

Hoffmeyer, Martin; Schrader, Jörg-Volker

Working Paper — Digitized Version

A medium term outlook for selected agricultural commodities

Kiel Working Paper, No. 133

Provided in Cooperation with:

Kiel Institute for the World Economy – Leibniz Center for Research on Global Economic Challenges

Suggested Citation: Hoffmeyer, Martin; Schrader, Jörg-Volker (1981) : A medium term outlook for selected agricultural commodities, Kiel Working Paper, No. 133, Kiel Institute of World Economics (IfW), Kiel

This Version is available at:

<https://hdl.handle.net/10419/46948>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Kieler Arbeitspapiere

Kiel Working Papers

Working Paper No. 133

A Medium Term Outlook
for Selected Agricultural Commodities

by

Martin Hoffmeyer and Jörg-Volker Schrader

Dezember 1981

Institut für Weltwirtschaft an der Universität Kiel

Kiel Institute of World Economics
2300 Kiel, Düsternbrooker Weg 120

Working Paper No. 133

A Medium Term Outlook
for Selected Agricultural Commodities

by

Martin Hoffmeyer and Jörg-Volker Schrader

Dezember 1981

Kiel Working papers are preliminary papers written by staff members of the Kiel Institute of World Economics. Responsibility for contents and distribution rests with the authors. Critical comments and suggestions for improvement are welcome. Quotations should be cleared with the authors.

Ag 577/82
Weltwirtschaft
Kiel

Contents

	page
Introduction	1
1. Food (wheat, coarse grains, sugar).....	4
1.1 The markets for wheat, coarse grains and sugar since 1960	7
Grain	7
Sugar	10
1.2 Future developments of determinants of demand and supply	11
1.2.1 Future trends of factors determining demand	12
1.2.2 Future trends of factors determining supply	15
1.3 Price trends for wheat, coarse grains and sugar to 1990	18
1.4 Problems of instability	20
2. The markets for agricultural raw materials	22
2.1 Cotton	22
2.2 Wool	29
2.3 Natural rubber	31
References	35

A MEDIUM TERM OUTLOOK FOR SELECTED AGRICULTURAL COMMODITIES

Introduction

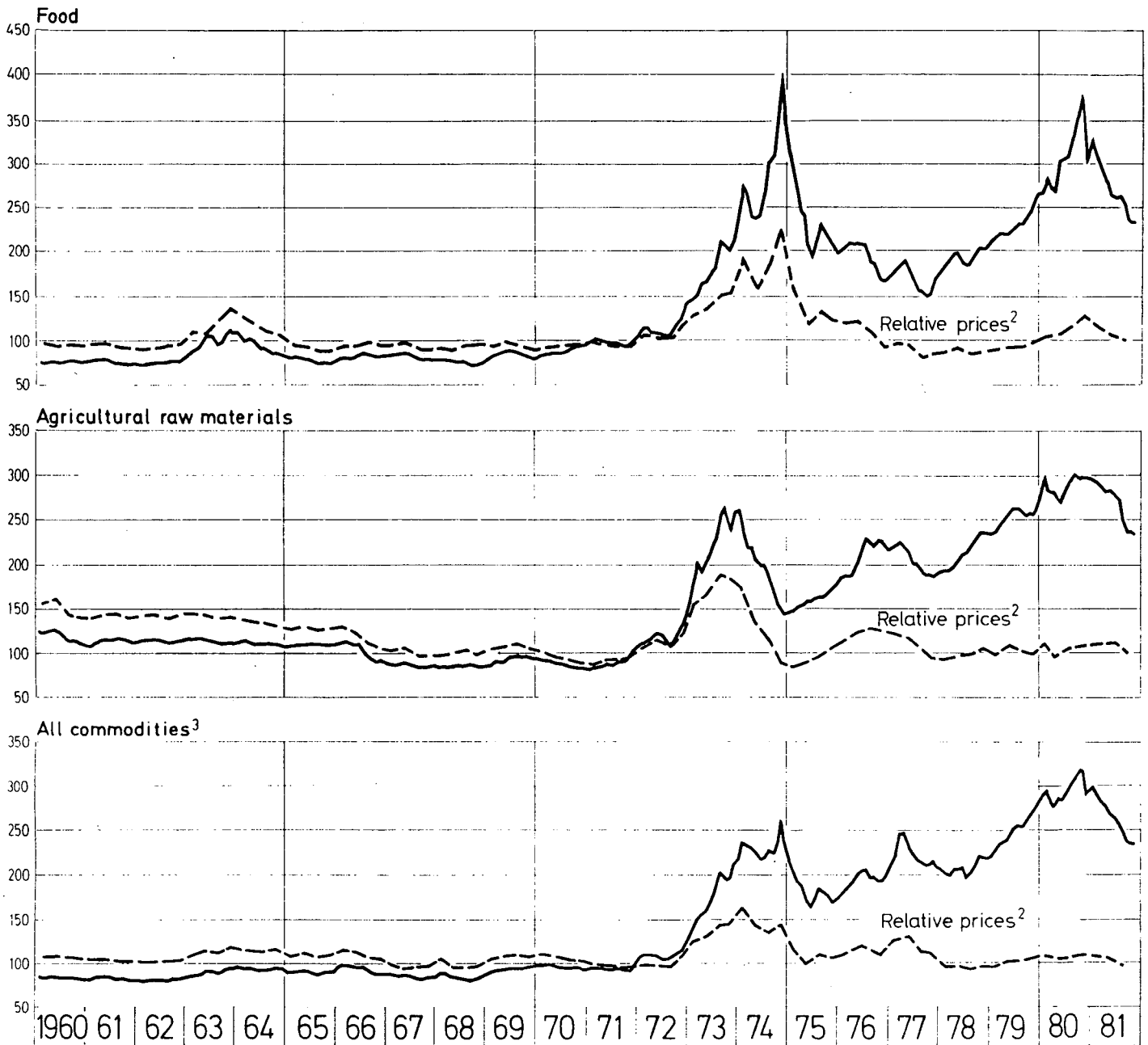
Analysing the development of food and agricultural raw material markets during the past twenty years, two phases could be distinguished. Following a long period with production surpluses, comprehensive stocks and stable prices, in the seventies the situation changed dramatically. During 1973 and 1974 food prices have nearly quadrupled on average (with substantial differences between individual commodities) and those of agricultural raw materials more than doubled (see Figure 1). The upsurge of food prices reflected above all poor crops in some importing regions for grains - crop failure in the USSR played an important role - as well as decreases of grain and oilseed production due to bad weather conditions in major exporting countries (in particular in the United States). On the international markets for sugar and beef production and supply shortages were mainly a consequence of producer responses on disappointing prices in the years before. For agricultural raw materials, the upswing in economic activity in industrial countries during 1973/74 - with a largely parallel course of the business cycle in individual countries - strongly stimulated demand and pushed up quotations since simultaneously supply development has proved as less dynamic. Finally, pessimistic expectations with regard to future supplies of agricultural commodities and fears of commodity cartels following the OPEC-price cartel were temporarily important market determining factors.

The price boom on international agricultural markets reached its peak in 1974 and was followed by a dramatic fall in prices as demand pressure weakened and production and supply of major exporting countries expanded considerably, above all, because of attractive producer prices. This development was levelling off into a period with limited surpluses of available supplies and somewhat increased stock ratios (world stocks/world con-

Figure 1

Price development on international commodity markets

- IfW commodity price index¹ (1970-72 = 100) -



¹ Index figures (in \$-terms), weighted by world export values of the most important commodities, except energy raw materials. - ² Index figures divided by UN Export unit value index for manufactured goods. - ³ Including metals.

sumption), though remaining lower than in the middle of the sixties; in the years 1976 and 1977 the food price level exceeded that at the beginning of the seventies by about 70-90 per cent (agricultural raw materials: by more than 100 per cent). After 1974 crop failures in the USSR and in some exporting countries as well as the cyclical shortfall of supplies in the livestock sector forced food prices upward again. On agricultural raw material markets renewed price increases were caused in particular by a distinctly growing rubber demand as well as by a marked rise of textile purchases, which couldn't be met by a - in the short-run - relatively inelastic supply.

The price increase between 1970 and 1979, measured by the IfW commodity price index (1970/72 = 100, in \$-terms), amounted for food to about 230 per cent and for agricultural raw materials to around 175 per cent; in the foregoing decade price levels changed only marginally. Parallel to this development, fluctuations of world market prices increased considerably. Looking for the period 1970-1979 at "relative" prices - the ratio of nominal quotations and the UN Export Unit Value Index for Manufactured Goods - for food a marginal increase could be stated whereas relative prices of agricultural raw materials didn't change (see Figure 1).

During the seventies development of international food trade - at the given national support systems and trade restrictions - chiefly reflected annual crop fluctuations and the regional distribution and/or development of animal production, while extent and direction of world exports of agricultural raw materials depended above all on demand in manufacturing and on the competitive position of man made materials. International trade of most agricultural commodities grew in the seventies faster than world production. Among the different commodities average growth rates of world exports ranged from 5-7 per cent a year for coarse grain, wheat and beef, to only about 2 per cent for cotton and rubber.

In view of fundamental changes on agricultural markets observed in the seventies as well as with regard to wide spread uncertainties concerning

future demand development and potential production capacity this contribution will concentrate on a medium-term outlook (up to 1990) for selected agricultural markets. Special emphasis is given to the question whether in the next years world production and consumption and/or available supply and demand will be balanced at unchanged or rising relative prices.

1. Food (wheat, coarse grains, sugar)

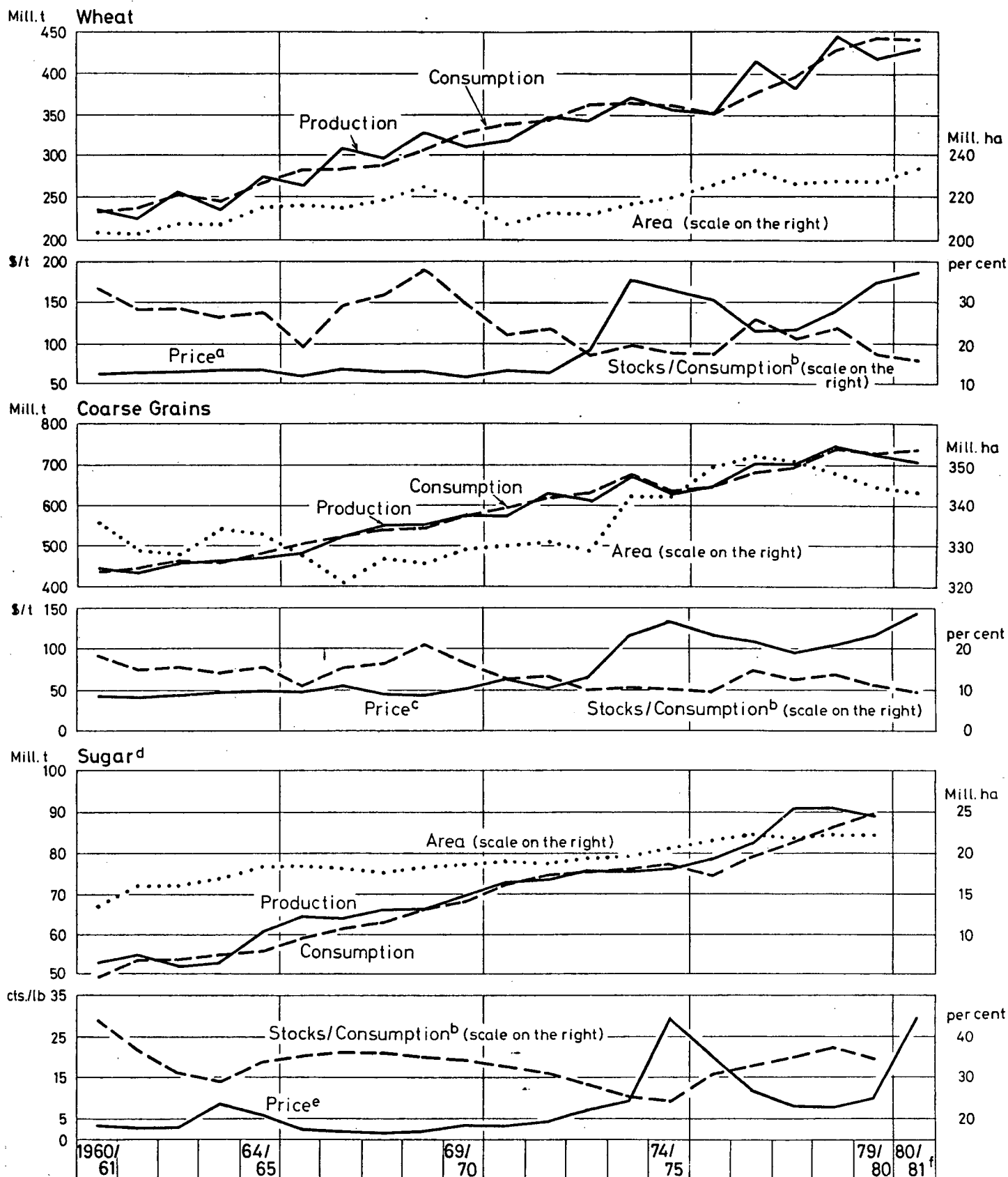
Following a long period of steady development in quantities and rather stable prices on a constant level the world food markets showed marked price increases in 1973 und again at the end of the seventies (Figure 2). On the background of persistent hunger problems in major regions of the world, decreasing economic growth rates in the majority of developed and developing countries and sharp rising energy prices this medium term outlook will concentrate on the development of commercial demand, supply and prices for wheat, coarse grains and sugar as the dominating commodities in the food sector. Even if there is common professional agreement that the world has the capacity to improve the diet of a growing population through 2000¹, there is some argument at which costs (prices) this would be achievable. The analysis of this question on a fairly global level along with a discussion of assumptions and results of other global food market projections will be in the center of this section. In addition to that the problem of instability, its causes and some measures to reduce price instability will be discussed in brief. Beyond the scope of this paper is the analysis of the world hunger problem. Although closely related to the development of commercial food markets, the malnutrition or even starvation of millions of people is highly dependent on the national and international distribution of income and food². So, adequate food supply on the

¹ The Global 2000 Report to the President, Vol. II, Washington 1980, p. 77.

² International food aid and national food programs which might correct the income dependent food distribution to a certain amount will not be dealt with explicitly.

Key-Indicators for the long-term Development of Selected Agricultural Markets

-World Total-



^aUS, Hard Red Winter, No 2, f.o.b. Gulf. - ^bEnding stocks as share in consumption. - ^cCorn, US, Yellow No 2, f.o.b. Gulf. - ^dCalendar years. - ^eWorld Contract No 11, N.Y. - ^fProjection.

Table 1 - Growth Rates* of Area, Yield and Production for Wheat, Coarse Grains and Sugar (% per annum)

- World Total -

	Ø 1960/61-1962/63 -1978/79-1980/81	Ø 1960/61-1962/63 -1969/70-1971/72	Ø 1969/70-1971/72 -1978/79-1980/81	Ø 1960/61-1962/63 1966/67-1968/69	Ø 1966/67-1968/69 -1972/73-1974/75	Ø 1972/73-1974/75 -1978/79-1980/81
Wheat						
Area	0.64	0.45	0.83	1.21	-0.27	0.99
Yield	2.59	2.51	2.66	2.60	2.25	2.91
Production	3.33	3.42	3.24	4.44	2.34	3.22
Coarse Grains						
Area	0.23	-0.03	0.49	-0.35	0.65	0.39
Yield	2.28	2.83	1.73	3.29	1.87	1.68
Production	2.73	3.20	2.26	3.25	2.70	2.24
Sugar ¹						
Area	2.20 ²	2.45 ³	1.92 ⁴	2.86 ⁵	1.69 ⁶	2.03 ⁷
Yield	0.94	0.92	0.95	0.47	0.91	1.53
Production	3.18	3.50	2.81	3.70	2.41	3.47

¹ Calendar years. - ² 1960/62-1977/79. - ³ 1960/62-1969/71. - ⁴ 1969/71-1977/79. - ⁵ 1960/62-1966/68. - ⁶ 1966/68-1972/74. - ⁷ 1972/74-1977/79. - * Growth rates of area and yield don't add up to growth rates in production because of independent averaging for the three variables.

Source: USDA, Foreign Agriculture Circular, Grains, Washington, D.C., actual. - FAO, Production Yearbook, Rome, actual.- International Sugar Organization, Sugar Year Book, London, actual.

world or even national average tells little about the nutritional situation in the respective region¹. On the other hand changes in income distribution or nutritional programs effect commercial demand, which has to be kept in mind discussing the future development of food markets.

1.1 The markets for wheat, coarse grains and sugar since 1960

Grain

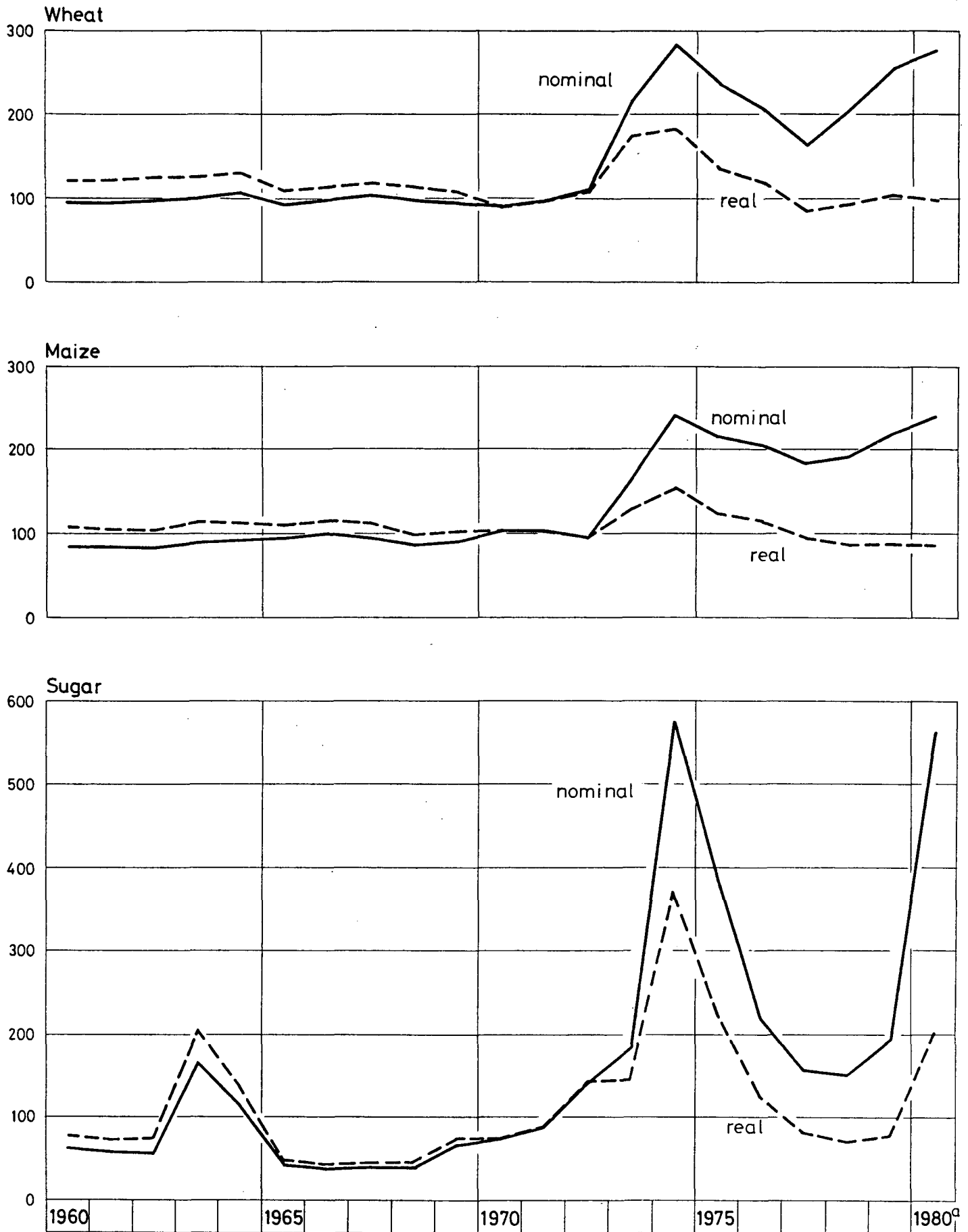
Comparing the developments for wheat and coarse grains the long term trends in production and consumption look quite similar (Figure 2), so the growth rate for wheat (3.3 per cent) is somewhat larger than for coarse grains (2.7 per cent, Table 1). A break down in two or three periods, somehow arbitrary always, points to a levelling off in growth rates in the second period 1967/68-1973/74 (Table 1), a consequence of high stocks and depressed prices in the foregoing period. Expansion rates increased again in the last period (1973/74-1979/80) but were smaller than in the first, especially for coarse grains. A similar pattern could be seen in the development of yields for coarse grains; in contrast wheat yields grew fastest in the last period. The rate of increase in area over the total time interval for wheat compared to maize was threefold with widely differing expansion rates in the three subperiods. The share of area in the growth of production over the whole interval was about 20 per cent for wheat und 10 per cent for coarse grains. To get a more realistic picture of the long term price-production relationship, in figure 3 indices of the product prices are depicted nominal as well as in relation to the UN-Export Unit Value Index for Manufactured Goods². At the end of the period the relative prices were slightly below the level of 1960.

¹ K.S. Parikh, Exploring National Food Policies in an International Setting: The Food and Agricultural Program of IIASA. WP-81-12. Laxenburg 1981, p. 3.

² As far as there is no ideal Index on the global level to represent the development of costs in grain production, the index chosen should indicate the global rate of inflation in the non-agricultural economy.

Prices for Wheat, Maize and Sugar, Nominal and in Relation to the UN Export Unit Value Index for Manufactured Goods (US-\$)

1970 - 72 = 100



^aPreliminary.

In the short and medium run a plausible negative relationship between stock-consumption ratio and prices shows up. The yearly gap between production and consumption is smaller for coarse grains than for wheat and so are the variations in stocks. This again seems to be plausible pointing to a lower price-demand-elasticity for wheat, a basic staple food. As could be expected with a lag of one or two years a positive relationship between prices and area can be seen. A dependency of yields on prices is economically reasonable; to bring about empirical evidence is much more difficult because rather large time-lags could be expected. Two steps in the causal chain might be differentiated. First, higher prices induce - via higher profitability - increased research in an improved technology (higher yielding varieties, more fertilizer acceptance of plants, better pesticides etc.). Secondly, in the long run this "high cost" new technology will become economically feasible and will be applied, but only if the profitability (via high prices) will be guaranteed for a long planning horizon. There is no doubt that, with respect to the first point mentioned, a lot of research is forced and financed by governments and international institutions independently of the price level, because there is still malnutrition and hunger around the world. However in spite of that, private research activity will be intensified by economic incentives. For illustration of the second point, the wheat yields of some industrialized countries are compared (Table 2). It could be assumed that the newest technology is known and available in all countries.

Table 2 - Wheat yields in selected countries (t/ha)

	Ø 1960-65	Ø 1968-73	Ø 1975-80
USA	1.7	2.1	2.1
Canada	1.4	1.7	1.9
Australia	1.3	1.2	1.4
EG-9	2.7	3.5	4.0

Source: USDA (FAS), Foreign Agricultural Circular,
Grain (actual), Washington, D.C.

Interpreting the remarkable differences in yield levels as well as in yield growth climatical factors, above all dry land conditions play an important role. This seems to be especially true for Australia but also for some regions in USA and Canada. Closely related to the amount of water available is the effect of fertilizer application on yields. Not surprisingly in 1971-75 the fertilizer consumption per arable hectare was 85 kg in USA and 195 kg in Western Europe¹. In Canada and Australia it was even lower. Nevertheless, beside progress in breeding wheat varieties less susceptible to drought and disease, higher prices could make better water management and by that more intensive fertilizer use economically feasible². Comparing producer subsidies per unit as a measure for international differences in producer prices for wheat across countries (average of the period 1968-1973) it amounted to about 55 \$/t in the EC-6, 25 \$/t in the USA and less than 10 \$/t in Australia and Canada³. Comparing these figures to the yields listed in table 2 a strong relationship between prices and yields seems to exist, a hypothesis which will be discussed again in the context with quantitative results of other studies.

Sugar

The growth rate of sugar production between 1960 and 1979 came close to 3.2 per cent, roughly the same rate as for wheat. In contrast to grains, here the expansion of area was more important than the increase in yields; but the latter showed a marked acceleration in growth rates over time (Table 1). There is a strong negative relation between stock/consumption ratio and prices, both variables showing a clear cyclical pattern. It is caused by a low demand and supply elasticity in the short run, but a quite strong supply

¹ The Global 2000 Report, op.cit. p.101.

² International Wheat Council, Press Release, London, 27th February 1981, p.6:6.

³ T. Josling, Developed-Country Agricultural Policies and Developing-Country Supplies: The Case of Wheat. IFPRI, Res.Rep.14, Washington 1980, p.53 f.

response on prices with a lag of about 3 years. The main reason is that it takes roughly three years to expand sugar cane production. Low short run elasticities not the least are a consequence of national policies isolating their national markets against international price changes and by that increasing price fluctuations on the world market. Despite international efforts to reduce instability by export quotas and a buffer stock in the framework of several consecutive international sugar agreements, price fluctuations show an increasing tendency (Figure 2). In the long term the sugar price seems to have risen in relation to the UN Unit Value Index (Figure 3). Partly this might reflect the circumstance of rising opportunity costs in sugar production during the late seventies as a consequence of using sugar cane for alcohol production, which is done in Brazil by now on quite a large scale¹.

1.2 Future developments of determinants of demand and supply

As much as it is true that all economic variables are interdependent, to keep a problem treatable, it is necessary to handle certain variables as exogenous (given) to the object under review. Analysing world markets for agricultural commodities growth rates of population, GDP and income usually are treated as given. For a lot of developing countries with a large agricultural sector this certainly is questionable. But even further, without a formal model the interdependencies within the agricultural sector, e.g. between demand and supply, between input and output prices and substitution processes on the production and consumption side etc. can't be handled adequately. Nevertheless, the review of possible future trends of demand and supply determined by

- population and income growth
- oil price increases

as well as the discussion of some implicit assumptions about

¹ F. O. Licht's International Molasses Report (Special Edition 1979), The Brazilian Alcohol Program and its Objectives. Ratzeburg 1979.

- income distribution
- resource capacities and
- trends in technical progress

should be helpful for the derivation of future price trends.

These very general qualitative results will be compared with other projections, based on rather detailed formal models.

1.2.1 Future trends of factors determining demand

Following economic theory, per capita demand is a function of prices, per capita income and tastes; on the aggregated level population growth and income distribution have to be added whereas shifts in tastes would be of minor relevance, at least for basic food. Deriving future trends in demand, past trends in income and population growth will be compared with projections given in "The Global Report"¹ and by the World Bank². Although the time periods covered are not fully comparable some general conclusions can be drawn. There is agreement that growth rates of population will decline. The deceleration is more slowly in developing countries than in industrialised countries (Table 3). With respect to growth in GDP and GDP per capita, because of differing time periods presented, the picture is not as clear. Whereas "The Global 2000 Report" gives the impression of declining growth rates in GDP and GDP per capita, the World Bank Report points to slightly increasing rates for the period 1980-90 compared to 1970-80³. For the development of global demand as important as the average increase in income is the distribution of income. With relatively high income elasticities for basic food as wheat in low income groups and even negative elasticities in high income groups, a redistribution

¹ The Global 2000 Report, op.cit., p. 48.

² World Bank, Price Prospects for Major Primary Commodities. Rep. No. 8/4/80, p. 29.

³ Also a slow increase is assumed in the figures given by the FAO. Representing the knowledge of mid 1978, this figures by now look rather optimistic. FAO, Agriculture: Toward 2000. C 79/24, Rome, July 1979, p. XXIII.

Table 3 - Past Development and Projections for Population and GDP

Growth Rates - per cent per annum -

	World Bank Projections			Projections in "The Global 2000 Report" ^c			
	1960-70	1970-80	1980-90		1960-70	1975-85	1985-2000
Population Growth				Population Growth			
Industrialized Countries	1.0	0.7	0.5	Industrialized Countries	1.09	0.57	0.52
Developing Countries	2.5	2.4	2.3	Less Developed Countries	2.56	2.50	2.37
Centrally Planned Economies	1.7	1.1	1.2	Centrally Planned Economies	1.54	1.25	1.21
World	2.0	1.8	1.7	World	1.93	1.79	1.77
GDP Growth (real)				GDP Growth (1975 const. \$)			
Industrialized Countries	4.9	3.4 ^a	3.7 ^b	More Developed Regions	.	3.87	3.05
Developing Countries	5.9	5.2	5.6	Less Developed Regions	.	4.97	4.28
				World	.	4.08	3.32
GDP per Capita Growth (real)				Per Capita Income Growth Rates (1975 const. \$)			
Industrialized Countries	3.9	2.7	3.2	Industrialized Countries	3.29	3.41	2.57
Developing Countries	3.4	2.8	3.3	Less Developed Countries	3.13	2.54	2.01
				Centrally Planned Countries	3.65	2.35	2.20
				World	2.80	2.26	1.53

^a1975-80. - ^b1980-85: 3.5, 1985-1990: 4.0. - ^cAlternative I.

Sources: The Global 2000 Report, op.cit., p.78. - World Bank, Price Prospects for Major Primary Commodities. Rep. No. 814/80, Washington 1980, p. 29.

of income could raise the global demand substantially. The very crude classification in two or three country groups (Table 3) at least gives no hint for a more equal distribution in future years. As far as no information is available pointing to a major change in distribution internationally as well as within developing countries it must be assumed that on the global level past relations between income and demand could be extrapolated¹.

The impact of rising oil prices is twofold. Conventionally it is discussed only as a major cost factor influencing the supply of agricultural commodities. The explosion of oil prices since 1973 induced numerous efforts to substitute oil by other energy forms, one being alcohol produced from biomass. Of special interest in this context is the likely future demand for food commodities to produce alcohol. Beside economic profitability the main determining factors are administrative programs subsidizing the production of ethanol from agricultural commodities. The two most important countries as well with respect to the quantity of alcohol produced as to the financial volume are Brazil and the United States. Whereas in Brazil sugar cane is the basic raw material², in US maize is used primarily. In addition certain other plants as cassava and sweet sorghum

¹ Undoubtedly, this is quite a far reaching assumption not taking into account all the information available on the country level. But that would require a different approach to the problem, above all with respect to the dimension of the work to be done. Beside the two studies mentioned above, there are quite a few global modelling approaches disaggregating for commodities and countries or regions (see: "The Global 2000 Report to the President", pp. 603-655). Well on the way, but with no empirical results up to now is another global modelling project undertaken at IIASA in Laxenburg/Austria (see: K.S. Parikh, Exploring ... op. cit.). Here quite detailed national agricultural sector models, disaggregated for about 15 commodities (one representing the non-agricultural economy) are linked, to allow for a realistic simulation of national policies. One example as discussed above might be the analysis of the effects of an equalizing income policy in poor countries on the world market prices of certain agricultural commodities.

² F.O. Licht's International ..., op. cit.

are potential raw materials¹. Because all these commodities are substitutable in consumption and/or production a marked increase in the utilization for non food purposes would effect all agricultural commodity prices. A very crude estimate of the effects of national programs already initiated or known as in the planing phase gives the impression that total demand wouldn't be raised substantially. Although the share of certain commodities - especially sugar cane - used already now for ethanol production is quite high, in relation to total food demand the effects up to 1990 will be rather limited². Nevertheless a continuing increase of relative oil prices would raise the profitability of the process, so more serious effects on food demand couldn't be excluded.

Summarizing trends in determinants of demand it is assumed that past trends will continue. However, persistant sharp rising oil prices could lead to an increase in the growth rate of demand in the long run.

1.2.2 Future trends of factors determining supply

The future development of production mainly depends on product prices which have to be discussed simultaneously with demand in the following section, on productivity increases and resource costs, especially for arable land. Having no better information available, input prices are assumed to increase with the global rate of inflation.

With respect to increases in productivity and development of resource costs it has to be asked whether the past relation between prices and this

¹ FAO, FAO Expert Consultation on Energy Cropping versus Food Production. AGD/ECFP/80/1, Rome, April 1980. - L. Brown, The Energy Cropping Dilemma. "CERES", Vol. 13, No. 5 (Nov.-Dec.), Rome 1980, pp.28-32. - R. Meekhoff, M. Gill, W. Tyner, Gasohol: Prospects and Implications. USDA, Ag. Ec. Rep. No.458, Washington 1980.

² J. -V. Schrader, Energiegewinnung aus nachwachsenden Rohstoffen in Konkurrenz zur Nahrungsmittelproduktion. Paper presented to the 21. Jahrestagung of the 'GEWISOLA', Stuttgart 1981.

factors could simply be extrapolated into the future. Coming to arable area first, the limited amount available on the global level as well as losses to other uses suggest rising costs of land use because of decreasing quality approaching the capacity line¹. If the cost increase will be faster in future years than in the past, c.p. a decreasing elasticity of area getting used for agricultural production with respect to product prices has to be assumed. If one thinks of the usual exponential curve it has to be asked, whether one is still in the flat or already in the steeper part. Unfortunately, empirical evidence is difficult to obtain. Elasticities derived from formal models are hardly comparable because the results crucially depend on model specification. A widely used approach is to "explain" the development of total arable area by a trendcoefficient decreasing over time, to take account of the restrictions mentioned above and by commodity prices, where the latter variable has a very small explanatory power². Looking on the past development of prices (Figure 3), this is not surprising at all, because there was only one relative short period of rising real prices. So already from a methodological point of view one can't expect to get empirically results showing a strong influence of prices.

The information about area planted with wheat in the USA, available in spring 1981 points to a sharp increase. As far as can be seen this is not just a shift from one crop to another but primarily an expansion of area planted to principal crops. This occurs despite the fact that the area planted to principal crops already last year reached a post war peak and

¹ A more thorough discussion of the problem could be found at FAO, Agriculture: Toward 2000, op.cit., p. 65. - The Global 2000 Report, op.cit., p. 96.

² For empirical results see: World Bank, op.cit., p.150, and the Global 2000 Report, op.cit., p. 554. The empirical results given in these studies are basically derived from the "GOL-Model": USDA, Alternative Futures for World Food in 1985. Vol. 1: World GOL-Model. F. A. E. R., No.146, Washington 1978.

the increase in real wheat prices during the previous years was rather limited¹. There is statistical evidence that even with the newest expansion the land qualified as "crop land" will be used to roughly 80 per cent only². As in USA, also in Canada, South America and Australia a continuing expansion of grain area is expected. Without overstating this developments and belittling the evident physical restrictions discussed above, the area response to prices seems to have been systematically underestimated in the past.

Coming to price response of yields a strong relation to area response could be expected. A farmer confronted with increasing profitability of crop production is to choose whether intensification or area expansion is economically the more rational way to expand production. As already outlined above (see chapter 1.1), an empirical estimation of the respective coefficients proves to be difficult, because of large time lags involved. The results available from the studies already mentioned point to an extremely low price-yield elasticity. This again is not surprising as a time trend is the other explanatory variable. Unfortunately the exact specification and empirical results (including statistical tests) are not published. The projections show decreasing growth rates in yields over time, a plausible result in the long run and on principle, but this more or less is an input to the model and not an empirical result³. As with elasticity of area on product prices the question is at which part of a curve with probably decreasing yield responses to price changes one moves at this time. Given the enormous differences in yields which can be observed around the world, it seems a reasonable assumption that the level of intensification (yields) is not the least a matter of profitability, i. e. the

¹ It can't be excluded that the index used for deflating commodity prices is inadequate insofar as the cost increase in agricultural production is overstated. As the increase in nominal prices was considerable, money illusion of farmers could be another explanation.

² International Wheat Council (IWC), op. cit., p. 6:4.

³ The Global 2000 Report, op. cit., p. 554 and 77.

price level. Even if the time lags involved are very large, for example because of institutional and technological deficiencies in a lot of developing countries, in the medium run the elasticity of yields with respect to prices should still be quite large.

Summing up this production determining factors no evidence evolved which gives an indication for a decreasing elasticity of production with respect to price over time. The model results discussed in this context point to a bias in specification systematically underestimating price response. As a result growth rates in area and yield are determined mainly by a decreasing trend with respect to time and thereby a decreasing (gross) price elasticity is the outcome.

1.3 Price trends for wheat, coarse grains and sugar up to 1990

The foregoing discussion of likely development of factors determining production and consumption gave no indication that past trends wouldn't continue. Generally speaking this would mean no major changes in relative prices for the basic food commodities under discussion in the years ahead. Among all the implicit assumptions necessary analysing and arguing on the very global level, one should be made explicit. Major shifts in national policies could change the price level and/or trend. A reduction of protection rates by the EC could certainly increase world market prices. On the other side an abolishment of negative producer protection prevailing in quite a few developing countries¹ would dampen world market prices. A relation between prices and policies might exist the other way round too. For example, increases in relative world food prices could reduce consumer protection policies in centrally planned countries as falling prices might lead to an increase of producer protection (and consumer taxation) in rich industrialized

¹ E. Lutz and P.L. Scandizzo, Price distortions in developing countries: A bias against agriculture. "European Review of Agricultural Economics", Vol. 7-1, The Hague 1980, p. 5-27;
M.D. Bale, E. Lutz, Price Distortions in Agriculture and Their Effects: An International Comparison. "A.J.A.E.", Vol. 63, No.1, Lexington, Feb. 1981, p. 8-22.

countries. The result of this purely hypothetical scenario could be a positive relation between prices and price elasticity.

The projection results published by the World Bank and in the "Global 2000 Report" give a more pessimistic picture with respect to price trends. In general they come out with real price increases for food commodities. The projection period is up to 1990 (World Bank) and 1985/2000 in the "Global 2000 Report". Although both models are disaggregated for commodities and regions (countries) the degree of complexity differs widely. Whereas the first is basically a market model based on time series data, the latter is quite a complex global systems model trying to be consistent with resource restrictions¹. It presents three different alternatives in dependence of the exogenous assumptions. Here only the first (medium) alternative will be discussed. Comparing the price projections with the base period 1969-70 = 100 the "Global 2000 Report" comes up with a price index for grain of 110-130 (1985) and 194-195 (2000). The "Subalternatives" reflect different assumptions on energy price developments². The World Bank projection shows an index of about 110 both 1985 and 1990 for wheat and roughly constant maize prices. The sugar price is projected to increase about 40 per cent up to 1985 and remaining unchanged after it.

As far as major differences between the own considerations and the "Global 2000 Report" results for grain³ show up, this should be discussed in somewhat more depth. Even if the alternative a (+10 per cent up to 1985) seems to be close to our considerations there is quite a large gap because real energy prices rose already sharply since 1974-1976. So as in the written text of the study put forward, the figures for grains now valid are 130 and

¹ The core of it is a static equilibrium model "GOL" which already was mentioned above. A more detailed description would be beyond the scope of this paper.

² a) Real energy prices remain on the 1974-1976 level;
b) they are more than doubling up to 2000.

³ Though the difference in sugar (World Bank) is larger, a more detailed discussion, because of a lack of background information is difficult. One reason is that the World Bank projection includes cyclical movements and for 1985 a price peak is forecast.

195 for 1985 and 2000 respectively¹. One reason given by the authors is that the "world's food sector must grow near-record rates"² up to 2000. This argument is not a very convincing one, because these growth rates were reached in the sixties, a period of slightly decreasing real prices. As argued above (chapter 1.2.2), the main reason for the relative pessimistic picture drawn by the authors could be seen in the small influence of prices on production, not the least a question of model specification. How price increases in the magnitude projected by the authors would be consistent with a decrease in production growth rates (compared to the past), remains unclear.

Coming back to the sugar price projection by the World Bank, beside cyclical influences, a slight increase in real sugar prices is not unrealistic and could be observed already in the past (chapter 1.1). Even if there is substitution in production, a strengthening of demand for sugar (for ethanol production) could be a sufficient reason.

With respect to the global food situation the two studies are in agreement, that past growth rates in production (and consumption) will roughly continue. Looking into the regional demand-supply situation, not analysed in this paper, there too both studies as well as FAO results³ are in accordance that the increasing dependence of developing countries on food imports from the major exporters (e.g. USA, Canada, Australia, Argentina and by now EEC) already seen in the past, is likely to increase and by that even aggravates the nutritional problems.

1.4 Problems of instability

Even if relative prices for basic foodstuff as grain won't rise in the medium term, sharp short term price fluctuations as observed in the mid seventies and again at the end of the decade (Figure 2), could cause hunger in poor countries in addition to the persisting structural problems of malnutrition.

¹ The Global 2000 Report, Vol.1, op.cit., p.17.

² The Global 2000 Report, Vol.2, op.cit., p.78.

³ FAO, Agriculture: Toward 2000, op.cit.

The basic reason for the price instability on the world market could be seen in a production instability on the global scale, which in the years to come might even increase as a growing amount of marginal area is cultivated. The degree to which production fluctuations induce price fluctuations on the international markets highly depends on national policies which might be classified using the elasticity of net exports with respect to world market prices as an indicator. The higher the elasticity, the more stabilizing the net trade of the country in question. Clearly this is a very broad definition of policy e. g. because it "blames" the national policy for differences in demand and supply elasticities between countries (not caused by policy measures) as well as perhaps for production variations (weather) not buffered by national stock policy. So the net export elasticity for each commodity gives an impression of what are the effects of one countries foreign trade independently whether caused or not hindered by national policy measures.

As a detailed empirical analysis (by product and country) would go beyond the scope of this paper, we would restrict ourselves to some more theoretical remarks. Beside natural causes for instability (e. g. climatical factors) the main reason for low or reduced net export elasticities are national policy measures like levy or quota systems which are quite common on agricultural markets, especially in industrialized countries. Aiming for stable prices within the country, internal shocks are exported and "given" instability on the world market not reduced. The abolishment of this kind of protection systems or the substitution by less destabilizing foreign trade policies (e. g. customs) could be an important step towards more stable world market prices. In addition to that a stabilizing stock policy on the national or international level, increasing net export elasticities, respectively price elasticities in general, could be very helpful.

Summarizing the results derived for the development of the global food situation, there seems to be good reason that past trends in real prices for food, e. g. no increases, will continue. A major point of risk is the future develop-

ment of oil prices. With respect to food prices the demand pushing effect of sharp price increases -via rising ethanol production from food products - could in the long run be much more important than the cost effects. Even a rough quantification of this possible future developments is hard to achieve at the present level of information.

2. The markets for agricultural raw materials*

In contrast to the food markets, the medium term development of the international markets for agricultural raw materials is strongly influenced by economic growth in the industrial countries which determines via the demand for final products (textiles, tires, other rubber products) that for raw materials. Other major factors in determining market trends are supply changes depending above all on product prices as well as on prices of direct substitutes (man-made fibres, synthetic rubber). Generally, compared to food markets, international trade in agricultural raw materials is less restricted by trade barriers because many industrial consuming countries do not meet climatical requirements for production of commodities like cotton and natural rubber. This mainly explains why a relatively high percentage of world production of agricultural raw materials is traded internationally (table 4). Although national and international markets for agricultural raw materials are more interdependent than food markets and although manufacturers use to respond directly to changes of world market quotations, price fluctuations in the seventies were not less pronounced than on food markets (figure 1, page 2).

2.1 Cotton

During the seventies world consumption and production of cotton expanded more slowly than in the decade before, whereas average growth of world trade has accelerated distinctly (table 5). Repeated supply deficits forced world market quotations strongly upward; however relative cotton prices fluctuated widely around a stagnant trend (figure 5). The bulk of the increase in world trade was attributable to the demand of centrally planned countries (above all

* The authors thank Mr. R. Schmidt for very helpful comments.

Table 4 - Main indicators of development of some international markets
for agricultural raw materials 1960-1980

	Cotton ¹	Wool	Natural rubber	(Synthetic rubber)
World production 1980 (1000 t)	14272	1627	3815	8625
Average annual changes (per cent)				
1960-70 ²	1.8	0.8	4.0	12.1
1970-80 ³	1.7	0.1	2.3	4.3
World consumption 1980 (1000 t)	14504	1500	3785	8635
Average annual changes (per cent)				
1960-70 ²	1.9	0 ⁴	3.5	12.2
1970-80 ³	1.6	-0.2	2.5	4.5
Consumption per capita 1979 (kg)	3.23	0.34	0.89	2.09
World stocks 1980 (1000 t)	4781	97 ⁵	1295	2140
Ratio world stocks/world consumption (per cent)				
1960	43.3	.	22.0	18.4
1970	38.8	.	33.6	21.3
1980	33.0	.	34.2	24.8
World exports (\$ mill.)	6728	3331 ⁶	4027	.
World exports 1980 (1000 t)	4978	934 ⁷	3255	2350
Average annual changes (per cent)				
1960-70 ²	0.9	0.2	1.2	9.5
1970-80 ³	1.7	-2.9	1.5	5.1
Ratio world exports/world production (per cent)				
1960	36.6	.	94.0	23.6 ⁸
1970	32.7	45.3	89.8	24.9
1980	30.2	33.4	85.3	25.9
Prices ⁹				
Ø 1970-72=100				
1960	107	107	211	. ¹⁰
1970	85	88	113	96 ¹⁰
1980	281	267	401	425 ¹⁰
Relative prices ¹¹				
Ø 1970-72=100				
1970	91	93	120	102
1980	102	97	145	153

¹ Figures refer to crop years. - ² Compound rates calculated on base of averages for 1959-61 and 1969-71. - ³ Compound rates calculated on base of averages for 1969-71 and 1979-80. - ⁴ 1965-70. - ⁵ Only major exporting countries. - ⁶ Greasy and degreased wool. - ⁷ Exports of greasy wool in 1979. - ⁸ 1963. - ⁹ In US-\$. - ¹⁰ Price for S-type rubber. - ¹¹ Calculated by dividing raw material prices by UN export unit value index for manufactured goods.

Source: International Cotton Advisory Committee, Cotton, World Statistics, Washington. - Commonwealth Secretary, Wool Quarterly, London; FAO, Trade Yearbook, Rome. - International Rubber Study Group, Rubber Statistical Bulletin, London.

Figure 4

Textile raw materials: consumption and determinants

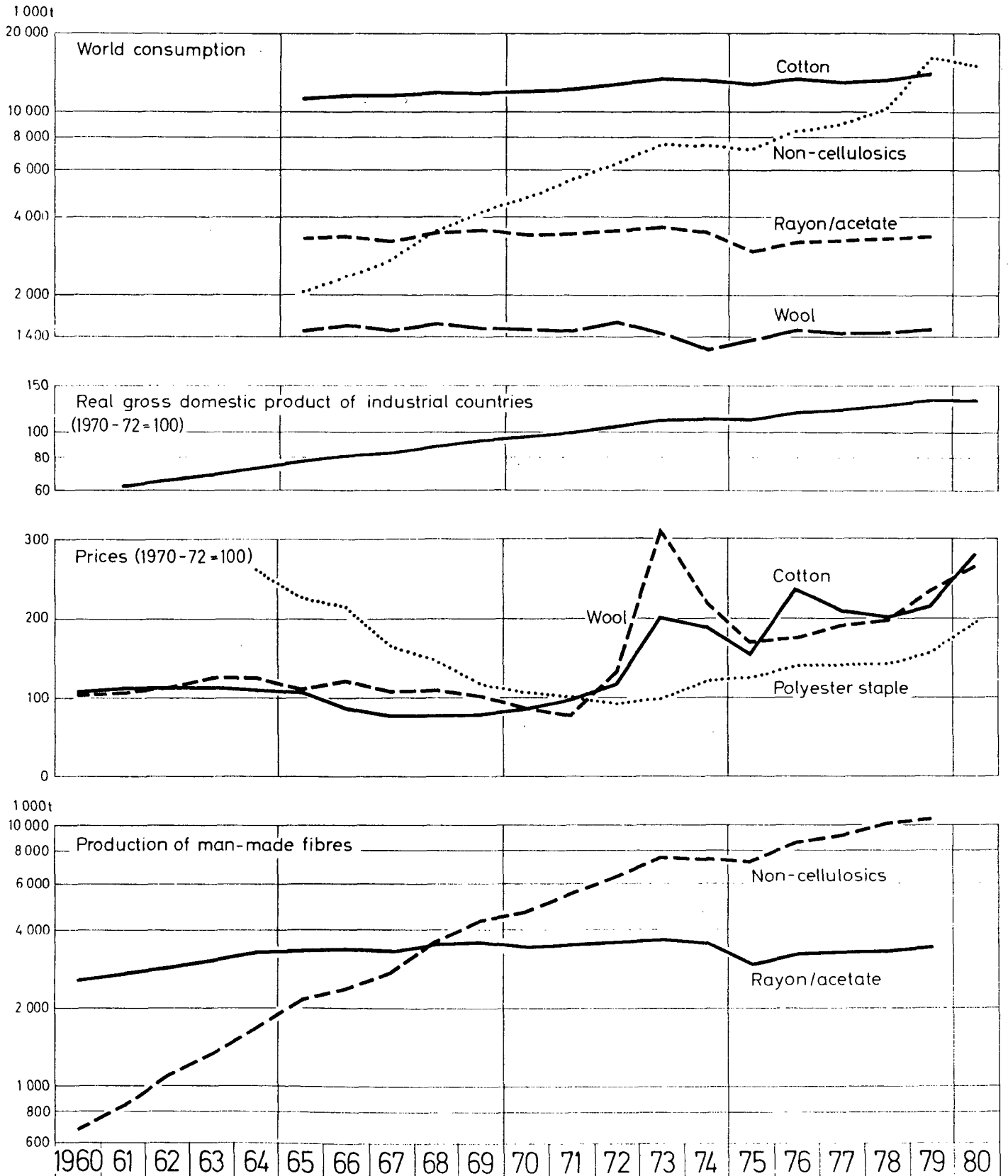
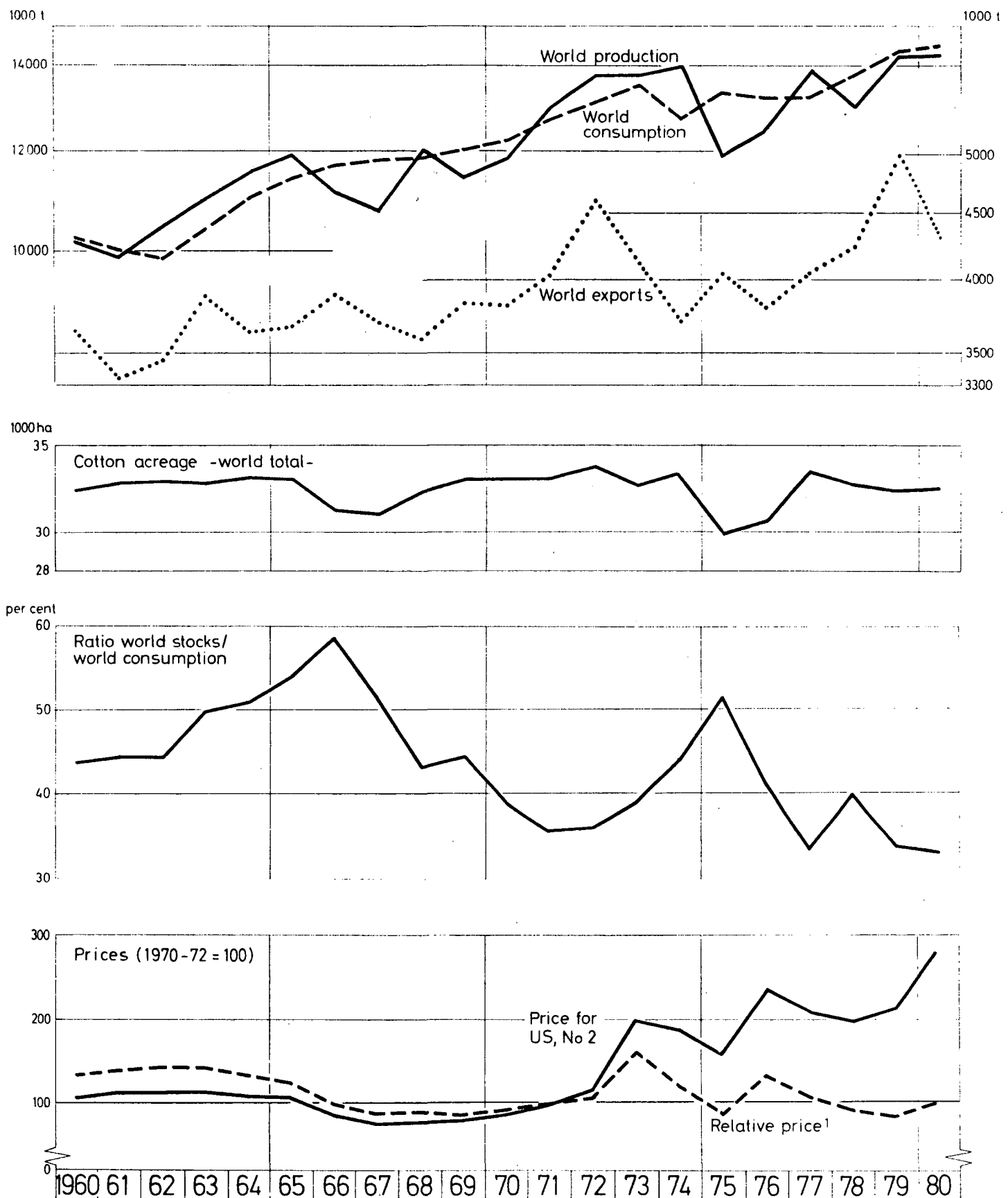


Figure 5

Main indicators for the development of cotton markets



¹Cotton price index divided by UN Export unit value index for manufactured goods.

China) as well as to world market purchases of developing countries, which - in order to meet rising domestic demand and to stimulate exports - expanded their production capacities for cotton yarns and cotton fabrics considerably. The reallocation of textile industries from industrial countries to developing countries began in the sixties and was continued until now, although textile exports to industrial countries were limited by import restrictions. In contrast to the developing countries cotton consumption and import demand of developed countries declined in the seventies (imports by 1.2 per cent per annum on average), mainly reflecting strong man-made fibre competition, and - at the given low income elasticity of demand - reduced growth of real disposable income. Due to rapid expansion of synthetic fibre output (chiefly polyester staple), which until the early seventies could be observed mainly in the developed countries - as well as in centrally planned countries - and because of the fast growing economies of scale in this sector the competitive position of synthetic fibres was improved basically. At the same time fierce competition in the man-made fibre sector contributed to changes in price relations between fibres in favour of synthetics consumption (but this development didn't continue in recent years (figure 4)). For this reason but also due to some specific properties of synthetics (especially in blended fabrics), consumption of synthetics rose outstandingly. In 1977 the contribution of synthetic fibres to total world fibre consumption came to 47 per cent, compared with 30 per cent in 1965, whereas in the same period the percentage of cotton dropped from 62 to 48 per cent. Only in recent years when the boom of oil prices pushed up costs of basic chemical feed stocks and direct energy inputs for synthetic fibres (however, existing over-capacities did only allow a partial upward adjustment of man-made fibre prices), natural fibres in manufacturing industries seem to have regained some of the competitive ground lost in the sixties and the early seventies; fashion trends in favour of natural fibres gave further support.

With regard to a medium-term outlook of cotton markets¹ the basic question

¹ See also: World Bank Staff Commodity Paper No. 2, International Cotton Market Prospects, Washington 1978. - FAO, Agricultural Commodity Projections 1975-1985, Rome 1979.

Table 5 - International cotton markets: past and projected

	Actual 1980/81 (1000 t)	Growth rates (per cent)		
		actual		projected
		1960/61- 1970/71 ¹	1970/71- 1980/81 ²	1980/81- 1990/91 ³
Production				
World	14275	1.9	1.7	1.7
Developed countries	3124	-3.0	2.5	0.5
Developing countries	5724	3.5	0.6	2
Centrally planned countries	5428	3.7	2.5	2
Consumption				
World	14402	1.9	1.6	1.6
Developed countries	3509	-0.7	-1.5	-0.5
Developing countries	5030	3.9	3.1	3
Centrally planned countries	5863	3.1	2.7	1.5
Imports				
World	4712	0.9	1.6	.
Developed countries	1952	-0.9	-1.2	.
Developing countries	1237	3.7	3.8	.
Centrally planned countries	1523	2.6	4.8	.
¹ Compound rates calculated on base of averages for 1959/60-1961/62 and 1969/70-1971/72. - ² Compound rates calculated on base of averages for 1969/70-1971/72 and 1979/80-1980/81. - ³ Tentative forecasts.				

Source: Cotton-World Statistics, Quarterly Bulletin of the International Cotton Advisory Committee, Washington.

arises as to whether in the years to come fundamental changes of "real" cotton prices (nominal prices deflated by UN Price Index for Manufactured Goods) can be expected. The answer depends above all - at the given relatively high production elasticity - on the assessment of future demand. Assuming that during the eighties real income growth in major consumer countries will be lower than in the past decade and "real" oil prices will rise on average by about 1-2 per cent annually (and by that price competitiveness of synthetic products will deteriorate only slightly) and production capacities for synthetic fibres will be reduced world cotton consumption could increase about by a similar rate experienced in the seventies. Likewise regional demand development patterns would not differ significantly from that in the decade before. Downward tendency of cotton consumption in industrial countries is likely to continue, though at lower rate than until 1980/81. In developing countries growth rates of cotton consumption will probably be comparable to that in the seventies (around 3 per cent). In contrast expansion of consumption in centrally planned countries is suggested to be distinctly lower because of continuing construction of synthetic fibre plants in this region and the endeavours to raise the synthetic fibre content in textile products.

With regard to future development of cotton basic production it should be pointed at the existing production reserves in major export countries as well as in other countries which will be increasingly utilized on condition that domestic prices will follow world market quotations very closely. As in the past, production growth might be achieved above all by raising yields whereas crop areas are not expected to extend markedly. In most countries production elasticity with respect to world market prices will probably remain relatively high over the coming years. This is mainly true for developed countries, above all for the United States, the most important export country (competing cash crops are here maize and soybeans; it is assumed that relative profitability of these commodities will not change significantly). In centrally planned countries the efforts to stimulate cotton production might ensure that it will be about in line with domestic demand. On the other hand growth of production surpluses of developing countries is expected to be lower than in the seventies reflecting in-

creasing domestic requirements and continuing substitution of textile exports for cotton exports. Regional projections for annual production growth up to 1990 rank from 2 per cent in developing countries and centrally planned countries to only 0.5 per cent in industrial countries (table 5). Summing up the production outlook it can be expected that - about stagnant or only a little rising "real" world market prices - total supply and demand will be about balanced.

2.2 Wool

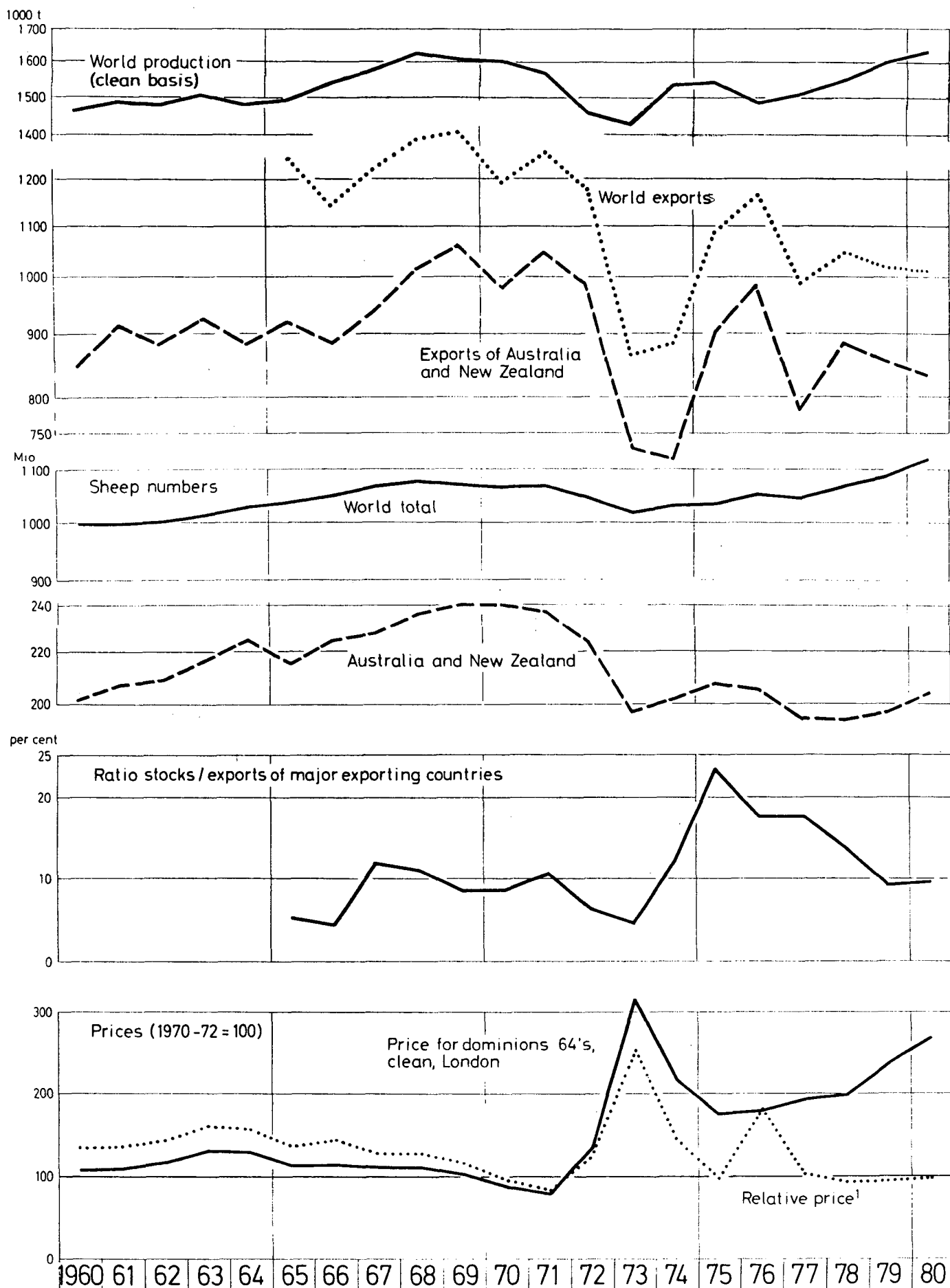
Future trends of international wool markets, which according to world export values, are less important than cotton markets, will not differ very much from the development observed since the mid-seventies. In Australia and New Zealand, origin of about four fifth of world wool exports, sheep farming (production of wool, mutton and lamb) at present prices offers distinctly more remunerative opportunity in livestock producing areas than beef cattle raising. Assuming more or less unchanged price relations between wool/lamb on the one and beef/wheat¹ on the other hand there is reason to believe that world market supply of raw wool will slowly and steadily expand over the future years². Development of wool consumption will be gradually stimulated because of increased cost competitiveness compared to man-made fibres (see above). With the oil price assumption (increase of "real" prices by 1-2 per cent annually) the competitive position of synthetic fibres will deteriorate further, even if more slowly than in the seventies. In addition fashion trends could promote wool demand further. The share of wool in total fibre consumption is likely to stabilize at about the level reached in last years (1977: 5.4 per cent). This percentage showed a declining tendency in the sixties and especially in the seventies, mainly as a result of the strong inter-fibre competition;

¹ In Australia wheat is partly in competition to sheep farming.

² In recent years large exports of live sheep from Australia to Near East Oil Countries took place. But it is unlikely to expect that this special trade will accelerate and affect growth of future wool production significantly.

Figure 6

Main Indicators for the development of wool markets



¹Wool price index divided by UN Export unit value index for manufactured goods

but this process had been halted (or even reversed) after the second oil price boom. The assessed demand and supply prospects point at further rising nominal price in the medium term, possibly at an average rate similar to that of manufactured goods on international markets.

2.3 Natural rubber

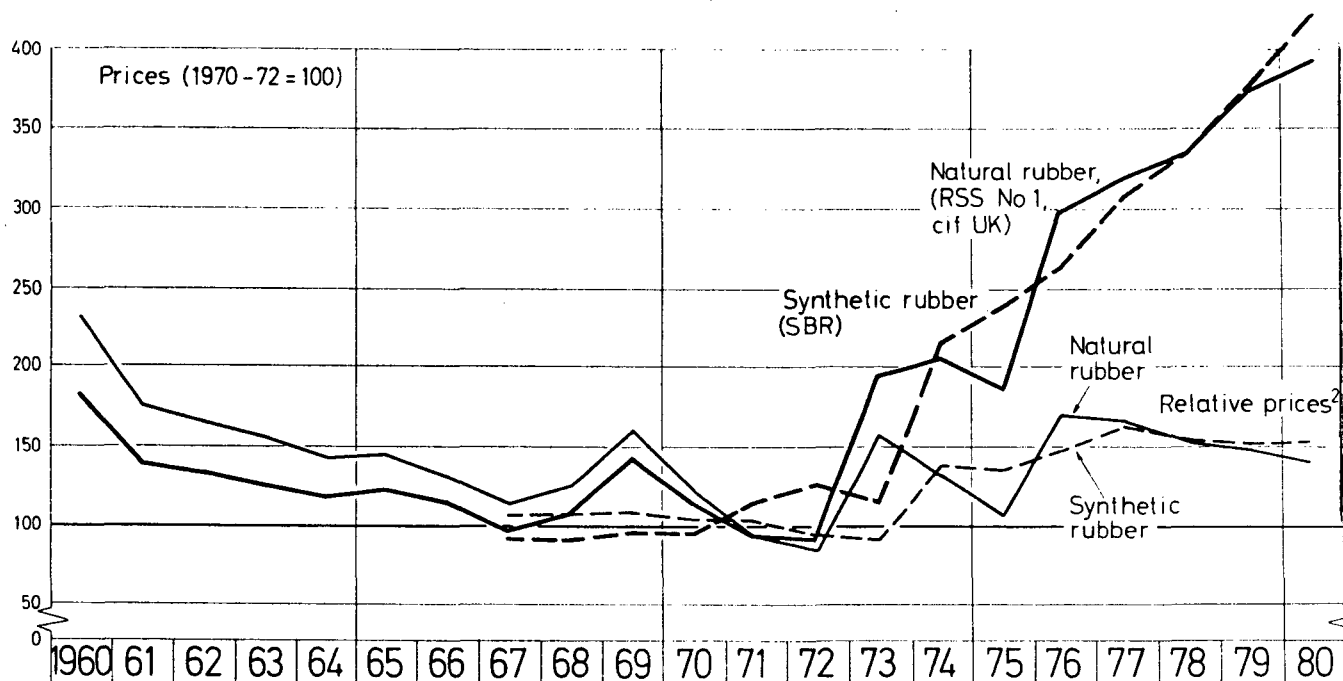
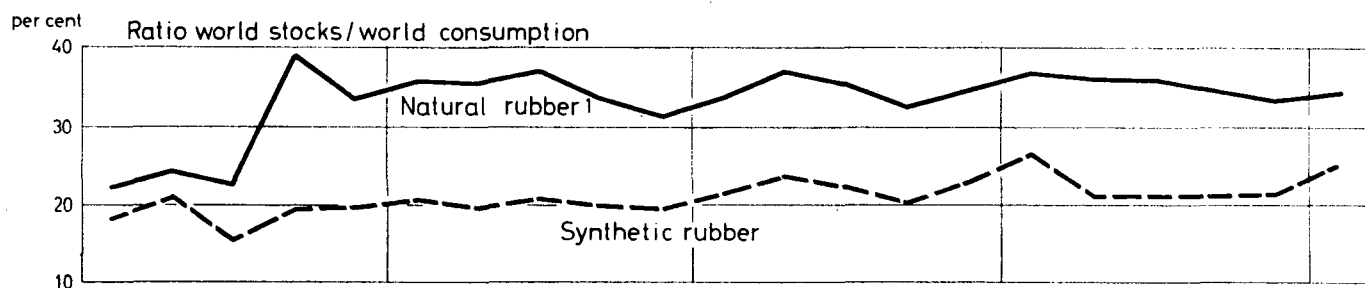
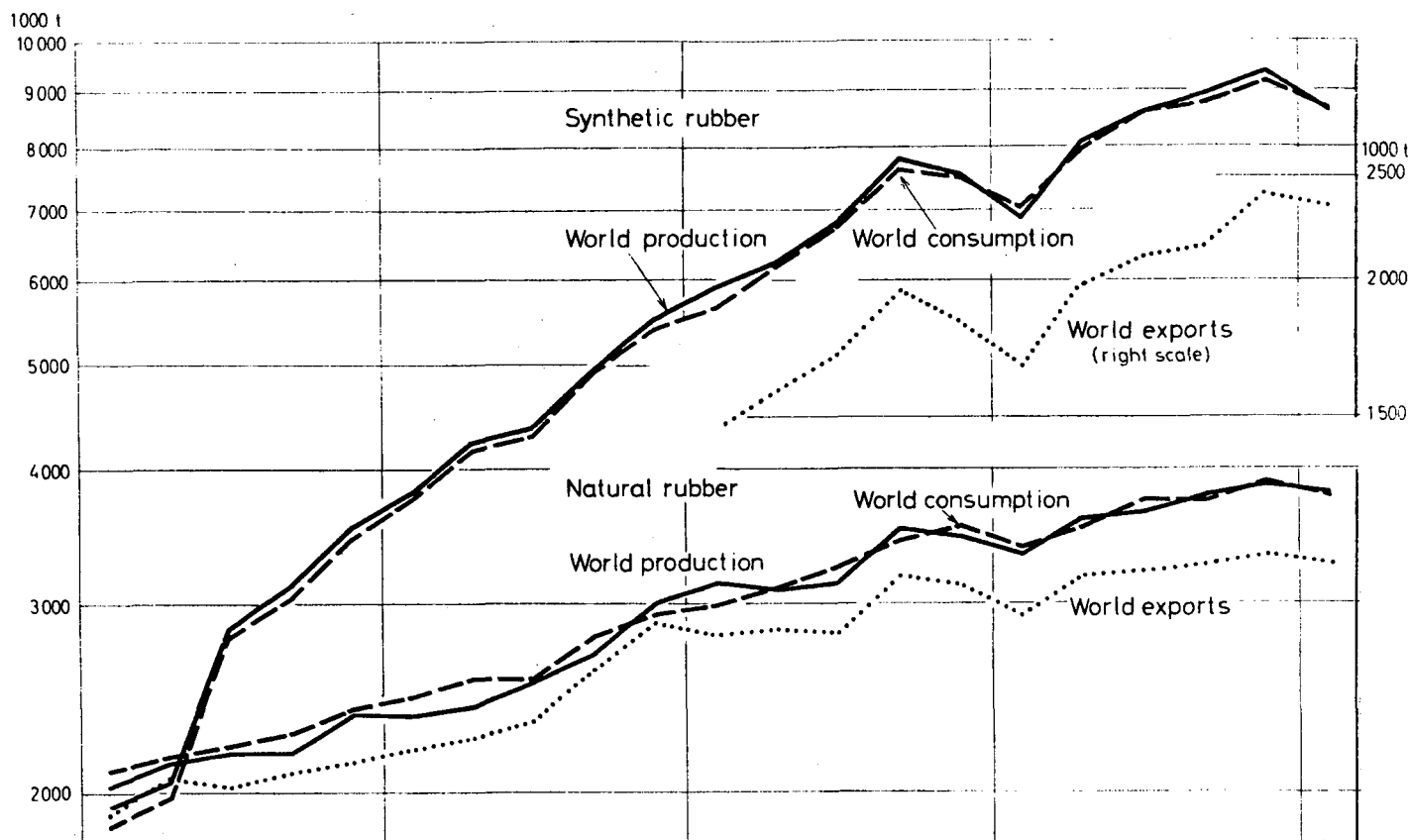
During the seventies the situation on natural rubber markets has fundamentally changed. Both, temporary strong demand expansion, especially for automobiles, and the oil price induced upsurge of synthetic rubber quotations led to rapidly rising prices for natural rubber¹ (figure 7). Although world total elastomer consumption of manufacturing industries grew by 3.7 per cent annually during 1970-1980 (after around 8 per cent in the decade before), demand for natural rubber developed less favourable because of substitution by synthetic rubber. Competitive advantages of the latter should mainly be seen in connection with technological innovations, i. e. the ability to offer a greater range of adequate and constant rubber qualities for many applications; furthermore fast rising production led to economies of scale. Until the early 1970's production capacities for synthetic rubber grew rapidly in the western industrial countries and afterwards also further in centrally planned countries and some developing countries. When 1973/74 and again 1979/80 sharp rising crude oil prices pushed up production costs for synthetic rubber (energy input especially for feed stocks is very high), prices of synthetic rubber were soaring faster than natural rubber quotations and the competitiveness of the former was weakened. The upward trend of natural rubber prices should also be explained by temporary supply deficits as a consequence of lack of new plantings with high yielding trees in major production countries (partly because of higher returns for competing products like tropical oil); this is mainly true for Malaysia and Indonesia, which together account for about two third of world production. The share of natural rubber in total elastomer consumption declined considerably before it was recently levelling off a little above 30 per cent.

¹ In 1981 followed a sharp price fall because of recession in industrial countries.

Figure 7

- 32 -

Main indicators for the development of rubber markets



¹Without stocks afloat. - ²Rubber price indices divided by UN Export unit value index for manufactured goods.

Concerning future trends¹, the growth of world total elastomer demand is projected to slow down slightly (table 6) because of reduced expansion of car and tire purchases. The main reason for this development has to be seen in lower growth rates of real disposable income in developed countries. Further rising gasoline prices will assist demand shifts towards energy saving compact cars and reduce average mileage per car. On the other hand there is a tendency to use more radial tires (instead of cross-ply tires); this could support natural rubber consumption² even if the live-time of radial tires is longer on average. Summing up the trends discussed above demand for natural rubber could keep pace with total elastomer demand.

Taking into account the current inadequate planting schemes in major producing countries (mainly directed to improve smallholders output) it cannot be excluded that in the future production will lag behind expected demand. In several countries production incentives seem, at the given national tax systems, too low. If no additional efforts are made in the immediate future to stimulate production of natural rubber (a tree takes about six years to become productive), production deficits will occur and it might be difficult to stabilize the share of natural rubber in total rubber consumption at present level. Considering this and assuming that the strong upward tendency of production costs for synthetic rubber will persist, the increase of natural rubber prices may continue in the medium term, possibly rather faster than prices on the international markets for manufactured goods.

¹ To the medium-term outlook of rubber markets see also: E. R. Grilli et al., The World Rubber Economy, Structure, Changes and Prospects. World Bank Staff Occasional Papers, No. 30, Washington 1980. - World Bank, Price Prospects for Major Primary Commodities, Washington 1980. - FAO, Agricultural Commodity Projections 1975-1985, Rome 1979.

² For production of radial tires more natural rubber is required.

Table 6 - International markets for natural rubber:
past and projected development

	Actual	Growth rates (per cent)		
	1980 (1000 t)	actual		projected ¹
		1960- 1970 ²	1970- 1980 ³	1980-1990
World elastomer				
Total consumption				
World total	12425	8.1	3.7	3.0
Natural rubber				
Consumption				
World	3785	3.5	2.9	2.4
Developed countries	2034	2.8	1.3	2
Developing countries	971	6.2	7.8	4
Centrally planned countries	780	3.8	1.0	1
Production				
World	3815	4.0	2.3	2
Developing countries	3642	3.6	2.2	2
Imports				
World	3200	1.8	1.5	.
Developed countries	2047	2.9	1.1	.
Developing countries	514	-7.9	6.2	.
Centrally planned countries	639	6.2	-1.7	.

¹ Tentative forecasts. - ² Compound rates calculated on base of averages for 1959/61-1969/71. - ³ Compound rates calculated on base of averages for 1969/71-1979/80.

Source: International Rubber Study Group, Rubber Statistical Bulletin, London.

References

- Allen, P.W., P.O. Thomas, B.C. Sekhar, A Study on Competition between Natural and Synthetic Rubber. The Techno-Economic Potential of NR in Major End Uses. Malaysian Rubber Research and Development Board, 1977.
- Bale, M.D., E. Lutz, Price Distortions in Agriculture and their Effects: And International Comparison. American Journal of Agricultural Economics, Lexington 1981.
- Brown, L., "The Energy Cropping Dilemma". CERES, Vol.13, Rome 1980, No. 5.
- Commonwealth Secretary, London: Wool Quarterly; Wool Intelligence.
- Cotton-World Statistics, Quarterly Bulletin of the International Cotton Advisory Committee, Washington.
- Dicke, H., M. Hoffmeyer, H.R. Krämer, H. Rodemer, J.-V. Schrader, Auswirkungen der Agrarpolitik der Europäischen Gemeinschaft auf den Agrarhandel mit Drittländern. Kiel 1980.
- FAO, Rome: Agriculture: Toward 2000. 1979.
- - , Agricultural Commodity Projections 1975-1985, 1979.
- - , FAO Expert Consultation on Energy Cropping versus Food Production. 1980.
- - , Production Yearbook.
- The Global 2000 Report to the President, Vol. II, Washington 1980.
- Grilli, E.R., B.B. Agostini, M.J. 't Hooft-Welvaars, "The World Rubber Economy". World Bank Staff Occasional Papers, No. 30, Baltimore, Maryland
- International Cotton Advisory Committee, Cotton World Statistics, Washington.
- International Rubber Study Group, Rubber Statistical Bulletin London.
- International Sugar Organization, Sugar Year Book, London.
- International Wheat Council, Press Release, London.
- Josling, T., Developed-Country Agricultural Policies and Developing-Country Supplies: The Case of Wheat, IFPRI, Res. Rep. 14, Washington 1980.
- Kohlmeyer jr., H.S., "How to Analyze the Cotton Market". Commodity Yearbook 1979, New York.

Licht's, F.O., International Molasses Report, Special Edition 1979, The Brazilian Alcohol Program and its Objectives. Ratzeburg 1979.

Lutz, E., P.L. Scandizzo, "Price distortions in developing countries: A bias against agriculture". European Review of Agricultural Economics, The Hague 1980.

Meekhoff, R., M. Gill, W. Tyner, Gasohol: Prospects and Implications. USDA, Rep. No. 458, Washington 1980.

Parikh, K.S., Exploring National Food Policies in an International Setting: The Food and Agricultural Program of IIASA. Laxenburg 1981.

Schrader, J. -V., Energiegewinnung aus nachwachsenden Rohstoffen in Konkurrenz zur Nahrungsmittelproduktion. Paper presented to the 21. Jahrestagung of the 'GEWISOLA', Stuttgart 1981.

Smit, H.P., Demand and Supply of Natural Rubber, Economic and Social Institute, Free University, Amsterdam, January 1981.

Tisdell, C.A., P.W. McDonald, Economics of Fibre Markets. Newcastle, Australia.

USDA, Washington: Alternative Futures for World Food in 1985, Vol. 1, 1978.

- - , Foreign Agriculture Circular, Grains, Washington.

World Bank, Price Prospects for Major Primary Commodities, Washington 1980.

World Bank Staff Commodity Paper No. 2, International Cotton Market Prospects, Washington 1978.