SUPPLY RESPONSE WITHIN THE FARMING CONCEPT

WEEK 1: DAY 4

AGRICULTURAL SUPPLY RESPONSE

by Kjeldsen-Kragh Professor, The Royal Veterinary and Agricultural University, Copenhagen

CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

A supply curve is the relationship between the prices, the non-price factors and the supply of a given product. It is important to know the supply curve of a given product for the following reasons.

Firstly, it is necessary to know the supply curve together with the demand curve when we want to explain the price determination and the market conditions. In this case, the supply curve is part of a descriptive analysis explaining market behaviour.

Secondly, the supply curve is an indispensable piece of evidence needed, when we are discussing what should be the "right" price of food products. This is a normative analysis showing what we "ought" to do to obtain some given objectives. How sensitive is the supply to price changes and to changes in other factors influencing the production conditions? What is the impact of the price level on the income distribution in the economy as a whole, and in the farming sector? What is the impact of the price level on the economic development in rural areas and in the society? The price level of food products is a strategic variable which has widespread implications for welfare and development.

In this article, the focus is less on the first set of questions and more on the second set of questions.

The first part of the article examines the price policies for agricultural products in the developing countries. In contrast to the industrialized countries, the developing countries have a tradition of taxing the agricultural sector, the most common pattern being a highly distorted price system. The politicians are confronted with severe economic constraints and with a conflict between agricultural interests and the interests of the rest of the society. An adequate price policy depends on the economic and social goals, and it depends on the agricultural structure in the country.

The second part of the article deals with the supply curve and the different factors influencing the supply of agricultural products. A distinction between price and non-price factors is very important. A main question is whether the price level of agricultural products should be increased. It might cause social distress especially in the shorter run. Is it so that a higher price level will cause a bigger supply of food products in the longer run? What should be the "right" terms of trade between the agricultural sector and the rest of the economy? Correct estimates of the impact of the important determinants of the agricultural supply curve are necessary to ensure adequate policy interventions.

2. AGRICULTURAL PRICE POLICIES

2.1. Agricultural sector is taxed

It is a well known fact that the developing countries have been discriminating against the agricultural sector. In their analysis representing 18 developing countries, Schiff and Valdes (1992) have investigated the direct, indirect and total nominal rate of protection for the agricultural sector in the period 1960-84. The sample averages are shown in table 1.

The exported agricultural products (food products, beverages, raw materials for industrial processing) are directly taxed in the sense that the farmers get a price for their exports that is

16.5% below the world market price level, which is already depressed as a result of the dumping by the industrialized countries of surpluses caused by their respective agricultural policies. On the other hand, the imports - constituted mainly of food products - are protected by 18.6%. This means that there is a distortion of 35.1% between the price level of exported and imported agricultural product. If the export and import products are taken together there is a taxation of 7.9 %. When the world market price level is used as a benchmark, it should not be forgotten that the world market price level is already depressed by the dumping of surpluses from the industrialized countries caused by their agricultural policies.

Table 1: Direct, indirect and total nominal rate of protection for 18 developing countries, 1960-84) sample average[a].

Direct price intervention in agriculture	
Protection of export products	- 16.5 pct
Protection of import products	+ 18.6 pct.
Protection for all agricultural products	- 7.9 pct.
Indirect price intervention in agriculture	
Indirect protection due to overvalued foreign exchange rate and protection of the industrial sector	- 22.5 pct.
Total direct and indirect protection	- 30.3 pct

[a] Plus represents protection and minus depicts taxation
Source: Schiff and Valdes, 1992.

Direct taxation of agricultural products is comparatively smaller than the indirect taxation of the agricultural sector. The indirect taxation is mostly an outcome of the protection of the industrial sector. Intermediary products and consumer goods bought by the agricultural sector are more expensive than they would be without the industrial protection. This leads to a discrimination in favour of the industrial sector as opposed to the agricultural sector. In addition, the overvalued exchange rate hurts the sectors that are trading with the outside world, whereas it is relatively favourable to the domestic market sector which does not compete with goods and services from abroad.

Several factors have contributed to an overvalued foreign exchange rate. Firstly, industrial protection results in a low level of the imports that reflects a lower foreign exchange rate. A lower import causes a lower demand for foreign currencies, so that the foreign exchange rate is lower when there is industrial protection compared to the situation without protection. Therefore, the industrial protection causes a real appreciation of the foreign exchange rate. Secondly, many developing countries have an import surplus, which means that the foreign exchange rate is overvalued unless the import surplus is being financed by foreign aid of one kind or the other. Thirdly, the inflation rate has been much higher in developing countries and the nominal exchange rate has not, generally speaking, been adjusted to the higher inflation rate, which has led the real exchange rate to be overvalued. We have the following relationship:

$$R.Ex.R. = Nom.\ Ex.R. \frac{\text{Inflation abroad}}{}$$

where R.Ex.R. and Nom. Ex.R. are respectively the real and the nominal exchange rate

In order to compensate for the direct and indirect taxation of the agricultural sector, the governments have often introduced input subsidies to the farmers. These input subsidies are not included in the figures of table 1.

2.2. Why did the developing countries end up with the highly distorted systems?

All these factors together have led to the emergence of a distorted system that is unfavourable to the agricultural sector. Some times the governments have deliberately discriminated against the agricultural sector to obtain low food prices which should favour the poor landless people in rural areas and the poorer classes in the urban areas. In addition, food products can be considered as wage goods, which has an influence on the wage level in the industrial sector. When the food prices are kept down, it is easier to keep the wage rate down, and a lower wage rate improves the competitiveness of the industrial sector.

It should not be forgotten that the choice of taxes on imports and exports are not levied deliberately to discriminate against the agricultural sector. In developing countries, there are several constraints to economic development that might necessitate imposition of such taxes.

One is the foreign exchange constraint. When the export earnings are not sufficient to finance the imports, it is understandable that the country tries to produce those consumption goods which could alternatively be produced at home, if the production at home is protected. This is the philosophy behind the import substitution strategy. The risk is that if this philosophy is driven too far, the country ends up with a wholly distorted price system. If the protected commodities also are used as intermediary factors in the production of other commodities, the latter are in reality taxed, so that there will be an ever spreading request of protection for more and more products.

Another constraint is the state budget. In developing countries, there are needs for public expenditure such as infrastructure, education and health care that have to be financed through taxation. The problem is that the taxation possibilities are limited. It is not possible to collect income taxes and value added taxes in developing countries at a large scale. Barter trade is still important, payment in kind is still used, thus making it difficult to introduce these taxes. Furthermore, the administrative set up to collect these taxes are usually not in place. The taxes that are easiest to collect are taxes on internationally traded goods, which means import taxes and export taxes. Land taxes should also be relatively easy to collect but here we often see political difficulties in introducing such taxes. The bigger landowners often belong to the political elite, who are not in favour of such taxes.

Several factors have contributed to the emergence of this highly distorted systems in the developing countries. Firstly, the government is faced with several contradicting objectives which have to be fulfilled, as illustrated in section 3. In such a case, it is necessary to have several policy instruments, each of which should primarily be related to one objective if possible. The Tinbergen goal-instrument model shows that if we have g goals we should at least have more than g instruments. There might have been an over-reliance on only too few instruments, especially, price policies.

Secondly, the policy makers are confronted with the heritage of a complex structure of interventions which has been built up over time. One intervention creates new distortions, and it calls for new interventions which create further distortions. Instead of modifying the original interventions, additional interventions are often introduced. Most of the negative effects of the interventions were unintended, often because of the complex structure of interdependencies which have not been taken into account due to the poor foundation of the decision making.

Thirdly, apart from ignorance and uncertainty in the decision making, there are political factors that often influence the decision making process even in cases where the problem in question is correctly specified and well understood. There are vested interest groups who are capable of exerting political pressure in order to obtain interventions which are not in the interest of the society as a whole, but in the interest of some specific parts of the society. The politicians want to be re-elected or they want to avoid trouble. That explains the importance of vested interests. It would be wrong to ignore those political factors, but they should not be accepted as ultimate facts. This argument speaks for a political science analysis as a supplement to the economic analysis to figure out how new political coalitions could be found. The international organisations and the donor countries could play an important role by making further support conditional on specific policy changes. It goes without saying that these "outsiders" should acquire a thorough understanding of the complex problems through a dialogue with the specific country before the conditions are specified

Because of the development of this highly distorted price system, a counter movement named structural adjustment took place in the 1980's. The structural adjustment theory emphasises the importance of the right prices and a free or less restricted interplay of the market forces. Prices are important signals, indicating scarcities and surpluses, and also, are important incentives for the consumers and the producers. Price policy is often used as an instrument to obtain certain economic goals.

The problems in relation to structural adjustments are twofold. Firstly, it is very difficult to transform a highly distorted price structure into a more market oriented system. Such a change might have significant economic and social consequences. The "right" sequence of policy changes should be carefully scrutinised before being implemented.

Secondly, there are several imperfections in the agricultural markets, so only few would advocate a no intervention policy in the agricultural markets. If there is no internal price regulations, the prices will be determined by the world market prices which are already distorted by the industrialised countries due to their protectionistic agricultural policies. Even without these distortions, the agricultural markets are characterised by high price volatility. Given the fact that the markets for agricultural products are far from being perfect in many developing countries, governments have to intervene to avoid distress in the production sector caused by low prices and distress in the consumption sector resulting from high prices.

To get a clearer picture of what kind of government interaction is needed, it is very important to examine carefully the functioning of the agricultural markets, and the economic and social consequences of any form of intervention. One piece of important evidence in that respect is the agricultural supply response, but it is far from being the sole evidence needed.

2.3. The dilemma of the policy makers

In developing countries, the policy-makers are confronted with a serious dilemma. On the one hand, they realise the importance of higher prices for agricultural products that might lead to a higher supply which could either substitute for imports or be exported. The income in the agricultural sector will increase, but whether the poorer producers will benefit sufficiently from the rise in income is an important question. Higher prices might benefit the larger producers, resulting in a situation where the richer farmers are buying land from the poorer farmers such that the land distribution become skewer. Higher prices might be detrimental to growth, equity, employment and poverty alleviation.

On the other hand, low agricultural prices are necessary to protect the poor consumers. The poverty problem in rural areas as well as in urban areas is not caused by a physical lack of food products, but by lack of entitlements, that is, the ability to acquire the necessary income to buy a sufficient amount of food (Sen, 1990). In such a situation, a price rise for food will further deteriorate the real value of the already low income earnings.

Apart from the severe income distribution problem, the policy makers are often confronted with another problem regarding the role of the agricultural sector in the economic development process. The agricultural sector has several roles to play. It has to produce food products. It has to provide savings and labour for other sectors and, at the same time, avoid an excessive migration to urban areas. It has to provide foreign exchange either by substituting imports or increasing exports. Finally, it has to serve as an "outlet" for industrial products and services produced in the country.

Some of those roles, e.g. the role of food producer and the role of being an "outlet" for goods from other sectors, call for a modernisation of the sector, which could involve a high price level for agricultural products. The role of providing savings for the development of other sectors might call for the exploitation of the agricultural sector by a low price level. The dilemma the policy makers are confronted with in this case, is the determination of an appropriate terms of trade between the agricultural sector and the rest of the economy (Sah and Stiglitz, 1984).

2.4. What are the objectives?

The agricultural supply response is important, but it should never be a crucial objective in itself to induce some increased supply by increasing the farm gate price. The question regarding an appropriate price policy should be looked upon in a wider context. The aim of agricultural policies should be to make a contribution to the overall goal of growth with equity. This overall objectives could be specified as follows:

Allocative efficiency and productivity: The existing resources should be allocated to obtain the highest possible productivity. An increase in the productivity can, at the same time, increase the income earnings in the farming sector without a big increase in the price level.

Acceleration of aggregate growth: There should be a balanced growth of agriculture, manufacturing industries and services. There are important interrelationships between the different sectors (linkages). There should also be a balanced growth in the different agricultural sub-sectors such as food crops, non food crops and livestock products.

Social objectives: The social objectives include, elimination of hunger, starvation, malnutrition and under nutrition, poverty alleviation and income redistribution. Special attention should be given to small farmers, employment creation for landless labourers and inhabitants of poor regions. There should be a reduction in rural-urban income differentials and migration. Rural industrialisation is an important supplement to agricultural development.

National food Security: Price stabilisation for both consumers and producers is also necessary. By linking the national food market to the international markets, some stabilisation can be reached in spite of the volatility of the international markets.

Social and political stability: Avoiding social and political instability is important for the long-run development. It poses an important constraint on the food price policy, because high price increases in numerous cases have caused social riots.

The objectives mentioned here should all be fulfilled simultaneously. This, however, is a difficult task unless a whole arsenal of instruments such as price policies, subsidies, public expenditure and taxes can be used. The use of certain instruments are restricted because of constraints mentioned before.

The more instruments available, the easier to fulfill the goals. If the necessary instruments are not available the country has either to sacrifice some of the objectives or to find some kind of compromise between the different objectives.

In practice, however, it should be possible to combine the objective of higher prices to small farmers, equity in income distribution and lower prices to poor food consumers. It can be obtained by increasing the producer prices, combined with a more efficient distribution system reducing the marketing margins, targeted food subsidies to vulnerable groups of consumers and a progressive land tax and income tax.

2.5. Agricultural structures are important

Price policy is an integrated part of the concept of supply response. Price policy has a substantial effect on income distribution, and hence, it should be structured in such a way as to take equity into consideration. Price policy has an impact on the income distribution between rural and urban areas as well as on the income distribution in rural areas and within agricultural sector.

Agrarian structures fundamentally affect the price-equity issues arising from the distribution of agricultural income among different groups within the sector. Broadly speaking, three different structures can be distinguished.

The first is the case where the sector consists, predominantly, of small farms. These farms being mostly owner occupied, there is no widespread extremes of wealth and income. Wage labour is provided by small farmers and landless labourers. Input and marketing systems, research and extension - so far as they are available - are adapted to serve the small farmers. An increase in producer prices will be spread rather evenly among most farmers. The landless labourers have to pay a higher food bill, but at the same time the prospects of being employed at a higher wage rate either in the agricultural sector or outside should be favourable because of the higher income level in the agricultural sector. This type of structure is known in many Asian and African countries.

The second structure, consisting of a smallholder sector mostly producing food coexisting with export oriented large scale plantations, is seen in parts of tropical Africa and some areas in Asia and Central America. The implication of price changes on income distribution will depend on the products that are affected. A change in food prices will lead to a change in the income of the small farmers in the same direction. If the small-holder agriculture is dominated by subsistence farming without commercial sale, the real income of the farmers will not change. The more important the commercial sale is, the more the farmers benefit from the price increases.

In the plantation sector, most of the products are exported. The income is dependent on the export conditions and the macroeconomic policies, and thus, is strongly influenced by government policies such as exchange rate policy and commodity taxation. The income position of landless labourers, mostly employed by plantations, will change in the same direction as the profitability of the export production, if the wage rate is adjusted. Experiences show that an upward rise in the wage rate will not necessarily take place, unless the labour is unionised.

The third structure is characterised by the combination of a modern commercial farm sector with large scale units and a small scale, semi-subsistence farming sector, where both groups grow basically the same crops. This structure is common in South America. Whatever is done with price policy alone is likely to worsen the absolute or relative income position of the peasant sector and the landless labourers. A cheap food price policy implemented through commodity taxation and overvalued exchange rate will harm the already small cash crop of the peasant sector. A reduced profitability of the commercial sector will either lead to lower wage rates for landless labourers or to further investment in labour saving machinery, which is "subsidised" by an overvalued exchange rate and often favoured by interest rate subsidies and ample tax depreciation rules. However, if savings from cheaper food outweigh the fall in wage rates, the position of the employed landless labourer could be maintained or improved. An increase in product prices will profit mainly the modern commercialised sector, which has greater access to new technologies, better marketing channels and commercial credit. The relatively higher income in the commercial sector will eventually result in a skewer land distribution, because the peasants will be bought out by the larger farmers.

3. THE SUPPLY CURVE

3.1. The supply curve and the price

3.1.1. The supply curve is based on a production function

The supply curve and the demand curve together determine the prices. In the agricultural markets, the prices are volatile, and in the long term, tend to turn against agricultural products.

The supply Q is assumed to be a function of the acreage A and the yield Y, where both are dependent on the expected price that is assumed to be the actual price in the past period. The yield is also a function of weather conditions.

$Q_t = A_t \lozenge Y_t$
$A_t = f_1(P_{t-1})$
$Y_t = f_2(P_{t-1}, W_t)$

where Q_t, A_t and Y_t are aggregates for a whole country or a whole region for the period t. These aggregates are based on the sum of the individual producers' activities.

Figure 1a and 1b represent the relationships between the price level and acreage, and between the price level and yield respectively. The total supply is determined by multiplying the acreage and the yield at a given price level .
[figures 1a, 1b]

To obtain a better understanding of the supply curve, one should have a closer look at the forces behind figures 1a and 1b. Figure 1b can be derived from a simple production function.
[figure 2]

In figure 2, there is a given amount of land, e.g. 1 hectare. For a given the production technology, utilisation of different levels of variable factors (e.g., fertilisers, or labour) N, gives us the yield curve Y_A

If we spend N_1 of the variable input, the yield will be Y_1. The marginal productivity of the input is equal to dY_1/dN_1, which is equal to the slope of the tangent R. P_{out} and P_{in} represent the output price and the input price respectively . The optimal use of the input is obtained when the marginal productivity of N equals the marginal costs of N, that is;

$dY/dN . P_{out} = P_{in}$ or $dY/dN = P_{in}/P_{out}$

When P_{in}/P_{out} is equal to dY_1/dN_1, the levels of N_1 and Y_1 represent an optimal situation. If the output price increases while the input price remains constant, then the yield will increase. In figure 1b, the input price is assumed to remain constant and the price indicator on the vertical axis is not the output price, but the relative price between output and inputs. If there is technological progress in the sense that new better farm practices are used, then the production curve will move upward. The new curve will be Y_B. In this case, the supply curve in figure 1b will move to the right.

3.1.2. Price volatility

To determine the market price, it is only necessary to combine the demand curve D_t with the supply curve S_t.

Demand curve:	$D_t = D(P_t)$
Supply curve:	$S_t = S(P_{t-1}, W_t)$
Equilibrium condition:	$D_t = S_t$

When the demand is determined by the present price level and the supply is determined by the past price level and erratic weather conditions, we will have the so called cobweb model where the price level fluctuates from period to period. In figure 3, the price level is P_1. In the following period 2, the supply will be S_2, and the corresponding price P_2. Then in period 3, the supply will be S_3, and the corresponding price level P_3 and so forth.
[Figure 3]

The time lag in the supply response where the price level in the former period determines the supply in the present period, is due to the fact that the production period is quite long. In the cereal sector it takes between 6 and 9 months from sowing to harvest in the temperate climate zones.

The cobweb model, the erratic weather conditions and the demand shifts can explain the higher volatility of agricultural prices as compared to industrial prices as a result of full competition and lower price elasticities in the demand and supply curves. That is one of the main reasons for government interference in the agricultural markets.

3.1.3. The long-run price trend

In the industrialised countries, there has been a long run deterioration of the terms of trade between agricultural products and industrial products as illustrated in figure 4.
[Figure 4]

Through time, the demand curve moves from D_1 to D_2. In case of industrialised countries, there is only a slight move because the population growth is low, and because the income elasticities for agricultural products are low. The supply curve moves from S_1 to S_2. At a given price level, the shift in the supply curve is larger than that in the demand curve. Increase in productivity because of technological progress is the reason why the supply move is relatively strong.

The behaviour of price in such a situation is clear. There is a decline in the price level for agricultural products. Because of the general inflation, there has not been an absolute drop in agricultural prices, but only a relative fall of agricultural prices in relation to the general price level.

3.1.4. The supply curve and the commodity

The supply curve for an individual crop and the supply curve for all crops together respond very differently to a price change. If the price of one crop increases in relation to the prices of other crops, there will be substitution of the land use towards the first crop and away from the other crops. For a single crop, the land is not a fixed factor, whereas, for all crops taken

together as one commodity with a common price level, the supply curve will be much less elastic. In this case, the amount of land is a fixed factor, at least in the short-run.

If one considers all crops and animal products together, there will also be a rather steep supply curve, at least in the short-run. For a large husbandry sector more of the land is used for animal fodder production, thus reducing the land available for cereals necessary for human consumption.

There are many studies estimating the supply elasticities for single agricultural commodities, but there are only relatively few studies concerning total agricultural supply response (Ghatak and Ingersent, 1984). This is not surprising, because, the impact of a change in the agricultural-industrial terms of trade on the total agricultural supply is very difficult to isolate from other influential factors. In other words, at the aggregate level other things are never equal.

Nevertheless, the question about the "right" terms of trade between agriculture and the rest of the society has been hotly debated. This issue is at the centre of the discussion about the role of the agricultural sector in the development process (Sah and Stiglitz, 1984 ;Timmer, 1988).

3.1.5. The supply curve and the time period

There is always a time period associated with a supply curve. This time period can be chosen differently. It can be the supply for the coming month or the supply one year or five years ahead.

It is evident that in the short-run all the production factors are fixed, whereas apart from the amount of land they are all variable in the long run . Even here, there is some flexibility because new land can be taken in or arable land today can be taken out of production.

Just after the harvest the cereal supply is totally inelastic. The supply just before the sowing season will show some elasticity. In the long-run, when farmers can leave the agricultural sector or when new capital and technological improvements can be acquired, the supply elasticity will be higher.

3.2. Price and non-price factors

The supply curve is normally considered as a technical relationship between price and output based on a given production function. The production function, however, is influenced by the quantity and the quality of a whole set of production factors that are at the disposal of the agricultural sector. Those production factors are land, capital, labour, technology and intermediary goods. The farmers' behaviour depends on the quantity and the quality of these factors and the prices they have to pay for these inputs. In addition, the institutional set up in the agricultural sector and in the society influences the way the farmers behave and in the way they respond to price changes.

Land: The production depends on the amount of land and the quality of the land, combined with the weather conditions such as temperature and precipitation. The production can be increased either by acquiring more land, or by increasing the yield of the land already cultivated. If the production methods are causing erosion, salination, water logging or other environmental damages, the long-run supply will be affected negatively.

Capital: Machinery, equipment and tools are necessary for production. On the farm, there should also be some storage facilities. The possibility to irrigate also has a major impact on production. The establishment of an irrigation system requires considerable investment, which needs public initiative and financing. The farmers often have to pay for the public services delivered from the public investment.

Labour: The production depends on the number of people working on the farm, and the number of hours worked. The possibility to hire workers, especially, at peak times and the possibility for members of the farm family to get employment outside the farm influences the production. The nutritional situation and the health situation in the countryside influence the work performance and the responsiveness to new initiatives.

Raw materials and services. The productivity depends on the availability of seed, fertilisers, pesticides and extension services. Are high yielding varieties of seeds adapted to natural conditions in the area available? The soil and the weather conditions are different from one area to another. The weather conditions influence which insects and which fungi the crops are exposed to, and therefore, it is important to have seeds that are resistant to the most common disease attacks. If manure from the livestock production is not sufficient, it is necessary to buy fertilisers. The research in new high yielding varieties and in sustainable production methods is necessary. The dissemination of the research results through extension service is of equal importance. To have access to advises is an important prerequisite for efficient production.

The availability of the production factors needed to obtain a high production level depends on the institutional set up in the agricultural sector and the rest of the society. Are the markets functioning and are the necessary public investments undertaken?

Markets. A market can not function properly if the transportation system is inadequate. If a region has a surplus production and the products cannot be "exported" out of the area, an increase in production will only cause a fall in the selling price. Transportation deficiencies make it difficult to get the necessary inputs at the right time and reasonable prices.

In addition, an efficient distribution system, where the marketing margins between the production price and the consumer price are not too high, is important. Sometimes, the purchase of farm products and the delivery of inputs are organised by often inefficient State agencies. To leave the distribution system to the private sector is also problematic. Buying middlemen will often have monopsony power and the selling middlemen will have a monopoly power. A solution might be the establishment of selling and buying co-operatives among the farmers.

When farmers have to buy intermediary goods and to invest, they need financing. An "official" credit market where all farmers, including the smallholders, can get finance at a low interest rate is necessary. Otherwise, they have to seek finance in the unofficial or grey capital markets with high interest rates.

A well functioning capital market can reduce the harmful consequences of adverse circumstances. In addition, there could be established future markets and insurance schemes covering the case of harvest failures.

Many farmers, especially small farmers are risk averse. Often they do not take new initiatives that would improve their long term conditions, if we disregard risks. Risks, such as harvest failures, unexpected price drops, lack of fertilisers on the market at the time needed etc. are inherent to agriculture, and in such cases poorer farmers with debt burdens are especially vulnerable. Credit markets, future markets and insurance schemes will reduce the risks.

Institutional arrangements: Under this heading one can mention the question about ownership. Either the farmer owns his land, or he is a tenant. There is also a class of landless labourers who could acquire their own land if land reforms were undertaken.

It is well known that private ownership releases forces and initiatives because the farmers feel that they work for their own interest. Normally, the small plots owned by small holders are much more intensively cultivated than those owned by larger holders. In a society where there is a bimodal farm structure in the sense that there is a subsector of large commercial farms and a subsector of semi subsistence peasants, a rise in the price of farm products can cause an even skewer land distribution because the smallholders are bought out by the larger farmers. Because of the less intensive production in the commercial sector, the total output could fall. A land reform that would create a less skew land distribution could increase the total production.

To what extent a tenure system limits the production in comparison with a private ownership system, depends on the specific content of the tenure system. If the tenant does not receive the total revenue of a supplementary effort in the production, the supply will be lower than in the case of private ownership. In a sharecropping system, the tenant has to pay, for example, half of the output to the landowner. A sharecropping system will reduce risks, but it gives less incentive to increase production.

Public investments. As already indicated above, the supply of adequate inputs needs public investment in research and in extensive services. Improving the performance of the markets needs investments in infrastructure and the distribution sector, e.g. storage facilities. Apart from that, there are investments in schooling and education, in health-care etc.

As demonstrated in this section, a large set of non-price factors have an important impact on the supply response of the agricultural output. The non price factors are sometimes described as the five "in.'s". They are, input delivery systems (irrigation, fertilisers), innovation of new high yielding varieties and new farming practices (research), information through extension services, infrastructure (transport, education, health care) and institutional changes such as new credit systems and land and tenure reforms (Streeten, 1987).

3.3. The aggregate supply curve and its determinants

The aggregate supply Q is influenced by a whole range of factors. The supply of agricultural products is determined not only by the conditions on the farms, but also by the conditions prevalent in the agricultural sector and the society.

Let us look at the variables in an aggregate supply function.

$Q = f(P_{out}, P_{in}, A, L, C, I, T)$

where Q is the output, $P_{out,}$ the farmgate price, $P_{in,}$ the price of inputs, A, the acreage, L, the labour input, C, the amount of capital, I, intermediate goods and T, the technological level.

It could be useful to be more explicit about the variables.

The output could be defined in different ways:

- Q could be the total production.
- Q could be the production sold out of the farms. It means that the farmers own consumption should be deducted from the total production.
- Q could also be the production sold on official markets for which there are official statistical figures. It means that the amount sold on unofficial markets, e.g. rural markets, or goods sold illegally is not included in Q.

P_{out} is the farm gate price level. This price level is influenced by macroeconomic policies such as foreign exchange rate policy, export taxes, import taxes and price subsidies. If the price level on the official markets are more or less fixed, the farm gate price will depend on the transportation costs and the efficiency of the distribution system. If there are private buyers for the agricultural output, they can get a monopoly rent, thus lowering the farm gate price. If State agencies are working inefficiently, either the farm gate price is lowered, or the agencies are accumulating deficits to be paid by the government. Both, the transportation system and the market system, have an important impact on the output and input prices.

The size and quality of acreage A have an impact on the supply. In addition, the size structure influences productivity in the sense that the farming intensity is normally higher on smaller farms than on larger farms. Hence, the importance of the land distribution and the legal framework in the context of supply response. Also, depending upon whether the farms are privately owned, or the farmers are tenants, the tenure conditions will vary, and they can be more or less conducive to new initiatives on the farms.

The labour input L depends on the amount of available labour, the number of hours worked and the efficiency of the labour force. If the farm gate price level increases, the number of working hours might be reduced. The farm consumption of its own products could increase which will, in turn, reduce the marketable surplus. The availability of products to buy from outside, and the price level for these products can have an important impact on the consumption and production behaviour of the farms. Even when the farm gate prices rise, if there are no goods on which the extra money can be spent, there will be no incentive to work more .

The amount of capital C on the farms is, of course, important. A well functioning credit system, so that new undertakings can be financed, is crucial.

The availability of the intermediary goods I, such as high yielding varieties of seeds, fertilisers, water etc. at the right time is important. If the fertilisers cannot be bought at sowing time, or the irrigation system cannot be repaired, the use of high yielding varieties needing those inputs might be irrational because the lower yielding varieties are often more resistant to unfavourable growing conditions.

The technological level T depends on the human capital on the farms. The educational level and the nutritional standard influence the absorption capacity of new farming practices among the farmers. The "supply" of technological know-how depends on the research activity in the area, and the dissemination of the know-how through extension services.

In sum, the supply response is not only a function of the output and input prices, but also a function of non-price factors. The crucial question is to find out the type of relationship that exists between the price and major non-price factors.

3.4. The relationship between price and non-price factors

There are several possible ways in which price and non-price factor influence each others. Figure 5 shows four possibilities.
[Figure 5]

In case (a), the non-price factors are already in place as is the case in the industrialised countries. It means that the supply response to price changes is relatively large. In the three other cases the non-price factors do not exist, and the response to price increases is different.

In case (b), it is assumed that a price increase in the short-run will only give a small supply response. But there are some important indirect effects of the price increase. The price increase will set in motion a range of initiatives. There will be both private and public initiatives to overcome the constraints from the non-price factors. The price increase will "get the agricultural sector moving", partly because higher farm incomes increase the savings for new investments.

It is evident that some "endogenous" progress will take place when the agricultural sector reacts to the price change. The technological innovations are determined by the relative factor endowments. For example, in land-scarce, labour-abundant economies we have witnessed bio-chemical innovations, which are land augmenting, and in labour scarce, land-abundant economies we have seen more mechanical innovations, which are labour augmenting.

In case (b), it is assumed that a price increase alone is sufficient to generate the pressure for new initiatives that would reduce the level of constraints. A price increase might be a necessary but not sufficient condition for progress. Either price increase might not be enough, or - even if the price increase works as suggested in case (b)- it may take too long before it works. In the intermediate period, before the large supply response occurs, the price level for the consumers will be high.

In case (c), it is assumed that a price increase should only be undertaken in conjunction with measures eliminating the non-price constraints. Here, a price increase alone is not considered sufficient, and thus, it is implemented in combination with a designed public investment programme.

In case (d), it is assumed that a price increase in itself is not necessary or desirable as an instrument. Instead, all the energy is concentrated in eliminating the non-price constraints. If the initiatives prove successful, the supply curve will move outwards and the consumer price will not increase. In this case, public expenditures substitute price increases. The problem is, how the government can acquire sufficient funds in order to finance the necessary

investments. There might be a deficit in the short run, but the productivity increase in the long run will lower the consumer food prices, so that taxes levied on high incomes could cover the deficit.

3.5. Household behaviour

As shown above, the aggregate supply response is influenced by a whole set of variables, which makes it a difficult task to obtain reliable estimates for the price elasticities of agricultural supply. Different estimation methods have been used different studies. There are cross country estimates, cross farm estimates, intersectoral general equilibrium model based estimates and time series estimates. (Chhibber, 1989). The size of estimated long-run aggregate price elasticity of supply varies substantially according to the method used. Cross country estimates are normally high, whereas cross farm estimates are low. It is not the place to go into details about the different methods. It should only be mentioned that it is unwise to rely on cross country estimates when the study includes widely different countries in different levels of development.

When we are considering developing countries, one should especially focus on estimates based on household models. Two factors are of special interest in house hold models. The first factor is the allocation of time. How is the time allocated between working hours and leisure? How are the working hours allocated between household keeping, agricultural production on the farm and work outside the farm? The second factor is that a sizeable share of the production on the farm is consumed on the farm and the rest is sold out of the farm. Consumption and production decisions are taken simultaneously.

The first question about the labour supply can be illustrated in a simple diagram with indifference curves as shown in figure 6. On the horizontal axis, we have leisure and on the vertical axis, the income earned. OZ is equal to 24 hours. As we move from Z to O, the leisure time decreases and the working time increases.
[Figure 6]

The straight lines W_1, W_2 and W_3 indicate the incomes earned when the wage rate, depending on the price level of the output, is increased from a low wage rate w_1, to medium wage rate w_2, to a high wage rate w_3.

The indifference curves show the trade-off between income and leisure. An income increase affects leisure in two ways. A higher income means that there will be a demand for more leisure. This is the income effect. A higher income caused by a higher wage rate means that the opportunity costs of leisure will increase implying a substitution of working for leisure. This is the substitution effect.

In figure 6, an increase in the wage rates from w_1 to w_2 causes an increase in the number of hours worked from ZL_1 to ZL_2. Here the substitution effect is stronger than the income effect. If there is a further increase in the wage rate from w_2 to w_3, the supply of labour will decrease. Now the income effect is stronger than the substitution effect.

From figure 6, we can derive the labour supply curve as shown in figure 7. At a low wage rate level, we have an upward bending labour supply curve. But after a certain wage level has been reached, the labour supply is backward bending.
[Figure 7]

The second question deals with the on-farm consumption as a share of the total agricultural production. If the price level of the agricultural output increases, the farm household can obtain the same money income from selling out of the farm by supplying a lower amount. It means that a greater share of the total output can be consumed on the farm. When the farmers are poor, the income elasticity for food produced on the farms will be high. (Livingstone, 1977).

When these two factors - a decrease in labour supply and an increase in home consumption - are taken into consideration, the total result could be a backward sloping supply curve for the marketable surplus.

The two factors mentioned here could be relevant, when we are dealing with poorer farming communities. Even though the supply curve is not backward sloping, the two factors might contribute to the explanation of the low price elasticity estimates.

3.6. Are price increases the solution?

Most of the poor people in the developing countries live in rural areas. Therefore, poverty alleviation is a question of creating income in the rural areas. The agricultural sector is a basic sector in rural areas. The low income level in the agricultural sector is due to low productivity and artificially low prices, as shown in section 2.1. It is evident that a higher price level for agricultural products will increase the farm incomes. Would it not be the solution of the problem? According to the so-called Structural Adjustment Programmes launched by IMF and IBRD in the 1980's it is crucial "to get the prices right".

Our analysis shows that the problem is far more complicated. The crucial problem is the low productivity in the farming sector. This low productivity is often explained by the poor production and marketing structures, because the necessary non-price factors are missing.

If a higher price level is introduced the question is whether this price increase, implemented through elimination of taxes on the agricultural sector, by itself initiate productivity gains. If the long run price elasticity is zero, the production will not increase, which means that there will be no real development of the agricultural sector. The higher farm incomes are a result of an income redistribution from the consumers and the public, in the case where the taxation is removed, to the producers.

If the long run price elasticity is large, a price increase will increase the supply, so that the consumer price level after the initial price rise will fall gradually, when the productivity increases.

As indicated in section 3.4, the question is whether a price increase by itself will initiate productivity gains. Often there are structural constraints, which should be removed, and which demand public undertakings. If the taxation of the agricultural sector is removed, the public revenue will decrease, putting the financing of the public expenditures under pressure. This argument is only valuable, however, if the taxation revenue in fact is spent on public investments removing the barriers to economic development in the agricultural sector.

It is evident, that the government should be cautious before it approves food price increases. If the long run price elasticity is very low, price increases will not initiate economic development of the agricultural sector.

4. CONCLUSION

This article has been divided into two parts. The first part deals with agricultural price policies and the second part with the supply curve. The question about the "right" terms of trade between agricultural and industrial products is very important since it has a crucial impact on the income distribution. There is no universal answer to the question. The price elasticity of the supply curve and the supply elasticity of the non-price factors are important empirical evidences which should be taken into consideration, when price policies are formulated.

In the first part, it is shown that the developing countries in the past have carried out agricultural policies and general economic policies which have taxed the agricultural sector. Sometimes, the taxation has been a deliberate policy guided by certain policy goals, and some other times, the result of piecemeal interventions creating unintended distortions. The agricultural price policy has an important impact on the income distribution and the economic development. Most of the poor people in the developing countries live in rural areas. This is why the income distribution between the different "classes" in rural areas is a question of special importance. The way in which a price increase influences the rural areas, depends on the agricultural structures in the country.

In the second part, the supply curve for agricultural products is analyzed. Knowledge concerning the supply curve for the agricultural sector in the short and in the long run is important, while designing the price policy. How large is the price supply elasticity, and how large are the supply elasticities of non-price factors? Price increases could either be combined with structural changes carried out by public investments or structural changes could substitute for price increases.

Normally, the supply curve is considered as a simple tool for economic analyses. The forces behind the supply curve, however, are very complex in case of developing countries, where the "structures" are not in place. The lower the price supply elasticities is, and the higher the supply elasticities of the non-price factors are, the more questionable it is to use price increases as an instrument. Even if the price supply elasticity is large in the long run, one should be aware of the problems in the transitory period, until the larger supply will lower the price level.

If a country chooses to increase food prices, it should be realized, that such an intervention ought not to stand alone. It should be combined with public investments in the agricultural sector, food subsidies for targeted groups and taxation of the richer people in rural and urban areas.

REFERENCES:

Chhibber, A. (1989). The Aggregate Supply Response. In Simon Commander (ed), Structural Adjustment and Agriculture. London.

Ghatak, S. and Ingersent, K. (1984). Agriculture and Economic Development. Harvester Press.

Livingstone, I. (1977). Supply Responses of Peasant Producers: The Effect of Own-Account Consumption on the Supply of Marketed Output. Journal of Agricultural Economics 2.

Sah, R.K. and Stiglitz, J.E. (1984). The Economics of Price Scissors. The American Economic Review March 1984.

Schiff M.W. and Valdes, A. (1992). The Political Economy of Agricultural Pricing Policy, volume 4, Washington DC.

Sen, A. (1990). Food, Economics and Entitlements. In C. K. Eicher and J. M. Staatz (eds.), Agricultural Development in the Third World. London.

Streeten, P. (1987). What Price Food? MacMillan.

Timmer, C.P. (1988). The Agricultural Transformation. In H. Chenery and T.N. Srinivasen (eds.), The Handbook of Development Economics.

Tinbergren, J. (1954). Centralization and Decentralization in Economic Policy. Amsterdam.

by Søren Kjeldsen-Kragh
The Royal Veterinary and Agricultural University
Department of Economics and Natural Resources
Unit of Economics
Rolighedsvej 26
DK-1958 Frederiksberg C
Copenhagen, Denmark