Agricultural Sector Modelling

Proceedings of the 16th Symposium
of the
European Association
of Agricultural Economists (EAAE)
April 14th – 15th, 1988
Bonn, FRG

edited by
Siegfried Bauer and Wilhelm Henrichsmeyer

Wissenschaftsverlag Vauk Kiel KG
1989

CIP-Titelaufnahme der Deutschen Bibliothek

Agricultural sector modelling:
April 14th–15th, 1988, Bonn, FRG / ed. by Siegfried Bauer and Wilhelm Henrichsmeyer. –
Kiel: Wiss.-Verl. Vauk 1989

(Proceedings of the ... symposium of the European Association of Agricultural Economists (AEEA); 16)
ISBN 3-8175-0028-9

NE: Bauer, Siegfried [Hrsg.]; European Association of Agricultural Economists: Proceedings of the ...

WG: 39;44;17 0537	DBN 89.067760.3 bai	89.03.30

Wissenschaftsverlag Vauk Kiel KG
P. O. Box 4403, 2300 Kiel 1
Germany, F. R.

ISBN 3-8175-0028-9

Druck und Verarbeitung:
pep, pocket edition printing GmbH, Darmstadt,
Tel. 44078

TABLE OF CONTENTS

Page

Editorial Remarks and Introduction 1

PART I: AGRICULTURAL SECTOR MODELLING IN OVERVIEW

Historical Review, Experiences and Perspectives in Sector Modelling 3
S.BAUER (FRG)

Some Views on Agricultural Sector Modelling 23
M.KEYZER (NETHERLANDS)

PART II: ECONOMETRIC MODELS

An Econometric Model of the French Compound Feed Sector 31
Y.SURRY (CANADA)

Importance of Risk in the Acreage Supply Decision of Italian Rice Producers 43
P.BERNI, D.BEGALLI, F.PERALI (ITALY)

WASMODEL-2: A Disaggregated Agricultural Sector Model 53
A.OSKAM, A.REINHARD, G.THIJSSEN (NETHERLANDS)

PART III: SECTORAL PROGRAMMING MODELS

Concept and Application of an Agricultural Sector Model for Policy Analysis in Turkey 71
H.KASNAKOGLU (TURKEY),
S.BAUER (FRG)

An Interregional Equilibrium Model to Evaluate the Impact of Agricultural Policy Measures or Development Projects on the Agricultural Sector in Developing Countries: Case Study 85
G.VERGANI (SWITZERLAND)
C.BOGAHWATTE (SRI LANKA)

Goal Conflicts in the Norwegian Farming Industry:Allocational Loss through the Pursuit of Non-Efficiency Goals 97
R.J.BRUNSTAD, E.VARDAL (NORWAY)

Page

PART IV: FARM BASED MODELLING CONCEPTS

Experiences with Farm Sample Models in Sector Analysis 103
C.H. HANF, C.NOELL (FRG)

Consumption of Farm Households and Agricultural Sector Modelling: Experiences for the FRG 113
H.SCHRADER (FRG)

Income and Profitability Analysis based on Farm Models 125
U.JORNER, S.NILSSON (SWEDEN)

Cost Calculation based on RICA Data 141
P.MAIRE (FRANCE)

Combination of an Animal Breeding Simulation Model with a Sector Model 147
F.MUEHLENBACH (SWITZERLAND)

Markov Chain Modelling of Differentiation of Farms 157
C.LIGETI, M.DOBOS (HUNGRY)

PART V: NATIONAL AND INTERNATIONAL MULTI-MARKET MODELS

A Multi-Market Model for Policy Impact Assessment 165
K.M.ORTNER (AUSTRIA)

Overview of the OECD Ministerial Trade Mandate Model 171
M.HARLEY (FRANCE)

PART VI: SPECIAL POLICY MODELLING ASPECTS

Simulation and Optimisation in Agricultural Policy Analysis: The Case of the British Potato Market 175
C.T.ENNEW, B.WHITE, A.J.RAYNER, G.V.REED, J.A.H.TAYLOR (UNITED KINGDOM)

Modelling National Interests in International Agricultural Policy 183
R.HERRMANN (FRG)

Experiences with Agricultural Policy Models for Centrally Planned Economics 193
C.CSAKI (HUNGARY)

Page

PART VII: SPECIFIC METHODOLOGICAL ASPECTS AND MODELLING CONCEPTS

On Agricultural Production Functions 207
J.M.BOUSSARD (FRANCE)

Model for Aggregation and Control of Crops Supply 219
P.-A.JAYET (FRANCE)

Threshold Price, Expected Price and Aggregation of Micro Markets 233
Y.Le ROUX (FRANCE)

A Differential Approach to Modelling the Agricultural Sector 253
F.B.SOARES (PORTUGAL)

PART VIII: DUALITY THEORY BASED MODELLING CONCEPTS

Economy and Technology of the French Cereal Sector: A Dual Approach 261
M.GUYOMARD, D.VERMERSCH (FRANCE)

Modelling Dynamic Adjustment Subject to Integrability Conditions 279
V.E.BALL, A.SOMWARU, U.VASAVADA (USA)

PART IX: EXPERIENCES WITH COMPREHENSIVE SECTOR MODELLING SYSTEMS

Modelling Alternative Common Agricultural Policies 287
C.FOLMER, M.A.KEYZER, M.D.MERBIS, H.M.E.SCHWEREN, P.J.J.VEENENDAAL (NETHERLANDS)

The EC Grain Price Policy at the Core of the CAP 307
L.MAHE (FRANCE)
K.J.MUNK (DENMARK)

Some Lessons from the Dynamic Analysis and Prognosis System (DAPS) 325
S.BAUER (FRG)

Page

PART X: ROUND TABLE DISCUSSION: CONCLUSIONS AND OUTLOOK (Introductionary Statements)

Methodological Aspects 345
J.-M.BOUSSARD (FRANCE)

Data Requirements and Evaluation 347
H.KASNAKOGLU (TURKEY)

Data-base Management in Relation to Economic Modelling 349
M.KEYZER (NETHERLANDS)

Policy Requirements and Dialogue with Modellers 351
A.BUCKWELL (UNITED KINGDOM)

Research Organization and Cooperation in the Field of Agricultural Sector Modellin 355
C.-H.HANF (FRG)

PART XI: WORKSHOP SESSION: SECTORAL PRODUCTION AND INCOME MODEL (SPEL)

Concept and Overview 359
W.HENRICHSMEYER (FRG)

Base Model 365
W.WOLF (FRG)

Short-term Forecast and Simulation System 375
W.WOLF

Medium-term Forecast and Simulation System

Introduction and Overview 379
W.HENRICHSMEYER(FRG)

Supply Component 385
H.WOLFGARTEN (FRG)

Demand Component 391
P.FERBER (FRG)

Market Component 395
P.FERBER, H.WOLFGARTEN(FRG)

Base Model (Version B): Feed Component 399
H.-T.ERKES, H.-P.WITZKE (FRG)

EDITORIAL REMARKS AND INTRODUCTION

The 16th Symposium of the European Association of Agricultural Economists was held at Bonn-Röttgen from April 15 - 16, 1988. This Symposium was organized by the editors of this volume on the subject of "Agricultural Sector Modelling". There was a surprisingly high degree of interest shown in the subject, which led to an unexpectedly large number of applications, from which about 120 participants were finally able to participate.

The volume contains the main papers of the plenary sessions, the contributions presented at parallel workshop sessions, a number of selected contributed papers and the introductory statements of the round table discussion at the end of the official symposium. In addition, the papers of the supplementary informal meeting on the SPEL model are included.

The range of contributions for this first seminar on "Agricultural Sector Modelling" far exceeded our expectations. More than 80 papers were applied by researchers from all over Europe and many from overseas. This shows the rapidly increasing interest of our profession in quantitative sector analysis. At the same time it created some minor problems with respect to the organization of the seminar and publication of its results.

When scheduling the seminar we had envisaged a much smaller number of participants and a more strictly defined concept concerning a workshop, focusing on theoretical aspects of and empirical experience with promising models for the agricultural sector. But the response showed that many of the colleagues from different parts of Europe had a much broader definition of "Agricultural Sector Modelling" than we had in mind. The subject "Agricultural Sector" itself was interpreted very liberally, and often a bias towards the farm and single commodity level was evident. As a result papers ranged from the national rice and potato market to the international coffee market and the European sector level. The contributed papers covered a variety of interesting aspects and methodological approaches, and quite a number were delivered by committed young researchers. The most encouraging contributed papers are also published in this volume.

The structure of this volume has been slightly rearranged in relation to the programme of the Seminar. We decided to follow a pattern based on the main methodological approaches explored in the papers. We are aware of the problems of such an arrangement, but any other structure would be fraught with difficulties.

The volume has been produced by using the Word Processing Technology currently most commonly applied to personal computers. Most of the authors delivered their papers on diskettes, apparently using very different processing types. This involved unexpected problems with this new technology and some delay in the publication process. The editors gratefully acknowledge the active help of Ms.

PART III: SECTORAL PROGRAMMING MODELS

CONCEPT AND APPLICATION OF AN AGRICULTURAL SECTOR MODEL FOR POLICY ANALYSIS IN TURKEY

H. KASNAKOGLU and S. BAUER
Middle East Technical University, Department of Economics (Turkey)
University of Bonn,Institute for Agricultural Policy (F.R.Germany)

1.Introduction

A systematic and comprehensive analysis of the agricultural sector and hence development and evaluation of related policies have not been in par with the importance of the this sector in the nation's economy. Despite the availability of relatively rich sources of data when compared to other countries, even today there does not exist an integrated data system in Turkey which covers the agricultural sector as a whole and integrates the sector with the rest of the economy and with the foreign countries. While the lack of information and appropriate tools for policy analysis has long been realized by policy makers and related agencies such as the State Planning Organization, Ministry of Agriculture, etc., not much distance was traveled towards its elimination. The search for the "best" agricultural sector model on the one hand and futile efforts to form a "perfect, all comprehensive" data base before any formal analysis, has continued for years by different agencies. The realization of the importance of appropriate information and policy tools and interactions between these tools and the databases, has resulted recently in a shift in emphasis from a search for "perfect model and all data" to "operational model and relevant data". In these lines, more systematic agricultural sector and policy analysis have been initiated by the Ministry of Agriculture and the World Bank as a first step towards the development of operational tools and to acquire the necessary experience.

In addition to the general necessity for employing sector modelling as a tool for current policy decisions as in any other country, there are a number of special reasons for intensified sector modelling and analysis investigation in Turkey. Among others one can point out the following:

- The agricultural sector as well as the Turkish economy is claimed to be a take-off development stage with enormous implications for adjustments. Large investments projects (such as irrigation, improvement in livestock) are underway. The impact of such policies on the agricultural sector and the economy in general cannot easily be foreseen.

- The economic policies of the recent years are oriented towards liberalization and free markets in the international and domestic fronts.

- Turkey has applied for full membership in EC. In this process, several adjustments need to take place regarding the structure of domestic and foreign trade both prior and after the entry to EC.

In the following sections we will present a brief overview of the agricultural sector in Turkey, followed by a description of an agricultural sector model (TASM) which is proposed as a tool for sector and policy analysis. Finally, some preliminary results of TASM will be presented.

2. An Overview of the Agricultural Sector and Policies in Turkey

Despite a steady decline in relative importance over the past four decades, the agricultural sector still continues to be an important component of Turkey's economic activity. Agricultural sector in Turkey today is characterized by richness in natural environment and the challenges and implications of new development strategies on structural, social and political adjustments. Below, we summarize some of these characteristics to provide a background for TASM (for more details on Turkish agriculture see Kasnakoglu, GÜrkan 1987, Kasnakoglu, Akder and Gürkan 1987).

- Over the past decade, the share of agriculture in the overall GNP has declined from 43% in 1950 to 22% in 1980. The agricultural sector however still provides employment opportunities for most of the population. 60% of the active population in 1980 was employed in agriculture as compared to 75% in 1950. Therefore, the social implications of developments in agriculture go beyond its share in GNP.

- Turkish agriculture contributes about 25% to total exports (1985) directly and about another 35% indirectly through agricultural based industries (processed products). Compared to the nearly 60% contribution to foreign exchange earnings, the imports of agricultural and food products constitute only about 6% of the foreign exchange spending. One should however not view the difference as agriculture's net contribution to foreign exchange earnings since the agricultural sector still depends on imports for some of its inputs, such as chemical fertilizers, pesticides, machinery and seeds in varying degrees.

- In various studies (World Bank 1983, World Bank 1985, Le-Si, Scandizzo and Kasnakoglu 1983, Akder 1985, GÜrkan and Kasnakoglu 1986 and Aktan and Baysan 1985) it has been shown that Turkish agriculture is highly competitive in the world markets. International trade and related policies constitute therefore an important element in an agricultural sector model for Turkey because of their direct and indirect effects on agriculture.

- A wide variety of commodities are produced in Turkish agriculture, which compete for the same resources and are interrelated as complements or substitutes on the demand side. Of the approximately 125 crops, excluding livestock, 40 major ones constituting over 95 percent of the agricultural crop value or area are incorporated in the model to be presented below. It is clear that when so many closely interrelated commodities are considered, partial analysis are bound to have significant limitations.

- Productivity in Turkish agriculture, when compared to EC countries, is still relatively low. In the case of labor, low productivity can partly be explained by disguised unemployment in rural areas. Yields in crop production vary regionally, and to a large extent with the irrigated and dry farming systems. The national average is nevertheless is still low with EC standards. This is even more true for livestock production, where the share of improved breeding herds is low and has been increasing only slightly over time. It follows that, the agricultural technology has to be specified very carefully in an applied sector model.

- The sector is mainly characterized by small scale family farming, in which mechanization has been accompanied by rental arrangements or unused capacity. Since the farm structures and man-land ratios did not adopt to increasing mechanization and due to lack of significant help from outside agriculture in the form of employment opportunities, disguised unemployment has increased. This situation of low marginal value of labor and increasing mechanization is difficult to explain with conventional economic models, and unless one introduces elements from farm-household models.

- Agricultural sector is characterized by interventions both in the domestic input, output and international markets. All major agricultural products constituting nearly 90% of the value of production are under the government support program. There are four ministries and 20 semi-autonomous agencies directly involved in the formulation and administration of agricultural price policy and in the processing and marketing of agricultural products. In general, the price policies in agriculture, aims at stabilizing prices and incomes. Modern agricultural inputs, on the otherhand, have been substantially subsidized until 1980's. Government is also engaged in the production and distribution of inputs and controls imports. Over the last years, input subsidies (for example in fertilizers) have been substantially reduced and support prices increased relatively less in real terms, resulting in lower use of some modern inputs and hence a slow down in yields and production. Government is also actively involved in the agricultural credit markets, as a supplier and regulator.

- The foreign trade policy follows a liberalization course, and the foreign exchange regime is expected to be complemented with a freely fluctuating exchange rate before the end of this year. The impact of these policies and that of membership in EC are topical issues in the public and at the policy making levels.

3. Basic Structure and Features of TASM

3.1. Basic Features of TASM

The work on TASM began in 1981, in connection with a World Bank mission to Turkey (World Bank 1982). The initial version has been updated and modified, among others, the livestock sector was extended, crop rotations were introduced, main inputs were specified on a quarterly basis and risk was incorporated in the Le-Si, Scandizzo and Kasnakoglu; 1983 version. The version of TASM we introduce in this paper, relies heavily still on a later version developed by Kasnakoglu and Howitt; 1985 and Kasnakoglu 1986, which among other things incorporated nonlinear cost structures and solved the problem as a non-linear programming problem as opposed to linearized earlier versions and utilized the positive quadratic programming approach developed by Howitt and Mean; 1985 to validate and calibrate the model (A comparison of the different versions of TASM can be found in Kasnakoglu 1986). The present version differs from the earlier versions in the following respects:

a. The model is not only specified for a single base year, but for eight base periods from 1979-1986. This allows for a more realistic model calibration and validation, as well as a consolidated forecasting and policy simulation approach.

b. The conceptual framework and the data base system are developed to permit continuous updating. Instead of a one time exercise, a continuous model application following the rolling plan principle is intended.

c. The present version of TASM relies more heavily on non-linear relations within a mathematical programming approach, and incorporates non-linearities in imputed factor prices beyond those for land

d. Finally, the new version of the model contains a more flexible and realistic structure for the feed and livestock sector, building on the Alternative Livestock version of TASM in Le-Si and Evans; 1983.

3.2. Basic Structure of TASM

The basic structure of TASM which is basically a mathematical programming model for the Turkish agricultural sector is summarized in Figure 1. A mathematical formulation of a slightly different earlier version can be found in Kasnakoglu; 1986. The model incorporates production activities which account for over 90% of the value of agricultural production in Turkey. Agricultural supply and the domestic and international demand components are represented within its commodity balances. The most important factor markets and linkages to the commodity markets are explicitly taken into account. Additionally, various intermediate flows, e.g. between crop and animal production, are incorporated. The objective function maximizes the sum of consumer and producer surpluses, plus net exports as defined within the model. The core of the model consists of production activities, resource constraints and a matrix of input-output coefficients. As far as possible, the data base has been constructed from, published and unpublished official statistics, to permit easy updating for future policy simulations. But the data employed was subjected to a critical consistency check prior to base runs and during the base calibration runs.

3.2.1. Summary of the characteristics of the linear parts

The model contains 55 agricultural commodities which are marketed and 15 intermediate commodities. A relatively large number of marketable commodities, compared to northern European countries, are fruits and vegetables.

Agricultural production technology is modelled by a set of 120 production activities. For all crop production activities, two levels of mechanization (animal power and tractor based) are considered. Additionally, a large number of production activities are differentiated according to dry and rainfed farming. While in principle single crop activities are considered, there are also fallow rotations and multiple crop (more than one crop per year) rotations.

Marketable production can be provided by alternative activities to allow for factor substitution. At the same time, complementary by-products, like straw, concentrates are considered. The livestock production activities provide milk, meat, wool, hide and eggs in fixed proportions.

The model differentiates between eight land categories, quarterly labor and machinery inputs, as well as fertilizer and seed inputs. There are several constraints which present internal linkages: Feed can be supplied from pasture and fodder crops (competition with land use for marketable products), as by- products of the agricultural production (straw) and of the processing activities (concentrates). Grain can be used for feeding animals in competition with domestic and foreign demand. Feed demand is broken into several categories to ensure proper feed rations. The livestock and crop sectors are also linked by supply and the use of animal power.

Commodity balances ensure, that the total supply matches total demand. Besides domestic supply, some commodities can be imported at a given import price and/or import quota. On the demand side, there are domestic demand for human consumption, generated through the demand curve, cereal demand for feeding animals and export demand in raw and processed forms.

The input-output coefficients are derived from official statistics, based on a special production-cost structure survey, which in our opinion is an important and rarely available asset for these kinds of models.

3.2.2. Non-linear Model Elements

Mathematical programming models have first been used at the micro level, especially for farm planning purposes. Then, the basic microeconomic approach has been adapted to sectoral and national analysis with some modifications. However, the economic conditions faced at the aggregate level differ significantly in many respects from those at the farm level:

- While the single farmer is in general faced with given output and input prices, at the sectoral level prices have to be explained by the operation of the market mechanism (aggregate supply and demand) as well as policy interventions.

- At the sectoral and even at the regional or farm group level, serious aggregation problems exist, due to the fact that, the natural and economic conditions vary from region to region and from farm to farm. The aggregation problem as defined in Day; 1963; does not have an operational solution. Therefore, if no additional calibration constraints are introduced, a sectoral model leads to a higher specialization of agricultural production than observed in reality. If on the other hand additional calibration constraints (behavioral constraints) are introduced, it is very likely that the real resource restrictions will not be binding and will have zero shadow prices. In both cases, such models are not very suitable for policy analysis.

- Finally, we have to realize the different purposes for which the farm and sector models are built. While the farm model is mainly applied for planning purposes (normative inquiry), the sectoral model has to explain and forecast sectoral developents in a positive sense. The task is therefore a challenging one of properly modelling farmers' behavior at the sector level.

In most of the applied agricultural sector models, ad hoc assumptions like the introduction of flexibility constraints, or restrictive crop rotations are employed to overcome these problems. The implications of such ad hoc considerations are in many cases not stated explicitly (implicit behavioral rules, features of supply and demand functions).

Our experience with TASM, suggests that, the incorporation of non-linear relationships into mathematical programming models may be one way of dealing with these problems. With the availability of powerful programming packages which can even be used on PC's for medium sized problems in the recent years, computational problems of applying non-linear programming are less serious. There is however the additional problem of estiating the non-linear model parts. Since the specification of the linear parts is itself a difficult job, it is sometimes argued that the estimation of the non-linear parts is nearly impossible, and even more so if the data base is poor. Based on our experiences with TASM, we tend to support the opposite view: A linearized model has to be specified in more detail, because of its discontinuous response features, which results in a number of problems if the base data is insufficient. On the other hand, if one accepts some basic theoretical relationships, it turns out that, a non-linear model may help to overcome at least some of the problems implied by a linear model and poor data base (For a more detailed discussion of these issues see Bauer and Kasnakoglu 1988).

While in conventional linear programming models either demand quantities (cost minimization) or output price (profit maximization) are assumed to be given, TASM employs price elastic domestic demand functions and consequently maximizes the sum of consumer and producer surplus. This formulation also allows for the incorporation of price and market intervention regimes, such as foreign trade policies, quota systems, support prices, etc.

The demand functions are estimated at the farmgate level, using price elasticities, base year consumption (production - exports+ imports - seed use - feed use - increase in stocks) and farmgate prices. The price elasticities are calculated from income elasticities using Frisch method (Le-Si, Scandizzo and Kasnakoglu; 1983). For forecasting and policy analysis, the demand curve is repositioned to account for population and income effects, using parameters estimated from base solutions.

The assumptions about factor fixities play a crucial role in programming models and the responsiveness of agricultural supply is to a great extent determined by these assumptions. For medium and long run analysis, only few factors are completely fixed (land to certain degree and sometimes labor). Other factors are available at given prices (i.e, fuel) or on a given supply function (i.e., fertilizers and feed). Even in the case of fixed factor availability, standard sectoral programming models may lead to misleading results. That is almost always the case, if the supply from the given stock depends on the return to the actual factor use, when the employment of the given factor stock involves costs (e.g. waiting costs, repair and maintenance); or when the marginal utility of less work is not equal to zero (leisure). Therefore, a functional relationship between the relative employment of factors in agriculture and their marginal values may be assumed at the sectoral level. This is true especially for labor, tractors and machinery use. For example, in the case of labor, we have attempted in TASM to introduce some basic results obtained from agricultural firm-household models. The procedure applied for the estimation of the necessary parameters and the implications on the responsiveness of the linear programming models are discussed in Bauer and Kasnakoglu; 1988. In relation to conventional programming models, this formulation also leads to more continuous response to changed exogenous variables.

In order to overcome the serious problems of validation in programming models and to avoid discontinuous response, non- linear cost functions are introduced into the model. This approach first applied by Howitt and Mean; 1985, is based on a two step model specification procedure. In the first step, a conventional programming model is extended by a set of calibration constraints. The shadow prices of these calibration constraints are then used to derive the parameters of the non-linear (in our case quadratic) cost function part. In the second step, these non-linear parts are added to the other linear or non- linear terms of the objective function and the calibration constraints are removed. The final model calibrates exactly with the given production level in the base year (See Bauer and Kasnakoglu 1988 for more details). This is even the case when the model contains only a minimal set of real resource constraints. In free trade versions of TASM presented below, only agricultural land is an absolute binding constraint, since labor and machinery use are modelled by price responsive supply functions.

These non-linear relations have proven to be useful for operational calibration and practical applications of TASM, with relatively large number of commodities and limited data base. However we have to note that, the cost implied in the non linear part cannot be explicitly attributed to different factors of production. Additionally, it has to be emphasized that, this approach needs a careful specification of the linear model part, the input and output coefficients.

4. Some Preliminary model Results

The version of TASM presented in this paper has been specified and tested for the base periods 1979-1986. Some results for these base runs (shadow prices, cost structure, quadratic cost function terms are presented in Bauer and Kasnakoglu; 1988.

For real policy applications,a forecasting version based on parameters estimated from the base runs is presently being developed. Additionally, the reliability of the model has been tested by carrying out several "hypothetical" policy runs. In the following pages, some results of a free trade run with alternative world prices will be presented.

As a background information, we should point out that Turkey has suffered from very high rates of inflation 50-100% in the base periods. Under such circumstances it is almost impossible to work out stable relationships in nominal Turkish Lira terms, which can be used for forecasting and policy analysis. We have therefore converted all national prices and values into US- Dollars using the average official exchange rates. Despite the improvements over the past few years, Turkish Lira is still overvalued, and the switch to a freely fluctuating exchange rate regime is in the agenda of the present government. In the realization of this switch, Turkish exports are expected to be more competitive and imports more expensive.

In order to examine the impact of these policies on agriculture, we have first removed all trade restrictions (quotas, taxes, subsidies, public enterprise trade policy) and modelled a so called free trade base scenario (Tables 1-6).Due to nearly 100% inflation and significant changes in the exchange rate, commodity specific exchange rates resulting from the seasonality of exports and imports deviate from the average exchange rates. With these reservations in mind, we have nevertheless used, average exchange rates for the first preliminary simulations.

In relation to the free trade run based on the official exchange rate in 1986, several runs with alternative world agricultural prices are carried out:

- 10% increase in the world market prices
- additional 20% increase in the world market prices (32% over the base)
- additional 30% increase in the world market prices (72% over the base)
- additional 49% increase in the world market prices (140% over the base).

The last alternative is mainly to test the reliability of the model under extreme conditions. Also, the results presented should not directly be taken for policy conclusions, because several trade restrictions, which are even under principally free trade conditions must be considered (international marketing, quality, product differentiation, limitations in processing). Finally, we are aware of the fact that, Turkey is a price taker in some products but also price maker for some products in the world markets. Therefore our assumption of price taking behaviour in the simulations should also be taken with care.

The results of the changing world market price simulations which are presented in Tables 1-6 can be summarized as follows:

- Imports of agricultural products, which are small to begin with will sharply decrease with the exception of rice.

- Domestic consumption will be effected, because internal prices will increase. The results in Table 3 for the 140% increase in the world market prices point very clearly to the limits of the present model version. What would be necessary in this case is to incorporate the domestic income effects of such an export price change.

- Table 4 suggests that, the factors used in agricultural production would also be affected, in absolute and relative terms.

- The domestic prices, modelled as internal shadow prices would in most cases follow, the changes in the world market prices. Even commodities which are not traded, costs will be affected, via increasing factor costs.

- Finally, the internal factor prices would, under the assumed conditions increase substantially. This is especially the case for fixed agricultural land. The shadow prices for feed are affected from the supply side (higher grain prices, shadow prices for land) as well as from the demand side (increased marginal value products).

5. Some concluding Remarks

The purpose of this paper has been to introduce the basic structure and features of an agricultural sector model for Turkey, TASM and to share some of our experiences in working with such models. In this context, the problem of validation and calibration in sector models have been highlighted and a new approach employed in TASM for endogenously estimating non-linear model parameters is summarized. Also, some preliminary model results are presented to demonstrate the model's continuous response to policy variables.

References

AKDER, H. (1985), Reflections on Turkish agriculture and common agricultural policy, METU Studies in Development, Vol.12, No.3-4, pp.343-351.

AKTAN, O., Baysan, T. (1985), Integration of Turkey to world economy: Liberalization, comparative advantage and optimum policies, METU Studies in Development, Vol.12, No.1-2, pp.49-106.

BAUER, S., KASNAKOGLU, H. (1988), Non-linear programming models for sector and policy analysis: Experiences with the Turkish agricultural sector model, Paper presented at the Second International Conference on "Economic Modelling", London, 28-30 March.

DAY, R. (1963), On aggregating linear programming models of production, Journal of Farm Economics, Vol.45, pp.797-813.

GÜRKAN, A.A., KASNAKOGLU, H.(1986), The contribution of agriculture to Turkey's economic development: Present and future, METU, ERC Monograph Series No.1, Ankara.

HOWITT, R., MEAN, P. (1985), Positive quadratic programming models, Working Paper No. 85-10, Department of Agricultural Economics, Davis/California.

KASNAKOGLU, H., HOWITT, R. (1985), The Turkish agricultural sector model: A positive quadratic programming approach to calibration and validation, Working Paper No. 85-9, Department of Agricultural Economics, Davis/California.

KASNAKOGLU, H. (1986), TASM: Turkish agricultural sector model, Yapi Kredi Economic Review, Vol.I, pp.19-46.

KASNAKOGLU, H., GÜRKAN, A.A. (1987), Past trends and future prospects of Turkish agriculture, Yapi Kredi Economic Review, Vol.I, No.2, pp.23-32.

KASNAKOGLU, H., AKDER, H., GÜRKAN, A.A. (1987), Agricultural labor and technological change in Turkey, METU, ERC Working Paper, February/87, Ankara.

LE-SI, V., SCANDIZZO, P., KASNAKOGLU, H. (1983), Turkey: Agricultural sector model, The World Bank AGREP Div. Working Paper No.67.

LE-SI, V., EVANS, M. (1983), Turkey agricultural sector model: Further results for the livestock sub-sector, World Bank, AGREP Div. Working Paper, No.68.

WORLD BANK (1982), Turkey: Industrialization and trade strategy, Report No. 3641-TU, Washington D.C.

WORLD BANK (1983), Turkey: Agricultural development Alternatives for growth with exports, Report No. 4204-TU, Washington D.C.

WORLD BANK (1985), Turkey: Agricultural sector adjustment loan. implementation volume,Report No.5576-TU,Washington D.C.

FIGURE 1: BASIC STRUCTURE OF TASM

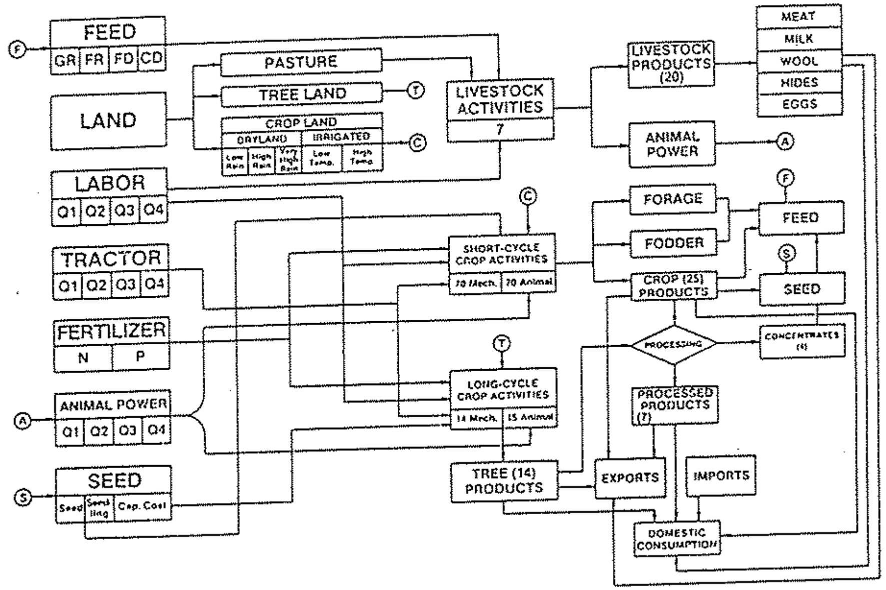

TABLE 1: EXPORT OF AGRICULTURAL COMMODITIES AT DIFFERENT WORLD MARKET PRICES

Products	Base run (Free trade)	World market prices (accumulated)			
		10%	20%	30%	40%
WHEAT	.	.	.	.	.
CORN	.	.	.	125.9	1380.3
RYE	184.7	302.9	407.8	410.5	416.4
BARLEY	.	.	473.8	1063.7	1442.6
CHICK-PEA	.	12.3	164.9	356.0	686.1
LENTIL	.	8.1	304.1	723.3	1436.6
POTATO	.	63.5	1369.5	3474.3	7120.3
ONION	.	.	.	11.7	519.2
GR-PEPPER	.	47.3	240.6	580.9	1168.5
TOMATO	.	.	.	1188.3	3779.8
OLIVE	177.9	184.3	204.1	229.0	279.4
GROUNDNUT	9.8	18.7	35.4	61.0	105.0
COTTON	58.3	110.4	169.8	190.3	213.8
SUG-BEET	3614.0	7261.1	13056.4	20896.3	34520.3
TOBACCO	452.0	531.7	696.2	984.4	1473.3
CITRUS	.	.	40.4	444.7	1147.9
APRICOT	1.3	11.2	32.2	69.2	135.0
MELON	.	224.3	1416.3	3399.3	7081.4
QUINCE	.	.	.	13.1	38.9
PISTACHIO	7.1	7.5	8.50	10.0	12.5
HAZELNUT	661.6	681.4	725.4	803.8	922.4
SHEEP-MEAT	435.1	471.1	567.7	684.2	826.2
SHEEP-MILK	957.7	1079.0	1400.7	1799.0	2431.8
SHEEP-WOOL	50.0	54.5	67.3	80.9	101.4
GOAT-MEAT	106.0	116.2	141.5	186.7	223.5
GOAT-MILK	444.2	489.8	605.1	810.4	1154.4
GOAT-WOOL	7.6	8.0	9.3	11.5	15.1
ANGOR-MILK	.	.	.	0.1	10.6
ANGOR-WOOL	0.7	0.4	.	.	.
BEEF	16.3	22.6	32.6	49.8	78.6
COW-MILK	.	.	.	.	.
BUFAL-MILK	242.4	278.3	350.5	454.4	532.7
POLTR-MEAT	.	.	6.1	24.6	55.8

TABLE 2: IMPORTS OF AGRICULTURAL COMMODITIES AT DIFFERENT WORLD MARKET PRICES

Products	Base run (Free trade)	World market prices (accumulated)			
		10%	20%	30%	40%
RICE	298.247	289.820	277.041	261.839	235.351
SESAME	22.238	16.453	7.202	.	.
CITRUS	208.890	100.992	.	.	.
SHEEP-HIDE	13.821	10.397	1.345	.	.

TABLE 3: DOMESTIC CONSUMPTION OF SELECTED AGRICULTURAL COMMODITIES AT DIFFERENT WORLD MARKET PRICES

Products	Base run (Free trade)	World market prices (accumulated)			
		10%	20%	30%	40%
WHEAT	11001.2	11001.2	10590.3	8778.3	5625.7
CORN	1766.2	1768.6	1729.4	1581.7	1265.3
RYE	169.6	164.8	154.3	135.3	102.4
BARLEY	1805.2	1828.4	1732.8	1552.9	1241.3
RICE	342.4	339.9	334.4	324.5	307.4
CHICK-PEA	568.2	565.1	535.6	482.4	390.2
DRY-BEAN	60.1	59.7	57.7	52.4	43.2
LENTIL	1098.4	1094.4	1032.5	921.0	727.7
POTATO	3967.8	3950.1	3782.1	3479.6	2955.4
ONION	1143.5	1140.3	1128.8	1100.8	1001.1
GR-PEPPER	733.4	726.1	696.5	643.2	550.9
TOMATO	4396.5	4392.6	4379.5	4200.6	3821.5
CUCUMBER	747.7	747.0	744.4	738.8	728.5
SUNFLOWER	925.1	915.4	873.0	762.4	570.1
OLIVE	867.0	832.7	757.3	621.4	386.0
GROUNDNUT	40.9	39.5	36.2	30.3	20.1
SOYABEAN	377.8	374.7	365.1	340.9	298.6
SESAME	54.7	53.3	50.2	45.5	39.7
COTTON	8.0	7.8	7.4	6.7	5.5
SUG-BEET	9514.3	9154.8	8363.9	6940.3	4472.8
TOBACCO	75.4	69.5	56.5	33.1	.
TEA	675.2	666.4	647.2	611.9	551.1
CITRUS	1251.5	1231.8	1201.2	1127.2	998.9
GRAPE	2554.4	2531.1	2480.3	2388.9	2230.7
APPLE	1783.6	1759.8	1708.2	1614.3	1451.6
PEACH	267.8	266.3	262.9	256.9	246.4
APRICOT	189.7	187.7	183.3	175.4	161.7
CHERRY	138.2	137.0	134.4	129.8	121.9
WILDCHERRY	77.4	76.2	73.7	69.1	61.0
MELON	4943.9	4904.6	4705.6	4347.3	3726.3
STRAWBERRY	34.4	34.3	34.1	33.8	33.2
BANANA	34.9	34.9	34.9	34.8	34.7
QUINCE	73.1	72.5	71.3	67.8	61.3
PISTACHIO	21.9	20.8	18.4	14.2	6.7
HAZELNUT	23.3	20.7	14.8	4.2	.
SHEEP-MEAT	178.2	162.5	128.0	65.9	.
SHEEP-MILK	969.4	912.0	785.6	558.2	164.0
SHEEP-WOOL	51.2	50.0	47.4	42.8	34.9
GOAT-MEAT	51.2	44.8	30.5	5.0	.
GOAT-MILK	417.6	392.9	338.4	240.5	70.6
GOAT-WOOL	6.8	6.7	6.5	6.1	5.4
ANGOR-MEAT	4.3	3.8	3.2	2.7	2.0
ANGOR-MILK	35.3	31.9	26.3	22.2	6.5
ANGOR-WOOL	2.6	2.6	2.5	2.1	1.6
BEEF	308.8	289.8	247.9	172.4	41.6
COW-MILK	2942.4	2826.7	2538.3	2011.1	1088.5
BUFAL-MEAT	41.4	43.2	46.2	51.4	60.3
BUFAL-MILK	123.7	103.2	58.1	.	.
POLTR-MEAT	128.1	125.5	110.6	76.0	15.9
EGGS	299.5	293.3	272.9	235.2	167.7

TABLE 4: RESOURCE USE AT DIFFERENT WORLD MARKET PRICES (SELECTED FACTORS)

Factors	Base run (Free trade)	World market prices (accumulated) 10%	20%	30%	40%
LIVESTOCK					
SHEEP	79037.952	81658.295	89667.443	96678.469	1.0646E+5
GOAT	22936.202	33491.376	25108.740	27965.715	32599.394
ANGORA	2329.389	2102.918	1735.348	1477.668	1130.224
CATTLE	13495.027	12964.396	11641.571	9223.771	4992.421
BUFFALO	1266.798	1320.377	1414.192	1572.383	1843.059
MULE	.	.	.	.	.
POULTRY	57212.831	56029.421	52135.991	44925.535	32028.121
FERTILIZER					
NITROGEN	1.1271E+6	1.1829E+6	1.2268E+6	1.2596E+6	1.2537E+6
PHOSPHATE	5.7100E+5	5.8993E+5	6.0237E+5	6.1324E+5	6.0338E+5
PURCHASED INPUTS					
SEED	6.9600E+5	7.3301E+5	8.0064E+5	9.0888E+5	1.0665E+6
FERTILIZER	4.2485E+5	4.4361E+5	4.5779E+5	4.6877E+5	4.6488E+5
CAPITAL	1.1711E+5	1.1663E+5	1.1543E+5	1.1354E+5	1.1026E+5
LABOUR UND TRACTOR USE					
LABOR-1Q	1.2487E+6	1.2474E+6	1.2434E+6	1.2158E+6	1.1432E+6
LABOR-2Q	2.2896E+6	2.3432E+6	2.4989E+6	2.7134E+6	3.0149E+6
LABOR-3Q	2.9572E+6	3.0546E+6	3.2901E+6	3.6617E+6	4.4033E+6
LABOR-4Q	1.7557E+6	1.8260E+6	1.9324E+6	2.0566E+6	2.3101E+6
TRACTOR-1Q	15774.097	16331.215	16328.869	16059.195	19566.632
TRACTOR-2Q	30255.598	30676.622	34545.876	41865.369	52541.653
TRACTOR-3Q	44744.897	46662.727	49585.662	53699.879	67318.117
TRACTOR-4Q	42832.914	46452.581	49313.475	51907.840	52835.085
FEED CATEGORIES					
STRAW	5584.830	5593.425	5618.572	5492.156	5208.196
CONCENTRATES	2452.637	2548.031	2582.284	2617.270	2662.122
GRAIN	5988.169	5974.706	6001.656	5871.286	5559.504
FODDER	840.299	842.549	1184.343	1389.332	1590.382
OILSEEDS	279.671	281.983	295.335	279.249	246.655
PASTURE	4784.120	4784.120	4784.120	4784.120	4784.120
FEEDGRAIN					
WHEAT	2495.071	2489.461	2500.690	2446.369	2316.460
CORN	844.485	842.587	846.387	1129.093	1069.135
RYE	368.503	367.674	369.333	361.310	342.123
BARLEY	4638.723	4628.293	4649.170	4217.403	3993.446

TABLE 5: SHADOW PRICES OF SELECTED AGRICULTURAL COMMODITIES AT DIFFERENT WORLD MARKET PRICES

Products	Base run (Free trade)	World market prices (accumulated) 10%	20%	30%	40%
WHEAT	-130.7	-130.7	-143.4	-199.1	-296.1
CORN	-133.4	-132.9	-141.5	-174.0	-243.6
RYE	-128.2	-141.1	-169.3	-220.1	-308.1
BARLEY	-107.5	-102.8	-122.3	-159.0	-222.6
RICE	-205.5	-226.1	-271.3	-352.7	-493.8
CHICK-PEA	-362.2	-370.0	-444.0	-577.2	-808.1
DRY-BEAN	-697.8	-709.7	-784.1	-980.9	-1323.8
LENTIL	-484.5	-490.8	-589.0	-765.7	-1072.0
POTATO	-130.2	-133.0	-159.6	-207.5	-290.6
ONION	-91.6	-93.0	-98.1	-110.5	-154.8
GR-PEPPER	-373.8	-393.3	-472.0	-613.6	-859.1
TOMATO	-191.3	-192.3	-195.6	-241.2	-337.7
CUCUMBER	-299.2	-300.7	-305.9	-317.8	-339.0
SUNFLOWER	-290.5	-299.2	-337.3	-436.7	-609.7
OLIVE	-517.8	-569.6	-683.5	-888.5	-1244.0
GROUNDNUT	-701.2	-771.3	-925.6	-1203.3	-1684.6
SOYABEAN	-507.3	-511.5	-524.6	-557.8	-615.7
SESAME	-910.6	-1001.7	-1202.0	-1510.5	-1890.0
COTTON	-739.8	-813.8	-976.6	-1269.6	-1777.5
SUG-BEET	-28.0	-30.8	-37.0	-48.1	-67.4
TOBACCO	-2594.0	-2853.4	-3424.1	-4451.4	-6232.0
TEA	-706.3	-723.9	-762.6	-833.3	-955.1
CITRUS	-184.1	-202.5	-231.2	-300.6	-420.9
GRAPE	-314.4	-336.1	-383.6	-469.0	-616.9
APPLE	-200.3	-217.4	-254.3	-321.6	-438.1
PEACH	-324.5	-337.1	-364.5	-413.9	-500.2
APRICOT	-282.7	-311.0	-373.2	-485.1	-679.2
CHERRY	-402.2	-423.7	-472.6	-559.8	-707.9
WILDCHERRY	-333.5	-362.0	-426.5	-542.0	-744.2
MELON	-165.9	-172.7	-207.2	-269.4	-377.2
STRAWBERRY	-1150.4	-1169.7	-1212.6	-1287.9	-1415.0
BANANA	-1730.1	-1735.9	-1748.3	-1769.9	-1806.8
QUINCE	-251.6	-264.2	-291.8	-374.2	-523.9
PISTACHIO	-2557.0	-2812.7	-3375.3	-4387.9	-6143.1
HAZELNUT	-1880.6	-2068.7	-2482.4	-3227.1	-4518.0
SHEEP-MEAT	-1063.3	-1169.6	-1403.5	-1824.6	-2554.5
SHEEP-MILK	-434.0	-477.4	-572.9	-744.8	-1042.8
SHEEP-WOOL	-1723.3	-1895.7	-2274.8	-2957.3	-4140.2
GOAT-MEAT	-1007.6	-1108.4	-1330.1	-1729.1	-2420.8
GOAT-MILK	-434.0	-477.4	-572.9	-744.8	-1042.8
GOAT-WOOL	-666.5	-733.2	-879.8	-1143.8	-1601.3
ANGOR-MEAT	-949.4	-1041.1	-1190.0	-1294.3	-1435.1
ANGOR-MILK	-495.9	-561.1	-667.0	-744.8	-1042.8
ANGOR-WOOL	-3446.7	-3791.4	-4897.3	-8591.7	-13572.7
BEEF	-1039.0	-1142.9	-1371.5	-1783.0	-2496.2
COW-MILK	-260.4	-277.6	-320.3	-398.4	-535.0
BUFAL-MEAT	241.8	342.0	517.3	813.0	1319.0
BUFAL-MILK	-434.0	-477.4	-572.9	-744.8	-1042.8
POLTR-MEAT	-1035.6	-1063.6	-1220.2	-1586.2	-2220.8
EGGS	-991.2	-1021.6	-1121.5	-1306.6	-1637.6

TABLE 6: SHADOW PRICES FOR SELECTED RESOURCES AT DIFFERENT WORLD MARKET PRICES

Products	Base run (Free trade)	World market prices (accumulated)			
		10%	20%	30%	40%
LAND					
DRY-EITH	12.561	19.234	58.529	139.330	280.092
IRR-EITH	118.392	135.604	224.614	466.320	885.056
DRY-GOOD	.		.	27.909	75.016
IRR-GOOD	.	.	.	.	.
TREE	152.084	278.602	554.302	1061.462	1934.197
PASTURE	3.829	9.020	16.931	29.905	52.697
LABOUR AND TRACTOR USE					
LABOR-1Q	0.251	0.251	0.250	0.244	0.230
LABOR-2Q	0.460	0.471	0.502	0.545	0.606
LABOR-3Q	0.594	0.614	0.661	0.736	0.885
LABOR-4Q	0.353	0.367	0.388	0.413	0.464
TRACTOR-1Q	2.179	2.256	2.255	2.218	2.703
TRACTOR-2Q	4.179	4.237	4.772	5.783	7.258
TRACTOR-3Q	6.181	6.445	6.875	7.418	9.299
TRACTOR-4Q	5.916	6.416	6.812	7.170	7.298
ANIMALPOWER					
ANIMAL-1Q	.	.	.	.	0.064
ANIMAL-2Q	.	.	0.025	0.088	0.181
ANIMAL-3Q	0.085	0.092	0.090	0.080	0.134
ANIMAL-4Q	0.273	0.311	0.332	0.345	0.312
FEED COMPONENTS					
STRAW	-21.197	-44.710	-80.785	-139.798	-242.100
CONCENTRATES	-47.383	-71.751	-109.608	-171.265	-279.493
CERIALS	-151.489	-144.840	-172.325	-223.146	-312.405
PASTURE	-47.383	-71.751	-109.608	-171.265	-279.493
OILSEEDS	-164.529	-161.586	-184.923	-244.259	-349.177
FODDER	-97.483	-92.716	-109.608	-171.265	-279.493
TOTALFEED	-47.383	-71.751	-109.608	-171.265	-279.493
FEED GRAIN COMPOSITION					
WHEAT	-30.164	-36.812	-26.885	-53.486	-98.924
CORN	-19.594	-25.560	-9.135	.	.
RYE	-45.864	-72.249	-88.182	115.513	-161.718
BARLEY	.	.	.	-0.877	-1.227

AN INTERREGIONAL EQUILIBRIUM MODEL TO EVALUATE THE IMPACT OF AGRICULTURAL POLICY MEASURES OR DEVELOPMENT PROJECTS ON THE AGRICULTURAL SECTOR OF DEVELOPING COUNTRIES. CASE STUDY : SRI LANKA.

G. VERGANI
Swiss Federal Institute of Technology,
Institute of Agricultural Economics, Zurich (Switzerland)

C. BOGAHAWATTE
University of Peradenya,
Departement of Agricultural Economics, Peradenya (Sri Lanka)

1. Introduction

This work aims at developing a suitable set of instruments in order to analyze the agricultural sector in developing countries.

This involves the evaluation of the possible reaction of the different market participants following the implementation of agricultural policy measures or development projects.

The evaluation of the impact of exogenous interventions on the agricultural sector has become the decisive factor to improve, on the one hand, the development assistance and, on the other hand, the decision making process. Its purposes are to demonstrate the impact of external constraints, compare methods of accomplishing goals, and providing information and feedback to the broader political community.

The agricultural sector is analysed through a simulation model developed in the framework of mathematical programming. The starting point for every further investigation will be today's agricultural markets, which will be described by means of a spatial equilibrium model. Then the changes occurring in the target area will be investigated through simulation of possible scenarios.

Various methodologies have been utilized to formulate simulation models. In studies in which the entire economy and, particularly, linkages between sectors are of interest, input-output analysis has been used. In other studies where the objective has involved identification of a sector's structure, various econometric approaches have been taken.

To simulate the project impact on a developing area or the effect of new policies, however, mathematical programming has proven to be a particularly useful tool.

Within the mathematical programming approach linear programming models have proven to be the most effective, due to the computational efficiencies of the simplex method.

However most of the linear programming models used by agricultural economists to simulate the impact of farm programs upon the agricultural sector, considered fixed prices or quantities, that is one of them was exogenous to the model. The objective function referred mainly to the maximization of the profit or minimization of the costs at farm level. This