Institut für Agrarpolitik, Marktforschung und Wirtschaftssoziologie der

Rheinischen Friedrich-Wilhelms-Universität zu Bonn

A Modelling Concept for the Long-Term Projection and Simulation of Agricultural World Market Developments

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World Agricultural Trade Simulation Model WATSIM

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Martin von Lampe

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To my parents

Preface

This dissertation was written at the Institute for Agricultural Policy of Bonn University, in the context of a research project undertaken for the German Federal Ministry for Food, Agriculture and Forestry. It would not have been possible without the help of a number of colleagues and friends, and I owe my gratitude to all of them, even though there is not enough room here to name them all. In particular, however, I am indebted to the following people:

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Last, but definitely not least, I owe my very special thanks to my wife Karin, who really was an indispensable mainstay for me throughout the generation of this study. She actually made me come 'home' after long days.

The figures in this study are also available in colours at the web-site of the Institute for Agricultural Policy at http://www.agp.uni-bonn.de/agpo/publ/dissert/disser_e.htm.

Bonn, 1999 Martin von Lampe

Abstract

A Modelling Concept for the Long-Term Projection and Simulation of Agricultural World Market Developments

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World Agricultural Trade Simulation Model WATSIM

Martin von Lampe

In recent years the long-term prospects for the agricultural world markets have been subject of intensive discussions mainly for two reasons. On the one hand, rising concern is given to the food security situation in a number of developing countries. Given the unacceptably high number of malnourished people, and the increasing world market prices for agricultural products in recent years, many experts are confronted with the questions of whether or not the carrying capacity of our planet has been reached, and how the growing population in the different regions can be provided with sufficient food if production resources are limited.

On the other hand, high levels of support for the agricultural sectors and large production surpluses in many developed countries, which could be exported only with the use of export subsidies, resulted to the need for international efforts to liberalise the markets. Whilst a number of measures was implemented in the past (e.g. the 1992 EU CAP reform, the 1993 GATT Uruguay Round Agreement on Agriculture, and the 1996 US Federal Agricultural Improvement and Reform Act), the EU Agenda 2000 reform package is just passed and other rounds of multilateral trade negotiations are scheduled to start in 1999. The outcome and impacts of these political changes will strongly depend on developments of the agricultural world markets.

A number of trade models was therefore developed to project world market developments. Few of these models, however, are suitable for long-term calculations, i.e. beyond a 6-10 years horizon, and those models which are explicitly designed for long-term projections provide little options to properly reflect the political environment for these market developments. This study attempts to fill this gap. Based on a standard partial equilibrium approach, the World Agricultural Trade Simulation Model (WATSIM) includes a broad set of policy measures that influence domestic and world markets by altering prices, production, demand or trade quantities. The main focus of the model, however, is the consideration of key factors for supply and demand prospects, i.e. those socioeconomic and natural variables that have a particular direct impact on the development of agricultural production and demand. Apart from total population these variables also include the urbanisation process and the development of real per capita income for the projection of food demand, and total land availability, irrigation, changes in the harvesting index and the development of feed efficiency for the projection of the agricultural producing sector.

The baseline results suggest that between 1994 and 2020 global meat and cereal markets are driven especially by population and real per capita income growth in many developing regions, which result in growing food demand particularly for meat and high-value cereals. Supply in most of these regions is not expected to keep pace with increasing demand, resulting in growing net imports. Many industrialised regions, in contrast, are expected to increase agricultural production beyond their own needs and thus to be able to provide the necessary quantities to the developing world. According to the results, world meat prices will remain relatively stable in real terms between 1994 and 2020, but real grain prices are projected to decline by between 1.0% and 1.8% p.a. With these rates, the decreasing trend of real world market prices is expected to slow down significantly compared to the past 45 years.

The results of the simulation runs with different scenarios – changed assumptions on income, productivity and irrigation as well as changed assumptions on agricultural policies – show that these principal trends are relatively stable in terms of macro-economic conditions. Changes in income, productivity or irrigation, however, have significant impacts for the domestic markets of the affected regions as well as for their import reliance or export capacities. Changes in agricultural policies, on the other hand, may have major consequences for regional and world markets especially in the medium term, whilst in the long run they are superimposed by changes in the general conditions for agricultural production and demand developments.

Kurzfassung

Ein Modellkonzept zur Vorausschätzung und Simulation langfristiger Entwicklungen auf den landwirtschaftlichen Weltmärkten

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World Agricultural Trade Simulation Model WATSIM

Martin von Lampe

Seit einigen Jahren sind die langfristigen Aussichten für die Weltagrarmärkte Inhalt intensiver Diskussionen. Hierfür sind vor allem zwei Entwicklungen verantwortlich. Einerseits ist die Besorgnis über die Ernährungssicherheit in einer Reihe von Entwicklungsländern gewachsen. Die Anzahl unterernährter Menschen ist immer noch inakzeptabel hoch, und steigende Weltmarktpreise für Agrarprodukte in den letzten Jahren haben dazu geführt, daß von vielen Experten die weitere Tragfähigkeit der Erde in Frage gestellt worden ist. Zunehmend stellt man sich der Frage, wie die wachsende Bevölkerung vieler Regionen trotz begrenzter Produktionsressourcen ausreichend mit Nahrung versorgt werden kann.

Andererseits haben das hohe Protektionsniveau für die landwirtschaftlichen Sektoren sowie große, nur mit Exportsubventionen auf dem Weltmarkt absetzbare Überschüsse auf den landwirtschaftlichen Märkten verschiedener Industrieregionen zu der Notwendigkeit geführt, internationale Schritte zur Liberalisierung der Märkte einzuleiten. Verschiedene agrarpolitische Änderungen sind bereits realisiert, wie die Reform der EU-Agrarpolitik von 1992, das 1993 geschlossene Abkommen von Uruguay im Rahmen des GATT sowie der *Federal Agricultural Improvement and Reform Act* der Vereinigten Staaten von 1996. Das Reformpaket Agenda 2000 der EU wurde erst vor kurzem verabschiedet, und die nächste Runde multilateraler Verhandlungen zur Liberalisierung der Weltmärkte soll noch im Jahr 1999 beginnen. Gestaltung und Auswirkungen dieser politischen Veränderungen werden stark von den Entwicklungen auf den landwirtschaftlichen Weltmärkten abhängen.

Um diese Entwicklungen besser abschätzen zu können, wurden in der Vergangenheit verschiedene Handelsmodelle entwickelt. Wenige dieser Modelle sind jedoch geeignet für langfristige Berechnungen, d.h. für einen zeitlichen Horizont von mehr als 6-10 Jahren, und diejenigen Modelle, die auf langfristige Vorausschätzungen ausgelegt sind, bilden die agrarpolitischen Rahmenbedingungen nur grob ab. Diese Lücke zu füllen, ist das Ziel dieser Arbeit. Aufbauend auf einem Partial-Gleichgewichtsansatz wird im *World Agricultural Trade Simulation Model* (WATSIM) ein breiter Satz von agrarpolitischen Maßnahmen berücksichtigt, die regionale und globale Märkte durch die Veränderung von Preisen, Angebots-, Nachfrage- oder Handelsmengen beeinflussen. Schwerpunkt der Arbeit ist jedoch die Berücksichtigung von Schlüsselfaktoren für die zukünftigen Angebots- und Nachfrageentwicklungen, d.h. derjenigen sozio-ökonomischen und natürlichen Rahmenbedingungen, von denen ein besonderer Einfluß auf die landwirtschaftliche

Produktion und die Nahrungsmittelnachfrage ausgehen. Neben der Bevölkerungsentwicklung sind dies insbesondere der Urbanisierungsprozeß und das zunehmende Pro-Kopf-Einkommen auf der Seite der Konsumnachfrage, sowie die Landverfügbarkeit, Änderungen der Anbauintensität und die Entwicklung der Futtereffizienz auf der Seite der landwirtschaftlichen Produktion.

Die Ergebnisse des Referenzlaufes zeigen, daß die globalen Fleisch- und Getreidemärkte vor allem von wachsenden Bevölkerungszahlen und steigendem Pro-Kopf-Einkommen in vielen Entwicklungsländern bestimmt werden, die die Nachfrage nach Fleisch und hochwertigen Getreiden ansteigen lassen. Für viele dieser Regionen wird erwartet, daß sie den wachsenden Bedarf nicht vollständig durch die eigene Produktion decken können, sondern zunehmend Nahrungsmittel importieren werden. Für viele Industrieregionen wird dagegen mit einem Anstieg der landwirtschaftlichen Produktion über den eigenen Bedarf hinaus, und damit mit steigenden Exporten gerechnet. Diesen Ergebnissen zufolge werden die realen Weltmarktpreise für Fleisch zwischen 1994 und 2020 auf nahezu unverändertem Niveau bleiben, während für Getreide Preisrückgänge von real zwischen 1.0% und 1.8% p.a. erwartet werden. Damit dürfte sich der Trend sinkender Realpreise auf den Weltagrarmärkten im Vergleich zu den vergangenen 45 Jahren deutlich verlangsamen.

Die Ergebnisse der verschiedenen Szenariorechnungen – veränderte Annahmen bezüglich der Entwicklung von Einkommen, Produktivität und Bewässerung, sowie veränderte Politikannahmen – zeigen, daß diese grundsätzlichen Trends verhältnismäßig stabil in Bezug auf makroökonomische Rahmenbedingungen sind. Änderungen in Einkommen, Produktivität und Bewässerung haben allerdings erhebliche Auswirkungen auf die heimischen Märkte der betroffenen Regionen und deren Importbedarf bzw. Exportmöglichkeiten. Veränderungen der agrarpolitischen Rahmenbedingungen können andererseits vor allem mittelfristig deutliche Auswirkungen auf regionale und globale Märkte haben, während langfristig die Entwicklung von Angebot und Nachfrage auf landwirtschaftlichen Märkten von Veränderungen in den allgemeinen Rahmenbedingungen dominiert wird.

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Abbreviations used in this study

AGLINK	Agricultural trade model of OECD
ASEAN	Association of Southeast Asian Nations
CAP	Common Agricultural Policy
CAPRI	Common Agricultural Policy Regionalized Impact Analysis
CGE	Computable General Equilibrium
CLS	Country Link System
CSE	Consumer subsidy equivalent
EuroCARE	European Centre for Agricultural, Regional and Environmental Policy Research
FAIR Act	Federal Agricultural Improvement and Reform Act
FAO	Food and Agriculture Organization of the United Nations
FAPRI	Food and Agriculture Policy Research Institute
GATT	General Agreement on Tariffs and Trade
GDP	Gross domestic product
GMS	Global Modeling System
ha	Hectare
IAP	Institute for Agricultural Policy, University of Bonn
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
IMPACT	International Model for Policy Analysis of Agricultural Commodities and Trade
incl.	Including
kg	Kilogram
kg/cap.	Kilogram per capita
LUC	Land used for crops
mio.	Million
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary least squares
p.a.	Per annum
p.c.	Per capita
PS&D	Production, Supply and Distribution Database
PSE	Producer subsidy equivalent
SPEL-EU	Sektorales Produktions- und Einkommensmodell der Landwirtschaft der Europäischen Union (Sectoral Production and Income Model of Agriculture for the European Union)
t	Metric tons
UN	United Nations
URAA	Uruguay Round Agreement on Agriculture
USDA	United States Department of Agriculture
WATSIM	World Agricultural Trade Simulation Model
WFM	World Food Model
WTO	World Trade Organization