          :      |      :      *  |  1988   18.9878   376.773  357.785
|          :      |   *  :         |  1989   5.44130   292.584  287.142
|          :   *  |      :         |  1990  -3.93881   363.802  367.741
```

Output 4.27

LS // Dependent Variable is AU
Date: 8-15-1991 / Time: 13:00
SMPL range: 1962 - 1990
Number of observations: 29

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	74.320925	26.084001	2.8492916	0.009
AU(-1)	0.3429074	0.1899755	1.8050079	0.084
T	2.5008024	0.7485270	3.3409649	0.003
PU(-1)	55.927667	20.550264	2.7215060	0.012
DPU(-1)	43.471675	19.762508	2.1997043	0.038

R-squared	0.960011	Mean of dependent var	287.4634
Adjusted R-squared	0.953346	S.D. of dependent var	38.06405
S.E. of regression	8.221689	Sum of squared resid	1622.308
Durbin-Watson stat	1.653244	F-statistic	144.0396
Log likelihood	-99.50170		

```
            Residual Plot               obs  RESIDUAL   ACTUAL    FITTED
|         :      *|       :        |  1962  -0.75016   258.882   259.632
|       * :       |       :        |  1963  -10.8284   234.000   244.828
|         :    *  |       :        |  1964  -2.82949   288.525   291.354
|         :     * |       :        |  1965  -2.19136   209.554   211.745
|         :       |       :      * |  1966   15.3823   260.392   245.010
|         :       |     * :        |  1967   6.68562   252.924   246.239
|         :    *  |       :        |  1968  -3.54150   288.971   292.512
|         :       *       :        |  1969   0.23908   228.411   228.172
|         : *     |       :        |  1970  -6.06766   252.637   258.705
|         :     * |       :        |  1971  -1.69312   269.838   271.531
|         :       |       :      * |  1972   15.6938   309.663   293.969
|         :       |*      :        |  1973   0.97534   251.431   250.456
|         :     * |       :        |  1974  -2.53334   271.008   273.541
|         :       *       :        |  1975   0.10911   290.248   290.139
|         :       |*      :        |  1976   1.35404   300.373   299.019
|         :       |    *  :        |  1977   5.21314   291.290   286.077
|         :       |  *    :        |  1978   3.04478   289.196   286.151
|   *     :       |       :        |  1979  -14.2076   300.835   315.043
|         :*      |       :        |  1980  -7.51948   316.559   324.078
|         :*      |       :        |  1981  -7.56476   253.106   260.671
|         :       |       *        |  1982   8.27987   321.813   313.533
|         :       |       :*       |  1983   9.40586   319.938   310.532
|         :   *   |       :        |  1984  -4.54247   329.546   334.088
|         :    *  |       :        |  1985  -2.91154   289.469   292.381
|         *       |       :        |  1986  -8.59038   299.168   307.758
|        *:       |       :        |  1987  -8.96213   325.505   334.467
|         :       |       :   *    |  1988   12.7318   376.773   364.041
|         :       |      *:        |  1989   6.83256   292.584   285.751
|         :      *|       :        |  1990  -1.21392   363.802   365.016
```

4.6 Some further examples: the demand equation

In this section on the demand equation again a number of estimation results are shown for equation (4.3). Occasionnaly, residuals have been presented as well. Note the low t-statistic for the lagged demand coefficient in Output 4.30 to 4.32 and for price in Output 4.33. The latter one has the wrong sign. This improves when using lagged prices in Output 4.34 or when using both lagged and current prices in Output 4.35. The time trend is not significant in Output 4.36, although this is exactly the specification used for generating the data: calearly inclusion of the disturbance term in (4.1) to (4.4) really disturbs the relationship. The final result is shown in Output 4.37.

Output 4.28

LS // Dependent Variable is DU
Date: 8-15-1991 / Time: 13:07
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	10.557409	5.3060491	1.9896931	0.056
DU(-1)	0.9807343	0.0257072	38.150112	0.000

R-squared	0.981125	Mean of dependent var	204.5957
Adjusted R-squared	0.980451	S.D. of dependent var	59.21519
S.E. of regression	8.279392	Sum of squared resid	1919.353
Durbin-Watson stat	2.343400	F-statistic	1455.431
Log likelihood	-104.9463		

Output 4.29

LS // Dependent Variable is DU
Date: 8-15-1991 / Time: 13:07
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-275.50026	9.5353232	-28.892598	0.000
Y	0.3713039	0.0073215	50.714108	0.000

R-squared	0.989230	Mean of dependent var	204.5957
Adjusted R-squared	0.988846	S.D. of dependent var	59.21519
S.E. of regression	6.253916	Sum of squared resid	1095.121
Durbin-Watson stat	1.841424	F-statistic	2571.921
Log likelihood	-96.52950		

```
            Residual Plot                obs  RESIDUAL   ACTUAL    FITTED
|         :       |       : *      | 1961  8.15781   111.388   103.230
|         :*      |       :        | 1962 -5.82553   112.256   118.082
|     *   :       |       :        | 1963 -9.55085   115.957   125.508
|  *      :       |       :        | 1964 -11.9548   117.266   129.221
|         :       |       : *      | 1965  7.99893   137.220   129.221
|         :       |  *    :        | 1966  2.31646   138.964   136.647
|         :      *|       :        | 1967 -0.60388   150.895   151.499
|         :   *   |       :        | 1968 -3.18207   155.743   158.925
|         :       |       :  *     | 1969  9.15750   171.796   162.638
|         :       |       *        | 1970  6.31392   168.952   162.638
|         :       |   *   :        | 1971  2.86639   172.931   170.064
|         :*      |       :        | 1972 -5.47586   179.441   184.917
|         :       |       :*       | 1973  7.49004   199.833   192.343
|         :       | *     :        | 1974  1.82890   197.885   196.056
|         :    *  |       :        | 1975 -2.67248   193.383   196.056
|         :       | *     :        | 1976  1.23483   204.717   203.482
|         :       *       :        | 1977  0.25168   218.586   218.334
|         :       | *     :        | 1978  1.50352   227.264   225.760
|   *     :       |       :        | 1979 -10.9471   218.526   229.473
|      *  :       |       :        | 1980 -9.06671   220.406   229.473
|         :       |       *        | 1981  6.32932   243.228   236.899
|         :       |*      :        | 1982  0.45985   252.211   251.751
|         :      *|       :        | 1983 -1.08807   258.089   259.177
|         :     * |       :        | 1984 -1.23281   261.658   262.890
|         :       |      *:        | 1985  5.66614   268.557   262.890
|         :       |   *   :        | 1986  3.11949   273.436   270.316
|         :*      |       :        | 1987 -5.92917   279.239   285.169
|        *:       |       :        | 1988 -6.97524   285.619   292.595
|         :       |       :  *     | 1989  8.74653   305.054   296.308
|         :       |*      :        | 1990  1.06321   297.371   296.308
```

Output 4.30

LS // Dependent Variable is DU
Date: 8-15-1991 / Time: 13:07
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-225.87932	50.479297	-4.4746923	0.000
DU(-1)	0.1731452	0.1729695	1.0010156	0.326
Y	0.3064333	0.0652170	4.6986685	0.000

R-squared	0.989616	Mean of dependent var	204.5957
Adjusted R-squared	0.988847	S.D. of dependent var	59.21519
S.E. of regression	6.253689	Sum of squared resid	1055.933
Durbin-Watson stat	2.051034	F-statistic	1286.555
Log likelihood	-95.98290		

```
            Residual Plot                 obs  RESIDUAL   ACTUAL   FITTED
|         :       |       :  *     | 1961   8.25611  111.388  103.131
|         *       |       :        | 1962  -5.96983  112.256  118.226
|      *  :       |       :        | 1963  -8.54817  115.957  124.505
|   *     :       |       :        | 1964  -10.9442  117.266  128.210
|         :       |       :  *     | 1965   8.78288  137.220  128.437
|         :       |*      :        | 1966   0.94294  138.964  138.021
|         :       *       :        | 1967   0.31553  150.895  150.580
|         :   *   |       :        | 1968  -3.03119  155.743  158.774
|         :       |       :   *    | 1969   9.11770  171.796  162.678
|         :       |   *   :        | 1970   3.49469  168.952  165.458
|         :       | *     :        | 1971   1.83692  172.931  171.094
|         : *     |       :        | 1972  -4.59937  179.441  184.040
|         :       |       :  *     | 1973   8.53679  199.833  191.296
|         :       *       :        | 1974  -0.00643  197.885  197.891
|         :  *    |       :        | 1975  -4.17049  193.383  197.554
|         :       | *     :        | 1976   1.81362  204.717  202.903
|         :       | *     :        | 1977   1.46297  218.586  217.123
|         :       | *     :        | 1978   1.61087  227.264  225.653
|  *      :       |       :        | 1979  -11.6936  218.526  230.220
|      *  :       |       :        | 1980  -8.30033  220.406  228.707
|         :       |       : *      | 1981   8.06754  243.228  235.161
|         :       |*      :        | 1982   0.84135  252.211  251.370
|         :      *|       :        | 1983  -0.96446  258.089  259.054
|         :     * |       :        | 1984  -1.47827  261.658  263.136
|         :       |     * :        | 1985   4.80285  268.557  263.754
|         :       |  *    :        | 1986   2.35909  273.436  271.077
|         : *     |       :        | 1987  -4.93959  279.239  284.179
|         :*      |       :        | 1988  -5.69310  285.619  291.313
|         :       |       :   *    | 1989   9.57271  305.054  295.482
|         :     * |       :        | 1990  -1.47565  297.371  298.847
```

Output 4.31

LS // Dependent Variable is DU
Date: 8-15-1991 / Time: 13:08
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	95.125374	17.976624	5.2916150	0.000
DU(-1)	0.0617013	0.1915226	0.3221618	0.750
T	6.2750141	1.3011073	4.8228259	0.000

R-squared	0.989860	Mean of dependent var	204.5957
Adjusted R-squared	0.989109	S.D. of dependent var	59.21519
S.E. of regression	6.179705	Sum of squared resid	1031.096
Durbin-Watson stat	1.872391	F-statistic	1317.870
Log likelihood	-95.62586		

Output 4.32

LS // Dependent Variable is DU
Date: 8-15-1991 / Time: 13:09
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-64.981722	101.64019	-0.6393309	0.528
DU(-1)	0.0116288	0.1888427	0.0615792	0.951
Y	0.1624267	0.1015765	1.5990583	0.122
T	3.6941255	2.0507545	1.8013494	0.083

R-squared	0.990768	Mean of dependent var	204.5957
Adjusted R-squared	0.989703	S.D. of dependent var	59.21519
S.E. of regression	6.008878	Sum of squared resid	938.7721
Durbin-Watson stat	1.880664	F-statistic	930.0967
Log likelihood	-94.21879		

Output 4.33

LS // Dependent Variable is DU
Date: 8-15-1991 / Time: 13:09
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-65.551926	100.92278	-0.6495255	0.522
PU	2.9238075	4.7639949	0.6137302	0.545
Y	0.1599075	0.0996284	1.6050398	0.121
T	3.8346768	1.7968487	2.1341122	0.042

R-squared	0.990899	Mean of dependent var	204.5957
Adjusted R-squared	0.989848	S.D. of dependent var	59.21519
S.E. of regression	5.966255	Sum of squared resid	925.5012
Durbin-Watson stat	1.731054	F-statistic	943.5578
Log likelihood	-94.00523		

Output 4.34

LS // Dependent Variable is DU
Date: 8-15-1991 / Time: 13:10
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-144.96666	53.346759	-2.7174408	0.012
PU(-1)	-20.513068	2.4265780	-8.4534962	0.000
Y	0.2702809	0.0532622	5.0745338	0.000
T	1.7845563	0.9609420	1.8570904	0.075

R-squared	0.997537	Mean of dependent var	204.5957
Adjusted R-squared	0.997253	S.D. of dependent var	59.21519
S.E. of regression	3.103809	Sum of squared resid	250.4744
Durbin-Watson stat	1.570673	F-statistic	3509.796
Log likelihood	-74.40055		

Output 4.35

LS // Dependent Variable is DU
Date: 8-15-1991 / Time: 13:11
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-156.86280	45.030744	-3.4834601	0.002
PU(-1)	-23.982345	2.2800248	-10.518458	0.000
PU	-7.9682308	2.3286799	-3.4217803	0.002
Y	0.2980386	0.0455533	6.5426343	0.000
T	1.2318261	0.8246979	1.4936695	0.148

R-squared	0.998322	Mean of dependent var	204.5957
Adjusted R-squared	0.998054	S.D. of dependent var	59.21519
S.E. of regression	2.612149	Sum of squared resid	170.5830
Durbin-Watson stat	1.413667	F-statistic	3719.455
Log likelihood	-68.63853		

Output 4.36

LS // Dependent Variable is DU
Date: 8-15-1991 / Time: 13:11
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-161.09448	41.491284	-3.8826101	0.001
DU(-1)	0.1819819	0.0775762	2.3458475	0.028
PU(-1)	-24.995429	2.1427966	-11.664863	0.000
PU	-8.9113343	2.1809889	-4.0859147	0.000
Y	0.2882297	0.0421410	6.8396448	0.000
T	0.1702207	0.8838090	0.1925989	0.849

R-squared	0.998635	Mean of dependent var	204.5957
Adjusted R-squared	0.998351	S.D. of dependent var	59.21519
S.E. of regression	2.404555	Sum of squared resid	138.7653
Durbin-Watson stat	1.739417	F-statistic	3512.624
Log likelihood	-65.54195		

Output 4.37

LS // Dependent Variable is DU
Date: 8-15-1991 / Time: 13:12
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-168.03990	20.121352	-8.3513227	0.000
DU(-1)	0.1896324	0.0653390	2.9022823	0.008
PU(-1)	-25.142204	1.9637557	-12.803122	0.000
PU	-9.0204429	2.0651714	-4.3678907	0.000
Y	0.2947377	0.0246910	11.937071	0.000

R-squared	0.998633	Mean of dependent var	204.5957
Adjusted R-squared	0.998415	S.D. of dependent var	59.21519
S.E. of regression	2.357794	Sum of squared resid	138.9798
Durbin-Watson stat	1.759830	F-statistic	4566.661
Log likelihood	-65.56512		

```
          Residual Plot                obs RESIDUAL   ACTUAL   FITTED
|          :      |*     :         | 1961  0.36499  111.388  111.023
|          :      *      :         | 1962  0.06065  112.256  112.196
|          :*     |      :         | 1963 -2.01023  115.957  117.967
|          :      *      :         | 1964 -0.07863  117.266  117.345
|          :      |   *  :         | 1965  1.24608  137.220  135.974
|          : *    |      :         | 1966 -1.79414  138.964  140.758
|          :     *|      :         | 1967 -0.36811  150.895  151.263
|          :      |   *  :         | 1968  1.56049  155.743  154.183
|          :      |*     :         | 1969  0.43230  171.796  171.364
|          :      |   *  :         | 1970  1.24813  168.952  167.704
|          :      |      :     *   | 1971  4.58727  172.931  168.344
|          :  *   |      :         | 1972 -1.24819  179.441  180.689
|          :      | *    :         | 1973  0.68852  199.833  199.144
|          :*     |      :         | 1974 -2.09982  197.885  199.984
|          : *    |      :         | 1975 -1.77117  193.383  195.154
|          :      |      :     *   | 1976  4.70009  204.717  200.017
|          :      *      :         | 1977 -0.01306  218.586  218.599
|          :      | *    :         | 1978  0.74330  227.264  226.520
|  *       :      |      :         | 1979 -5.23551  218.526  223.761
|     *    :      |      :         | 1980 -4.31019  220.406  224.717
|          :     *|      :         | 1981 -0.37153  243.228  243.600
|          :      |      *         | 1982  2.57395  252.211  249.637
|          :      *      :         | 1983 -0.11937  258.089  258.209
|          :      *      :         | 1984  0.13871  261.658  261.519
|         *:      |      :         | 1985 -2.90988  268.557  271.466
|          :    * |      :         | 1986 -0.65999  273.436  274.096
|          :      |   *  :         | 1987  1.34823  279.239  277.891
|          :      |*     :         | 1988  0.27043  285.619  285.349
|          :      *      :         | 1989  0.04971  305.054  305.005
|          :      |      : *       | 1990  2.97696  297.371  294.394
```

4.7 Some further examples: the price and stocks equations

Finally there is the price equation or, looking at it from the other angle, the stock equation. A scatter diagram for price and stocks is given in Figure 4.11. Regression results are shown below in Output 4.38 and 4.39.

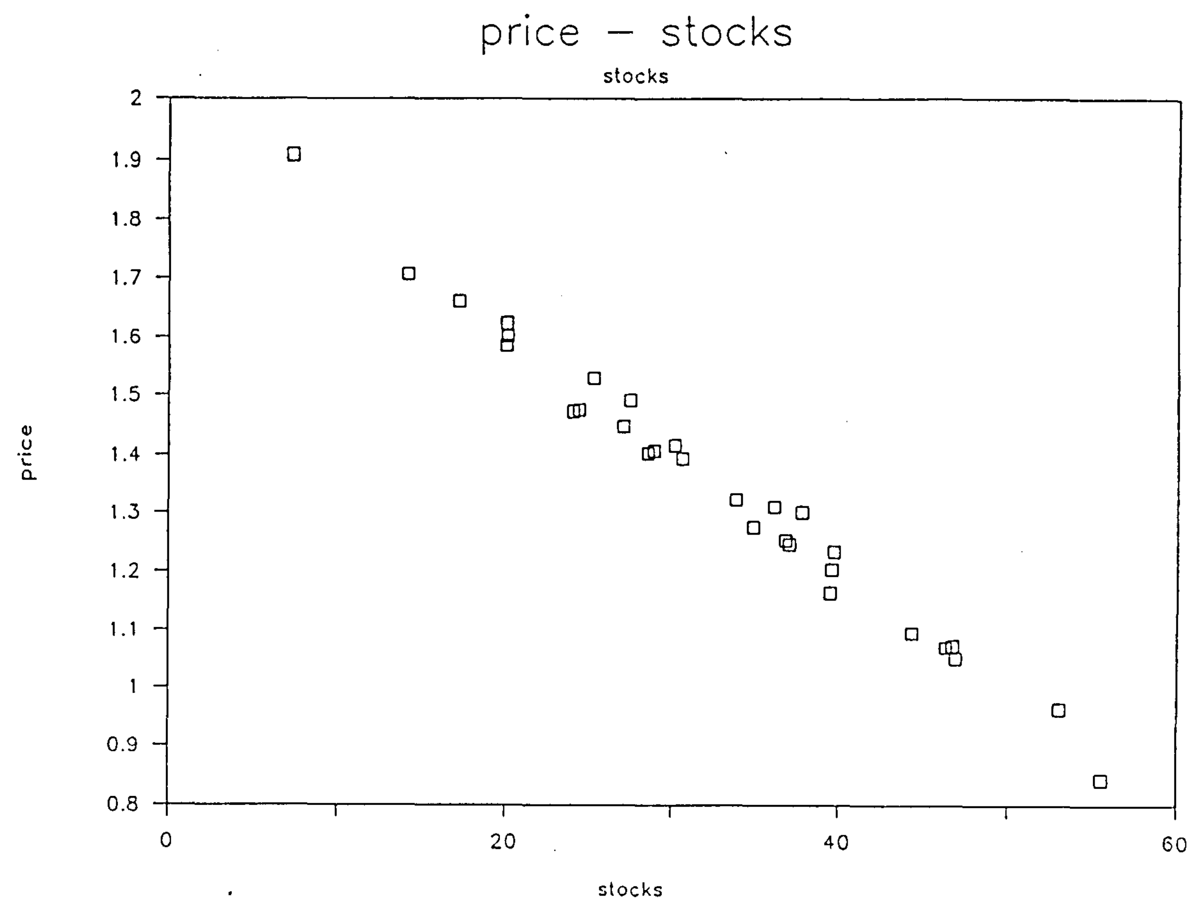


Figure 4.11

Output 4.38

LS // Dependent Variable is PU
Date: 8-15-1991 / Time: 13:13
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	2.0138436	0.0156006	129.08793	0.000
ZU	-0.0204260	0.0004535	-45.037791	0.000

R-squared	0.986384	Mean of dependent var	1.350880
Adjusted R-squared	0.985898	S.D. of dependent var	0.238299
S.E. of regression	0.028299	Sum of squared resid	0.022423
Durbin-Watson stat	2.831977	F-statistic	2028.403
Log likelihood	65.41489		

```
            Residual Plot                obs RESIDUAL  ACTUAL   FITTED
|          :     *|      :         | 1961 -0.00245  1.60113  1.60359
|          :   *  |      :         | 1962 -0.01381  1.44706  1.46087
|          :      |      :   *     | 1963  0.04408  1.90842  1.86434
|          :   *  |      :         | 1964 -0.01067  1.09604  1.10670
|          :      *      :         | 1965 -6.6E-05  1.32267  1.32274
|          :      |      :*        | 1966  0.03072  1.23362  1.20290
|          :      *      :         | 1967 -0.00118  1.66080  1.66198
|          :     *|      :         | 1968 -0.00359  1.05082  1.05441
|          *      |      :         | 1969 -0.02601  1.27499  1.30100
|          :      |*     :         | 1970  0.00450  1.39333  1.38883
|          : *    |      :         | 1971 -0.01899  1.58632  1.60531
|          :      |*     :         | 1972  0.00415  1.07042  1.06627
|          :    * |      :         | 1973 -0.00857  1.25277  1.26134
|          :  *   |      :         | 1974 -0.01719  1.40680  1.42399
|    *     :      |      :         | 1975 -0.05051  1.47197  1.52248
|          :      |      : *       | 1976  0.03480  1.31019  1.27538
|          :   *  |      :         | 1977 -0.01054  1.24634  1.25689
|          :      |      :  *      | 1978  0.03825  1.49116  1.45290
|          :      |    * :         | 1979  0.01900  1.62381  1.60481
|          :      |      : *       | 1980  0.03398  0.96452  0.93054
|          *      |      :         | 1981 -0.02901  1.40174  1.43075
|          :      |      :       * | 1982  0.05950  1.30058  1.24108
|       *  :      |      :         | 1983 -0.04085  1.47463  1.51547
|          :      |   *  :         | 1984  0.01459  1.07285  1.05826
|      *   :      |      :         | 1985 -0.04245  1.16494  1.20738
|          :      |   *  :         | 1986  0.01703  1.41529  1.39827
|          : *    |      :         | 1987 -0.01855  1.70630  1.72485
|        * :      |      :         | 1988 -0.03541  0.84391  0.87932
|          :      |      :*        | 1989  0.03097  1.52947  1.49850
|          :      *      :         | 1990 -0.00174  1.20350  1.20524
```

Output 4.39

LS // Dependent Variable is ZU
Date: 8-15-1991 / Time: 13:13
SMPL range: 1961 - 1990
Number of observations: 30

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	97.691633	1.4700690	66.453775	0.000
PU	-48.290592	1.0722238	-45.037791	0.000

R-squared	0.986384	Mean of dependent var	32.45686
Adjusted R-squared	0.985898	S.D. of dependent var	11.58675
S.E. of regression	1.375962	Sum of squared resid	53.01161
Durbin-Watson stat	2.884012	F-statistic	2028.403
Log likelihood	-51.10786		

```
           Residual Plot                obs  RESIDUAL   ACTUAL    FITTED
|          :     *|      :         | 1961  -0.28688   20.0851   20.3720
|          :  *   |      :         | 1962  -0.74040   27.0721   27.8125
|          :      |      : *       | 1963   1.78653   7.31946   5.53293
|          :    * |      :         | 1964  -0.35228   44.4111   44.7634
|          :      *      :         | 1965   0.01559   33.8346   33.8190
|          :      |      :*        | 1966   1.58201   39.7016   38.1196
|          :     *|      :         | 1967  -0.26434   17.2261   17.4905
|          :      *      :         | 1968   0.02447   46.9711   46.9467
|          :*     |      :         | 1969  -1.22267   34.8988   36.1215
|          :      |*     :         | 1970   0.19208   30.5991   30.4070
|          :*     |      :         | 1971  -1.08642   20.0008   21.0872
|          :      | *    :         | 1972   0.38995   46.3904   46.0004
|          :    * |      :         | 1973  -0.35417   36.8405   37.1947
|          :  *   |      :         | 1974  -0.87886   28.8774   29.7562
|    *     :      |      :         | 1975  -2.55370   24.0557   26.6094
|          :      |      : *       | 1976   1.73102   36.1530   34.4220
|          :    * |      :         | 1977  -0.44644   37.0585   37.5050
|          :      |      : *       | 1978   1.77932   27.4621   25.6828
|          :      |   *  :         | 1979   0.74827   20.0252   19.2770
|          :      |      :  *      | 1980   1.92103   53.0355   51.1145
|          *      |      :         | 1981  -1.45426   28.5467   30.0010
|          :      |      :       * | 1982   2.94654   37.8325   34.8860
|      *   :      |      :         | 1983  -2.08219   24.3987   26.4809
|          :      |    * :         | 1984   0.89965   46.7826   45.8829
|       *  :      |      :         | 1985  -1.95416   39.4820   41.4362
|          :      |   *  :         | 1986   0.79060   30.1369   29.3463
|          :*     |      :         | 1987  -1.14507   14.1483   15.2933
|          *      |      :         | 1988  -1.39546   55.5431   56.9386
|          :      |      *         | 1989   1.39721   25.2298   23.8326
|          :      *      :         | 1990   0.01307   39.5868   39.5737
```

Bibliography

Burger, K. and Smit, H.P. (1989), Long-term and short-term analysis of the natural rubber market, Weltwirtschaftliches Archiv, Vol. 125 (4).

Chu, Ke-Young and Morrison, Thomas K. (1986), World non-oil primary commodity markets. A medium-term framework of analysis, IMF Staff Papers 33(1): 139-184.

Conrad, J.M. and Clark, C.W. (1987), Natural resource economics, Cambridge University Press.

Ghosh, S., Gilbert, C. and Hughes Hallett, A. (1987), "Stabilizing Speculative Commodity Markets", Oxford University Press.

Grilli, E.R. and Yang, Maw Cheng (1988), "Primary Commodity Prices, Manufactured Goods Prices and the Terms of Trade of Developing Countries: What the long Run Shows", World Bank Economic Review, Vol. 2, No. 1, pp. 1-47.

Herrmann, R., Burger, K. and Smit, H.P. (1990), Commodity policy: price stabilisation versus financing, in L.A. Winters and D. Sapsford (ed.) Primary Commodity Prices: Economic Models and Economic Policy, Cambridge University Press, Cambridge.

Hwa, Erh-Cheng (1985), A model of price and quantity adjustments in primary commodity markets, Journal of Policy Modeling 7(2): 305-338.

Kanan, N., H. Smit, J. Bade, K. Burger, M. Pomp, D. Wansink (1989): Supply management of commodity exports by developing countries, Report to UNCTAD.

Labys, W. and Pollack, Peter K. (1984), "Commodity Models for Forecasting and Policy Analysis", Croom Helm, Kent.

MacBean A. and Nguyen, D.T. (1987a), Commodity Policies: Problems and Prospects, London, Croom Helm.

Pomp, M. and H. Smit (1989): Producers' cooperation for rationalization of investment and supply of primary commodities, Report to UNCTAD.

Rowe, J.W.P. (1965), "Primary Commodities in International Trade", Cambridge, Cambridge University Press, pg. 196.

Smit, Hidde P. (1984), Forecasts for the world rubber economy to the year 2000, Globe Industry report no. 2, London: MacMillan.

Smit, Hidde P. and Burger, Kees (1986), Cooperation in marketing of natural rubber: a simulation analysis of supply alternatives, Geneva: UNCTAD/ST/ECDC/34

ANNEX-10

PLANNING A COURSE OF STUDY

PLANNING A COURSE OF STUDY

Sutrisno

Workshop
The Development and Use of Computer Simulation Model
for Forecasting Supply, Demand, and Prices of Agricultural Commodities
in ASEAN Countries

August 4 - 15, 1993
Ciawi - Bogor, INDONESIA

PLANNING A COURSE OF STUDY +)

A comprehensive plan which shows the scope and teaching sequence of learning activities for a particular course is generally called a course of study. This course of study indicates the contents of the course and when or how long the various topics will be taught. A course of study is the design for instruction and is prepared by :

- assessing clientele needs,
- identifying instructional objectives,
- structuring the course content in an appropriate logical sequence.

Rational for Preparing a Course of study

* Requires instructors to think through what is to be taught.
* Communicates information about a course to others.
* Guides instructors to prepares lesson plans.
* Participants can achieve at a higher level ; participants have a greater understanding of what is expected of them.
* Sequencing the subject matter relate to the amount learned and retention of knowledge and skills.
* Helps an instructor needing to secure instructional resources.

Contents of a Course of Study

A course of study generally contains the following :

* Introductory statement specifying :
    - Course description
    - Objective(s) of the course
    - Expected output
    - Course requirements

+) Prepared by Soetrisno for used by the participants to the Training on Development and Use of Computer Simulation Model for Forecasting Supply, Demand, and Prices of Agricultural Commodities in ASEAN Countries held in Ciawi-Bogor, Indonesia from 4 to 15 August 1993. This material is adapted from L.H. Newcomb, J.D. McCracken, and J.R.Warmbrod: "Methods of Teaching Agriculture", Danville. Illinois: The Interstate, 1986.

* Sequenced course outline.

The sequenced course outline is a usable "road map" or organization of instructional content for instructors. Instruction should be logically sequenced. More basic or prerequisite skills should be taught prior to the more complex skills. Instructor should develop an order that is as educationally sound as possible. The remaining planning activity after this stage is the development of instruction plan and the continual updating of the course of study. Sequenced course outline generally contains the following:

- Instructional areas stating the major or broad topic to be taught,
- Problem areas indicating the sub-topic of the instructional area to be taught, and
- Time allocation for each problem area.

* Instructional Plan.

When planning a course of study, the instructor included problem areas for teaching a specific subject. At the time the sequenced course outline was developed, the instructor had little more in mind than the basic topics to include in the problem areas listed in the outline. The instructor begins instructional planning with the problem area as stated in the sequenced course outline. At that point, the instructor has the title and the basic subtopics in mind. This title, which is the general notion of the problem, then has to be developed. A skeleton must be constructed and then filled out. This structuring and filling out is included in the planning of the problem area which is called "instructional planning." Not only does the instructor need to decide on specific content to be taught as a part of each problem area listed in the sequenced course outline, but the instructor must also plan on ways to teach so that participants or clientele master the subject matter or content which is included in the problem area. This requires serious contemplation. Subject matter as well as teaching techniques must be selected and sequenced. Without prior planning, optimum teaching effectiveness is seldom achieved. Yet many instructors resist the disciplined effort such planning requires and quite often ask if plans need to be in writing. The written instructional plan generally contains:

I. Unit (Topic) of Instruction
II. Problem Area
III. Situation
IV. Instructional Objectives
V. Interest Approach
VI. Anticipated Problems
VII. Contents and Techniques of Instruction
VIII. Application of Learning
IX. References and Teaching Aids
X. Evaluation

Responsibility for Planning

Who should plan?

The primary responsibility for planning a course of study rests with the instructor. The instructor is to be an expert on subject matter. The Instructor should be knowledgeable concerning the needs of the clientele or participants. The needs ar often best understood by the instructor. While others can and should be involved in recommending what should be taught, the instructor is best suited to plan the course of study.

Is written plan needed?

Remember the principle of learning. "When the subject matter to be learned possess meaning, organization, and structure that is clear to students, learning proceeds more rapidly and is retained longer." This is at the heart of what developing written plans is all about. Through written plans, the instructor is bound to develop more sensible and complete organization and structure which can then be made clear to participants or clientele. Otherwise, organization is fragmented and the structure of the subject matter and learning experiences is much more imperfect.

Efficiency is gained by recording the planning before teaching a problem area. Less time is spent re-thinking, and then plan can be used for subsequent classes. The act of writing out a plan forces the instructor to process the subject mater. When instructors think through a concept thoroughly enough to figure out how best to make it clear to others, then they understand it better and are able to teach it with greater authority and clarity.

By taking time to write down the plan for teaching, the instructor is more likely to be able to draw upon and make use of more of the principles of learning. An instructor is also apt to do a better job of properly selecting and using a variety of techniques of teaching.

Annex - A

AN EXAMPLE OF A FORMAT OF
SEQUENCED COURSE OUTLINE

Program : Development and Use of Computer Simulation Model for Forecasting Supply, Demand, and Prices of Palm Oil

Institution: Agricultural Training Center, Indonesia

Instructor : Dr. X

Date : 1-30 August 1994

Instructional Areas/Problem Areas	Number of hours			
	Day-1	Day-2	....	Total
Economic Condition				
Factors affecting demand	1			1
Factors affecting supply	1			1
....		2		2
Regression Analyses				
Regression models and estimation			5	5
Aptness of the model			3	3
....				
Data entry and transfer			4	4
....				
....				
ETC.....				

Annex - B

INSTRUCTIONAL PLAN EXAMPLE

I. UNIT OF INSTRUCTION: Regression Analyses

II. PROBLEM AREA : Aptness of the model

III. SITUATION: The participants have studied regression analyses some years ago during their graduate studies. Refreshing some of the important aspects of testing the model is essential in gaining better understanding for forecasting.

IV. INSTRUCTIONAL OBJECTIVES:

Upon completion of this problem area, the participants will be able to:

A. Examine the aptness of the model for the data before further analysis based on that model is undertaken
B. ....
C. ....

V. INTEREST APPROACH:

Show residual plots in a model to examine randomness in the residuals arranged in time order. Ask the participants what the graph means to the aptness of the model.

VI. ANTICIPATED PROBLEMS:

The interest approach should lead to the identification of such problems as:

A. What is aptness of the model?
B. How can departures from the model be identified?
C. What remedial measures can be undertaken?
D. ....etc.

VII. CONTENTS AND TECHNIQUES OF INSTRUCTION:

Summary of Content	Teaching Technique
A. What is aptness of the model? Give definitions of the term. Describe the importance in examining the aptness of the model. Etc...............	Show transparency and explain
B. How can departures be identified? 1............................ 2............................	....
C. ETC......................	....

VIII. APPLICATION:

Participants are given opportunity to practice identifying departures and correcting it.

IX. REFERENCES AND TEACHING AIDS:

A. References
   1. Neter,...: Applied Linear Model.....
   2. Etc....................

B. Teaching aids
   1. Transparencies
   2. OHV
   3. ETC............

X. EVALUATION:

A written evaluation sheet will be given by the end of the training.

=end/sws=

ANNEX-11

PROJECT DOCUMENT (INT/92/KO4)

PROGRESS REPORT OF
PEREZ - GUERRERO TRUST FUND (PGTF)
ON THE DEVELOPMENT AND USE OF
A COMPUTER SIMULATION MODEL FOR FORECASTING SUPPLY, DEMAND, AND PRICES OF AGRICULTURAL COMMODITIES IN ASEAN COUNTRIES

AS AT 31st DECEMBER 1993

PGTF PROJECT MANAGEMENT
MINISTRY OF AGRICULTURE
REPUBLIC OF INDONESIA

ANNEX-11

DESCRIPTION OF SERVICES

PROJECT INT/92/K04 · The development and use of a computer simulation model for supply, demand and price of agricultural commodities in ASEAN countries.

Work to be performed by the sub-contractor

The project aims at development and use of a computer simulation model for supply, demand and prices of agricultural commodities in ASEAN countries, e.g., frozen chicken meat, frozen prawn, canned pineapple, palm oil, rubber, forestry products, tapioca, coconut oil, canned tuna, carrageenan, cocoa and pepper. The resulting simulation model would provide an opportunity for member countries of the Group of 77 to develop their own ability in forecasting supply, demand and prices of their agricultural commodities.

The projects seeks to improve policies and plans of production, development as well as trade of major agriculture export commodities in ASEAN countries and to improve forecasting methods and information on supply, demand and prices of major ASEAN agriculture export commodities.

Terms of reference

1). The first output for this project is computer simulation model construction. To produce this output activities such as data collection for construction of a computer simulation model for forecasting and projecting supply, demand and prices of major agriculture export commodities will be implemented by consultants. The consultants will also prepare documents with detailed description of the model and its use, economic interpretation and a manual to be used for training in the use of the model.

2). The second project output is trained commodity analysts (20 trainers and 120 officers) capable of using the computer simulation model for forecasting supply, demand and prices of agriculture export commodities in ASEAN countries. The activities will be divided into two kinds of training viz ASEAN Training for Trainers and National Training for Commodity Analysts :

A. <u>ASEAN Training for Trainers</u>

The purpose of the training will be to present the simulation model in detail to the participants, through explaining and discussing the economic interpretation of the model and training in installing and operating the model. The computer simulation model will be developed and made available to the participants, completed with its data base on floppy disks to be used on a personal computer, including a detailed description, documentation, structure and economic interpretation.

A two-week training will be held in Jakarta. The trainees should be qualified participants from relevant Government office and private organizations from all ASEAN member-countries.

B. <u>National Training for Commodity Analysts</u>

Following up of the ASEAN Training of Trainers, regular activities to update and improve the model and forecasts will be continued in each participating countries through a National Training for Commodity Analysts. For these purposes, the trainees will become instructors for the National Training of Commodity Analysts in their respective countries. Inputs for the activities will be borne by each

ASEAN countries, such as the training cost and computer hardware for the training.

Preliminary contents and programme is as follows:

1. Introduction review
2. Modelling of commodity markets
   - Model structure
   - Model of supply
   - Model of demand
   - Model of prices
3. Regression Analysis
   - Equations models
4. Regression software use time series package (TSP).
   - Data generate
   - Graphs
   - Regression analysis
   - Exercises
5. Computer simulation
   - Supply analyst
   - Demand analyst
   - Price analyst
   - Simulation exercises

6. Computer simulation model of market for agricultural export commodities.
   - Data input
   - Specification
   - Parameter changes
   - Simulations and forecasts in Lotus
   - Exercises
7. Changing the model
   - Re-estimation with regression analysis
   - Further simulations
8. Discussion of model simulation results
   - Model structure
   - Applicability for policy use
   - Improvements
   - Further action

9. Further activities
   - Planning data exchange
   - Cooperation between participants and with consultants

3). The third project output is a computer-base system (installed computer hardware and software) for forecasting supply, demand and prices of agricultural export commodities in ASEAN countries. An overview of project activities and outputs and a preliminary workplan are given in table 1 and 2 below :

The funds from the Perez-Guerrero Trust Fund are aimed at financing the following :

<u>Personnel</u>

National consultant 12 man months.

<u>Equipment</u>

One personal computer with hard disk, printer and other equipment.

<u>Data Collection</u>

Data collection and processing for computer simulation model construction.

<u>Training</u>

Travel cost for the participants from ASEAN countries, training facilities, accommodation, perdiem and instructors.

<u>General Operating Expenses</u>

General operating expenses related to the project, including preparation, reproduction of documents, budget for secretariat assistance, local transportation and cost of communication.

A more detailed breakdown of these expenditures is given in Attachment 2.

Attachment 2

SCEDULE OF SERVICES AND FACILITIES TO BE PROVIDED BY THE SUB-CONTRACTOR

No.	Activities	Details of Expenditure	Amount ($US)	Source of Funding
1	Data Collection	Team members	3,000	PGTF
2	Construction of a Computer Simulation Model Implementation	Consultants		PGTF
	Local Consultant	2x6x US$ 750	9,000	PGTF
3	ASEAN Training for Trainers	- Airfare Participant from		PGTF
		Thailand 2xUS$950	1,900	
		Malaysia 2xUS$476	952	
		Philippines 2xUS$1.214	2,428	
		Singapore 2xUS$414	828	
		Brunei Darussalam 2xUS$540	1,080	
		Indonesia 5xUS$150	750	
		- Accommodations (US$100/day/person) 15 x 12 x US$100	18,000	
		- Perdiem US$50/day/person 15 x 12 x US$50	9,000	
		- Local Travel US$5,000	5,000	
		- Training Facilities US$4,000	4,000	
		- Honorarium for Instructor (US$50/hour) 12 x 8 x US$50	4,800	PGTF
4	Procurement	- One Wearnes 486DX2-50 PC 4MB RAM, 200MB HDD, 2 HD FDD, SVGA monitor, mouse, HP Deskjet 550C printer, table, chair & accessories. US$6,162 (1xUS$6,162)	6,162	PGTF
5	Secretariat		10,200	PGTF
6	Project Evaluation		2,500	PGTF
7	Dissemination of Report	- Report (US$2,000)	2,000	PGTF
		Total PGTF contribution	81,600	

TABLE 1. OVERVIEW OF PROJECT ACTIVITIES AND OUTPUTS

	Activities	Purpose of Activities	Duration	No of Participant	Source of Fund	Output
1	Notification to ASEAN Countries	To solicit agreements for participants from ASEAN Countries	2 months	-	-	List of countries willing to participate in the project
2	Appointment of Consultant	To hire consultant to construction of the model	2 months	-	-	Consultant hired
3	Procurement of hardware and software	This is needed for development of model	2 months	Project management	PGTF	Computer hardware and software installed
4	Data collection	To Construct of a Computer Simulation Model	1.5 months	5 participants from Indonesia	PGTF	Data production Export/Import, Stcok, Supply Demand and Price
5	Model Construction	To detailed description of the model	4 months	Consultant National	PGTF	Computer Simulation Model Construction
6	Training					
	6.1. ASEAN Training for Trainers	To train the trainers who will in turn train participants in their respective countries in the use of a Computer Simulation Model for forecasting supply, demand and price of agricultural commodities	12 day	5 participants from Indonesia	PGTF	- Commodity analysts (15 Trainers) - Trained Persdnnel who will be trainers in respective countries
	6.2. National Training for commodity analyst in respective countries	Enable the trainers to train other officers in respective countries	16 days	Varies according to the needs and resources of the countries	Local	- Commodity analysts (120 officers)

TABLE 2 WORKPLAN AND PRELIMINARY TIME SCHEDULE

No.	ACTIVITY	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
1	Administrative	....	....	....	....	....	....	....	....	....	....	....	....
	- notification to ASEAN countries	....	....										
	- Appointment of consultants	....	....										
	- procurement		....										
2	Data collection			....	....								
3	Construction of the model by the consultnats				....	....	....	....					
4	Issue of invitations					....	....	....					
5	ASEAN Training for Trainers								....				
6	Preparation Training of Commodity analyst in respective countries									....	....		
7	National Training of Commodity Analyst in respective countries											....	....
8	Evaluation and Dissemin-ation of report								....				....