THE ECONOMICS OF AGRICULTURAL SUBSIDIES

ELAND A. BOSCH

Stellingen

1. De stelligheid waarmee macro-economische voorspellingen worden gepresenteerd staat vaak in schril contrast met de betrouwbaarheid van deze voorspellingen.

2. Studenten in de economie kunnen meer inspiratie opdoen door van Keynes te lezen dan door over Keynes te lezen.

3. Het beleid inzake het verminderen van handelsbelemmeringen tegen export van ontwikkelingslanden dient meer afgestemd te worden op de exportbehoefte van ontwikkelingslanden dan op de gewenste bescherming van eigen produktie.

4. De levensvatbaarheid van een uitgebreide E.G. is onder meer afhankelijk van een politieke aanvaarding van agrarische inkomensverschillen, die ontstaan zijn door verschillen in economische efficiency. Een eerste stap in de richting van deze acceptatie is de recente consensus om output subsidies aan kwantitatieve bovengrenzen te binden.

5. Popper's adagium, dat een theorie die veel uitsluit waardevoller is dan een die weinig uitsluit maar vaker bevestigd wordt, lijkt bij veel maatschappij-wetenschappelijk onderzoek een ondergeschikte rol te spelen.

6. De invloed van een aantal specifieke eigenschappen van de Engelse taal op Wittgenstein's latere denken inzake begripsvorming zou een nadere studie verdienen.

7. "Gesundes Volksempfinden" is gevaarlijk als enige bron van recht, maar de huidige Nederlandse strafrechtpleging lijkt deze bron geheel te veronachtzamen hetgeen kan leiden tot rechtsvervreemding.

8. Het is eenvoudiger een xenofobe politieke stroming te veroordelen dan de oorzaken ervan weg te nemen.

9. Wanneer de huidige criminaliteit een toenemende functie is van jeugdwerkloosheid en politioneel personeelstekort, dienen met meer spoed en creativiteit extra vacatures bij de politie vervuld te worden door werkloze jongeren.

10. Groepsbesluiten zijn door compromis - inflatie vaak minder intelligent dan individuele beslissingen. Een consequentie hiervan voor het overheidsbeleid zou kunnen zijn dat, binnen de grenzen van democratische contrôle, besluiten zoveel mogelijk door één verantwoordelijk persoon genomen worden.

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The Economics of Agricultural Subsidies
15 mei 1985, Wageningen

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The Economics of Agricultural Subsidies

Proefschrift
ter verkrijging van de graad van
doctor in de landbouwwetenschappen,
op gezag van de rector magnificus,
dr. C. C. Oosterlee,
in het openbaar te verdedigen
op woensdag 15 mei 1985
des namiddags te vier uur in de aula
van de Landbouwhogeschool te Wageningen

ISN = 223282 - 03

Promotor: dr. F.P. Jansen, hoogleraar in de landhuishoudkunde
van de tropen en de subtropen

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This study on the economics of agricultural subsidies consists of two Parts.

In the first Part I have reviewed and analysed the comprehensive but hitherto scattered literature on the subject.

The second part contains the findings of an empirical study on agricultural subsidies in the Caribbean carried out by the author from April 1982 to March 1984.

I am greatly indebted to Prof. Dr. F. P. Jansen who read the earlier drafts thoroughly.

His invaluable suggestions have considerably improved the quality of this work.

As far as the empirical study is concerned I was greatly aided by Mrs. M. Maharajh, Mr. H. Maharaj and Prof. Dr. G. Schieffer. They assisted me in the supervision and organisation of data collection.

I was also fortunate in obtaining frequent counsel from Mr. D.I. Field in organising and analysing the data on dairy farming.

The Department of Agricultural Economics of the University of the West Indies was most helpful in providing the necessary facilities for the administration of the collection of a large amount of farm data.

Finally, I wish to express my gratitude to Mr. F. B. Lauckner. He ensured that my substantial requests for computer facilities were fulfilled efficiently despite the limited resources at his command.

SUMMARY AND POLICY RECOMMENDATIONS

PART ONE

1. Agricultural subsidies have been defined as a government induced change of relative prices of goods, services and factors of production in the agricultural sector. These agricultural price changes may result from a large number of different government measures varying from direct cash transfers to government trade policy. Workable definitions have been derived by a further classification into specific categories of agricultural subsidies.

2. Agricultural subsidies have been considered to be economically justified when under a system of laissez-faire public welfare decreases.
   They have been defended on three grounds, viz. the existence of domestic distortions, price instability, and the infant-industry argument.

3. Domestic distortions like monopoly power, pollution and other externalities, can theoretically be overcome by a subsidy policy in the direction opposite to the distortion.

4. Large price fluctuations of basic foodstuffs have a detrimental impact on the economy. Conversely, minor price variations are needed for profit maximization and for attuning supply to demand. The principal problem in designing an appropriate agricultural price policy is how to prevent large price fluctuations without undercutting the function of price as a market signal.

5. The infant-industry argument can not be adequately defended on theoretical grounds as developed by Mill, Bastable, Kemp and Meade. In accordance with modern equilibrium theory, protection has to be based on the existence of dynamic internal economics, i.e. the net positive diffuse impact on welfare stemming from the learning

process of the industry under protection.

6. Subsidies do not only have the desired effects. Suboptimal behaviour by subsidized agents often leads to welfare losses. Also, welfare in non-subsidized sectors may decline because of a reallocation of resources towards the subsidized sectors.

7. In theory, the distorting and inter-sectoral impact of agricultural subsidies can best be ascertained by the use of macro-economic models. Total impact analysis, however, has not been very successful so far, mainly because of the data required.

8. The estimation of welfare effects of agricultural subsidy programs, notably for developing countries, has mostly been based on partial equilibrium analysis. The estimation of elasticities and changes in economic surplus is of great analytical value, because it provides answers to ex-ante questions about who will benefit most from the subsidy, and how cost-effective the subsidy will be in raising farm output.

9. The inaccuracy in approximating welfare changes by changes in economic surplus is an increasing function of the proportion of individual income spent/earned with respect to the commodity or group of commodities in question, the magnitude of the (induced) price change, the interdependency of the goods that are added up in the surplus measure, and the proportion of the value of the commodities concerned as compared to total GNP.

10. Direct farm income subsidies are more geared to relieving the symptoms rather than the basic causes of income inequity.
    If, however, the major political objective is to guarantee farmers' incomes, direct farm income subsidies seem to be most appropriate since such a policy is less distorting and much cheaper than a policy that guarantees income by direct farm input or direct farm output subsidies.

11. Direct farm output subsidies, studied within a partial equilibrium framework, are either indirect money transfers (i.e. taxes) from consumers to farmers without additional welfare losses to consumers, or direct money transfers from consumers to farmers or government with additional welfare losses to consumers.

12. Generally, it will be uncertain whether farmers will benefit from farm output price stabilization, whereas it is probably true in most cases that consumers will suffer a welfare loss from such a policy (provided we are not dealing with major price fluctuations of basic foodstuffs).

13. It has been suggested that the establishment of active sales agencies and a thorough analysis of markets in developed countries by experts from developing countries may form a better means of boosting farm exports than the imposition of farm export subsidies.

14. When direct farm input subsidies are not accompanied by improved farm technology, the resulting shift in farm output supply will be nothing but parallel and likely to occur at net social cost.

15. Farm input utilization is determined by a large number of different factors affecting the farm input demand and supply side, whereas a farm input subsidy only affects a few of these factors, and to some degree in an unpredictable way.

PART TWO

16. The empirical estimation of welfare effects of agricultural subsidies is extremely difficult when a large number of subsidy programs is being implemented at the same time. Hence, an optimal determination of the subsidy mix in terms of cost-effectiveness in meeting the objectives is feasible only when the total number of support measures is limited.

Another reason for starting on a small scale with agricultural subsidy programs is that most new subsidy programs suffer from administrative problems in their initial stages.
These infant disease costs can be minimized by allowing subsidy programs to benefit as much as possible from the experience gained in earlier subsidy programs.

17. The determination of the optimal subsidy mix in a dynamic context requires adequate subsidy statistics. Therefore, it is advisable to allocate part of the subsidy budget to the collection and organisation of subsidy statistics.

18. The empirical study of farm labour distortions in Trinidad and Tobago has shown how a distinction between distorted and undistorted farm production could be made with the help of estimated production functions.

19. It has been argued that agricultural subsidy programs can be successful only if farmers are maximizing their profits and hence respond logically to induced changes in relative prices. A practical method to test price-responsiveness, with the help of cross-section data only, is the normalized restricted profit function (NRPF) approach.

20. A serious limitation to the NRPF-approach is that this method cannot be applied when agricultural prices are fixed. It must be noted that if farm prices are fixed, an optimal response to subsidies is doubtful anyway.

21. Elasticities indirectly derived from the NRPF are more reliable than those that are directly obtained from single-equation production functions.
Nevertheless, the signs and relative magnitudes of the various elasticities of either approach may match.

22. The empirical analysis shows that farm input subsidies had no

impact on input utilization of crop farmers. Apart from monopoly power in farm input supply, four fundamental administrative defects causing this program failure were identified.

23. In the ex-ante analysis of a fertilizer subsidy it was estimated that the shadow price of saving foreign exchange by subsidizing locally produced fertilizer only, would have been relatively high.

24. The computed analysis of production value into a price and a volume component concerning temporary crops, has provided support for a price stabilization program beneficial to farmers.

25. The concept of guaranteed threshold prices has been introduced in the ex-ante analysis of farm output subsidies. A sensitivity analysis within a partial equilibrium framework has been employed to determine the relative cost-effectiveness of different anti-distortive guaranteed threshold price programs.

PART ONE

THE CONCEPT OF AGRICULTURAL SUBSIDIES

CHAPTER 1

A DEFINITION OF AGRICULTURAL SUBSIDIES

1.1 Subsidies as a Government Induced Change of Relative Prices of Goods, Services and Factors of Production

Agriculture today is supported by governments almost everywhere. Experience shows that agricultural subsidies, once established, are not easily removed when the initial reason for their establishment no longer exists. Vested interests tend to develop quickly. This phenomenon has sometimes resulted in excess capacity, e.g. in the E.E.C. and the U.S.A. When excess capacity, induced by subsidies, results in decreasing world market prices, farmers elsewhere may press for similar support measures from their own governments. Agricultural subsidies in one country, induced by agricultural subsidies abroad, may finally lead to world-wide protectionism. Keeping in mind the prevailing balance of payments situation in many developing countries, many governments may consider the imposition of trade barriers to be cheaper (at least in the short run) than a further increase in their agricultural expenditure.

Against this background it is easy to see that international organisations dealing with trade and development are showing an increasing interest in the various types of agricultural subsidies.[1] It indicates the importance of a consensus or the need for a common denominator on this matter. In other words: a definition of agricultural subsidies.

For analytical purposes too we need a better definition than the ones that are, either explicitly or implicitly, commonly used. The general idea one has of subsidies, is that they involve (real) money transfers from one group in society to another, in particular from tax payers (via the government) to designated groups in society, either businesses or private households. This common notion of subsidies, applied to the agricultural sector, neither provides a firm basis for international comparison, nor serves an analytical purpose.

The 'Joint Economic Committee' [2] which studied the federal subsidy programme in the U.S.A., defined subsidies as public sector rewards that directly change relative prices in the private sector. Prest considers this new concept, for which we are much indebted to C.S. Shoup, member of the Joint Economic Committee (JEC), as the least unsatisfactory definition of subsidies. [3]

Let us enquire into this JEC-definition of subsidies before we start to determine its applicability to agricultural support measures.

According to the JEC-papers relative prices in the private sector apply to prices of goods and services as well as to rewards of factors of production (i.e. capital and labour). Income effects alone (increased consumption because of an increase in real income but no change in relative prices) constitute an indirect effect and income and substitution effects (the latter: increased consumption because of a change in relative prices but no increase in real income) constitute a direct effect.[3]

In our opinion, this distinction between direct and indirect, is a weak point in the definition.

Generally speaking it can never be easy to apply Slutsky's[4] equation, which analyses the demand change induced by a price change into two separate effects, the substitution effect and the income effect, to a real world situation where prices can change every second and decisions on resource allocation can be taken every

minute.

Perhaps this arbitrary distinction between pure income effects on the one hand and income and substitution effects on the other enhances the general applicability of the definition but one could also argue that a change in relative prices induced by income effects as a result of government support measures should not be excluded in advance.

For instance, a general income allowance (hence no subsidy according to the JEC-papers) could, depending on the distribution of incomes and elasticities of demand with respect to the various income-categories, entail substantial changes in relative prices.

We prefer to use the definition that subsidies are payments other than those which would normally be paid for the goods, services and factors. (5)

Hence subsidies in our definition are government induced changes of relative prices. (6)

Of course, it may not be always possible to ascertain the price that would normally be paid.

We feel however, one should not try to define an economic concept only in such a way that one can work with the definition. An alternative approach would be first to attempt a general definition of the concept of subsidies and then analyse it into categories.

1.2 A Classification of Subsidies

On the basis of our general concept of subsidies many classifications could be thought of. (7)

Since our principal objective is to sharpen our perception of the nature of subsidies, hence to facilitate both international comparison and economic analysis, we opt for an instrumental classification.

Largely in accordance with the JEC-study (8) we distinguish five categories of subsidies, viz:

(i) direct cash transfers

(ii) provision of cheap credit

(iii) 'benefit in kind' subsidies (sales by government at lower-than-market prices)

(iv) purchase subsidies (purchases by government at higher-than-market prices)

(v) regulatory subsidies
- -fiscal (e.g. taxes and tax concessions)
- -monetary (e.g. rate of interest)
- -legislative (e.g. land tenure regulations)
- -foreign trade directed (e.g. rate of exchange, trade barriers).

Subsequently we want to distinguish between direct sector subsidies and indirect sector subsidies or inter-sector subsidies.

The economy of a society can be divided into the agricultural sector and the non-agricultural sector, for convenience sake called the industrial sector.

We define direct agricultural subsidies as subsidies affecting farm input prices, farm output prices and farm income without having a direct impact on other prices. Conversely, indirect agricultural subsidies are either subsidies affecting prices in both sectors simultaneously (agriculture and industry), or subsidies first affecting prices in industry which in turn have an impact on agricultural prices.

A third distinction we wish to make is related to the analysis of subsidies.

A subsidy must have an impact on market prices. This impact, or the difference between the ex-ante price and the cum-subsidy price, is referred to as the incidence of the subsidy.

The private and public costs and benefits of a subsidy are referred to as the effects of the subsidy.[9]

1.3 The Incidence of Direct Agricultural Subsidies[10]

1.3.1 The Incidence of Direct Farm Income Subsidies

Direct farm income support is government intervention in agri-

culture to modify the distribution of farm incomes other than by farm output - or farm input support.

Of course, when dealing with low-income countries with a large rural society this type of farm support can only be applied to a fairly limited extent.

For instance in the E.E.C. we have examples of direct cash transfers to so-called hill-farmers.

Other possibilities are income tax concessions or reduced national insurance contributions[11] for specified groups of farm households. Either approach is a pecuniary support measure. Therefore it always causes a non-zero incidence (i.c. change of farm labour reward). By definition these support measures are to be identified as agricultural subsidies.

1.3.2 The Incidence of Direct Farm Output Subsidies

Direct farm output subsidies are perhaps the most commonly applied agricultural support measures. It appears that three general classes can be distinguished, namely:

(i) direct measures to raise or stabilize farm output prices
(ii) direct farm import restrictions
(iii) direct farm export support measures.

(i) The incidence of Direct Measures to Raise or Stabilize Farm Output Prices

These support measures entail in principle a non-zero incidence on farm output prices. Hence they are also considered to be agricultural subsidies.

Unlike the case of direct farm income support the magnitude of the incidence is often unknown[12] because the direction of price changes is dependent upon various factors.

First, an increase in farm output prices may bring about many interacting supply and demand responses subject to the corresponding elasticities.

Secondly, supply may move along the supply function or the supply

function itself may shift to the right. In the latter case the price incline permits improved efficiency. Subsequently, the long-run effects of increased supply may in turn entail a lowering of prices. Thirdly, when dealing with foodgrains price support measures have a further differential impact because of the distributional effects on income and employment.

Generally speaking, it is easier to ascertain the incidence of pecuniary measures [13], than the incidence of non-pecuniary methods. [14]

For the purpose of international comparison the relative level of subsidization can sometimes be approximately calculated by the amount of direct governmental costs. In many cases, however, for example a guaranteed price system without deficiency payments from the government, the consumer pays for the greater part of the subsidy (vide chapter 3).

In other cases farmers may 'subsidize' themselves for instance by the creation of stabilization funds by farmers' organizations.

(ii) The Incidence of Direct Farm Import Restrictions

Direct farm import restrictions are tariff and non-tariff barriers to farm import trade.

In principle they result in a non-zero incidence on domestic and import prices.

However, here too the magnitude of the incidence can be quite difficult to ascertain.

First, it must be noted that trade restrictions are sometimes by-passed because of administrative inefficiencies.

Secondly, the organisation of the trade (ex ante marketing margins as compared to the height of the tariff barrier, degree of monopoly and separation between import and domestic trade) plays an important role in determining the incidence (and effects).

Perhaps zero incidence is easier to disprove with respect to a tariff than in the case of a non-tariff import restriction.

The latter may range from quotas to severe quality control measures.

(iii) The Incidence of Direct Farm Export Support Measures

Direct farm export support is a form of government intervention to raise farm prices of export commodities. Hence, it entails in principle a non-zero incidence.(15)

1.3.3 The Incidence of Direct Farm Input Subsidies

Direct farm input support measures can best be subdivided in two general categories.
The reason is that we have farm inputs for which a ready (international) market price exists (e.g. fertilizers, seed, machinery, land) on the one hand and farm inputs that are, firstly, connected to regional or national circumstances and, secondly, hardly traded through private channels (e.g. education, infra-structure) on the other.
Hence, we wish to distinguish:

(i) direct support measures for farm inputs with a ready market price
(ii) direct support measures for farm inputs without a ready market price.

(i) Direct Support Measures for Farm Inputs With a Ready Market Price

This type of support is a form of government intervention to reduce the price of farm inputs for farmers and thus, in principle, a direct agricultural subsidy. To mention a few: cash transfers to farmers subject to the purchase of inputs; input subsidies in kind; reduction of indirect taxes and import duties; agricultural land tenure legislation; and provision of preferential credit to farmers.
The estimation of the incidence of this type of measure is highly

dependent on the input supply market as well as the administrative framework involved.

(ii) Direct Support Measures for Farm Inputs Without a Ready Market Price

The public provision of these farm inputs may increase the economic efficiency of farm production.
The corollary is that an eventual non-zero incidence of these direct support measures will only occur indirectly in the long run (e.g. changes in land prices due to irrigation works, changes in fertilizer prices due to extension of, and education in, their use).
In consequence, it will be even more difficult to ascertain the allocation and magnitude of these incidences than in the cases we discussed previously.
Since the distorting impact of these public support measures is assumed to be less than that of the subsidies we discussed above, these measures seldom cause disturbances in international trade relations.
For completeness sake we wish to describe briefly the four most common categories of public support for farm inputs without a readily ascertainable market price.

A. Reduction of Agricultural Risks

Neither farm income subsidies, nor farm output subsidies, nor farm input subsidies (i) can sufficiently protect farmers against production failures resulting from unavoidable disasters such as adverse weather conditions or unexpected wide-spread diseases. Especially in developing countries where profits are often modest or non-existent, risks impose severe barriers to the adoption of new farm technologies.
Commercial insurance companies are for obvious reasons generally not interested in offering insurance against 'normal' premium

rates to farmers in developing countries partly because of the incidence of fraud (the insured consumer has some control over the probability of the event in question), the lack of information, and the low standard of organisation and administration (difficulty of loss adjustment). The history of agricultural insurance has also shown that in the early stages of agricultural development (e.g. the U.S.A. and Canada in the inter-bellum) only the government is willing to offer insurance to farmers. These arguments also imply that there is no market for agricultural insurance in developing countries.

B. Technological Development and Agricultural Education

Many authors have stressed the importance of research and education[16]. Technology, to some extent, can be transferred internationally and thus has its market price. Local support for improved varieties, fertilizers and equipment for which a ready market price exists, must therefore be classified as a clear-cut agricultural subsidy.

Most technological development and agricultural education, however, has to be regarded as long-term and price-neutral. There is a long time from fundamental research (research centre, university) via applied research (co-operation of research centre and university) to newly adopted farming systems incorporating yield-increasing technologies that ensure optimal conservation of resources and high productivity of labour, land and other farm capital.

C. Land Improvement and Water Management

Land improvement and water management often involve large scale projects like the construction of dams and irrigation works. Here too, we are dealing with support measures without a ready world market price, which are, in principle, price-neutral. After

the completion of such a project, both the price of land and (farm) income levels may have risen. These long-term effects are generally wide-spread.

Generally speaking, the costs are easier to compute than the benefits.

Only in case of small scale projects do the benefits cause regional divergences in income. Sometimes, the government imposes additional taxes on the areas that have been benefited. Quite often, large scale projects are combined with the agricultural subsidies we described above. Whenever possible these more clear-cut subsidies (easier assessment of a non-zero incidence) should be separated in the appraisal of a project.(17)

D. Improvement of Agricultural Infrastructure

Agricultural infrastructure can apply both to physical infrastructure (for instance: roads, public utilities, storage facilities, harbours, public transport, etc.) and institutional infrastructure (for instance: extension, organisation of the market, legislation, etc.). Infrastructural improvements often comprise subsidy elements which are more evident, for example disparities in public transport costs.

Again, in order to render an international comparison of agricultural subsidies more feasible, these more evident subsidies have to be distinguished from the infrastructural programs.

1.4 The Incidence of Indirect Agricultural Subsidies

We stated earlier that indirect agricultural support measures result either from general policy measures or from policy measures which initially change relative prices in non-agricultural sectors (for convenience sake: industrial subsidies).

The principle is the same as in previous sections. When payments concerning the agricultural sector differ from those

in the absence of these indirect agricultural support measures, the measures are to be identified as indirect agricultural subsidies.

It will immediately be clear that the empirical proof of both the causal relationship and non-zero incidence is not easy. The field of indirect agricultural subsidies is in principle infinite.

We would need an input-output model which showed in detail all direct and indirect effects of adjustment policies on all economic agents in society. From such a model we could in theory derive the effects on prices within the agricultural sector.

Another complicating factor is that these policy measures are not always meant to support agriculture. Nevertheless we feel that a brief discussion of indirect subsidies is indispensable.

First, we will highlight some major examples of general subsidies affecting agricultural prices. Then we shall make some brief remarks on the relationship between industrial subsidies and agricultural prices.

1.4.1 Examples of General Subsidies Affecting Agricultural Prices

Domestic foodprograms

Food or nutritional (school) programs, dependent on their size, may boost domestic demand for agricultural produce and hence affect relative farm prices.

Supply of domestic resources

A change in fiscal policy or legislation may alter prices of domestic factors of production such as energy or fertile land. Also when the world market price increases at a faster rate than domestic prices, problems in trade relations may arise. A recent example of this was the provision of local gas by

the Dutch government to farms and other businesses at a lower price than the world market price [18].

Taxation policies

A general income allowance or a reduction in direct taxes may, depending on the distribution of income and the income elasticities for agricultural produce for various income categories, affect farm prices.

Monetary policies

A devaluation of the domestic currency may boost agricultural exports and raise local food prices accordingly. A revaluation may have opposite effects. A change in the money supply may affect interest rates which may in turn influence farm investment and hence alter farm prices.

Trade policies

The imposition of general trade barriers to save foreign exchange may alter agricultural prices in a number of ways. For instance, general trade barriers may affect the supply of essential farm inputs as well as the competing supply of farm output.

1.4.2 Industrial Subsidies Affecting Agricultural Prices

Quite a few developing countries have tried to break the vicious circle of a stagnant low-income society with a large rural sector by putting the emphasis on industrial growth. A full discussion of the complex structural relationship between the industrial and the agricultural sector in relation to industrial policies would lead us beyond the scope of this section.[19]

In cases where industrial policies have had a distorting impact on agriculture we do better speak of negative indirect agricultural subsidies.

Sometimes the impact varies in its incidence. A policy to

increase industrial wages may on the one hand boost demand for farm output and on the other hand divert labour and capital from agriculture to industry.

In Argentina well-known industrial policies pursued in the 1930's led in the first place to a decline in the traditional export sector.

Also in other Latin-American countries industrial policies (low farm-output prices (fixed levels) and rising farm input costs (forced utilisation of locally produced inputs and trade barriers to foreign input supply)) have had a detrimental impact on agricultural prices.

NOTES

1. Vide e.g. 'Subsidies in GATT', GATT-secretariat paper CG, 18/W/79, special distribution, 13 March 1984.
2. Joint Economic Committee, 'The Economics of Federal Subsidy Programs', Staff Study and Parts 1-6, 1972, 1973, U.S. Government Printing Office, Washington D.C.
3. Prest, A.R. 'How much subsidy? A Study of the Economic Concept and Measurement of Subsidies in the United Kingdom', The Institute of Economic Affairs, 1974; and 'The Economic Rationale of Subsidies to Industries', in 'The Economics of Industrial Subsidies', papers and proceedings of the Conference on the Economics of Industrial Subsidies held at the Civil Service College, Sunningdale, February 1975, London, Her Majesty's Stationary Office.
4. This analysis of a price change on demand was first made by Slutsky (1915) and later by Hicks and Allen (1934).
5. OECD, 'Transparency for Positive Adjustment', Paris, 1983, p.15.
6. The notion 'rewards' (vide JEC-definition) is not necessary either. Taxes can also be perceived as a special category of subsidies.
7. Prest, A.R., 1974, op. cit., pp. 25-27.
8. Our conceptualization of regulatory subsidies is wider. In our interpretation a subsidy needs not to be a public reward. E.g. we include taxes and trade barriers.
9. Vide chapter 3.
10. A non-zero incidence is crucial to the assessment of a presumed subsidy. Whether the established incidence distorts domestic or foreign economies will be discussed in chapter 3.
11. It goes without saying that these types of income support hardly apply to low-income nations.
12. Not to mention the difficulty to ascertain the incidence of a farm subsidy when this subsidy forms part of a whole package of agricultural production incentives. Quite often this is the case (vide Part Two). Sometimes, if not often, it is even difficult to falsify a zero incidence.
13. E.g. guaranteed price systems.

14. E.g. buffer stock policies or output regulations.
15. The smoke-screen that surrounds the field of subsidization becomes even thicker when we think of the statistical data requirements for the falsification of zero incidence. The principle is clear: non-zero incidence implies a subsidy. However, the point at which one has to assume that the incidence differs from zero will often remain subject to a certain degree of arbitrariness.
16. A pioneer in this respect is T.W. Schultz. His emphasis on investment in human capital has influenced many contemporary scholars. Vide: 'Transforming Traditional Agriculture', New Haven, Yale University Press, 1964; and 'Investment in Human Capital, The Role of Education and of Research', Free Press, New York, 1971.
17. In financial appraisals, subsidies can be computed as a separate item in the sources (like taxes in the uses) before the summing up the current or the cumulative surplus (deficit) (the latter equals the sum of the current surplus (deficit) and the opening cash balance). Vide e.g. J.P. Gittinger 'Economic Analysis of Agricultural Projects', The Economic Development Institute (EDI) of the World Bank, the John Hopkins University Press, Baltimore, 1982, pp. 182-213.
18. The Dutch government has never accepted that it was subsidizing Dutch glass house growers. In practice, The Netherlands, the worlds second greatest exporter of agricultural produce, was unwilling to risk a deterioration in relations with her principal (i.e. E.E.C.) partners and promised to raise the domestic price of gas.
19. Vide e.g. Mellor, J.W., 'The New Economics of Growth, A Strategy for India and the Developing World', Cornell University, 1976, Ch. VII.

CHAPTER 2

THE ECONOMIC RATIONALE OF AGRICULTURAL SUBSIDIES

Subsidies are, in our opinion, economically justified when under a laissez-faire policy public welfare decreases. Based on this principle we can distinguish three economic arguments for agricultural subsidy programs[1], viz.:

-the existence of domestic distortions in commodity and factor markets
-agricultural price instability
-the infant industry argument.

It will be clear that there are also non-economic reasons for subsidizing agriculture. These non-economic arguments sometimes stem from the political influence displayed by agricultural lobbies, or emerge from political beliefs (in a democracy) subject to the prevailing vote-maximization model. We must further bear in mind, that when genuine reasons for subsidizing agriculture are predominantly political or social, the arguments nevertheless may be made (ex-post) on economic grounds. It may perhaps be trivial to state here that the importance of economic reasoning to policy making should never be exaggerated but it is not our intention to suggest here that social or political arguments are always suspect.

For instance, the political argument for self-reliance in the provision of food may be fully justified when there are serious doubts on the durability of established trade relationships, even if trading partners do possess a comparative advantage and imported food commodities are much cheaper than locally produced food.

The self-reliance argument may also be based on strategic considerations[2]. Social arguments stemming, for instance, from an undesirable land-owner-tenant structure, or from a skew demographic distribution, may also be valid.

Quite often, social, political and economical arguments are interrelated.

For example, when we are dealing with equity objectives, e.g. a reasonable income for the rural poor.

In this study we wish to confine ourselves to general economic arguments which can be settled both theoretically and empirically (vide Part Two).

The economic justification for agricultural subsidy programs should be clear from a study of their cost effectiviness in attaining their objectives.

2.1 The Existence of Domestic Distortions in Commodity and Factor Markets

For the theory of domestic distortions[3] in commodity and factor markets we are greatly indebted to three Indian economists, viz: Bhagwati, Ramaswami and Srinivasan [4].

In an earlier paper[5] Bhagwati and Ramaswami showed that in the case of domestic distortion a suitable subsidy policy on domestic production would be an optimum solution. The proposition that no tariff (or trade subsidy) could exist that yields a solution superior to that under free trade was not valid. Kemp and Negishi [6] have correctly argued, that given the presence of distortion, there is always a level of tariff (or trade subsidy) which is superior to free trade, though not superior to the suitable subsidy on production. Furthermore, Kemp and Negishi argued that a third proposition, that no production subsidy can yield greater welfare than non intervention when the nation has monopoly power, was incorrect as well.

Bhagwati and Ramaswami accepted these objections and further generalised the argument, together with T.N. Srinivasan, in their second paper. Our analysis is largely based on this second paper. In addition, we will demonstrate the various implications of their analysis in graphs. The generalization of the optimal policy under distortion in either commodity markets or factor markets, is as follows:

Notation

C_i, X_i -consumption and domestic output, respectively of commodity i, i = 1,2

$U(C_i)$ -welfare function

U_i -marginal utility of commodity i

DRS -social indifference curve depicting the marginal domestic rate of substitution in consumption

DRT -production possibility curve depicting the marginal domestic rate of transformation in production

FRT -international relative price or the foreign rate of transformation depicting the marginal rate at which a commodity (factor) can be transformed into another through trade.

p_c -equals DRS, ratio of the price of the first to that of the second commodity

p_t -equals DRT = $-\frac{dX_2}{dX_1}$

p_f -equals FRT, only if no national monopoly power exists; ratio of the world price of the first to that of the second commodity, that is, the average terms of trade.

The change in welfare due to a small deviation from a free trade equilibrium is:

$$dU = U_1\, dC_1 + U_2\, dC_2 = U_2 \left(\frac{U_1}{U_2}\, dC_1 + dC_2\right).$$

$\frac{U_1}{U_2} = p_c$, is the marginal condition for utility maximization. Hence,

$$dU = U_2 (p_c\, dC_1 + dC_2) = U_2 (p_f dC_1 + dC_2 + (p_c - p_f)\, dC_1)$$

$$= U_2(d(p_f C_1 + C_2) - C_1 dp_f + (p_c - p_f)\, dC_1).$$

Assuming equilibrium in trade, $p_f C_1 + C_2 = p_f X_1 + X_2$, then

$$dU = U_2 \, (d \, (p_f X_1 + X_2) - C_1 dp_f + (p_c - p_f) \, dC_1)$$

$$= U_2 \, (p_f dX_1 + dX_2 + (X_1 - C_1) \, dp_f + (p_c - p_f) \, dC_1)$$

$$= U_2 \, (dX_1 \, (p_f + \frac{dX_2}{dX_1}) + (X_1 - C_1) \, dp_f + (p_c - p_f) \, dC_1)$$

$$= U_2 \, (dX_1 \, (p_f - p_t) + (X_1 - C_1) \, dp_f + (p_c - p_f) \, dC_1). \qquad (1)$$

We can distinguish four possible deviations from the optimum, i.e. DRS = DRT = FRT, viz:

(i) DRS = FRT $\neq$ DRT

(ii) DRS = DRT $\neq$ FRT

(iii) DRS $\neq$ DRT = FRT

(iv) DRT $\neq$ DRS $\neq$ FRT

The situation, where DRS = DRT = FRT, is an optimal equilibrium, because here the social indifference curve is tangential to the relative price line and tangential to the production possibility curve; in other words, the marginal rate of substitution in consumption equals the relative prices which are equal to the opportunity costs of production. Figure 1 depicts this optimum [7].

Figure 1 A) Optimum without Trade B) Optimum under Trade

The quantity of non-agricultural goods in figure 1 is measured along the horizontal axis and the quantity of agricultural goods along the vertical axis.

For all four deviations from the optimum, the derivative of the welfare function is analysed. If this derivative with respect to a subsidy[8] is non-zero, then by continuity it is also nonzero for some finite interval for values of subsidies, which implies that welfare, U (C_1, C_2), can be raised by applying this subsidy.

(i) DRS = FRT $\neq$ DRT

This domestic distortion implies, that the opportunity costs of production do not equal relative prices. In other words: the private cost of production is higher or lower than the social cost of production (market prices $\neq$ shadow prices). Two alternative cases can be distinguished here, viz: a production externality (a) and a factor differential (b).

(a) Production Externality

Distortions in commodity markets with respect to agriculture are relevant to our problem. They comprise inter alia:

-monopoly in farm inputs and farm outputs

-monopsony power in farm outputs (a comparatively small number of middle men purchasing farm outputs find themselves often in an advantageous position vis-a-vis farmers)

-externalities, e.g. concerning the environment (economies like maintenance of the environmental equilibrium, and diseconomies like pollution, erosion and land clearing).

Since DRS = FRT $\neq$ DRT, we have $p_c = p_f$, $dp_f = 0$ (it is assumed that the country has no monopoly power) and $p_f \neq p_t$.

Equation (1) reduces to $dU = U_2(dX_1 (p_f - p_t))$ (2)

If $(p_f - p_t)$ 0, then dU can be raised by a policy that causes an increase in the production of X_1, either by subsidizing the production of X_1, or by taxing the production of X_2.

X_1 has to be decreased (in the geometric illustration of figure 2 (a): a movement from Eq (Aut) to Eq (Aut)' along the curve of DRT), mutatis mutandis, if $(p_f - p_t) < 0$. Hence, a production tax-cum-subsidy policy is the optimum (as compared to laissez-faire) solution here. A factor tax-cum subsidy might change the volume of X_1 as well. However, since a factor tax-cum-subsidy will cause a change in the production of X_1 less directly, it is considered a second-best policy.

Finally a tariff [9] may also cause a change in the production of X_1, but since it is uncertain whether this policy measure increases or decreases welfare [10] it is regarded as a third-best solution. (In figure 2 (b) and (c): a movement from Eq (Aut)' with the possibility of trade in Eq (Trade)', to Eq(Aut))', without the possibility of trade, along the curve of DRT).

The situations of the optimum policy, a tariff (t) increasing welfare and a tariff (t) decreasing welfare, are depicted in figures 2(a), 2(b) and 2(c) respectively.[11]

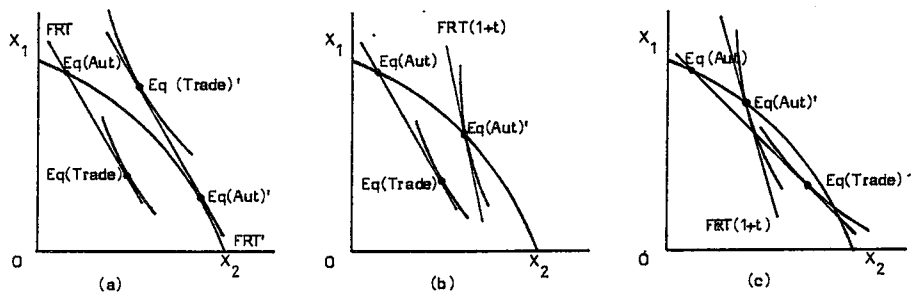


Figure 2 DRS = FRT ≠ DRT Optimum Policy: Production Tax-Cum Subsidy (a), A Tariff Increases Welfare (b) and A Tariff Decreases Welfare (c)

(b) Factor Differential

This type of domestic distortion also appears to be relevant to our study of agricultural subsidies, in particular with respect to developing countries. Hayami and Ruttan[12] found that difference in physical inputs and human capital are the major sources of productivity gaps between countries. Differences between factor endowments are sometimes caused by distortions in factor markets. Examples of this are:

-factor price differentials (agriculture versus non-agriculture)
-downward rigidity of wages
-immobility of factors (viz: land and labour).

The optimum policy (to laissez-faire) in dealing with distortions in factor markets is a factor tax-cum-subsidy in the opposite direction of the distortion, e.g.: an agricultural labour subsidy or an industrial labour tax (or, in practice, policies probably easier to implement with similar contra-distortion effects).
Here too, we have $dU = U_2 (dX_1 (p_f - p_t))$. The situation is virtually analogous to the one in (a). Thus we can follow, mutatis mutandis, the same argument. A tax-cum-subsidy on the use of the factor of production is the optimum policy, a tax-cum-subsidy on the production of X_1 the second-best policy, and again, a tariff because of its less direct and even to some extent, uncertain effect, the third-best policy to laissez-faire.
Figure 3 shows that a production tax-cum-subsidy takes the country to its 'distorted' production possibility curve DRT only, and that a factor tax-cum-subsidy, may push a country further up to its 'un-distorted' production possibility curve DRT'.

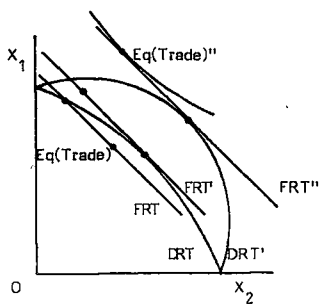


Figure 3 DRS = FRT ≠ DRT Optimum Policy: Factor Tax-Cum-Subsidy

(ii) DRS = DRT ≠ FRT

This domestic distortion implies that neither the opportunity costs of production nor the marginal rate of substitution in consumption equal the relative prices.
Since DRS = DRT ≠ FRT, we have $p_c = p_t = p_f$ and $dp_f \neq 0$ (monopoly power). Equation (1) reduces to $dU = U_2 (X_1 - C_1)\, dp_f$. (3)

Hence a change of the relative prices by means of a tariff (t) appears to be the optimum policy to neutralise the price distortion.
That the second-best and third-best policies cannot be determined in this situation may also be seen from the illustration in figure 4.

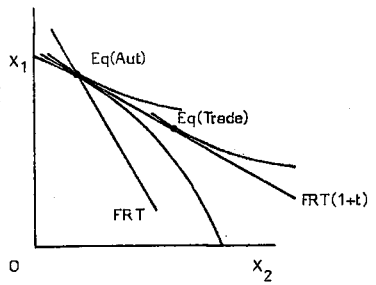


Figure 4 DRS = DRT ≠ FRT Optimum Policy: Tariff (t)

(iii) DRS ≠ DRT = FRT

A relevant example of this distortion is e.g. a bias in consumer preferences against agricultural commodities (suppose, consumers prefer coca-cola to milk, which does not result in a relative price change because of the relative insignificance of their demand; health considerations may incline the government to a policy of indirect taxes on coca-cola and a consumption subsidy on milk).

Since DRS ≠ DRT = FRT, we have $dp_f = 0$ (no monopoly), $p_f = p_t$ and $p_c \neq p_f$. Equation (1) reduces to $dU = U_2 ((p_c - p_f)\, dC_1)$ (4)
Hence the optimum policy will shift (rotate) the consumers indifference curve by means of a consumption tax-cum-subsidy.
A tariff may also raise the country's welfare and an induced shift in production from X_1 to X_2 or from X_2 to X_1 by a production tax-cum-subsidy, may through its income effect, entail an improvement in welfare as well.

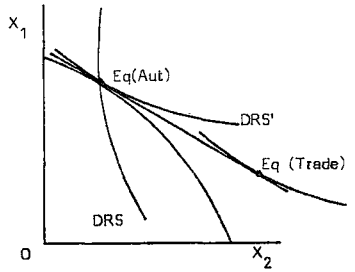


Figure 5 DRS $\neq$ DRT = FRT Optimum Policy: Consumption Tax-Cum-Subsidy

(iv) DRT $\neq$ DRS $\neq$ FRT

Excluding the case where DRT = FRT and assuming monopoly power we have $p_f \neq p_t$, $dp_f \neq 0$ and $p_c = p_f$. Equation (1) reduces to

$$dU = U_2 (dX_1 (p_f - p_t) + (X_1 - C_1) dp_f) \quad (5)$$

Hence the optimum solution is a simultaneous policy of a tariff (export subsidy) and a production tax-cum-subsidy in the case of a production externality or a factor tax-cum-subsidy in case of a factor differential. It will be clear that second or third best policies cannot be determined in this situation.

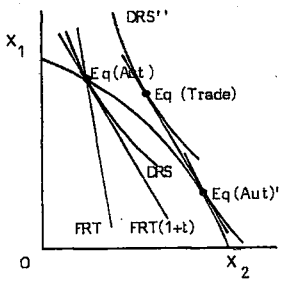


Figure 6 DRT $\neq$ DRS $\neq$ FRT Optimum Policy: Simultaneous Tariff and Production /Factor Tax-Cum-Subsidy

In figure 6 we see that, a tariff (t) causes a rotation of FRT in Eq(Aut) making FRT (1+t) = DRS. Subsequently, a production/factor tax-cum-subsidy entails a movement along DRT from Eq (Aut) to Eq (Aut)',thus decreasing the production of X_1 and increasing that of X_2. In this new equilibrium, Eq (Aut)', DRT = DRS = FRT (1+t).

Trade can increase welfare more by pushing DRS' further from 0 to DRS'' in Eq(Trade).

It must be noted that these theoretical results are contingent upon the existence of a single equilibrium point. They may not apply to abnormal cases, e.g. fixed product prices, where multiple equilibria exist.[13]

Another important theoretical consideration is that resources cannot be transferred freely, which implies that a tax-cum-subsidy has to be studied in a dynamic context.[14]

2.2 Agricultural Price Instability

The fixity of many farm inputs, notably of land and family labour, makes it difficult for a farmer to respond adequately to movements in farm prices (either input or output prices). This together with the well-known inelasticity of demand for most farm produce, like staples, may lead to wide farm output price fluctuations.
These price fluctuations[15] make farming a hazardous business. Even if a farmer could free himself from the above indicated inelasticity of supply (e.g. by means of an increased flexibility in utilization of farm inputs), he still would suffer from variations in weather conditions, as well as from variations in other factors beyond his control (e.g. pests, diseases). These hazards are always present in agriculture and result in deviations from the equilibrium volume of farm output, and hence in price instability.
It must be noted that not all agricultural industries are subject to inelastic supply and natural hazards. For example, pig farming, poultry farming and mushroom cultures sometimes[16] form exceptions in this respect. On the other hand, (minor) price variations may be an efficient instrument in attuning supply to demand and vice versa. It can even be proven that when the structure of farm production is not too rigid, profits are higher under fluctuating prices than under stable prices (vide pp. 80-81).
The state of farm technology is important in this respect. A more advanced farm technology enables the farmer to adjust production

to price movements better.

The underlying factors causing fluctuations in farming income are illustrated in figure 7.

If one observes carefully the simplified relationship between farm production, farm income and agricultural subsidies, as depicted in figure 7, one is given cause to wonder if agricultural price stabilization policies are directed more towards symptoms than to the basic causes of price and income instability.(17) Firstly, farm income fluctuations can be caused by five (not entirely independent) variables (vide fig. 7).

Of these five variables only two (viz. input and output prices) are directly influenced by subsidies. The variations in volumes of output and input can easily affect the objectives of such price policies.(18)

Secondly, subsidies directed towards farm incomes do not guarantee that farmers will in fact invest more in farming. Farm investment is more likely to be a function of the profitability of farming than a function of (perhaps only temporary) income subsidies.

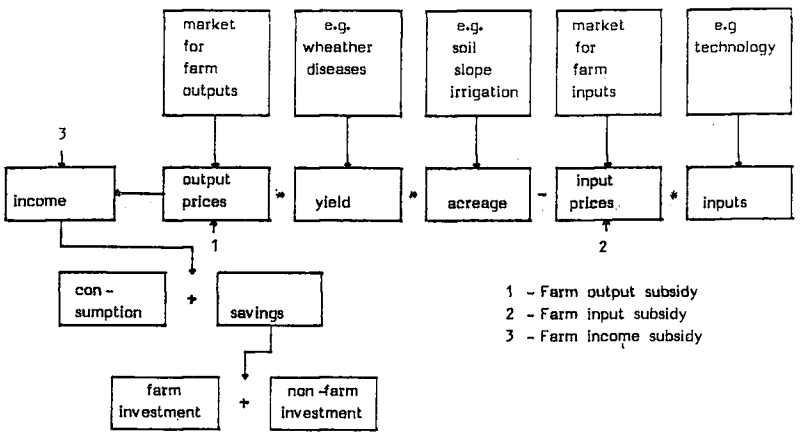


Figure 7 Limitations of Agricultural Price Stabilization Policies

The principal problem in designing an appropriate price policy is how to prevent large price fluctuations without at the same time undercutting the instrumental function of price as a market signal.[19]

Large price fluctuations of basic foodstuffs have a detrimental impact on the economy.
The worst situation is when rising prices reflect a serious shortage of basic food items. In these circumstances the whole economic and social structure is at bay.
Even when rising food prices are less menacing, the impact on the economy can still be devastating since rising food prices bring about an upward pressure on wages in all industries and declining demand for all non-food commodities, regardless of the impact on income distribution.
In other words: rising food prices may lead to smaller revenues at higher costs.
A proximate effect, inter alia, is an increasing unemployment rate.

The general problem of price instability can manifest itself in the short term and in the long term.[20] Short term price instability, or seasonal price fluctuations, may lead to sub-optimal storage plans and imperfect distribution patterns, which can also entail wide spread adverse effects in the economy (particularly via changes in real income and nutritional standards). [21]

A long run misallocation of resources (loans, fixed investments) can entail production cycles. These production cycles mostly apply to perennial (export) crops because of the substantial time-lag between price-induced farm investment and actual supply response.
A declining trend in prices could lead to an erratic reallocation of resources in the agricultural sector, thus threatening future foreign exchange earnings.

In a stagnant agricultural sector based on traditional farm technologies (i.e. an extremely rigid production structure) prices will both fluctuate on a larger scale and more frequently than in the case of a more advanced technology.

Many traditional low-income farm-households are net consumers of foodstuffs. They often lack sufficient carryover stocks to compensate for years of heavy losses.

Therefore, in these circumstances farm output prices which are too low may even worsen the situation by a migration to urban areas. Policies to reduce these wide and frequent price fluctuations in low-income countries must improve the state of technology. (22) This will enhance production flexibility. Furthermore a shift of production functions creates carryover stocks for years in which there are bad harvests.

One problem is that this type of policy requires large investment and long gestation periods (vide p.26).(23)

Meanwhile, acute problems of high food prices or erratic re-allocation of resources in the agricultural sector have to be solved by short-term subsidy programs like deficiency payments, buffer stocks or food aid.

2.3 The Infant Industry Argument

The infant industry argument, probably the oldest existing argument for protection, was forwarded in the 1840's by the German economist and politician Friedrich List.(24) The core of the argument implies that an industry cannot compete if it is too small. It has to be protected initially against competition from abroad. This protection enables the industry to develop economies of scale in production. Import restrictions can be removed when the infant industry has become fully developed. Since List, the argument has been accepted for a long period of time by many international trade theorists.

This general acceptance came under substantial pressure when J.E. Meade and M.C. Kemp published their new views on this economic

argument.[25] Kemp particularly disputed the Mill-Bastable dogma which implies that the protection of an industry is beneficial to society if it has passed Mill's and Bastable's tests.

The test derived from Mill states that infant industries must eventually be able to compete at world market prices. Bastable's test demands in addition that the future gains from the infant industry must compensate for the losses due to protection during the infant industry period.

Kemp argued that there is no need for protection on the basis of these tests alone since the costs in the learning (infant) period are more than offset by the profits the industry enjoys later. Kemp also found that a third condition should be fulfilled, i.e. the existence of external economies (the capital market does not function properly, or investors are not properly informed about the prospects of investments).

T. Negishi[26] convincingly disputes Kemp's and Meade's arguments. In his analysis, on which this section draws heavily, Negishi applies the theory developed by Debreu.[27] Firstly, Negishi argues that the analysis of Kemp does not take account of changes in consumer surplus resulting from the protected infant industry. Kemp's analysis loses its significance from the point of view of social costs and benefits (i.e. welfare economics). Secondly, Negishi claims that protection can be beneficial even if no external effects exist. This second proposition is based on the existence of dynamic internal economies, specifically in the indivisibility of factors of production which is inherent in the learning process of the infant industry.

The core of Negishi's argument, viz. the welfare gains from the dynamic internal economics, can best be understood by giving a brief example.

Suppose, a country wishes to become self-sufficient in the provision of vegetables, because the expensive imports of these perishable commodities (cooled transport) impose a constant drain on foreign exchange earnings. Suboptimal ecological conditions, however, hamper

an extension of traditional vegetable production.
Against this background the country decides to start a hydroponic farm project. This type of farming, under plastic cover, could enable farmers to control pests, diseases, soil erosion and climatic conditions. It would, however, be impossible for this farm to compete with foreign suppliers at current market prices unaided. Also, other vegetable farmers would only adopt hydroponic farming if the pilot-farm was proven to be financially viable.
Therefore, the country chooses to impose (temporary) trade barriers on a number of vegetables.
The costs of this policy consist in the main of: a direct loss in consumers' surplus (increased prices of vegetables); inflationary pressures from these higher prices; possible trade retaliation; and the direct public costs of starting the project.
This is the price the country pays for the experience gained in the pilot project.
The learning process of the project contains the following elements: infrastructural facilities, building of the covered farm, equipment, nursery, replanting, pest and disease control, monitoring the feed system, harvesting, grading, packing and marketing.
The internal dynamic economics apply to the present and future diffusive impact on welfare stemming from this learning process. Once the operation is brought under control, trained staff can be used to build, organise and monitor other hydroponic farms.
All future hydroponic farms may benefit from this single experiment. The costs of the experience gained in the pilot project have to be put against the future welfare gains from the hydroponic vegetable farming sector.

One final point is worth noting. In order to obtain maximum impetus and an optimal cost/benefit ratio, a country has to start on a small scale.
In a single pilot project infant diseases can be overcome at minimum cost.
When several pilot projects are started simultaneously however, infant diseases costs are merely multiplied by the number of projects.

The formal proof of Negishi's propositions, albeit largely based on (non-empirical) equilibrium theory, is on our opinion too important to be omitted in this section. First we will introduce the notation. Subsequently, we will highlight the necessary and sufficient conditions for his justification of the infant industry argument.[28]

Notation

$(\bar{x}, \bar{x}^*)$[29] – consumption vector without infant industry

(x, x^*) – consumption vector with infant industry

$(\bar{y}, \bar{y}^*)$ – input and output vector of other industries without infant industry

(y, y^*) – input and output vector of other industries with infant industry

$(\bar{p}, \bar{p}^*)$ – price system without infant industry

(p, p^*) – price system with infant industry

$(\bar{q}, \bar{q}^*)$ – vector of input and output of the infant industry prior to its development

(q, q^*) – vector of input and output of the infant industry under protection

U – set of commodity vectors preferred or indifferent to (x, x^*)

Y – technologically possible set of (y, y^*)

Z – (U-Y); set of initial resources which makes consumption preferred or indifferent to (x, x^*) possible if the production is carried out properly

(c, c^*) – vector of initial resources; $\bar{p}'c + \bar{p}^{*\prime}c^* \leqslant \bar{p}'z + \bar{p}^{*\prime}z^*$ for any $(z, z^*) \in Z$

Q – technologically possible set of (q, q^*)

Necessary conditions for the protection of the infant industry

Suppose that because of the infant industry the resources available to consumers and other industries change from c and c^* respectively to $z = c + q$ and $z^* = c^* + q^*$. Such a change is desirable to the society if $(z, z^*) \in Z$ (Z is convex) and even preferable if (z, z^*) belong to the inner points of Z.

If we assume unchanged prices and if $(z, z^*) \in Z$, then $\bar{p}'z + \bar{p}^{*\prime}z^* \geqslant \bar{p}'c + \bar{p}^{*\prime}c^*$, and thus $\bar{p}'q + \bar{p}^{*\prime}q^* \geqslant 0$.

Hence, if the growth of an infant industry is desirable, the industry must be profitable in the long run, thus $\max (\bar{p}'q + \bar{p}^{*\prime}q^*) > 0$, subject to given prices (p, p^*) and the technological restrictions $q \in Q$, $q^* \in Q^*(q_1)$. The condition $\bar{p}'q + \bar{p}^{*\prime}q^* > 0$ implies that $\bar{p}^{*\prime}q^* > 0$, which in turn implies that $q_1 > \bar{q}_1$. If the infant industry is to develop, i.e. if $(c + q, c^* + q^*) \in Z$ then there is a certain minimum scale of production in the period of its infancy.
This implies, as Negishi argues, the necessity of the existence of some indivisible factor of production for the growth of the infant industry. The arguments below are based on the possibility of diminishing costs due to the existence of such a factor.

The infant industry has passed Mill's test if $p^{*\prime}q^* \geqslant 0$. If also $p'q > 0$ then the industry could have grown without protection since it is profitable as a private undertaking (this is the case emphasised by Kemp and Meade, with Bastable's test being interpreted as $p'q + p^{*\prime}q^* > 0$). According to Negishi, typical cases of the infant industry are such that $p'q < 0$ and $p^{*\prime}q^* \geqslant 0$, the long run profit $p'q + p^{*\prime}q^*$

being either positive (no need for protection) or negative.

In the latter case and if the development of the industry is desirable to the society (i.e. $(c, c^*) \notin Z$), it will be clear that the industry cannot grow without protection.(30)

Sufficient conditions for the protection of the infant industry

Since the set of vectors indifferent to or preferred to (x, x^*) is denoted by U, a sufficient condition for $(\bar{x}, \bar{x}^*) \notin U$ is $p'x + p^{*\prime}x^* > p'\bar{x} + p^{*\prime}\bar{x}^*$. Using the equalities of supply and demand, this can be rewritten as $p'(\bar{\bar{y}} + c) + p^{*\prime}(\bar{y}^* + c^*) < p'(q + y + c) + p^{*\prime}(q^* + y^* + c^*)$. Therefore the sufficient condition for protection is $p'(y - \bar{y}) + p^{*\prime}(y^* - \bar{y}^*) > -p'q - p^{*\prime}q^*$. In other words, the infant industry should be promoted by protection if its loss during the infancy is less than $p'(y - \bar{y}) + p^{*\prime}(y^* - \bar{y}^*)$. Negishi suggests that this test can be applied to industries located in the same country as the infant industry in question.

The same type of argument can be put forward if the infant industry has monopoly power. Even then it might be possible that protection is theoretically desirable.

So much for equilibrium theory. Our main difficulty with Negishi's sufficient condition is that it requires full knowledge not only of the future prices of the commodities produced by the infant industry, but also of the prices of other industries. For $p'(y - \bar{y}) + p^{*\prime}(y^* - \bar{y}^*)$ has to be estimated. Import restrictions to foster agricultural production in its infancy, by means of import substitution, not only change the prices of the infant industry but change all prices. The new set of prices (p, p^*) will not simply be the old prices plus tariffs.
Substitution possibilities differ between goods and factors of production both on the demand and supply side.(31)

A final complication is, that trade restrictions which bring about a reduction in the demand for imports will have the effect of depressing the equilibrium exchange rate (i.e.: the over-valuation of the

domestic currency).[32]

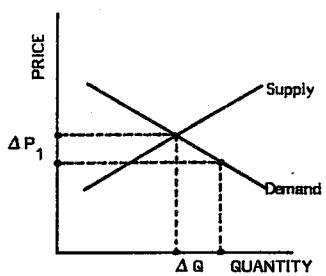
That the infant industry argument may apply in principle to the agricultural sector in many developing countries may be admitted (potential economies of scale, existence of dynamic internal economies and substantial initial costs of technological development). Also, in cases where excess agricultural supply is dumped on the world market by affluent countries, developing countries are left with no other alternative than a policy of import restrictions.

In the first section of this chapter we stated that, given the existence of a distortion, there always exists a nonzero second best tariff which yields an equilibrium superior to that of free trade.
However, stringent conditions are, inter alia, that those who gain from the trade restrictions compensate the losers (!). Furthermore, the resources in the economy have to be reallocated smoothly to the new equilibrium. The latter condition demands a high degree of flexibility in economies. This is probably not the case in many developing countries. The (inflationary) costs that trade restrictions can impose in these countries, may very well offset the benefits of protection for the infant industry.

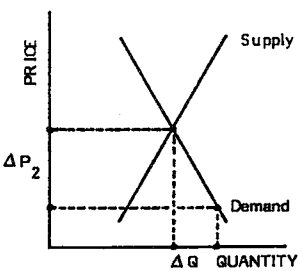
NOTES

1. In order to be consistent with our definition given in chapter 1, the following is necessary. Agricultural subsidies as discussed in subsequent sections of this study do not apply in principle to negative agricultural subsidies, i.e. policy measures entailing a negative incidence on farm output prices or a positive incidence on farm input prices (either direct (e.g. agricultural taxation) or indirect (e.g. resulting from industrial policies)).
2. For a more extensive discussion on the self-reliance vide e.g. Galtung, J., 'A Structural Theory of Imperialism', Journal of Peace Research, Nov. 1971.
3. International distortions, like some features of multi-nationals, acid rain, and polluted international rivers, sometimes may also give scope for subsidies (notably tariffs).
4. Bhagwati, J. et al., 'Domestic Distortions, Tariffs and the Theory of Optimum Subsidy: Some Further Results', Journal of Political Economy, Vol. 77, No. 6, 1969, pp. 1005-1010.
5. Bhagwati, J. and Ramaswami, V.K., 'Domestic Distortions, Tariffs and the Theory of Optimum Subsidy', Journal of Political Economy, Vol. 71, No. 1, 1963.
6. Kemp, M.C. and Negishi, T., 'Domestic Distortions, Tariffs and the Theory of Optimum Subsidy' (Comment), The Journal of Political Economy, Vol. 77, No. 6, 1969, pp. 1011-1012.
7. As for the shape of the transformation curve vide Johnson, H.G., 'Factor Market Distortions and the Shape of the Transformation Curve', Econometrica, Vol. 34, 1969, pp. 686-698.
8. For convenience sake, albeit not entirely consistent with our definitions, subsidies are meant to be positive subsidies and taxes negative subsidies.
9. A tariff here can be either positive or negative; the notion is not consistent since we defined a tariff also as a subsidy, but it will be perfectly clear what we mean.
10. Depending on the shape of the production functions and the welfare function.

11. It will be clear that the choice, of both the slope (and position) of FRT and the shapes of DRT and DRS, contains a substantial element of arbitrariness. We emphasize therefore, that these geometric examples are merely illustrations.
12. Hayami, Y. and Ruttan, V.W., 'Agricultural Development. An International Perspective', The John Hopkins Press, Baltimore 1971.
13. Bhagwati, J., et al., op. cit. p. 1006, implication of foot note 2; and Foster, E., and Sonnenschein, H., 'Price Distortions and Economic Welfare', Econometrica, Vol. 38, 1970, pp. 281-297.
14. Lapan, H.E., 'International Trade, Factor Market Distortions, and the Optimal Dynamic Subsidy', American Economic Review, Vol. 66, No. 3, 1976, pp. 335-346.
15.



Excess supply (ΔQ) under elastic demand and supply



Excess supply (ΔQ) under inelastic demand and supply

16. Provided they are not trapped in cobweb-type price cycles.
17. Vide also e.g. R. Fox, 'Brazil's Minimum Price Policy and the Agricultural sector of Northeast Brazil', Research Report 9, International Food Policy Research Institute, June 1979.
18. In section 3.3.2.2 we will discuss an empirical instrument for determining if farm income fluctuations are due more to market failures than to fluctuations in production.
19. A price policy always contains the danger of transmitting inappropriate price signals to farmers. Vide OECD, 'Positive Adjustment

Policies', Paris, 1983, pp. 67-72.

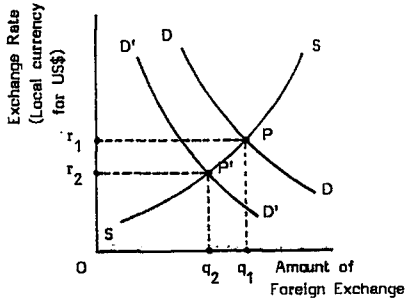
20. Fox, R., op. cit., p. 43; Tomek, W.G., 'Stability for Primary Products: Means to What Ends', Occasional Paper 28, Cornell University, 1969.
21. Berg, A., 'The Nutrition Factor', The Brookings Institution, Washington D.C., 1973.
22. Here again the problem is a vicious circle: price fluctuations increase risk aversion, but risk-taking behaviour is needed (investment in new farm technologies) to reduce price fluctuations.
23. Since the political horizon of many governments does not reach over a long period of time, most politicians are tempted to neglect these long-term programs and prefer to stick to the shorter run policies.

    Vide also R. Barker and Y. Hayami, 'Price Support versus Input Subsidy for Food Self-sufficiency in Developing Countries', American Journal of Agri. Ec., Vol. 58, No. 4, Nov. 1976, p. 617.
24. List, F., 'Das National System der Politische Oekonomie', Jena, 1928.
25. Kemp, M.C., 'The Mill-Bastable Infant Industry Dogma', Journal of Political Economy, Vol. 63, 1960, pp. 65-67.

    Kemp, M.C., 'The Pure Theory of International Trade', Prentice Hall, 1964.

    Meade, J.E., 'Trade and Welfare', Oxford University Press, 1955.
26. Negishi, T., 'Protection of the Infant Industry and Dynamic Internal Economy', Economic Record, Vol. 34, 1968, pp. 56-67.
27. Debreu, G., 'The Coefficient of Resource Utilization', Econometrica, Vol. 19, 1961, pp. 273-292.
28. Vide also Negishi, T., 'General Equilibrium Theory and International Trade', North Holland Publishing Company, Amsterdam, 1972.
29. The vectors without (*) apply to the present, and the vectors with (*) apply to the future.
30. Note that this holds independently of externalities.
31. For a general discussion on the differences between nominal and effective rates of protection, vide: Corden, W.M., 'The Structure of a Tariff System and the Effective Protective Rate', Journal of Political Economy, Vol. 74, June 1966.

32.



This depression of the equilibrium exchange rate can be shown as follows: a country's demand for foreign exchange (DD, D'D') is based on its demand for imports. The U.S.A.'s supply of dollars (SS) is based on the exchange rate: the higher the price of dollars, the cheaper the imports and the more dollars will be supplied. Import restrictions will cause a downward shift of DD to D'D'. The result is the establishment of a new equilibrium at P', with the depressed exchange rate r_2 and a smaller amount or foreign exchange $0q_2$ supplied and demanded.

CHAPTER 3

ESTIMATING THE WELFARE EFFECTS OF AGRICULTURAL SUBSIDIES

3.1 Partial versus General Equilibrium Analysis: Theoretical and Practical Implications

In explaining the interaction of demand and supply schedules Marshall largely applied partial equilibrium analysis. Only isolated markets were analysed. It was assumed there was no inter-relationship with other markets.

And, more important, demand and supply schedules were fixed:

> 'It is to be assumed that the general circumstances of the market remain unchanged throughout this period (of analysis); that there is, for instance, no change in fashion or taste, no new substitute which might affect the demand, no new intention to disturb the supply.'(1)

Marshall's major intention was to construct operational instruments that could be utilized in empirical analysis. He believed that from a thorough understanding of individual market forces one could arrive at a comprehensive macro-economic theory.(2)

Conversely, general equilibrium analysis applies to the study of the simultaneous operation of different market forces. In theory, this would render a far better approximation of reality.

Macro-economic models have been used to evaluate the overall economic impact of policy measures. However, despite the dramatic improvement in statistical estimation techniques, to date 'total impact analysis' has not been proved to be a very promising approach to subsidy appraisal. This phenomenon will be discussed below. On the other hand, we will point out how important it is to take account (as much as possible) of the general equilibrium implications of agricultural subsidy programs.

A later sub-section is devoted to the gains and shortcomings of partial equilibrium analysis.

3.1.1 General Equilibrium Implications of Agricultural Subsidies

3.1.1.1 Limitations to the Use of Macro-Economic Models

In 1979 the OECD-Council adopted a programme of work on positive adjustment policies.
This program lead to a study in which a large number of OECD member countries reported on their subsidy programs as well as on their methods of impact appraisal.(3)
With respect to the use of macro-economic models to evaluate the overall impact of subsidies the following problems were noted.(4)
First, the data requirements exceeded the data available.
Secondly, most member countries found that these large models were useful only if the subsidies significantly affected aggregate levels of output or public expenditure.
Lastly, these large models are usually demand-driven. This means that supply is treated as an endogenous variable, which makes the model unsuited to dealing with exogenous government incentives to supply (in practice a characteristic of most subsidies).
This OECD study is of particular interest to us. It reveals how the developed countries, in terms of administration, public finance, macro-economic analysis and data collection, are in fact evaluating their subsidy programs.
The limited validity of most applied macro-economic models seems to suggest implicitly that for the appraisal of subsidy programs in developing countries one should not aim at applying comprehensive methodologies.

Another interesting macro-economic report, a trifle closer to our subject, concerns a systematic analysis of data on agricultural subsidies in Latin-America.(5)
The major aim of this report was to indicate the usefulness of quanti-

fying government expenditure policies. The expressed aim was (as in the OECD report) to improve budget data and budget classification.

3.1.1.2 General Equilibrium Effects

Although total impact analysis may not always be feasible, mainly because of the data requirements, it is still important to consider general equilibrium implications.
Firstly, if one neglects the distorting impact on other economic agents or sectors one may overstate the social benefits of the subsidy.
Secondly, ignoring the intersectoral and distributional effects of the subsidies may lead to erroneous policy recommendations about the direction of changes in the subsidy programs.

(i) Distortions

The government costs of an agricultural subsidy program consist of the actual expenditure (or reduced revenues) and the costs of administration.(6)
These two cost items are not net welfare costs to society. In fact, the actual expenditure is a social opportunity cost of public funds not being spent elsewhere in the economy. Accordingly, the costs of administration are social opportunity costs as well.
Civil servants and equipment may be removed from one budget item to another.
Before discussing the distortions, two important side effects for which actual expenditure has to be adjusted have to be mentioned.(7)
First, actual expenditure may be overstated because of increased tax revenues due to increased wages and profits in the subsidized sector (minus the decreases in tax revenues from non-subsidized activities).
Secondly, they may be understated when the subsidy reduces general revenues (e.g. a subsidy based on the infant industry argument in the primary stages of resource allocation).
Economic literature on subsidies identifies two major sources of dis-

tortions that have to be added to the adjusted government costs.[8]

First, the 'excess burden' of a subsidy. This concept refers to the transfers of funds to economic agents without increasing their productivity.[9] These economic agents merely take advantage of the subsidy. A suboptimal behaviour that often leads to welfare losses (in every subsidy there is an element of windfall gain which is enjoyed by those who, even in the absence of the subsidy, would have undertaken the desired activity anyway).[10]

Secondly, the distorting impact from subsidies on resource allocation. Welfare in non-subsidized economic activities may decrease because of inflationary pressures due to subsidies elsewhere.

For instance: a reduction of non-subsidized productivity, an increased idleness of resources, and capital and labour shortages in non-subsidized sectors.[11]

(ii) The Intersectoral and Distributional Impact from Agricultural Subsidies

Subsidization, in our view, is an attempt to assist the allocating power of the price mechanism. Therefore, it seems logical that prior to a decision on public assistance one must examine the impact of changes in relative prices on income distribution and sector performance. With respect to the examination of interacting price effects resulting from agricultural subsidies four market sides are of particular interest to us.

First, the supply-side of farmers producing food and non-food commodities.

Second, the demand-side of consumers (including farmers) of food commodities.

Third, the supply-side of farm inputs i.e.: factors of production, i.e. labour, land and other capital; and inputs like seed, fertilizer and equipment.

Fourth, the industrial demand-side of farm output (i.e. the food and non-food processing industry; trade and transport).

First we discuss the major side effects of direct agricultural subsidies,

starting from the farm supply-side.

Then, we will highlight some specific effects from indirect agricultural subsidies, notably consumer subsidies.

In order to clarify the discussion the four market sides and the major interacting effects have been represented in figure 8.

In the following text we will refer to the numbered lines that represent the effects.

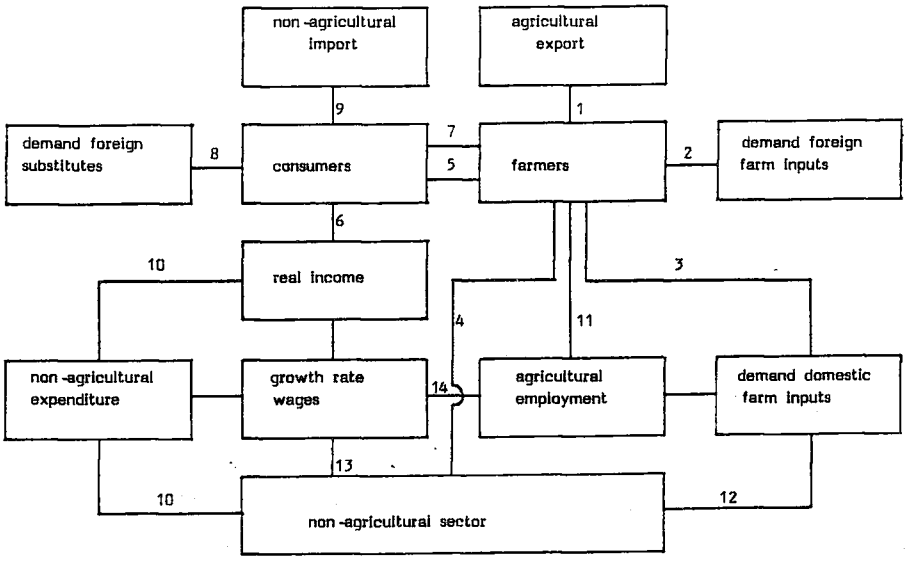


Figure 8 General Equilibrium Effects from Agricultural Subsidies

Optimal direct agricultural subsidy programs are subject to a number of a priori considerations concerning farm production. The distribution of farm capital (i.e. the distribution in farm sizes) is important to the magnitude and direction of output response to incentive programs.

Large farms generally produce a larger marketable surplus and purchase a larger amount of farm inputs. For this reason, direct agricultural subsidies tend to be skewed towards large farms.

The next factor concerning the initial response conditions, relates

to the state of technology. We stated earlier that in a state of advanced farm technology subsidies may entail a shift in production. A continuing process of economies of scale brings about higher production levels even if prices later decline because of the increasing aggregate supply/demand ratio.

Conversely, the production response in a state of traditional farm technology will be much more inelastic.

A final important aspect regarding production change, is the reduced production of non-subsidized output or the decreased utilization of non-subsidized farm input.

A large shift, for instance, from foreign exchange crops to domestic food crops may not be desirable in the long run. An unbalanced subsidization of farm inputs may entail diseconomies or externalities (vide the empirical analysis in Part Two).

With regard to the objective of balanced subsidization of farm inputs the following illustration may be helpful. Imagine that farm production is represented by the contents of a cask constructed with clap-boards. The maximum volume of water the cask can contain is determined by the lowest clap-board.

Suppose now, that these clap-boards represent farm input constraints such as:

rotation scheme (mainly because of soil fertility and diseases, most crops can not be grown continuously on one and the same plot); soil fertility (not every type of soil is suitable to the subsidized crop); farm budget (the need for additional credit may impose a serious barrier to an optimal subsidy response); transport facilities; storage facilities; water; fertilizer; and chemicals.

The idea is clear. If an agricultural subsidy program only enhances a number of clap-boards but leaves one or two at the original size, the contents of the cask will remain unchanged.

An important implication is, that statistical information on farm production is indispensable to an effective direct agricultural subsidy program.

A subsidy induced increase in farm production has the following inter-sectoral effects.
It may increase agricultural exports which in turn enhance foreign exchange earnings (1).
It may increase the amount of imported farm inputs which decreases foreign exchange savings (2).
It may increase domestic demand for farm inputs produced in the non-agricultural sector (3).
It may increase the supply of food and non-food commodities to the non-agricultural sector (4).
These last two direct effects on the non-agricultural sector may, of course, cause further multiplying effects in the economy, notably with respect to employment, income and capital formation.
Two secondary effects are of particular interest: the effect on consumers and the effects on employment.

Lower food prices caused by a farm output increase result in higher real incomes for consumers (5) and (6). This may lead to increased demand for (other food and non-food) agricultural commodities (7); to a decreased demand for imported (food and non-food) agricultural commodities (8); to increased demand for imported non-agricultural commodities (9); and to increased demand for domestic non-agricultural commodities (10).
The relative magnitude of these income effects are dependent on the income-elasticities of the various income categories. Moreover, it must be realised that the demand schedules in the various income groups will not remain unchanged.

The employment effect is basically direct and indirect. The direct effect is threefold.
First, the increased farm production may require more labour (11). This, of course, depends largely on the labour-intensity of the subsidized farm output. In fact the effect may even be negative if the farm capital/labour ratio increases because of extended farm mechani-

zation.

Secondly, increased utilization of farm inputs may cause an increase in employment in farm input sectors (12).

Thirdly, employment may increase in all stages relating to agricultural commodities if more resources are devoted to marketing and processing of food and non-food commodities (4).

The indirect effect relates to the fact that most food commodities are a principal wage good. Lower food prices therefore bring about a downward pressure on nominal wages which in turn may boost employment in the non-agricultural sector as well as in the agricultural sector (13) and (14).

Agricultural price policies may also start at the consumer end. The problem of determining the differential income effect of relative price changes on consumers of different income classes and the differential price effect on the production and income of farmers, is basically the same, irrespective of whether the price change is initiated at the supply side or at the demand side.

Mellor has studied this problem in considerable depth.(12) The underlying result is of particular importance to a study of agricultural subsidies when the adjustment to food price changes largely occurs through the income effect. Income and expenditure elasticities vary greatly among various income groups.

The study revealed, for instance, that a reduced price variation increased the decline in farm income in years of production decline for the third to the fifth deciles in farm income distribution. Conversely, it stabilized income for the lowest income farmers (net consumers) and the highest income farmers (largest marketable surplus).(13)

Other studies show that real income can be increased more efficiently by the distribution of cheap foodstuffs rather than by direct cash transfers.(14)

Moreover it was shown that such a distribution may generate an additional demand for nongrain foods at an even faster rate proportionally than it increases foodgrain consumption which would assist further in improving the overall nutritional status of the poor.(15)

3.1.2 Partial Equilibrium Analysis of Agricultural Subsidies

Partial equilibrium analysis has been used extensively in the evaluation of agricultural support programs. Here we will briefly review the literature on this subject.

Subsequently, we will attempt to answer the question why this approach, despite its serious theoretical drawbacks, can still be considered as fairly useful to policy evaluation. The major fields where partial agricultural welfare analysis has been applied, are:

(i) agricultural price support measures
(ii) agricultural price stabilization measures
(iii) trade restrictions
(iv) agricultural research benefits.

3.1.2.1 A Brief Review of the Literature

(i) Agricultural Price Support Measures

The two pioneers in applying partial welfare analysis to price support measures were Nerlove [16] and Wallace. [17] They measured social, costs and benefits from various alternative farm price support programs in the U.S.A., viz.: government procurement, deficiency payments and bufferstock policies. Net social loss (NSL) was taken as the difference between government expenditure and the net social benefits to farmers and consumers.

Wallace also analysed the social costs and benefits of farm input control (e.g. acreage allotments).

The net loss of any of the programs was highly dependent on the estimated elasticities of supply and demand.[18]

Since then a large number of economists has applied this technique based on the estimation of elasticities and the concept of economic surplus.

Their analyses brought about a few refinements, inter alia: Johnson [19] introduced the concept of second-best solutions in estimating NSL; Welch[20] took the factor of uncertainty into account; Josling[21] dis-

tinguished between marginal and average social costs.
More recent papers with some relevance to our study are, inter alia: Buxton et.al. (1974) [22]; Haessel et.al. (1975) [23] ; Barker et.al. (1976) [24]; Whitby (1977) [25] ; Ahmed (1979) [26] ; Nieuwoudt (1979) [27] and García (1981) [28].

(ii) Agricultural Price Stabilization Measures

A pioneer in this field was Waugh.[29] His article (1944) was the first of a large flow of partial welfare analyses on price stabilization. The dispute was not restricted to agriculture. In section 3.3.2.1 we give the outlines of this discussion.
In addition, we will argue why, within certain limits, price variation may increase welfare.

(iii) Trade Restrictions

The partial equilibrium framework required for measuring the static welfare effects from protection has been familiar since Marshall introduced the concept of economic surplus.
This framework was applied first by Barone[30] and subsequently by other textbook writers. They demonstrated both the loss from protection and the possibility of national gain from exploiting foreign countries.
In the late twenties the 'Bridgen Committee' calculated the excess costs of protected production.[31] Later Viner [32] and Corden [33] improved on the results of the Committee study.
Johnson [34] generalizes the concept further in his well-known article on the scientific tariff.
A recent extensive literature review on welfare analysis of restrictions on international trade has been written by Corden.[35]

(iv) Agricultural Research Benefits

The first major evaluation of agricultural research benefits was carried out by Schultz.[36] He compared the value of inputs saved with the cost of research and development.

Since Schultz' work there have been many partial equilibrium analyses of agricultural research benefits.

The importance to us of the various studies is in the way they have differed in specification of demand and supply schedules[37] and, in particular, on the nature of supply function shifts.

For instance, diverging shifts result in fewer benefits to farmers than parallel or convergent shifts (vide also section 3.4.1).

Griliches [38] assumed a parallel shift (horizontal or vertical), Peterson [39] a proportional shift; Akino and Hayami [40] a pivotal shift; and Lindner and Jarrett[41] and Rose [42] studied all four possibilities; pivotal (diverging), proportional (diverging), parallel and converging. A recent extensive review of the literature has been written by Norton et. al.[43]

3.1.2.2 **Partial Welfare Analysis: Pros and Cons**

In the previous sub-section we have seen that many agricultural policy appraisals are based on partial equilibrium analysis and the estimation of changes in economic surplus. The use of this tool will be demonstrated in the following sections.

In appendix 2 we will evaluate the theoretical problems in measuring welfare changes by economic surplus.

Suffice it to say here that the measurement of welfare changes by economic surplus runs into problems if:

a) the price changes are relatively large
b) a large proportion of the income is spent on or earned from the commodity or group of commodities being examined
c) the elasticity of substitution with respect to the other commodities in the surplus measure is large

d) the value of the commodities in question, as compared to total GNP, is relatively large.

Economic surplus refers to the Marshallian twins, viz.: producer's surplus and consumer's surplus.

Consumer's surplus can be depicted by the Dupuit-triangle, that is the triangular area below the demand curve and above the price line. It is the difference between the consumer's total benefit and the total cost of the product to the consumer.

The monetary measure is depicted in figure 9.

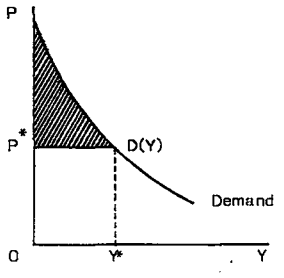


Figure 9 **Consumer's Surplus**

Consumer's surplus, the shaded area in figure 9, equals: $\int_0^{Y^*} D(Y)dY$.

Producer's surplus is the relevant area above the supply line. The area depicts the difference between what the farmers actually receive for their produce sold and the minimum amount they would have been prepared to accept.

It is just a diagrammatic way of measuring farmer's profits plus rent. A more suitable term is economic rent (vide appendix 2).

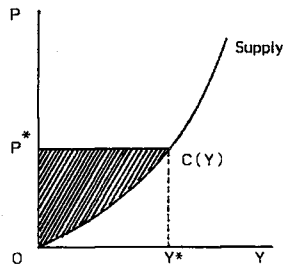


Figure 10 **Economic Rent**

The economic rent related to production of Y* at price P* has been depicted by the shaded area in figure 10.

Since the supply curve is just the marginal cost curve, we can write:

$$\text{Economic rent} = P^*Y^* - \int_0^{Y^*} C'(Y)\,dY$$

$$= P^*Y^* - C(Y^*) + C(0),$$ where C(Y) is the marginal cost function. Since C(0) equals fixed costs, the rent payments to land and capital, we have exactly the interpretation described above: economic rent is profits plus rent.

We will conclude this section by discussing both the shortcomings and advantages of the use of partial equilibrium analysis.

Shortcomings

The assumptions of partial equilibrium analysis restrict the scope of its application.

The following major ceteris-paribus clauses are assumed: the rate of exchange is in equilibrium; world market prices are exogenous; no major substitution in production; no major changes in marketing costs; and no changes in consumers' demand preferences. In addition we have to assume perfect knowledge on the part of economic agents and also perfect mobility in market adjustment.

It will be clear that any result of partial equilibrium analysis will be contingent upon these assumptions.

A further drawback is that the analysis is isolated and refers to one market only.

The important general equilibrium implications which we discussed earlier are therefore omitted.

In particular, the welfare impact through the income effect is an important omission.

Neither income distribution and employment, nor rural-urban labour migration, nor the flow of savings, nor the composition of farm output and the adoption of capital- or labour intensive technologies can be understood by one partial equilibrium analysis by itself. Theoretical limitations of the concept of economic surplus constitute a further drawback (vide appendix 2).

Advantages

One of the main questions posed by policy makers, prior to the implementation of an agricultural policy program, concerns the direct and short-term impact of agricultural subsidies on the volume of farm output.

Another important ex-ante question is: who will benefit most from the subsidy?

It will become clear from the following sections that the side of the market with the lower elasticity gets the greater part of the subsidy.

On the other hand it can be seen that the effectiviness in terms of raising farm output levels, is an increasing function of each of the elasticities.

Partial equilibrium analysis, i.c. the estimation of elasticities and economic surplus can therefore be considered a useful tool in answering these ex-ante questions.

A second merit of partial equilibrium analysis is its illustrative power. The Marshallian diagrams clearly show the policy maker the direct operational impact of government intervention.

Lastly, it is important to emphasize that partial equilibrium analysis is just one tool.

It does not exclude the simultaneous use of other methods of analysis.[44] Quite often economic analysis has to provide answers within a short period of time, without sufficient statistical information or without computer facilities at hand.

In these cases in particular it has proven its great analytical value.

3.2 Direct Farm Income Subsidies

One of the most common (social/political) justifications for agricultural subsidy policies in developing countries is their effect on income distribution.

In figure 7 and the related discussion we pointed out that a farm income subsidy is more a palliative aimed at dealing with symptoms rather than at dealing with the basic causes of income inequity. For farm income is the functional result of five different input and output factors.

A farm income subsidy therefore merely redistributes poverty. A significant improvement in the income of the rural poor can only be achieved through increased productivity.[45] Of course, we can justify this subsidy when temporary aid is imperative, for instance, in cases like bad harvest years, draught or other (regional) disasters. In most instances financial constraints will limit the application of income subsidies to regional policies only. This further emphasizes the fact that farm income subsidies are basically unsuited to offsetting substantial price fluctuations.

In this section we will briefly discuss the impact of farm income subsidies (if any) and secondly compare the difference in utility between farm income subsidies and farm input subsidies.

3.2.1 The Impact of Farm Income Subsidies

Depending on the distribution in farm size, an increase in nominal farm income may have a differential impact.[46] An increase in farm income increases first the marketable surplus of farm produce.

Secondly, it could prevent small-scale farmers from migrating to urban areas.

The propensity of small-scale farmers to migrate is probably, inter alia, a function of expected future gains in agriculture vis-a-vis expected future gains in non-agricultural activities, age and risk aversion.[47]

A third effect on small-scale farmers is that the higher income will reduce risk, which would make them more ready to accept new farm technologies.

Fourthly, large farmers will produce more because of the increased

demand, re-invest sooner and invest more.

Conversely, we may note several effects which would decrease welfare. First, farmers (either large or small-scale) who are not only maximizing farm profits, but also allocating their inputs between farm and non-farm activities, including leisure, may, because of an income subsidy, reduce their farm investment in favour of the various alternative possibilities.

Although the income subsidy is already inflationary in itself, this will also cause a decline in marketable surplus of food items.

Secondly, the positive income effect of small-scale farmers staying on their land may be overshadowed by the reduced opportunity for large scale farmers to benefit from their economies of scale by buying the abandoned plots.

For administrative purposes farm income subsidies are often related to some production factor.(48) Actually, in these cases we do better speak of farm input subsidies.

Such a production factor cum farm income subsidy has more advantages.

By using this policy, a government can stimulate agricultural production in a particular direction, e.g. labour intensive, land or capital intensive, or it can stimulate production of a particular crop or type of livestock.

The most usual type of this sort of farm support is the income subsidy based on acreage.

One disadvantage of this type of farm income subsidy is that it is highly beneficial to larger farmers and will worsen farm income distribution.

3.2.2 Utility Comparison between Farm Income Subsidies and Farm Input Subsidies

It can be shown with the help of indifference curve analysis, that a farm input subsidy which initially brings about [49] the same level of welfare to farmers as a farm income subsidy, will be more costly to the government (although this conclusion is to some extent dependent on some arbitrary assumptions[50]).

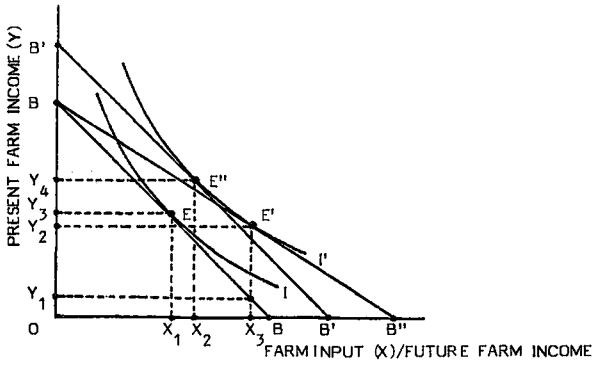


Figure 11 Indifference Curves of Present and Expected Future Farm Income Levels

In the initial equilibrium E, the farmer's indifference curve I is at a tangent to his budget line BB. From his farm income he invests OX_1 in farm input (X) and spends Y_3B of his income (Y).
Hence he leaves OY_3 for consumption and other expenditure. The farmer must make a choice between present consumption and future income. He is prepared to spend Y_3B for OX_1 of farm input to secure his future income.
The Government can raise his welfare in two ways; either by farm income subsidy, or by farm input subsidy. If the government decides to subsidize farm input X, the farmers budget line will shift to BB'', and his welfare will be increased from I to I'. At E', his new equilibrium, the farmer invests OX_3 in X and pays only Y_2B. Since the farmer would have paid Y_1B without the input subsidy, the costs of the input subsidy to the government amount to Y_1Y_2.

Conversely, a farm income subsidy which pushes the farmer's welfare to the same level I', implies a new budget line B'B' parallel to BB and at a tangent to I'. In this equilibrium E'', the farmer invests OX_2 and pays Y_4B'. The costs of the income subsidy equal the parallel shift of the budget line, hence BB', which is less than the costs of the input subsidy, i.e. Y_1Y_2.

Although it is cynical to say so, we may state, that for situations where these findings are valid (the indifference curves do exist), and where the government is more interested in rural vote catching than fostering agricultural production, a farm income subsidy, is likely to be the most appropriate policy.

3.3 Direct Farm Output Subsidies

3.3.1 Farm Output Price Support Measures

In this section we will analyse the partial equilibrium effects in a situation where technology is static and where there is no substitution in supply, i.e. we assume no supply shifts. The basic principle of the analysis would be the same even if there were.(51)
In addition we will briefly discuss the principal methods of applying the analysis.

3.3.1.1 Partial Equilibrium Effects

Two major categories of direct output price support measures can be distinguished, viz: guaranteed prices and deficiency payments, and guaranteed prices and minimum import prices. These categories are illustrated in figure 12 and figure 13 respectively.

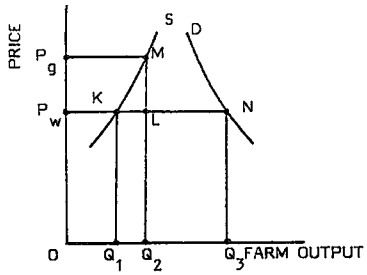


Figure 12 Guaranteed Price and Deficiency Payments

In figure 12 S depicts the domestic supply curve of a certain farm output and D the demand curve for this farm output. Suppose the government raises the price from Pw to Pg. Assuming a fixed supply schedule, this will cause an increase in output from Q_1 to Q_2. The price for consumers is maintained at the world market price level Pw, because of the deficiency payments to the farmers. This deficiency payment equals Pg - Pw and is paid on Q_2 of farm output at a budget cost of PgPwLM. For convenience sake we assume that S has a constant elasticity in the range KM. Furthermore, C is a scalar which includes supply shifters and e_1 is the elasticity, hence $Q = CP^{e_1}$.

The appropriate criteria for evaluation of this price support measure are the following:

1. Direct Government Cost: PgPw L M = $Q_2(Pg - Pw)$.
2. Increase of Farmers' Surplus or Economic Rent: Pg Pw K M =

$$\int_{P_w}^{P_g} CP^{e_1}\,dP = \left[\frac{1}{1+e_1} C P^{(1+e_1)}\right]_{P_w}^{P_g} = \frac{1}{1+e_1}(P_gQ_2 - P_wQ_1).$$

3. Shadow Costs of Resources used in Additional Production:

$Q_1Q_2MK =$

$$\int_{Q_1}^{Q_2} \left(\frac{Q}{C}\right)^{\frac{1}{e_1}} dQ = \left[\frac{1}{1+\frac{1}{e_1}} \left(\frac{Q}{C}\right)^{(1+\frac{1}{e_1})}\right]_{Q_1}^{Q_2} = \frac{1}{1+\frac{1}{e_1}}(P_gQ_2 - P_wQ_1).$$

4. Net Savings in Foreign Exchange:

$$Q_1Q_2\ L\ K = Pw\ (Q_2 - Q_1).$$

As one can easily conclude, the consumers bear no costs and enjoy no benefits from this policy measure. The policy merely transfers money to the farmers.

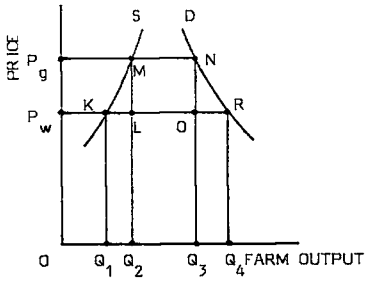


Figure 13 Guaranteed Price and Minimum Import Price

A combined policy of guaranteed prices and import price barriers is illustrated in figure 13. Consumers as well as importers have to face a certain price threshold. The demand function D in the range NR is defined as $Q = B\ P^{e_2}$.

The implications for the economy are the following:

1. Direct Government Revenue: (tariff) $LONM = (Pg - Pw)\ (Q_3 - Q_2)$.

2. Increase of Farmers' Surplus or Economic Rent:

$$PgPwK\ M = \frac{1}{1 + e_1}\ (PgQ_2 - PwQ_1).$$

3. Shadow Costs of Resources used in Additional Production:

$$Q_1Q_2\ M\ K = \frac{1}{1 + \frac{1}{e_1}} \quad (Pg\ Q_2 - Pw\ Q_1).$$

4. Net Savings in Foreign Exchange:

$$Q_1Q_2\ L\ K + Q_3Q_4\ R\ O = Pw\ \left[(Q_2 - Q_1) + (Q_4 - Q_3)\right].$$

5. Decrease of Consumers' Surplus:

$$Pg\ Pw\ R\ N = \int_{Pw}^{Pg} B\ P^{e_2}\ dP = \left[\frac{1}{1 + e_2}\ B\ P^{(1 + e_2)}\right]_{Pw}^{Pg} = \frac{1}{1 + e_2}\ (PgQ_3 - PwQ_4).$$

Apparently, the consumers are the ones who pay for this policy measure. The area M L O N can be regarded as a transfer from consumers to the government, the area Pg Pw K M is a transfer from consumers to farmers, and the area K L M represents a transfer from consumers to the resources for the additional production. Sometimes, the remaining area N O R is referred to as the consumers' cost.

3.1.1.2 **Methods of Implementation**

Farm output price support measures are often implemented to tackle distortions or to reduce farm income inequity.
A major problem is that it is difficult to meet the objective of assisting only the rural poor. Also, a price policy, based on the lowest income group, that would assure a reasonable income level to all would exceed budget constraints. On the other hand, general price support methods may worsen income distribution.

With respect to the determination of the level of guaranteed prices, two methods can be distinguished, viz. formula methods and non-formula methods. The formulae most commonly used are:

1. Farm income formulae, where the price support level is based on a certain net income level for the farming community as a whole or for certain types of holdings. An important disadvantage of this formula lies in the difficulty of its calculation.

2. Cost of production formulae, where the price level is related to the estimation of all or some costs of production. Again the difficulties of defining and measuring of the costs of production constitute a major drawback.(52)

3. Parity formulae, under which the price level is based on a historical average price received for the produce and an index of farm input prices. If the price indices include changes in volume, then these formulae may be considered as superior to the ones ad 1. and 2. The lack of sufficient statistical information can, however, limit its applicability.

4. Multiple factor formulae, where many factors are taken into account, like recent demand trends, prices in representative markets, future price prospects, cost of production, farm incomes and inflation rate. These formulae are widely used in the heavily subsidized agricultural sector of the E.E.C. A disadvantage is the substantial scope for disagreement among the price-setting members in policy-making discussion groups.

The question as to which of the above mentioned formulae is best in a particular context, depends largely on the political objectives and the available statistical information.

Non-formula methods, where price levels are based on elements like the cost of the support policy, administrative convenience, and supply and demand prospects, may in part be statistically assessed but are not brought into a fixed relationship by a formula.

A general advantage of formula methods is, that they provide a higher degree of price security to farmers. Conversely, non-formula methods have a higher degree of flexibility.

Apart from the problems related to the availability of recent statistical data, many developing countries also lack the necessary administrative framework to implement price support policies. A minimum of market administration and quality standards legislation is indispensable. For these reasons, price support measures, notably in developing countries, are often carried out in combination with buffer stock policies, enabling the government to tackle some administrative problems and to encourage minimum quality standards.

3.3.2 Farm Output Price Stabilization Measures

We stated earlier that large price fluctuations of agricultural commodities may have a detrimental impact on the economy, basically through the income effect.
For these adverse effects we refer to the discussion on the general equilibrium implications in section 3.1.1.
The principal problem is how to damp these major fluctuations without undermining the adjusting power of minor price fluctuations as a market signal.
In this section we will first analyse the welfare effects of these minor fluctuations.
Then we will analyse farm income fluctuations into a price fluctuation component and a production fluctuation component. Thirdly, we will briefly discuss the methods of implementing farm price stabilization policies.

3.3.2.1 Partial Equilibrium Effects of Minor Price Fluctuations

In a partial equilibrium framework, Waugh[53] showed that consumers gain more from a price decrease, caused by shifts in supply, than they lose from an equal price rise. Consumers therefore, gain from price fluctuations and lose from price stabilization. Probably unaware of Waugh's work, Oi[54] demonstrated similar results for producers. Producers gain from price fluctuations due to shifts in demand, and accordingly lose from price stabilization.

Massell integrated the two approaches[55] and found that where demand and supply shift randomly, the total gains from price stabilization are always positive, provided the gainers compensate the losers.

Abstracted from further generalizations[56] which include, inter alia, additive stochastic disturbances, these basic findings are depicted in figures 14 and 15 respectively.[57]

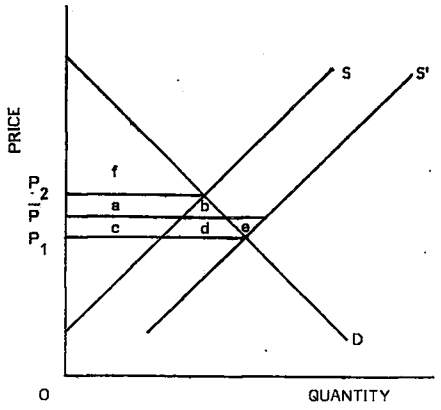


Figure 14 Price Stabilization and Supply Shifts

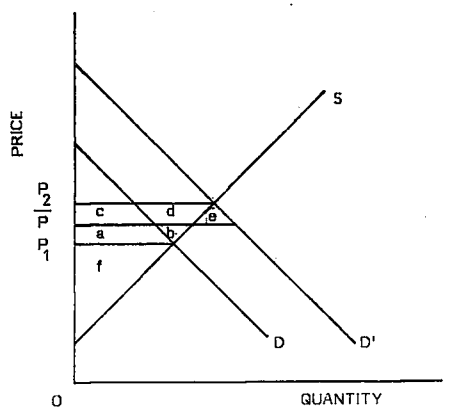


Figure 15 Price Stabilization and Demand Shifts

Waugh's argument is reflected in figure 14, where consumers can face two prices, viz: P_1 and P_2. Consumers' surplus with respect to P_1 and P_2 can be written as $CS(P_1) = (a + b + c + d + f)$, and $CS(P_2) = f$.

Assuming P_1 and P_2 occur with equal frequency, the expected value of consumers' surplus is given by: $E(CS, P) = f + 1/2(a + b + c + d)$.

If prices are stabilized at $\bar{P}$, the expected value of consumers' surplus at this fixed price, i.e. $E(CS, \bar{P})$, equals $(a + b + f)$.

Hence, $E(CS, \bar{P}) < E(CS,P)$, and the reduction in welfare equals $1/2(c + d - a - b) > 0$.

Oi's findings are analogous. In figure 15 producers are confronted with two competitive prices P_1 and P_2, each with equal probability. Economic rent with respect to P_1 and P_2 is respectively: $ER(P_1) = f$, and $ER(P_2) = (a + b + c + d + f)$. Hence, $E(ER, P) = f + 1/2(a + b + c + d)$. When prices are stabilized at $\bar{P}$, $E(ER, \bar{P}) = (a + b + f)$. Again

the reduction in welfare amounts to $E(ER, P) - E(ER, \bar{P}) = 1/2(c + d - a - b) > 0$.
Massell combined these two results, assuming that producers will compensate consumers in loss of welfare and vice versa.(58)

In figure 14 a price reduction from P_2 to $\bar{P}$ benefits consumers by (a + b) and costs producers a, which results in a net gain of b. A price rise from P_1 to $\bar{P}$ results in a gain to producers of (c + d + e), and a loss to consumers of (c + d), which results in a net gain of e. Price stabilization at $\bar{P}$ therefore provides a net gain of (b + e) to consumers and producers jointly.

In figure 15 price stabilization at $\bar{P}$ entails a similar result, i.e. a net gain of (b + e) to consumers and producers jointly.

Notwithstanding the theoretical value of the general argument, we doubt if this kind of partial equilibrium analysis will be useful to the study of farm output price stabilization measures. For a fuller understanding of our argument - the results of Massell cum suis are not relevant to agriculture - we have to investigate the gains and losses due to price fluctuations (or conversely: losses and gains from price stabilization) more closely.
Gains and losses from price fluctuations are implicitly based on the assumption of convexity in profit functions.(59)

Intuitive Proof:

Producers, in adjusting their production plans, will produce more of a specific output if they expect higher prices, and produce less of this output when they expect lower prices. The profit from their adjustments in production induced by price fluctuations will exceed the gains from producing a fixed amount of output at a stabilized price. These are precisely the features of a convex profit function lying above a tangential 'passive' linear profit function (e.g. a fixed production plan with proportional profits). An 'active' profit maximi-

zing producer will shift away to cheaper inputs when current input prices rise and accordingly try new output possibilities if current output prices decline. In either case, the 'active' profits will exceed the 'passive' profits.

Formal proof:

Notation: p - vector of output prices
c - vector of input prices
π - profit function
x - vector of inputs
y - vector of outputs

Convexity implies that if $(p'', c'') = (tp + (1 - t)p', tc + (1 - t)c')$ then $\pi(p'', c'') \leq t\pi(p, c) + (1 - t)\pi(p', c')$ for $0 \leq t \leq 1$.

Suppose now, that producers face output price p_1 with probability q, and price p_2 with probability (1 - q). The stabilized output price vector is $\bar{p} = qp_1 + (1 - q)p_2$.
When the profit function is convex we have:
$q\pi(p_1, c) + (1 - q)\pi(p_2, c) \geq \pi(\bar{p}, c) = \pi(qp_1 + (1 - q)p_2, c)$.

Hence, average profits with price fluctuations exceed average profits under price stabilization.

Returning to agriculture, this result only holds if profit maximizing farmers can adjust their production plans to price changes. Where farm inputs are extremely rigid output price stabilization measures may be advantageous to farmers.

We conclude that theoretically it is uncertain whether social welfare will increase or decrease from farm output price stabilization measures. This conclusion is supported by our geometric illustration in figure 16.

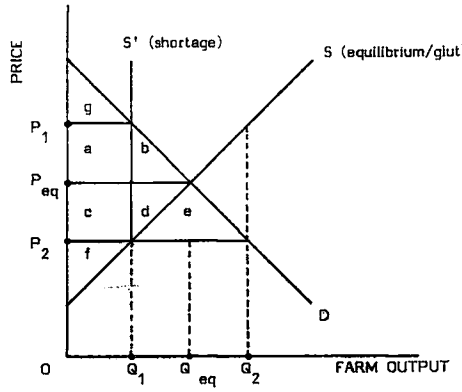


Figure 16 Stabilization of Farm Output Prices

When there is a shortfall in farm production (Q_1) the supply curve S' will become inelastic as soon as it reaches its maximum volume. Thus, we depict S' as a kinked supply curve.

When there is a shortage, Q_1 is marketed at the high price P_1. Under average conditions the normal supply curve S meets demand D at the point of equilibrium (Q_{eq}, P_{eq}). Beyond equilibrium, when there is a glut, the price will drop according to the slope of the demand curve D. At (Q_2, P_2) the excess supply is marketed at the low price P_2.

A price reduction from P_1 to P_{eq} benefits consumers by a and costs farmers a as well.

$$CS(P_1) = g \quad ; \quad E(CS, P_{eq}) = (a + g)$$
$$ER(P_1) = (a + c + f) \quad ; \quad E(ER, P_{eq}) = (c + f)$$

Therefore, the net gain from price stabilization in this case is zero. A price rise from P_2 to P_{eq} costs consumers (e + d + c) and benefits farmers by (c + d).

$$CS(P_2) = (a + b + c + d + e + g) \; ; \quad E(CS, P_{eq}) = (a + b + g)$$
$$ER(P_2) = f \quad ; \quad E(ER, P_{eq}) = (c + d + f)$$

Therefore, the net loss from price stabilization in this case equals e.

To summarise our partial welfare analysis, farmers will generally gain from price stabilization measures if (c + d) > a. The fact, that consumers have to bear the cost (i.e. c + d + e - a) not to mention the administration costs of a price stabilization policy, is sometimes neglected in the usual arguments justifying a price stabilization policy.(60)

3.3.2.2 Variations in Production Value Analysed into a Market- and Production Component

To determine if farm income fluctuations are due more to market failures than to fluctuations in production one can analyse the fluctuations of gross farm revenues or total value into a price fluctuation component and a production fluctuation component.(61)

The formula to be used is based on the well-known Taylor series approximation of the variance of the product of two stochastic variables. In our case: total value of aggregated farm production (TV) equals the price level (P) times the volume of farm production (Y).
Hence: $\text{Var (TV)} \cong \overline{Y}^2 \text{ Var (P)} + \overline{P}^2 \text{ Var (Y)} + 2\,\overline{P}\,\overline{Y} \text{ Cov (P, Y)}$
The right-hand side can be rewritten thus:

$$\frac{\overline{Y}^2 \text{ Var (P)} + \overline{P}^2 \text{ Var (Y)} + 2\,\overline{P}\,\overline{Y} \text{ Cov (P, Y)}}{\overline{Y}^2 \text{ Var (P)} + \overline{P}^2 \text{ Var (Y)}} = Rp + Ry + Rpy.$$

This facilitates interpretation since Rp + Ry, the direct effects of price and production fluctuations, are positive and sum to unity. Rpy, the interaction term, can be negative, indicating a reduction in variance of the total value. If sufficient data exist, the volume of farm production Y can be analysed in a similar way into a yield component and an acreage component.

If the variation in total value is largely due to fluctuations in production, then the most suitable program will have to deal with the causes of this production variation (e.g. by public investment like irrigation).
If, on the other hand, the variation in total value is mainly caused by price fluctuations, then a policy of buffer stock measures (or other market regulations) can be justified.

3.3.3.2 Methods of Implementation

Although farm output price stabilization measures are nearly innumerable, we feel that we can be brief about the principal argument.

Categories of Price Regulations:

1. Free Range of Guaranteed Prices where the price fluctuations are reduced but not to a fixed lower and upper limit.
2. Minimum Guaranteed Prices where a lower price limit is fixed.
3. Fixed Range of Guaranteed Prices where both the lower and upper limits are fixed.
4. Fixed Guaranteed Price where one fixed price level has been established.

The following methods of implementation[62] can be distinguished:

1. International Trade Restrictions. Vide Section 2.3 and the next two sections of this chapter.
2. Price Legislation. Here, the old adage comes into its own: every single government regulation entails another government regulation. The economic postulate to which we refer here has not been falsified yet by empirical evidence: if a price is fixed and demand exceeds supply a black market will emerge; and, if a price is fixed and supply exceeds demand wastage and thus a loss in welfare will be the net result. Another government regulation to deal with the latter problem is a system of limited price guarantees, where prices are only guaranteed for a fixed

volume of farm output. This measure basically implies a two price system, and, where retail prices are maintained at a high level, it becomes a form of export subsidy.

3. Buffer Stock Policies. Buffer stocks can be controlled by the government, by farmers or by farmers' organizations. Buffer stock policies are notorious for their operational problems and limitations. Firstly, wastage in shortage. Secondly, the tendency for costs to increase beyond budget limits. The agencies responsible for operating buffer stocks are often reluctant to lower their prices. Thirdly, problems of a logistic nature; for example management of transport and communications. Fourthly, the method can be quite expensive, and hence is not a suitable one for individual developing nations to pursue by themselves.

   Lastly, the effectiveness of public buffer stock policies is often muted by the existence of private carryover stocks.

4. Output regulations. For instance, tapping of rubber was restricted under the schemes of price control during the inter-bellum, and the plucking of tea was restricted under the International Tea Agreement. However, in both cases the measures were supported by other policies.

5. Stabilization Funds. These funds can be built up from years in which output is high and may compensate price falls in bad years (seasons). Under the horticultural auction system in The Netherlands, producers pay a small percentage of their (daily) receipts into the auction fund which is used to compensate those producers whose products are withdrawn when no buyer wants to pay the established minimum price.

This brief enumeration is of course not exhaustive. Nevertheless, it clearly demonstrates the various limitations of price stabilization measures, especially in relation to developing countries.

3.3.3 Farm Import Restrictions

3.3.3.1 Partial Equilibrium Effects

The partial equilibrium effects of import restrictions have already been discussed in section 3.3.1.1 (vide figure 13). An extreme use of this policy measure leads to complete protection, i.e. autarchy. A departure from a domestic deficit to autarchy is depicted in figure 17. Clearly consumers are the ones who pay a high price for such a policy.

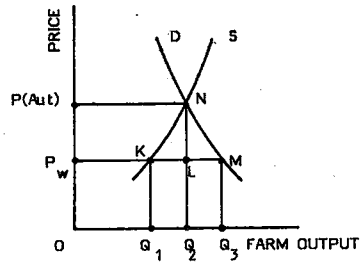


Figure 17 Prohibitive Import Restrictions

The static effects of prohibitive import restrictions are as follows:

1. Direct Government Cost: t (KQ_1Q_3M) = t $P_w(Q_3 - Q_1)$, t = ad valorem tariff.

2. Increase in Farmers' Surplus or Economic Rent:

$$P_{aut}P_wKN = \int_{P_w}^{P_{aut}} CP^{e_1}dP = \frac{1}{1 + e_1}(P_{aut}Q_2 - P_wQ_1).$$

3. Shadow Costs of Resources used in Additional Production:

$$Q_1Q_2NK = \int_{Q_1}^{Q_2} \left(\frac{Q}{C}\right)^{\frac{1}{e_1}} dQ = \frac{1}{1 + \frac{1}{e_1}} (P_{aut}Q_2 - P_wQ_1).$$

4. Net Savings in Foreign Exchange:

$Q_1Q_3M\ K = P_w(Q_3 - Q_1).$

5. Decrease of Consumers' Surplus:

$$P_{aut}P_w\ M\ N = \int_{P_w}^{P_{aut}} B\ P^{e_2} dP = \frac{1}{1 + e_2}\ (P_{aut}Q_2 - P_wQ_3).$$

3.3.3.2 Methods of Implementation

Since it is not our intention to list here all the implications of the various methods of implementation as reflected in the GATT regulations[63] only some of the major points will be high-lighted.

Imports can principally be restricted by three categories of trade intervention, or by combination of these categories, viz.:

1. Financial methods
2. Quantitative Methods
3. State Trade Monopsony

(1) Financial Methods

-Minimum Import Prices; when import prices are lower than a certain minimum level a levy is imposed to make up the difference.

-Variable Levies; a levy on imports will be raised if domestic prices fall below the guaranteed minimum and be lowered if domestic prices rise above the upper limit of the guaranteed range.

-Prohibitive Tariffs; when imports of a certain commodity are entirely banned.

(2) Quantitative Methods

It has often been argued that these measures give more effective protection to the domestic agricultural sector than financial methods. A further advantage, in particular for developing countries, is that quantitative measures are easier to administer (e.g. via import licenses) than financial methods.

(3) State Trade Monopsony

This measure has sometimes been used in developing countries during periods of food shortages. The applicability of this method depends largely on the standard of administration in a particular country (e.g. with respect to the incidence of corruption).

3.3.4 Farm Export Subsidies

3.3.4.1 Partial Equilibrium Effects

Figures 18 and 19 are the obverse of figures 12 and 13.

Figure 18 depicts a common type of export subsidy, with no direct effects on the domestic consumers. Figure 19 shows the effects of an export subsidy policy that also causes a domestic distortion.

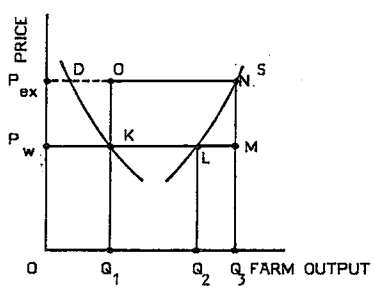


Figure 18 Common Export Subsidy

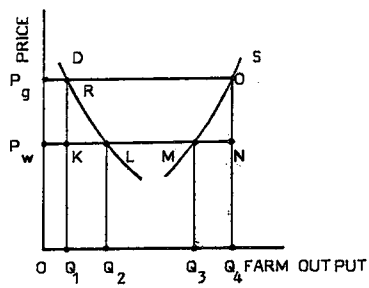


Figure 19 Guaranteed Price for Farm Export Produce with a Domestic Demand

The effects of export subsidy with no direct impact on domestic consumers, figure 18, are as follows:

1. Direct Government Cost: K M N O = $(P_{ex} - P_w)(Q_3 - Q_1)$.

2. Increases of Farmers' Surplus or Economic Rent: K L N O =

$$\int_{P_w}^{P_{ex}} C\, P^{e_1}\, dP - Q_1 (P_{ex} - P_w) = P_{ex} \left(\frac{Q_3}{1 + e_1} - Q_1\right) - P_w \left(\frac{Q_2}{1 + e_1} - Q_1\right).$$

3. Shadow Costs of Resources used in Additional Production:

$$LQ_2Q_3N = \int_{Q_2}^{Q_3} \left(\frac{Q}{C}\right)^{\frac{1}{e_1}} dQ = \frac{1}{1 + \frac{1}{e_1}} (P_{ex}\, Q_3 - P_w\, Q_2).$$

4. Net Savings in Foreign Exchange: $LQ_2Q_3M = P_w(Q_3 - Q_2)$.

The effects from the guaranteed export price policy, figure 19, are as follows:

1. Direct Government Cost: K N O R = $(P_g - P_w)(Q_4 - Q_1)$.

2. Increase in Farmers' Surplus or Economic Rent: $P_g P_w M O$

$$\int_{P_w}^{P_g} C\, P^{e_1}\, dP = \frac{1}{1 + e_1} (P_g Q_4 - P_w Q_3).$$

3. Shadow Costs of Resources used in Additional Production:

$$M\, Q_3\, Q_4\, O = \int_{Q_3}^{Q_4} \left(\frac{Q}{C}\right)^{\frac{1}{e_1}} dQ = \frac{1}{1 + \frac{1}{e_1}} (P_g Q_4 - P_w Q_3).$$

4. Decrease in Consumers' Surplus:

$$P_g P_w\, L\, R = \int_{P_w}^{P_g} B\, P^{e_2} = \frac{1}{1 + e_2} (P_g Q_1 - P_w Q_2).$$

5. Net Savings in Foreign Exchange:

$$K\ Q_1Q_2L + M\ Q_3Q_4N = P_w\left[(Q_2 - Q_1) + (Q_4 - Q_3)\right].$$

Evidently, in the latter case, the major costs are borne both by consumers and the government.

As far as the incidence of export subsidies in developing countries is concerned the following observations are worthy of note. Developing countries with a dominant agricultural export sector generally find themselves in a vulnerable position vis-a-vis the world market. Their government revenues are largely dependent on these agricultural exports. When world market prices decline it will be difficult for these governments to subsidize their farm exports out of decreasing revenues. A further problem is, that these exports often stem from perennial crops like coffee, cocoa, rubber, citrus or tea, which do not admit of a flexible response in supply. This problem can be further aggravated by the predominance of only a few crops within one country. Again, it is doubtful if export subsidies are the best way to foster agricultural exports.

Experience shows that in general, farm exports have been boosted by increased diversification in supply, by new agricultural (processed) produce, and in particular by an improvement in marketing. For instance, the success stories of the Israeli and the Dutch boom in farm exports are marketing success stories rather than subsidy success stories. Unfortunately, a thorough analysis of markets in developed countries by experts from developing countries, let alone the establishment of active sales agencies, still receives too little consideration.

3.3.4.2 **Methods of Implementation**

Apart from guaranteed prices for farm export produce which cause domestic distortions (vide: figure 19) we can distinguish five major groups of agricultural export support measures.

1. Multiple Exchange Rates.
This support measure implies a partial devaluation (concealed devaluation concerning a particular crop or area) in order to lower the export price in international currency and at the same time to increase returns to farmers.

2. Remission of Export Taxes.
In its impact this policy measure is somewhat similar to multiple exchange rates. The prices perceived by farmers are raised because of a reduction in taxes on export revenues. Like the previous measure, this method too is limited in its application. Neither method can be maintained in the event of a decline in world market prices.

3. Buffer Stock Policies.
This approach can probably be applied succesfully in particular by countries with a comparatively large world market share.

4. Limited Price Guarantees.
These measures may serve to dispose of excess supplies on the world market by raising the price of a fixed volume on the domestic market.

5. Pooling, Stabilization Funds and Direct Cash Transfers.
These systems require a central marketing board or a similar body, that can deal with the heavy administrative burden involved.

3.4 Direct Farm Input Subsidies

In this section we will analyse the partial equilibrium effects of farm input subsidies, and in addition discuss the operational dynamics of input subsidy programmes.(64)

3.4.1 Partial Equilibrium Effects

The differential impact of input subsidies on input demand and supply and farm output supply can be elegantly illustrated in one graph (vide figure 20).

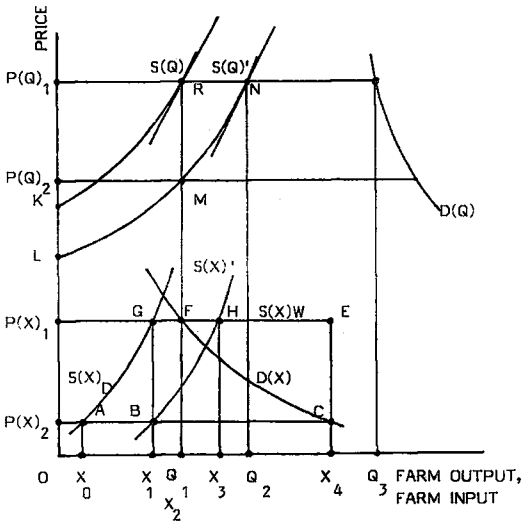


Figure 20 Farm Input Subsidy, Farm Input Market and Farm Output Supply

In figure 20, S(Q) and S(Q)' depict the farm output supply curves, without and with subsidy; $S(X)_D$, $S(X)'_D$ and $S(X)_w$ are respectively the domestic supply curves of farm input X and the world supply curve of X; D(Q) represents the demand curve for farm output Q; and D(X) is the demand curve for X.

Situation prior to the imposition of the input subsidy:

-domestic producers of X sell a volume of X_1 at the price $P(X)_1$

-farmers purchase a volume of X_2 at $P(X)_1$ of which amount $(X_2 - X_1)$ has been imported

-farmers produce Q_1 of farm output at the world market price $P(Q)_1$

-consumers purchase Q_1 at $P(Q)_1$ of which amount $(Q_3 - Q_1)$ has been imported.

Suppose the government decides to subsidize farm input X (e.g. seed) at price $P(X)_2$. Since demand at this price corresponds to X_4 of farm input, the government has to subsidize $(P(X)_1 - P(X)_2)$ for each unit of farm input.

The imposition of the subsidy causes a downward shift of S(Q) over an equal distance as the subsidy $(P(X)_1 - P(X)_2)$ perpendicular at X_2 c.q. Q_1. Hence, $(P(Q)_1 - P(Q)_2)$ equals $(P(X)_1 - P(X)_2)$. The reason for this shift is, that the volume of Q_1 of farm output can be produced with less cost, viz. $(P(Q)_1 - P(Q)_2)$ for each unit of farm output. Since the market price is $P(Q)_1$, farmers will increase their production to Q_2.

The domestic producers of farm input X may increase their production accordingly, e.g. to X_3, assuming a parallel supply shift. (65)

Assuming: $S(Q) = CP^{e_1}$; $S(Q)' = EP^{e_3}$; $S(X) = FP^{e_4}$; $S(X)' = GP^{e_5}$, the major partial welfare effects are the following:

1. Direct Government Cost of the Subsidy:

$$P(X)_1\ P(X)_2\ C\ E = X_4\ (P(X)_1 - P(X)_2).$$

2. Increase in Farmers' Surplus or Economic Rent:

$$P(Q)_1\ L\ N - P(Q)_1\ K\ R = \int_L^{P(Q)_1} EP^{e_3} - \int_K^{P(Q)_1} CP^{e_1} =$$

$$\frac{1}{1+e_3}\ P(Q)_1 Q_2 - \frac{1}{1+e_1}\ P(Q)_1\ Q_1.$$

3. Shadow Costs of Resources used in Additional Production:

$$(OQ_2NL - OQ_1RK) + (X_1X_3HB - X_0X_1GA) =$$

$$\left[\int_O^{Q_2} \left(\frac{Q}{E}\right)^{\frac{1}{e_3}} dQ - \int_O^{Q_1} \left(\frac{Q}{C}\right)^{\frac{1}{e_1}} dQ\right] + \left[\int_{X_1}^{X_3} \left(\frac{X}{G}\right)^{\frac{1}{e_5}} dX - \int_{X_0}^{X_1} \left(\frac{X}{F}\right)^{\frac{1}{e_4}} dX\right] =$$

$$\left[\frac{1}{1+\frac{1}{e_3}}\ P(Q)_1Q_2 - \frac{1}{1+\frac{1}{e_1}}\ P(Q)_1Q_1\right] + \left[\frac{1}{1+\frac{1}{e_5}}\ (P(X)_1X_3 - P(X)_2X_1) - \frac{1}{1+\frac{1}{e_4}}\ (P(X)_1X_1 - P(X)_2X_0)\right].$$

4. Increase in Surplus or Economic Rent of Domestic Producers of Farm Input:

$$P(X)_2B\ H\ P(X)_1 - P(X)_2\ AGP(X)_1 = \int_{P(X)_2}^{P(X)_1} G.P^{e_5}dP - \int_{P(X)_2}^{P(X)_1} FP^{e_4}dP =$$

$$\frac{1}{1+e_5}\ (P(X)_1X_3 - P(X)_2X_1) - \frac{1}{1+e_4}\ (P(X)_1X_1 - P(X)_2X_0).$$

5. Net Change in Foreign Exchange (reduced import from output minus increased import farm input):

$$Q_1Q_2NR - (X_3X_4EH - X_1X_2FG) = P(Q)_1\ (Q_2 - Q_1) - P(X)_1$$

$$\left[(X_4 - X_3) - (X_2 - X_1)\right].$$

If one observes the induced supply shift from S(Q) to S(Q)' more closely, the implicit assumption of no improvement in technical efficiency becomes apparent. It has been reflected namely by tangents of the supply curves at R and N respectively.

The downward shift in output supply can be either:

-parallel; same technical efficiency: $\frac{\delta S(Q)}{\delta X} = \frac{\delta S'(Q)}{\delta X}$

-convergent; reduced technical efficiency: $\frac{\delta S(Q)}{\delta X} \geqslant \frac{\delta S'(Q)}{\delta X}$

-divergent; improved technical efficiency: $\frac{\delta S(Q)}{\delta X} \leqslant \frac{\delta S'(Q)}{\delta X}$

It must be feared, that when input subsidies are not accompanied by improved farm technology (e.g. not only more seed but also higher yielding varieties; not only more fertilizer but also better fertilizing practices, etc.) the shift will be nothing but parallel (and probably at net social costs).

Hayami and Ruttan emphasized this argument in a more general context. Borrowing their illustration[66] we depict in figure 21 two supply response curves drawn for traditional technology and advanced technology, M_0 and M_1 respectively.

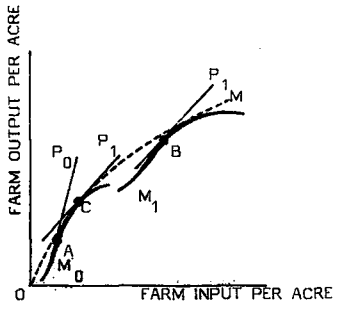


Figure 21 Traditional and Advanced Technology

The meta production function (M) is the envelope of many such supply response curves, each representing a different degree of technology. It can be easily observed, that even if the input/output price ratio declines from P_0 to P_1 (e.g. by an input subsidy), farmers cannot move from A to B, and will be trapped at C, unless M_1 becomes available.

3.4.2 The Operational Dynamics of Farm Input Subsidies

In this paragraph we will prove the conceptual framework, vide figure 22, that has served as a theoretical foundation for our empirical case study as far as farm input subsidies are concerned.

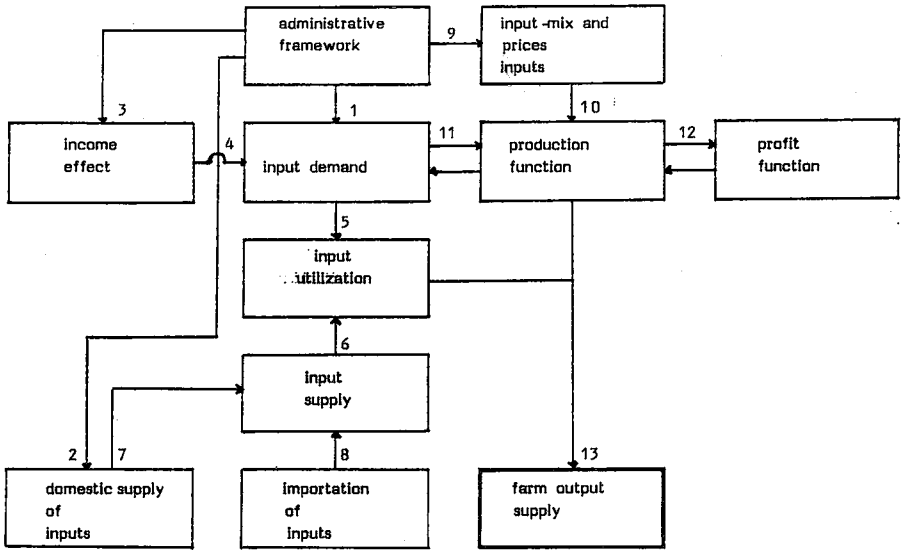


Figure 22 The operational Dynamics of Farm Input Subsidy Programmes

The administrative framework of farm input subsidy programmes may consist of physical input transfers as well as of money transfers. In either case it is uncertain before hand to what extent the subsidy will raise the demand for farm input.

A price reduction of the input can have both an income effect (3) and a substitution effect (1). The latter can enhance input demand (1) but the net effect (1) - (4) will also depend on other factors influencing input demand, in particular those factors related to the production function (11). The administrative framework also largely determines the coverage of the subsidy programmes, i.e. the degree of participation by farmers. The relationship between the administrative framework and the input-mix and prices of other inputs (9) is very important. If, for instance, production is only elastic when there is a combination of two or more inputs (a likely case) and only one input is being subsidized, the subsidy programme is bound to fail (10).

The dual relationship with respect to the profit function, the input demand functions and the production function, (11) and (12) will be explained and demonstrated in the empirical case study. The principle is, that farmers base their decisions in part on output/input price ratios which form the relation between these three functions.

The administrative framework can also have an impact on input supply (2) especially in the case of physical input transfers, but also with regard to storage, transport and other marketing facilities concerning input supply. A monopoly in domestic input supply can hamper the subsidy programme (7). In anticipating the subsidies, domestic producers of these inputs may form a cartel and raise their prices accordingly. Increased importation of inputs will entail a drain on foreign exchange resources (8).

The utilization of input is the final result from all these factors affecting the demand side (5) and the supply side (6).

Eventually, depending in part on its elasticity of production and its cross-elasticity, with respect to other farm inputs, the increased utilization of the subsidized farm input may entail a rise in farm output supply (13).

NOTES

1. Marshall, A., 'Principles of Economics', An introductory volume, MacMillan, sixth edition, London, 1910, p. 342.
2. Marshall, A., op. cit., Book IV, 'The Distribution of the National Income'.
3. OECD, 'Transparency for Positive Adjustment', 1983, ibidem. We are much indebted to this comprehensive publication.
4. OECD, 'Transparency for Positive Adjustment', 1983, op. cit., p. 249.
5. Elías, V.J., 'Government Expenditures on Agriculture in Latin-America', Research Report 23, International Food Policy Research Institute, May 1981.
6. The other direct welfare costs of agricultural subsidies are discussed in subsequent sections of this chapter.
7. Vide e.g. Shoup, C.S., 'The Economic Theory of Subsidy Payments', The Economics of Federal Subsidy Programs, op. cit., pp. 55-73.
8. Vide e.g.: Bishop, J. and Haveman, R., 'Selective Employment Subsidies: Can Okun's Law be repealed?', American Economic Review, May 1979, pp. 124-130;
   Break, G.F., 'Subsidies as an Instrument for Achieving Public Economy Goals', The Economics of Federal Subsidy Programs, op. cit., pp. 1-6.
9. Also referred to as rent-seeking behaviour induced by subsidies. Vide e.g. 'Subsidies in GATT', GATT-secretariat paper, 1984, op. cit., p. 5.
10. OECD, 'Transparency for Positive Adjustment', 1983, op. cit., pp. 17-18.
11. These latter two distortions are empirically examined in Part Two. It refers in the main to the distorting impact from industrial subsidies on agriculture.
12. Mellor, J.W., 'Agricultural Price Policy and Income Distribution in Low Income Nations', World Bank Staff Working Paper 214, Washington D.C., 1975.
13. Ibidem, p. 11.

14. Vide e.g. Ahmed, R., 'Foodgrain Supply, Distribution and Consumer Policies within a Dual Pricing Mechanism: A Case Study of Bangladesh', I.F.P.R.I., Research Report 8, May 1979; and George, P.S., 'Public Distribution of Foodgrains in Kerala - Income Distribution Implications and Effectiveness', I.F.P.R.I., Research Report 7, March 1979.
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48. Vide e.g. Meester, op. cit. pp. 40-45; and FAO, op. cit., p. 70.
49. The indifference curve applies in fact to present income and consumption on the one hand and future income on the other hand.
50. Loosely formulated: a sufficient condition is, that the indifference curves I and I' exist and are convex in the neighbourhood of the equilibrium points. This implies that E' will always be above the new budget line B'B' which makes the input subsidy costlier than the income subsidy.
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59. Vide e.g. Varian, H.R., 'Microeconomic Analysis', Norton & Co. Inc., U.S.A., 1978, p. 34.

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Vide Burt, O.R., and Finley, R.M., 'Statistical Analysis of Identities in Random Variables', American Journal of Agricultural Economics, Vol. 50, 1968, pp. 734-744.

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63. Vide e.g. Dam, K.W., 'The GATT Law and International Economic Organization', University of Chicago, Chicago and London, 1970.

64. Methods of implementation may vary in detail but not much in principle, e.g. cash transfers and subsidies in kind.

65. We do not include shifts in input demand. The actual changes in demand and supply schedules are highly dependent upon the method of input subsidy implementation.

66. Vide Hayami and Ruttan, 1971, op. cit., pp. 193-194.

PART TWO

AN EMPIRICAL STUDY OF AGRICULTURAL SUBSIDIES AND FARM LABOUR DISTORTIONS IN TRINIDAD AND TOBAGO

Part two of this study consists of the major findings of an evaluation of agricultural subsidy programs in Trinidad and Tobago. The evaluation was carried out by the author from 1982 to 1984 and concerned a number of direct farm input and farm output support measures.

The declining terms of trade against agriculture were important to the analysis of the agricultural subsidies on the two Caribbean sister-islands. This was mainly caused by relatively high industrial wages, a heavily subsidized industrial sector, and the low status of agricultural labour. (1)

The empirical analysis therefore may have particular relevance to agricultural subsidies directed against farm labour distortions.

The investigation is based mainly on the results of two stratified sample surveys, viz. a survey of 609 crop farms (April-June 1983) and a survey of 79 dairy farms (October 1983).

Since secondary data were in limited supply, the method employed consists in the main of a number of consecutive partial equilibrium analyses.

CHAPTER 4

THE INCIDENCE OF FARM LABOUR DISTORTIONS

Our analysis of the incidence of farm labour distortions consists of three stages.

The first step in the assessment of the distortions is based on answers to the questions on risks and limiting factors in increasing farm production. We hypothesized that the relative importance of the difficulty of hiring farm labour and the wages of workers being too high as compared to other risks and limiting factors to be chosen by the farmers from a list, would provide an initial indication.

The second step was the estimation of production functions from a cross-section of the data. This procedure provided information on the two components of farm labour distortions namely farmer's own labour distortion and hired labour distortion.

Thirdly, we investigated the economic efficiency of farm production that was found to be relatively less distorted. This would provide a basis for ex-ante analysis of agricultural subsidy programs.

The three stages are discussed below in sections 4.1, 4.2, and 4.3.

4.1 Risks and Limiting Factors for Increasing Farm Production

Concerning the questions on risks and limiting factors we asked the farmers to choose three risks or limiting factors out of 20 possible constraints, and rank them in order of importance.

Three types of constraints were recorded most often, viz.: 'not enough land'-1-; 'can't get workers to hire' and 'wages of workers too high' -2-; and 'price of farm produce is too low' -3-.

The rank and frequency of the recorded constraints are depicted in table 1. Only frequencies of more than 10% are included.

Table 1 Risks and limiting Factors; Rank and Frequency of Recording in Percentage of Farmers

	land(1)			labour(2)			price(3)		
	rank			rank			rank		
	1	2	3	1	2	3	1	2	3
	% of farmers			% of farmers			% of farmers		
Temporary Crops									
vegetables	23(*)			12				12	11
root crops	13			21	13		14	24	
grain/legumes (excl. rice)	29			12	12			23	
rice				46	34				
Perennial Crops									
bananas/plantains				20				13	
cocoa				20	13	15	11	16	
coconut				27					14
coffee				25	32				
citrus				29					
Dairy Farming				30			60		

(*) Example: 23% of vegetable farmers stated 'not enough land' was the most important limiting factor.

It is clear, that the labour constraint seems to be the major impediment to increasing farm production.
'Not enough land' appears to be a serious constraint as well, especially to temporary crop farmers.
The relative importance of this land-constraint will be discussed in the next section. An interesting finding is, that other constraints on the input side, like prices of fertilizer, chemicals, and equipment were not recorded very often.

4.2. The Estimation of Production Functions

Crop Farming

We knew from preliminary sample results that a vast majority of crop farmers farmed part-time.
The estimation of production functions would reveal if a significant difference existed between the production functions of part-time farms and full-time farms.
Next, we hoped to ascertain the distorting impact on hired labour.
Thirdly, production functions might reveal the relative importance of the land-constraint.

First we attempted to estimate 'normal' types of agricultural production functions for all crop farmers. We therefore grouped part-time and full-time farmers together.
'Normal' or undistorted production functions contain as independent variables, inter alia: acreage, type of soil, slope, irrigation, fertilizers, equipment, and hired labour.
These independent variables are, under undistorted conditions, often found to reflect the farmers' assets and managerial capabilities as well as the environmental factors beyond the farmers' control. Both categories, as hypothesized, determine the yield.
However, the results from the regression of production (measured in returns) on the normal independent variables were disappointing. We found that the independent variables failed to provide an explanation for the results.

Then, as a second step in the estimation of production functions for crop farmers, we included the answers to the questions:
'On average, about how many hours per week do you spend on your farm?'
With the inclusion of answers to this question the regression results improved considerably.

More or less acceptable regression results were obtained for seven out of the eleven estimated production functions (vide: (3), (4), (5), (7), (9), (10) and (11) in table 2.

The regression results in table 2 lead us to the following observations.
First, no normal (undistorted) relationship as indicated above, could be established so far.
The reason was that too often we lacked data on farm inputs like fertilizer, seed or hired labour.
Further enquiry into these missing data revealed that many part-time farmers utilized farm inputs on an irregular basis.
This strongly confirmed our suspicion (which we already held) of distorted crop production on part-time farms.

Secondly, we observed that with regard to the temporary crops (3), (4) and (5) the variation in production levels is almost entirely explained by the number of hours per week the farmer spends on his farm.

This confirmed our doubts concerning the land-constraint as stated by temporary crop farmers (excl. rice). The non-significance of acreage in production functions (3), (4) and (5) reduces a major influence of this constraint.
We also tried to include total acreage, i.e. not only the acreage of the major crop [2] and the acreage owned. But neither trial improved the fit. Concerning the perennial crops (7), (9), (10) and (11) we see that the variation in production levels is also explained by the number of acres and to a lesser extent by the available equipment.
In case of the perennials we may tentatively conclude that production is mainly determined by the amount of easily picked fruit the farmer can harvest within the time available.

Table 2 OLS - Estimates of Production Functions including Farmer's Own Labour Input

Crop		Functional Form	n	Constant Term	Coefficient of: Acreage	Equipment TT$	Hired Labour TT$	Own Labour	R^2	DW
Temporary Crops										
Vegetables	Tr. (1)	linear	172	104.75	17.68	0.32		145.69	0.11	1.90
					(8.67)	(0.10)		(118.36)		
Rootcrops	Tr. (2)	linear	67	-2269.66	777.52			102.11	0.29	1.57
					(188.22)			(26.42)		
Rootcrops	To. (3)	double-log	29	2.71	0.17	-2.89		1.27**	0.57	2.10
					(0.22)	(0.13)		(0.23)		
Grain/legumes	Tr. (4)	linear	36	-1178.9	700.74*	0.18*		73.90**	0.48	2.69
					(431.67)	(0.083)		(24.47)		
Rice	Tr. (5)	linear	48	-194.22	-64.81			87.15**	0.85	2.02
					(137.61)			(5.62)		

Tr. Trinidad; To. Tobago; n number of observations; Own Labour in hours per week; * significant, t 0.80; ** significant t 0.99; ( ) standard error

Table 2 continued

Crop		Functional Form	n	Constant Term	Coefficient of: Acreage	Equipment TT$	Hired Labour TT$	Own Labour	R^2	DW
Perennial Crops										
Cocoa	Tr. (6)	linear	49	-3278.1	246.62	-3.01		187.96	0.25	2.13
					(74.27)	(0.16)		(120.51)		
Cocoa	To. (7)	double-log	26	2.11	0.39*	-4.66		0.88**	0.48	1.35
					(0.24)	(0.07)		(0.22)		
Coffee	Tr. (8)	double-log	18	3.54	0.25	0.13	8.65	0.67	0.40	1.31
					(0.24)	(0.07)	(0.07)	(0.48)		
Coconut	Tr. (9)	linear	33	-7147.03	2.36**	1.19**		298.06**	0.79	1.96
					(0.55)	(0.17)		(77.02)		
Coconut	To. (10)	double-log	11	0.93	-0.59*	0.16*		2.30**	0.83	1.35
					(0.67)	(0.16)		(0.68)		
Citrus	Tr. (11)	double-log	34	1.0	0.46**	0.87*		1.46**	0.91	1.93
					(0.13)	(0.05)		(0.14)		

The larger the acreage the more easy fruit there is to pick. The remainder is left on the trees.

Finally, the serious distortion with respect to the hired labour input could only be confirmed by the absence of data. As compared to actual labour requirements, hired labour was hardly used at all.

The third step in estimating production functions was crucial in assessing the incidence of distortions because by running regressions for full-time crop farmers only, we could see if normal production functions could in fact be estimated.

Based on the available degrees of freedom and on the labour intensity of the crops, we more or less arbitrarily chose a 40-hours lower limit for rootcrop farmers and a 50-hours lower limit for vegetable farmers.

The number of full-time farmers in the other categories of crops was too small as compared to the number of degrees of freedom we needed for the estimation of normal production functions.

The results of these two regressions for full-time crop farmers are depicted in table 3.

These are of particular interest for the analysis of farm input subsidies. The production function for root crops is estimated for 39 farmers, which accounts for 41% of the total number of root crop farmers surveyed. The average returns of full-time root crop farmers are 2092 $TT/acre against 1018 $TT/acre for part-time root crop farmers. (3)

The production function for vegetables is based on 49 full-time vegetable farmers, i.e. 31% of the total number surveyed.

The returns for full-time farmers are 7503 $TT/acre against 5847 $TT/acre for the part-time vegetable farmers.

Because of the much larger acreage of full-time vegetable farms (2.9 acres full-time against 1.3 acres part-time) the corresponding disparity in total returns is more significant on vegetable farms than on root crop farms (viz.: root crop farms, 3556 $TT(ft) and 1833 $TT(pt); vegetable farms, 21834 $TT(ft) and 7601 $TT(pt)).

Table 3 OLS - Estimates of Production Functions for Full-Time Vegetable (≥50 hrs/wk) and Root Crop Farmers (≥40 hrs/wk)

Crop	Functional Form	n	Constant Term	Coefficient of: Acreage	Equipment $TT	Fertilizer $TT	Pesticides $TT	Seed $ TT	Hired Labour $TT	R^2	DW
Vegetables (50 hrs/wk)	linear	49	4182.5	-4.50	3.05	23.99**	-4.45*	48.53**	-3.04*	0.71	2.30
				(9.66)	(0.10)	(6.41)	(4.90)	(10.23)	(2.86)		
Root Crops (40 hrs/wk)	linear	39	-611.8	7.21**	2.28	14.09**	-9.00*		3.76**	0.79	1.83
				(2.91)	(0.04)	(3.09)	(4.35)		(1.02)		

n number of observations; * significant, t 0.80; ** significant, t 0.99; ( ) standard error

Our conclusion is, that a normal relevance of hired labour, chemicals, fertilizer and seed to crop returns could not be falsified with regard to full-time rootcrop and vegetable farmers.
Albeit without proof, we venture to postulate that the same will be true for other categories of full-time temporary crop farmers for which we possessed insufficient data.

From these three consecutive steps we can tentatively deduce that the high opportunity costs for the farmers' own labour leads to a distorted production on 50% to 70% of temporary crop farms.
As for perennial crops, we assume a much heavier impact from farm labour distortion mainly because of the high labour intensity of perennial crop farming. Two factors seemed to confirm this assumption: first, the large discrepancy between average returns and world averages (vide section 6.3.2);
secondly, according to the sample results, we noted that the percentage of full-time perennial crop farmers as compared to full-time temporary crop farmers was extremely low.

Dairy Farming

The survey of 79 dairy farmers was analysed into a category of 17 'marginal' farmers with annual production levels of not more than 20.000 kg milk, and a category of 62 'better' dairy farmers with higher production levels.(4)
All dairy farmers in the sample claimed to be full-time farmers. Since it is much more difficult to be a part-time dairy farmer than a part-time crop farmer, we were inclined to accept these answers. The apparent absence of a distortion concerning the farmer's own labour enabled us to estimate a normal production function for both categories of dairy farmer (vide table 4).

Table 4 OLS - Estimates of Production Functions for High-Producing - (1) and Low-Producing Dairy Farmers (2)

Functional Form	n	Constant Term	Coefficient of						R^2	DW
			Calving Rate	Acreage Improved Pasture	Concentrate Feed $TT	Fertilizer $TT	Farmer's Own Labour Input	Fencing $TT		
double - log (1)	62	6.87	0.57**	3.63*	-0.14*	-68.55	-2.88		0.43	1.73
			(0.10)	(0.02)	(0.07)	(0.01)	(0.16)			
double - log (2)	17	1.17	0.99**				0.70*	3.05*	0.54	1.64
			(0.38)				(0.68)	(0.03)		

n number of observations; * significant, t 0.80; ** significant, t 0.99; ( ) standard error;
Calving Rate is the ratio: births/average no. of cows in milk plus average no. dry cows;
Farmer's Own Labour Input in hours per week

Comparing table 4 with table 3, we note that the fit for full-time temporary crop farming is superior to that for dairy farming. However, the following could be tentatively concluded.

Apart from a minor influence from the farmer's own labour on production levels for low-producing dairy farmers, production levels generally seem to be more related to the quality than to the quantity of the farmer's own labour input. For it is clear that the major factor influencing production for both categories is the calving rate. In other words, the farmer's skill in getting his cows in calf.

4.3 Economic Efficiency: A Prerequisite of Agricultural Subsidies

Agricultural subsidy programs to enhance farm production can only be succesful if farmers are maximizing their profit and hence respond to changes in relative prices.

This profit-maximizing behaviour can be ascertained by a test for economic efficiency.

A practical method of testing economic efficiency with the help of a cross-section of the data only is the normalized restricted profit function approach.

Lau and Yotopoulos [5] have developed this approach which is based on Mc Fadden's theory of profit functions. [6]

We will discuss this valuable tool for agricultural subsidy analysis in appendix 1.

A problem is that this approach can not be applied when input prices are fixed.

For this reason we could not test the economic efficiency of dairy farms since most inputs were supplied by the government at fixed (subsidized) prices.

For full-time root crop farmers we lacked the necessary information on farm input prices. We could therefore only test the economic efficiency of full-time vegetable farmers.

The principle of the normalized restricted profit function approach implies the estimation of a profit function and the corresponding input demand functions.

Table 5 OLS - Estimates[11] of the Normalized Restricted Profit Function and Input Demand Functions for Full-Time Vegetable Farmers

Normalized Restricted Profit Function

Constant	Coefficients					R^2	DW
	$\alpha 1$	$\alpha 2$	$\alpha 3$	β_1	β_2		
6.9	-0.51*	1.21*	-1.02*	0.22**	0.31*	0.28	2.18
	(0.54)	(0.75)	(0.58)	(0.08)	(0.31)		

Input Demand Functions

	Coefficients			
	α_1^D	α_2^D	α_3^D	α_4^D
	-0.3155	-0.048**	-0.009**	-0.074
	(0.347)	(0.005)	(0.001)	(0.029)
R^2	0.2	0.64	0.54	0.12

Estimation Equations:

Normalized restricted profit function: $\ln \frac{\pi}{p} = \text{constant} + \sum_{i=1}^{m} \alpha_i \ln \frac{c_i}{p} + \sum_{i=1}^{n} \beta_j \ln Z_j$

input demand functions: $\frac{\frac{-c_i x_i}{p}}{\frac{\pi}{p}} = \alpha_i^D, \quad i = 1 \ldots m.$

Notation

c_1 - wage hired labour
c_2 - price fertilizer
c_3 - price seed
c_4 - price pesticides
x_1 - hours hired labour
x_2 - amount fertilizer
x_3 - amount seed
x_4 - amount pesticides
Z_1 - value equipment
Z_2 - acreage
p - output price
π - profit: returns - $\sum_{i=1}^{4} c_i x_i$

The hypothesis of profit maximization is not falsified when the coefficients, concerning the respective farm inputs are equal in either type of equation.

Since the profit function is derived from a Cobb-Douglas type of production function, a test of constant returns to scale is necessary for the test of profit maximization (vide appendix 1). The regression results are shown in table 5.

Unfortunately, the fit of the estimated normalised profit function was rather poor: $R^2 = 0.28$.

Conversely the fit of the estimated input demand functions of seed and fertilizer is acceptable, i.c. 0.54 and 0.64 respectively.

We assigned a level of significance of 0.01 for the test of the hypothesis of constant returns to scale and for the test of profit maximization.

The tests of both the hypotheses of constant returns to scale and the hypothesis of profit maximization are depicted in table 6.

Table 6 Tests of Hypotheses of Constant Returns to Scale and Profit Maximization

Hypothesis of Profit Maximization	Computed F	Critical F-values
$\alpha_1 = \alpha_1^D$ $\alpha_2 = \alpha_2^D$ $\alpha_3 = \alpha_3^D$	$\frac{\sum_{i=1}^{3} (\alpha_i - \alpha_i^D)^2/3}{\sum_{i=1}^{49} e_i^2/45} = 0.212$	$F(3,45)_{0.99} = 4.2$
Hypothesis of Constant Returns to Scale[8]		
$\beta_1 + \beta_2 = 1$	$\frac{(\beta_1 + \beta_2 - 1)^2/2}{\sum_{i=1}^{49} e_i^2/46} = 0.271$	$F(2,46)_{0.99} = 5.1$
Both Categories of Hypotheses not Rejected		

For both hypotheses the computed F-value did not exceed the critical F-value from the F-distribution.
Hence we conclude tentatively (poor fit profit function) that the hypothesis of profit maximization can not be rejected.
Extending this tentative result loosely, we assume that, given the actual production structure, full-time crop farmers are in principle efficient farmers.

Generally, agricultural subsidies affect farm production that is relatively undistorted first, i.e. only when this category of 'undistorted' farmers responds efficiently to price changes.
For this reason it is important to ascertain the price responsiveness of farmers prior to the implementation of the subsidies.
Otherwise subsidies are mere social income support programs having no substantial impact on production levels.

If price responsiveness is doubtful, it may be better to refrain from direct subsidization and try something else.
For instance, the more price-neutral public investment programs we discussed in section 1.3.3 are likely to be preferred in these cases.

NOTES

1. E.g., from our discussions with farmers we learnt that very few wanted one of their sons to become a farmer.
   Whether or to what extent the low status of agricultural labour is related to the period of unfree labour before emancipation in 1838, or to the period of the importation of indentured labour from India (1838-1917) or to the demonstration effect of petroleum induced industrialization and urbanization or to other factors is a question we will not attempt to answer here.
2. The questions and answers on farm production and marketing in the questionnaire apply only to the farmer's main crop.
3. Again, average and total returns for one main crop only.
4. We took the 1982-production figures as a basis.
5. Vide Yotopoulos, P.A. and Lau, L.J., 'Microeconomic Output Supply and Factor Demand Functions in the Agriculture of the Province of Taiwan', American Journal of Agricultural Economics, Vol. 58, 1976, pp. 333-340.
6. Vide McFadden, D., 'Cost, Revenue and Profit Functions' in 'Production Economics: A Dual Approach to Theory and Applications', Vol. 1, Eds. M. Fuss and D. McFadden, North-Holland Publishing Company, Amsterdam, 1978.
7. Joint estimation of both equations by means of generalized least squares (i.c. Zellner's method) may lead to more efficient estimates. Vide Zellner, A., 'An Efficient Method for Estimating Seemingly Unrelated Regressons and Tests for Aggregation Bias', Journal of the American Statistical Association, Vol. 57, June 1962, pp. 348-368.
8. The tests are defined in appendix 1.

CHAPTER 5

ECONOMIC ANALYSIS OF FARM INPUT SUBSIDY PROGRAMS

In this chapter we attempt to explain why a number of farm input subsidy programs have not been succesful in improving the agricultural terms of trade. The major reasons for programme failure, in our opinion, are explained systematically with the help of the analytical framework outlined in section 3.4.2.
Subsequently we will evaluate the actual impact on utilization of farm inputs and on production levels. In a second section we discuss the relevance of estimating production functions for subsidy appraisal. A third section is devoted to an ex-ante analysis of fertilizer subsidy.

5.1 Ex-post Analysis of Farm Input Subsidy Programs

5.1.1 Administrative Design

Most of the farm input subsidy programs to be analysed in this chapter came on stream in the early seventies.
The whole package contained some 25 different programs, viz. subsidies on land preparation, fertilizers, chemicals [1], spraying equipment, machinery and equipment, water storage/irrigation, coffee rehabilitation, cocoa rehabilitation, orchard establishment, soil conservation, pasture establishment, ground limestone, livestock housing, livestock feed, vehicles, wheel tractors, drying facilities, farm roads, bridges and culverts, fencing, molasses, jiffy pellets and pots, bee-keeping equipment and loans.

Except for livestock feed, where subsidization was paid at source, the administrative design of most of these specific input subsidies implied application, assessment, approval, and (delayed) payment subject to presentation of bills.

From the analysis of the survey results and our discussions with farmers and extension officers we identified four major defects in the administrative system, viz.:

(i) the programs were not sufficiently directed against farm labour distortion
(ii) lack of familiarity with the large number of different subsidies
(iii) the diseconomies of administrative procedures
(iv) the delays in subsidy payments

(i) The Programs were not Sufficiently Directed Against Farm Labour Distortion

This defect is probably the most serious. In section 2.1. where we discussed domestic distortions, it was proven theoretically that the best policy against a factor distortion is a factor tax-cum-subsidy in the opposite direction of the distortion.
A tax-cum-subsidy on production was considered a second-best solution. In our case the latter implies farm output subsidies (vide next chapter). Conversely, it is difficult to see how farm input subsidies, other than for labour or labour-substituting technologies, can possibly be successful.
If most farmers feel they can better improve or make their present income levels more secure by other activities or are impeded in their efforts to increase production by serious labour shortages, cheap fertilizer[2] or chemicals will not improve the state of affairs. In other words, the subsidy will then only have an income effect. The farmer will purchase the same amount of the cheaper farm input and save some money.
An exception has to be made for the so-called tractor pool. This program formed part of the subsidy on machinery and equipment. The tractor pool, where farmers could hire tractors at low prices, reduced the hired labour constraint for temporary crop farmers in a number of cases.
In principle, other subsidies on mechanization could have a similar

result, but the fourth defect, i.e. delays in subsidy payments, ensured that in our case these were merely used for cheap replacement (i.e. at no faster pace than usual).
The tractor pool, on the other hand, was a subsidy which had no time delays (except for the waiting list).

For dairy farming we noted a similar inbalance in farm input subsidization. As stated earlier, in addition to the hired labour constraint we observed a distortion in the quality of the farmer's own labour. The dirty stables, the large number of cases of mastitis and the low calving rates corroborated this view.
Dairy farming requires constant close monitoring of animals in a hygienic environment which in turn requires both efficient management and sufficient farm labour.
Farm input subsidies for dairy farming consisted in the main of cheap provision of concentrate feed. Clearly, this subsidy was not directed against quantitative or qualitative labour distortion.

(ii) Lack of Familiarity with the Large Number of Different Subsidies

No less than 41% of the farmers in the surveys were found to be entirely unaware of farm input subsidy programs.
The remaining 59% can be analysed as follows: 14% of farmers could mention one subsidy; 27% could mention 2-4 different subsidies; 14% could mention 5-8; and less than 4% could recall more than 8 different subsidies.
The distribution of relative awareness was rather askew. Large farmers closer to urban centres were found to be more subsidy-conscious than small-scale farmers in rural areas. Despite considerable governmental efforts to promote the programme, we feel that the complexity of the whole package impeded a wider coverage.

(iii) The Diseconomies of Administrative Procedures

The first diseconomy was the time involved in administrative procedures for application, assessment, approval and payment of the subsidies.

Our regional estimates vary from 50% to 80% of the available man-hours. Since most subsidies were administered by extension services, this brought about a serious reduction of usual extension work.

Secondly, complicated procedures encouraged fraudulent use of the subsidies by e.g. making it possible for farmers to apply twice for the same farm input.

A third problem for the extension services was the conflict in being an extension-officer trying to create good relationships with farmers on one hand, and on the other hand being a subsidy-officer who has to assess subsidy applications (e.g. rejecting unrealistic bills for the purchase of fertilizer and chemicals, and repeatedly warning farmers not to apply for a larger acreage, for a subsidy on land preparation, than was in fact being cultivated).

(iv) The Delays in Subsidy Payments

Most delays in subsidy payments varied between 6 months and 1 1/2 years.

These belated payments, combined with a high rate of inflation (i.c. 15%) which was already enhancing the time-preference of recipients, probably increased further the income effect of the farm input subsidies.

5.1.2 **Monopoly in Supply of Subsidized Farm Inputs**

Apart from deficiencies in administrative design, the impact of farm input subsidies on utilization can also be reduced by higher farm input prices. Of course, a subsidy induced shift in demand for farm inputs facing an unchanged supply schedule, will always entail rising prices. However, under normal circumstances (more or less full competition) supply will shift as well, which dampens the price increase.

A problem arises when producers of farm inputs (or importing firms of farm inputs from abroad) anticipate the subsidies and form a cartel or when monopoly power already exists.

In such circumstances a large part of the subsidies, in stead of being transferred to farmers, is siphoned off by monopolistic suppliers. The existence of monopoly power can be ascertained by computing Herfindahl's index.[4]

In our case, one of the heaviest subsidized farm inputs, i.c. fertilizer, was locally produced. The computed index for three major categories of fertilizer varied between 0.5 and 1.0 (minimum = 0 and maximum = 1), which does not falsify the existence of monopoly power. The exercise of monopoly power can be ascertained by the computation of Lerner's index.[5]

In our case it was important to investigate if $\frac{(P - MC)}{P}$ or $\frac{(P - AC)}{P}$

(AC are the, easier to compute, average costs which are an approximation for MC assuming constant returns to scale; proof trivial) increased after the imposition of the subsidy program on fertilizer. However, neither MC nor AC could be computed, so we decided to compare the growth rate of retail prices for fertilizer and chemicals with the general inflation rate of approximately 15%.

The following average growth rates for prices were computed (1977-1982).

Price Super Phosphate (heavily subsidized fertilizer)	24%
Price Diathane (heavily subsidized chemical)	25%

The chemical was imported duty-free. Since the growth rate of prices of most other subsidized farm inputs kept pace with or lagged behind the estimated 15%, we tentatively concluded that monopoly power was exercised with respect to fertilizer and chemicals.

5.1.3 Utilization of Farm Inputs and Production

In this section we will evaluate the actual impact on utilization of farm inputs and production levels.

Crop Farming

The ex-post evaluation concerning input utilization was carried

out with simple chi-square tests.(6)
This was possible since we faced a with-without situation with respect to 41% non-participating crop farmers and 59% participating crop farmers. Of course, we could only test the most important subsidies in terms of participation. These were, in order of importance, the subsidies on land preparation, fertilizer and chemicals.

First we tested the existence of a relationship between participation in a farm input subsidy program and utilization of that specific farm input for all crop farmers. The test results are given in table 7 below.

For most cases in table 7 we found no relationship between subsidy and utilization.
Conversely, a strong relationship was found between the subsidy for land preparation and the number of hired labour hours with a tractor.
A weak relation was revealed with chemicals and fertilizers.
The next step in our analysis was the computation of Pearson's ratio for the different categories of participating crop farmers. In the case of vegetable farmers we established a similar, but stronger, relationship to that in table 7 (i.e. hired labour for ploughing and rotavating by tractor, expenditures on fertilizers and chemicals).
No relationship at all could be established for the other categories of crop farmers.
The third step was to see if, within the category of vegetable farmers, regional clusters could be found.
In fact, our trial for one specific vegetable area proved to be the last piece in the puzzle.
The proportions of farmers in this area participating in subsidies on mechanical land preparation, chemicals, fertilizers and spraying equipment were 80%, 83%, 88% en 66% respectively.
The subsidy-minded farmers in this area were also utilizing these farm inputs heavily. Subsequently we subtracted the tables on

Table 7 First Analysis - All Crop Farmers, Relationship Farm Input Subsidies and Utilization Farm Inputs

Tested Subsidy On:	Relationship Measurement:	Pearson's Ratio	χ^2(df,0.90)	χ^2(df,0.995)	Tentative Conclusion
Mech. Land Prep.	Cult. Acreage Wet Season	1.94	6.25	11.34	no relation
Manual Land Prep.	Cult. Acreage Wet Season	0.56	6.25	11.34	no relation
Mech. Land Prep.	Cult. Acreage Dry Season	1.72	6.25	11.34	no relation
Manual Land Prep.	Cult. Acreage Dry Season	0.51	6.25	11.34	no relation
Land Preparation	Hired Labour Tractor	11.67	6.25	11.34	strong relation
Land Preparation	Hired Labour Cutlassing	3.08	6.25	11.34	no relation
Land Preparation	Hired Labour Bed Formation	4.20	6.25	11.34	no relation
Fertilizers	Expenditure Fertilizers	9.23	6.25	11.34	weak relation
Chemicals	Expenditure Weed Killers	6.56	4.61	9.21	weak relation
Chemicals	Expenditure Insecticides	1.95	6.25	11.34	no relation

participation and utilization for this category of subsidy-minded farmers from the corresponding tables for all crop farmers, and computed Pearson's ratio's again.

Apart from the fact that all computed ratio's for all crop farms minus the subsidy-minded farmers declined substantially, the relationships which had previously established also disappeared, namely:

- subsidy on land preparation/hired labour (tractor) : 5.46
- subsidy on fertilizer/expenditure on fertilizers : 5.25
- subsidy on weed killers/expenditure on weed killers : 2.06

Our last step was to investigate if a causal relationship existed between the high degree of participation and the high level of utilization of the inputs for subsidy-minded farmers.

For this purpose answers to the following question were analysed:

(a) If you had not received a subsidy for the inputs you stated (in the previous question), would you have used the same amount of input or less of it?

(b) Which inputs would you use more of if the amount of subsidies were increased?

We were aware that these questions are rather transparent. We therefore expected a bias towards a decreased utilization when the subsidy was decreased, and conversely a bias towards increased utilization when the subsidy was increased.

The findings, however, conflicted with our expectations. It appears that the subsidy-minded farmers hardly would use any less inputs if the subsidies were decreased. Also, the number of subsidy-minded farmers, who would use more farm inputs if the subsidy were increased, was relatively low.

The answers of subsidy-minded farmers to questions (a) en (b) are displayed in table 8.

Table 8 Reaction of Subsidy-Minded Farmers to Increase/Decrease in Farm Input Subsidies

Subsidy on:	Participating Farmers	Increased Subsidies Would Use:		Decreased Subsidies Would Use			
		More Inputs		Less Inputs		The Same Amount	
	No.	No.	%	No.	%	No.	%
Mechanical Land Preparation	33	3	9	3	9	30	91
Chemicals	34	18	53	4	12	30	88
Fertilizers	36	21	58	6	17	30	83
Spraying Equipment	27	2	7	6	22	21	78

Although the hypothesis of a causal relationship between participation and utilization has to be rejected, the findings do show the relative importance of the subsidy on fertilizers as compared to other farm input subsidies.

In addition we computed the ratio's of the answers to the following twin-questions:

(c) Which of the subsidies you receive, do you consider to be most important for maintaining your level of production?

(d) Which of the subsidies you receive, do you consider to be least important?

	('most/least important' ratio)
Subsidy on mechanical land preparation	7/9 = 0.78
Subsidy on chemicals	9/3 = 3.0
Subsidy on fertilizers	15/2 = 7.5
Subsidy on spraying equipment	2/12 = 0.17

Despite the fact that the survey may show that the subsidy on fertilizers may possibly have an impact, we conclude that current farm input subsidy programs for crop farmers have had no impact on the utilization of farm inputs. Private discussions with farmers and extension officers corroborated to this view.

Against the background of the rejection of the hypothesis on the relationship between the participation in farm subsidy programs and the utilization by crop farmers, a test on the impact on production becomes, of course, superfluous.(7)

Apart from this a-priori zero impact, an ex-post evaluation of the impact on production was hampered in any case by the existence of other subsidies.

Dairy Farming

With respect to dairy farmers we noted a close relationship between the input subsidy programs and levels of utilization.

The major input subsidy was the one for concentrate feed. Apart from a few exceptional cases in our survey (administrative pro-

blems in applying for the subsidy) all dairy farmers received this input subsidy. Hence we could not carry out a chi-square analysis.

Nevertheless, we tentatively conclude that there was an over-utilization of concentrate feed because of the subsidies. The first reason is that the ratio kg. concentrate feed/lit. milk was computed at 61% for the high producing and 82% for the low producing farmers (the usual ratio is approximately around 35%). Secondly, the significant negative coefficient for concentrate feed (vide table 4) indicates that utilization has been pursued far beyond optimal levels.

A second important subsidy was the one for pasture improvement. We found a close but perhaps trivial relationship between participation in the subsidy program for pasture establishment (49% of farmers) and acreage under improved pasture.

In answer to the question - if the price of concentrate feed increased by 25 percent per bag, would you:

(e) buy less or the same amount of concentrate feed?

(f) grow more pasture or keep the same acreage of pasture?

42% of the farmers would buy less and 58% would buy the same amount of concentrate feed, and not less than 83% would grow more pasture.

Conclusions concerning the observed relationship between the subsidy on concentrate feed and pasture improvement could be summarized as follows:

(i) substitution - a price increase of 25% in concentrate feed entails an extension in improved pasture on 83% of dairy farms

(ii) elasticities[8] - a reduction of 1% in public expenditure for concentrate feed leads to a 0.14% increase in milk production; and an extension in improved pasture of 1% entails a production increase of 3.16%

(iii) 'most/least important' ratio - 38 dairy farmers considered the subsidy on pasture improvement, 8 considered the subsidy on concentrate feed to be most important.

(iv) public expenditure - from the total input subsidy payments to dairy farmers of 27.400.000 $TT, 27.250.000 $TT was spent on concentrate feed and only 22.900 $TT on pasture improvement.

The exact magnitude of welfare loss from the subsidy on concentrate feed is difficult to ascertain because several distorting effects have to be added to this loss.

First, we are convinced, that the subsidy maintained a large group of inefficient dairy farmers (viz. low calving rates, mastitis). Without the subsidy, a certain proportion of these marginal farmers would possibly have left the industry.

Secondly, in view of the potential substitution vis-a-vis pasture improvement ((i) above) the emphasis on concentrate feed in fact impeded a production increase from pasture improvement. Because, if we keep total expenditure on farm input subsidies unchanged, a minor increase in the ratio (expenditure pasture improvement/expenditure concentrate feed) would enhance milk production.

5.2 The Relevance of Production Functions to Subsidy Analysis

Farm input subsidy programs are generally focussed on farm inputs with a large marginal physical product which are relatively underutilized.

These two properties are often ascertained with the help of production functions. Below, we shall briefly review these typical tools for designing the appropriate farm input subsidy policy. Next, we will discuss the corresponding values for full-time vegetable and root crop farmers and high- and low producing dairy

farmers (vide tables 3 and 4) respectively.

Under normal or undistorted conditions, it is hypothesized that a profit maximizing farmer will allocate his inputs in the following fashion:

$$\max.\ \pi = \sum_{j=1}^{n} P_{qi}\, Q_i - \sum_{j=1}^{m} P_{ij}\, X_{ij} + \lambda(X_k - \bar{X}_k) + \mu\left(\sum_{j=1}^{m} P_{ij} X_{ij} - B\right),$$

where P_{qi} is the price of the i-th product, Q_{ij} ; P_{ij} is the price for the j-th input, X_{ij} , used for the i-th product; λ and μ are Lagrange multipliers, X_k is the short-term physical input contraint (e.g. land, labour) and B is the budget available to the farmer.

In theory, by inverting the coefficient matrix and computing the scalor equation, the n × m + 2 differential equations can be solved, so that the optimal input-output mix can be determined. In reality, where continuous functions rarely exist, an appropriate method that approximates to this equilibrium under constraints is given by e.g. linear programming.

The marginal physical product of a farm input (MPP) is the first derivative of output with respect to an input, hence $\frac{\delta Q_i}{\delta X_{ij}}$

The over- or underutilization of a farm input can be ascertained by the relative marginal value productivities computed at the mean.

This can be obtained as follows. Farm profit is maximized when the marginal profit with respect to a farm input is zero.

$$\text{Hence } \frac{\delta \pi_{ij}}{\delta X_{ij}} = \frac{\delta P_{qi} Q_i}{\delta X_{ij}} - \frac{\delta \sum_{i=1}^{m} P_{xij} X_{ij}}{\delta X_{ij}} = 0$$

$$\text{(without subscripts)} \quad P_q \frac{\delta Q}{\delta X} - P_x = 0$$

$$\frac{\frac{P_x X}{P_q Q}}{\frac{\delta Q}{\delta X}\ \frac{X}{Q}} = \frac{\frac{P_x X}{P_q Q}}{E_X^Q} = 1$$

$P_x X$ and $P_q Q$ are often substituted by their average values, i.e. $\overline{P_x X}$ and $\overline{P_q Q}$.

The degree of over- or under utilization is approximated by solving the ratio for P_x, i.e. the marginal value product (MVP).

The computed value can thus be compared with the actual average input price. If the MVP exceeds $\overline{P}_x$ then the farm input is under-utilized; conversely, if $\overline{P}_x$ exceeds MVP then the input is over-utilized.

Of course, the application of this rule of thumb is highly contingent upon the reliability of the production function estimates.

One reason why some caution must be exercised in the use of single-equation production functions for subsidy analysis is the existence of simultaneous equation bias. This bias relates to the mutual interdependencies within the farm input matrix, and between inputs and outputs. Theoretically, a production function model would be better described by a system of simultaneous equations, each representing a different causal relationship. Again, the data requirements of such a model prevent its wide application.

Mainly for this reason single-equation production functions have often been used, implicitly based on the hope that the estimated elasticities are not greatly biased.

One great advantage of the normalized restricted profit function approach is that these mutual inter-dependencies rarely exist. For the variation in profit is solely explained by the variations in input prices and fixed assets (vide table 5).

A drawback is, that this approach which is statistically more efficient cannot be applied when most farmers face similar input-

and output prices.

In this respect it is interesting to observe with respect to full-time vegetable farms the differences between indirect production elasticities from the normalized restricted profit function approach and the direct elasticities from the estimated single-equation production function.

Table 9	Indirect Estimates (table 5)	Direct Estimates (table 3)
Prod. Elasticities:		
Fertilizer	0.048	0.62
Seed	0.009	0.53
Equipment	0.22	2.48

Intuitively, the smaller indirectly estimated elasticities will correspond more closely to reality than the direct estimates. Nevertheless, the signs as well as the relative magnitudes do match.

We think that the direct estimates are overstated here due to a neglect of positive cross-elasticities of farm inputs in the single-equation production function.

In table 10 we have depicted the marginal physical product and the marginal value product. The figures in table 10 also seem to suggest that the computation of the two yard-sticks, MPP and MVP, better are based on profit- and input demand functions than on production functions.

Since the average price for a bag of fertilizer amounts to 50 $TT, the MVP of 93 indicates under-utilization of this farm input.

Conversely, for seed we observed an average price of 100 $TT, which implies over-utilization when compared with a MVP of 83. Over-utilization is also confirmed by the negative MPP's for chemicals and concentrate feed. As for chemicals, we conclude that subsidization of this farm input may even have aggravated the externalities from this input use, i.e. pollution of surface

waters and residuary chemicals on purchased vegetables.

Table 10 Marginal Physical Products and Marginal Value Products

Type of Production	Marginal Physical Product (Lbs, lit)		Marginal Value Product ($TT)	
	NRPF[10]	SEPF[11]	NRPF[10]	SEPF[11]
Full-Time Vegetable Production				
hired labour		-3.04		
fertilizer	1.86	23.99	93	1201
chemicals		-4.45		
seed	0.83	48.55	83	489
Full-Time Root Crop Production				
hired labour		3.76		272
fertilizer		14.09		704
chemicals		-9.00		
acreage		7.21		3288
Dairy production (High)				
calving rate		35.13		
improved pasture		1025.02		18150
concentrate feed		-0.48		
Dairy Production (Low)				
calving rate		58.03		
farmer's own labour		27.50		697
fencing		21.23		

However, we repeat, no causal relationship could be established between subsidy and utilization up to this point.
Further we note in table 10 a much higher MVP for improved pasture than for land for root crop farming.
To conclude the ex-ante analysis based on estimated elasticities, potential scope for subsidization seems to exist only with regard to fertilizer and improved pasture. Scope for extension and education concerning dairy farm management is confirmed by the computed MPP's for calving rates.

5.3 Ex-Ante Analysis of a Subsidy on Fertilizer

Even if we exclude the problems of administrative design and labour distortions, part of a fertilizer subsidy for full-time vegetable farmers will still be siphoned off by monopolistic suppliers. We shall demonstrate below how a partial equilibrium framework may provide a practical basis for appraisal of these monopoly effects.
We computed the following elasticities from the estimated coefficient for fertilizer in the input demand function:

- price elasticity of demand for fertilizer with respect to vegetables - 1.048
- own price elasticity of vegetable supply 0.057
- production elasticity of vegetables with respect to fertilizer 0.046[12]

The other assumptions concerning parameters and data stem from our survey results as well as from secondary data collection. They are summarized in table 11.

Our partial equilibrium analysis applies only to full-time vegetable farmers. This is because, for the category of part-time farmers, we assume no potential impact on utilization and production.

Table 11 Assumptions for the Partial Welfare Analysis of a Fertilizer Subsidy to Vegetable Farmers

Total no. of vegetable farmers	3200
No. of full-time vegetable farmers	980
Total value vegetable production	38 604800 $TT
Value full-time vegetable production	21 400000 $TT
Fertilizer consumption on all vegetable farms	1 500000 lbs
Fertilizer consumption on full-time vegetable farms	1 100000 lbs
Ex-ante price of 100 lbs fertilizer (Super Phosphate)	50 $TT
Price incidence of monopoly power in fertilizer supply	10 %
Fertilizer subsidy to vegetable farmers	30 %

A fertilizer subsidy to part-time farmers probably has only an income effect. Furthermore, the exercise of monopoly power will in fact raise this income subsidy. In stead of 60000 $TT (i.c. 0.3 x 400000 x 50 $TT/100 lbs) part-time vegetable farmers will receive 66000 $TT (i.c. 0.3 x 400000 x 55 $TT/lbs). This amounts per part-time farm household to respectively: 27 $TT and 30 $TT. The net income effect will be 18 $TT and 21 $TT. In section 3.4 where we discussed the partial equilibrium effects of an input subsidy the world supply curve of fertilizer was completely elastic.

Conversely, in our case the subsidy only applies to locally produced fertilizer. Therefore, the slope of the monopolistic supply curve bends upwards.(13)

Based on the estimated elasticities, we assume that a subsidy of 15 $TT per bag (in figure 23: $P_{x_1} - P_{x_2}$) would increase demand from 1 100000 lbs to 1 445840 lbs.

In figure 23 this has been depicted by parallel demand shift from A to C.

However, since supply is not completely elastic a new equilibrium will be achieved at B. $P_{x_3} - P_{x_1}$ is the incidence of monopoly power, which equals 5 $TT/bag.

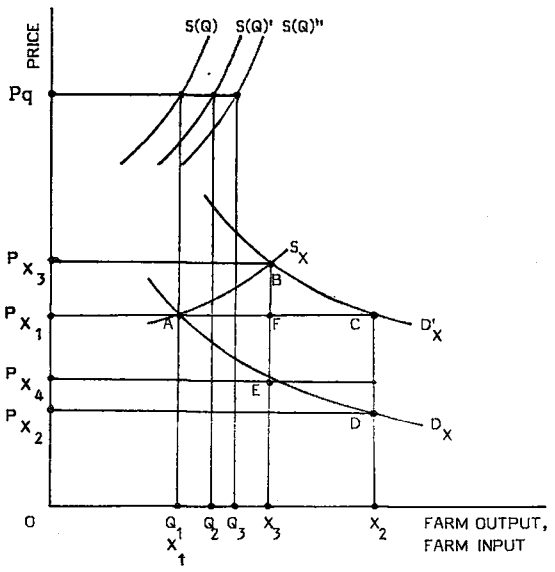


Figure 23 Farm Input Subsidy and Monopoly in Farm Input Supply

At B the farmers pay 55 $TT/bag and receive 16.5 $TT ($P_{X_3} - P_{X_4}$) afterwards from the government. The quantity of fertilizers at B is X_3, i.c. 1365144 lbs. Based on the estimated production elasticity with respect to fertilizer and assuming no monopoly, the subsidy would increase production to Q_3. The corresponding value of this production increase is 309495 $TT. The exercise of monopoly power reduces somewhat this potential production increase. This time the increase is only $Q_2 - Q_1$, i.c. 237280 $TT.

With reference to section 3.4.1., the impact of monopoly power on the 5 distinquished welfare effects from a fertilizer subsidy can now be quantified.

1. **The Impact of Monopoly on Direct Government Cost**

The direct government cost ex-monopoly is represented by the area $P_{x_1} P_{x_2}$ DC, i.c. 216876 $TT.
Cum-monopoly we have: $P_{x_3} P_{x_4}$ EB, i.c. 225249 $TT.
The exercise of monopoly power, therefore, increases direct government cost by 8373 $TT, that is 4%.

2. **The Impact of Monopoly on Farmer's Surplus**

Farmer's surplus would be represented ex-monopoly by the area above the shifted supply curve S(Q)" and under the world market price P_q.
Assuming a parallel supply shift, the ex-monopoly increase is farmer's surplus is therefore $\frac{1}{0.057}$ (309495 $TT) = 292805 $TT.

Conversely, the cum-monopoly increase in farmer's surplus amounts to $\frac{1}{0.057}$ (237280 $TT) = 224484 $TT.

The exercise of monopoly power reduces welfare to farmers by 68321 $TT, which is 23%.

3. **The Impact of Monopoly on Resources used in Additional Production**

The ex-monopoly increase in resources for additional production is on the one hand represented by the area under S(Q)" from Q_1 to Q_3 and on the other hand by X_1X_2 CA.

Hence: $\frac{1}{1 + \frac{1}{0.057}}$ (309495 $TT) + 172920 $TT = 189333 $TT.

The cum-monopoly increase in used resources is:

$$\frac{1}{1 + \frac{1}{0.057}} (237280\ \$TT) + \frac{1}{2} (P_{x_3} + P_{x_1}) (X_3 - X_1) = 151784\ \$TT.$$

Apparently, under monopoly, 20% less resources will be used.

4. The Increase in Monopoly Surplus

Here we have the extra profit to the monopolistic supplier of the subsidized fertilizer. This monopoly profit is represented by the area P_{x_3} P_{x_1} AB, which can be approximated by

$1/2\ (X_1 + X_3)\ (P_{x_3} - P_{x_1}) = 61629$ \$TT.

5. The Impact of Monopoly on Foreign Exchange Savings

When the government subsidizes locally produced fertilizers as well as imported fertilizers, the situation is similar to the one we displayed in figure 20.(14)

Assuming that P_{x_1} is the world market price, the change in foreign exchange savings ex-monopoly is represented by the difference between the areas $P_q(Q_3-Q_1)$ and $X_1 X_2$ CA.

Hence: 309495 \$TT - 172920 \$TT = 136575 \$TT.

Cum-monopoly the change is only represented by

$P_q(Q_2-Q_1) = 237280$ \$TT.

To conclude, the exercise (and public protection) of monopoly power in the supply of subsidized farm input entails the following three major welfare effects: it decreases farmer's welfare, it enhances direct government cost, and it saves foreign exchange. The shadow price, however, of saving foreign exchange by subsidizing local fertilizer only is relatively high. This can easily be shown by computing the relevant cost/benefit ratio's for either approach, viz. cum- and ex-monopoly.

Cost/Benefit Ratio's	Cum-Monopoly	Ex-Monopoly
$(C/B)_{FE}$ (15)	2.05	1.98
$(C/B)_{D}$ (16)	1.00	1.35

These findings also illustrate our discussion about the distorting effects of subsidies (vide section 3.1.1). For we have shown here how the reaction of a monopolistic supplier of fertilizer to an indirect subsidy decreased the impact of a direct subsidy to the farmers.

Conversely, if we assume in the case of a fertilizer subsidy ex-monopoly a shift in local fertilizer supply, e.g. from A to F (which is not unlikely to happen in the longer run), $(C/B)_{FE}$ would then amount to:

$$\frac{\text{change farmer's surplus} + P_q(Q_3-Q_1) - X_3X_2CF}{\text{direct government cost}} = 2.59.$$

This time, the welfare gains, as compared to the situation of subsidy cum-monopoly, are three-fold. For, now the foreign exchange savings from reduced vegetable imports largely exceed the losses from imported fertilizer, viz.:

309495 $TT - 40348 $TT = 269147 $TT.

NOTES

1. I.e. herbicides, insecticides, fungicides, nematicides, and acaricides.
2. However, we do not wish to deny the existence of a possible substitution between e.g. fertilizer and labour under undistorted conditions.
3. The average calving rate for high producers was 56 and for low producers 40. Even in suboptimal weather conditions, as in Trinidad, this rate should be at least 70.
4. Herfindahl, O.C., 'Concentration in the Steel Industry', Colombia University 1950. The formula is $H_t^a = \sum_{j=1}^{n} s_{it}^2$ where s_i is the relative share of the ith firm in the industry's output. This index, like the Gini-coefficient, measures a degree of concentration. It may demonstrate the existence of monopoly power but not necessarily the exercise of it.
5. Lerner, A.P., 'The Concept of Monopoly and The Measurement of Monopoly Power' Review of Economic Studies, Vol. 1, No. 3, 1933 - '34.
   The formula of this well known index is $\frac{P-MC}{P}$, where P is the average cost price of the product, and MC the marginal unit cost of the product.
   Under equilibrium this index equals $-\frac{1}{E}$, or minus the price flexibility of demand.
   (Viz. $MC = \frac{dC}{dq} \simeq \frac{d(pq)}{dq} \rightarrow \frac{P-MC}{P} = \frac{P - \frac{d(pq)}{dq}}{P} = \frac{-q\,dp}{p\,dq} = -\frac{1}{E}$)
6. Pearson's chi-square test was used to verify if the observed frequencies in a distribution table differed significantly from an expected frequency distribution (i.e. total independence between two sets of variables).
   The decision rule we applied was: no relation (participation on the one hand, and utilization/production on the other hand) if the computed ratio from the tables did not exceed the X^2- value according to the X^2- distribution.
7. Indeed, the computed Pearsons' ratios were insignificant.

8. Since farm inputs are not predetermined with respect to farm output, but due to various interdependencies, the derived elasticities are statistically not quite consistent.
   The signs and relative magnitude of the derived elasticities, however, may keep their analytical value (vide next section).
9. Only with respect to the significant coefficients (vide tables 3, 4 and 5).
10. Based on the normalized restricted profit function approach; significant coefficients only (hence, in our case, from the input demand functions).
11. Based on the single-equation production function, significant coefficients only.
12. Vide appendix 1.
13. In our case we had over-capacity in the fertilizer plant, so we assumed no shift in fertilizer supply.
14. Except for the shift in local fertilizer supply. In our case domestic production remains unchanged.
15. $(C/B)_{FE} = \frac{\text{change farmers' surplus + foreign exchange savings}}{\text{direct government cost}}$
16. $(C/B)_{D} = \frac{\text{change farmers' surplus}}{\text{direct government cost}}$

CHAPTER 6

ECONOMIC ANALYSIS OF FARM OUTPUT SUBSIDY PROGRAMS

The first section of this chapter contains a brief ex-post analysis of four guaranteed price systems.

The source of farm income variation for temporary crops is analysed in the second section. Here we applied the same method as in section 3.3.2.2.

In the third and last section we shall discuss the principal problem of Part Two, viz. how to restore the terms of trade for agriculture by means of agricultural subsidies.

6.1 Ex-Post Analysis of Farm Output Subsidy Programs

We stated earlier that many developing countries may lack the necessary administrative framework to implement price support measures efficiently. The brief ex-post analysis clearly demonstrates that the program implementation described in our study forms no exception in this respect.

6.1.1 Administrative Design

The deficiency payments for perennial crops, i.c. the difference between the guaranteed price and the world market price, were paid to the relevant growers' associations.
These growers' associations used to pay an interim price to the farmers until the (belated) political decision on the annual guaranteed price level was taken. After the decision the farmers were paid the full guaranteed price.

Copra

The guaranteed price system for copra farmers was first installed in 1975.
The next decision came two years later, i.c. in 1977, so that in 1976 the same price was paid as in 1975.
In 1978 and 1979 there was no guaranteed price.
Conversely, in 1980 and 1981 new guaranteed prices were installed. Subsequently, no political decision was made in the following two years, 1982 and 1983.

Cocoa and Coffee

Guaranteed prices for cocoa and coffee were installed in 1981. The full amount, however, was only paid in that year and not in the following years, 1982 and 1983.
An interim price was paid by the grower's association in 1982 and 1983. This price varied around 50% of the 1981 price.

Dairy Farming

For dairy farming, the deficiency payments were made to a dairy factory. The factory was practically the sole buyer of fresh milk, because more than 85% of dairy farmers sold their milk to this one factory.

The guaranteed price system for milk came on stream in 1973. No price decisions were made in 1976, 1978, 1979 , 1982 and 1983. In these years the factory paid the same price to farmers as in the year before.

In table A where the annual prices and production volumes are given for the period 1970 - 1981, the actual guaranteed prices are marked with an asterix.

Of course, the rather irregular deficiency payments did not much reduce the price insecurity of the farmers.
The major impediment to a smooth operation of guaranteed price systems was again, in our opinion, the absence of clear policy formulation. It was for instance not clear, whether the policy was meant to support farm incomes or it was a genuine attempt to reduce farm labour distortion. This political inconsistency probably lead to the serious time delays in establishing the level of guaranteed prices.
When a political agreement on the pricing was finally reached, administrative procedures concerning the actual payments resulted in further delays.

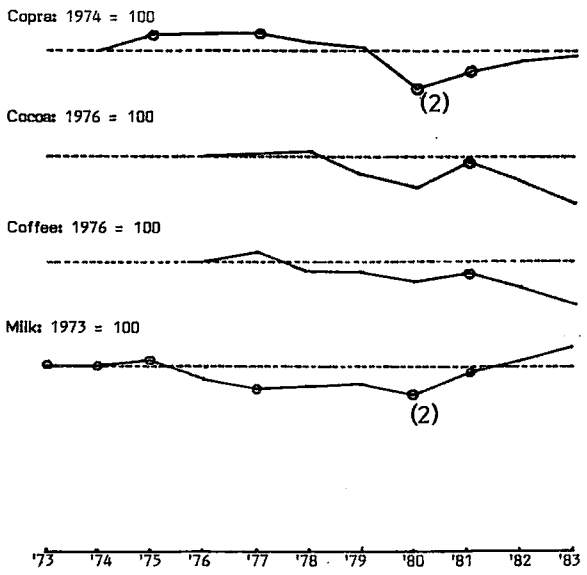
Our point is that the time preference of farmers for subsidy payments should not be underestimated. A cost reduction from a lower guaranteed price that is belatedly established, will be largely overshadowed by a decreased impact on production. Also, it is probably more efficient to pay a relatively low price within a month than a relatively high price after a year.

6.1.2 Actual Production Response to Guaranteed Price Systems

We did not possess a sufficient number of observations to falsify, for instance, hypotheses on turning points in production trends or on reduction in price variations.
However, from background information on the actual implementation of guaranteed price systems, the survey results, and the price and production figures in table A, we were able to infer sufficient circumstantial evidence to confirm a potential positive responce to an agricultural price policy.
The relevant time-spans to be analysed are for
copra : 1974-1983; cocoa: 1976-1983 [1]; coffee: 1976-1983 [1]
and milk: 1973-1983.
For the analysis of annual production figures we do not include the years prior to 1973, because in 1973, i.c. the first year

of the oil-boom, farm labour began to migrate in substantial numbers to urban areas. This migration, as can be seen by the annual production figures, brought about a significant decrease in production levels of perennial crop farms and dairy farms.
As expected, this sharp decrease in production levels is not shown by the figures concerning temporary cropfarming (vide table *B*).

The reason is, as we discussed in chapter 4, that the small-scale temporary crop farms were less dependent on hired labour than the large perennial crop farms and dairy farms.
In graph 1 we have given the annual production figures for the four distinquished categories of farm production.



Graph 1. Annual Production Figures and Guaranteed Prices

The guaranteed-price years[3] have been depicted by the encircled indices. Although the number of observations is rather small, in most cases we do observe a positive influence on the production trend.
For the years where the (guaranteed) price increases amounted to more than 50% (copra : 1975 and 1981; milk : 1980) the turning points in production trends are more clearly demonstrated.
Returning to the survey observations on farm level, the following can be noted.
Perennial crop farmers as well as dairy farmers stated that the guaranteed price level was not high enough to enable them to hire more farm labour.

The actual production responses to guaranteed prices merely consisted of an extra effort in improving the harvesting practices and in reducing post-harvest losses. In the questionnaire we included several questions concerning changes in farming practices. We were anxious to find out if price increases would entail longer-term production responses by a deliberate attempt to improve, inter alia, weeding-, pest/disease control-, pruning- and other pre-harvesting practices. Unfortunately, this was not the case.
The majority of farmers claimed in fact to be reluctant to invest their time in an improvement of pre-harvesting practices because of insecurity with regard to a continuation of the guaranteed price systems.

6.2 Analysing Variations in Agricultural Production Value into a Market and a Production Component

We argued earlier that, in a normal situation without major food shortages or market distortions, it was not certain if variations in farm output prices would always decrease welfare. The gains from price variations because of profit maximizing behaviour by farmers could very well exceed consumer's losses

if any (vide section 3.3.2.1).

However, in our case, we do not have a normal or undistorted situation. Most of the farm production is in fact distorted. Output prices appear to be too low to bribe more part-time farmers to the full-time job.

It is evident that a price variation around a relatively low average will differ considerably from a price variation around a 'normal' average.

In section 3.3.2.2 we showed that the variation in production value can be analysed into a price component and a production component. Further, we assumed that the impact of price stabilization measures is proportional to the size of the price component.

According to the sample results, the proportions of production costs as well as of marketed surpluses did not vary too much over different farm sizes, nor did they fluctuate widely over the various regions.

The analysis into the variation of production value may thus also serve as an analysis into the variation of farm incomes. The analysis is not relevant, however, to production values of copra, cocoa, coffee and milk. The reason is, that the guaranteed price systems for these four categories of farm production in fact reduced much of the annual price variations. Moreover, we would also have to leave out the period up to 1973, which would reduce the number of observations too much. Conversely, the analysis could be quite meaningful with respect to temporary crops. Here we faced neither guaranteed prices nor severe discontinuities in farm production conditions.

The results of the analysis with regard to two different vegetables and rootcrops are depicted in table 12.

Table 12 Direct Effects of Production and Price Variation concerning Vegetables and Root Crops (vide table B)

Tomatoes (1970-1981):

linear trend tomato prices: $P_t = -470.15 + \underset{(58.37)}{442.20}\ t$ $(R^2 = 0.85)$

after trend elimination: $R_p = 0.614$ $R_y = 0.386$ $R_{py} = -0.662$

Cabbages (1970-1982):

linear trend cabbage prices: $P_t = 37.42 + \underset{(31.65)}{201.29}\ t$ $(R^2 = 0.80)$

after trend elimination: $R_p = 0.615$ $R_y = 0.385$ $R_{py} = -0.423$

Sweet Potatoes (1970-1981):

linear trend sweet pot.prices: $P_t = -33.27 + \underset{(17.27)}{151.12}\ t$ $(R^2 = 0.88)$

after trend elimination: $R_p = 0.408$ $R_y = 0.592$ $R_{py} = -0.526$

Dasheen (1970-1981):

linear trend dasheen prices: $P_t = -253.79 + \underset{(19.71)}{156.22}\ t$ $(R^2 = 0.86)$

after trend elimination: $R_p = 0.919$ $R_y = 0.081$ $R_{py} = -0.431$

The estimated direct effects of the price fluctuation, i.c. R_p, indicate that except for sweet potatoes, more than 50 percent of the variability in farm income can be attributed to price variations.

The linear interaction term, i.c. R_{py}, was negative in all four cases, indicating that price and production interactions have tended to reduce the variance in total production value.

The results of our analysis provide some support for an agricultural price stabilization policy with respect to seasonal crops. It is important that a reduction of annual price variations should stabilize farm income as well.

As has been shown in chapter 4, the main reason for the low aggregate domestic production value (and hence of a high food

import bill) of temporary crops is the existence of a serious distortion with respect to the farmer's own labour input.
A more stabilized farm income may indeed bribe more part-time temporary crop farmers to the full-time job.
Of course, we are aware of the fact that it is easier to state the desirability of a price stabilization program than to implement one. In particular with regard to seasonal crops, which are often highly perishable, a price stabilization program may encounter many problems. Viz., inter alia:
- the lack of quality standards and quality control
- the need for cool storage facilities
- the need for transport facilities.

A possible approach could be to start a program of e.g. buffer stocks with respect to one temporary crop only.
Again, the relatively high initial costs may be overshadowed by long term benefits from the learning process.
When the program operates will it may be extended to the next crop, etc.

6.3 Ex-Ante Analysis of Anti-Distortive Farm Output Subsidies

Below we will attempt to show how the agricultural terms of trade can be improved with the help of farm output subsidies.
We stated earlier (vide section 2.1) that, theoretically, the best policy of dealing with a factor distortion would be a factor tax-cum-subsidy.
However, in our case (and presumably in most cases) direct subsidization of farm labour will be extremely difficult to implement.(4)
In this section we shall analyse the partial welfare effects of a guaranteed price system when agriculture suffers from serious labour distortion.
First we introduce our theoretical conceptualization of an anti-distortive guaranteed threshold price.

Secondly, based on this concept, the partial welfare effects will be estimated for copra-, cocoa-, coffee- and milk-production.

6.3.1 The Concept of an Anti-Distortive Guaranteed Threshold Price

A guaranteed price can bribe a part-time farmer to take a full-time job and further enable him to hire more labour.
When labour restriction has been removed, idle land and other farm inputs can be employed more efficiently. This increased efficiency will push the production possibility curve to higher levels (vide figure 24).
Of course, we realize that substantial labour distortion may require a quite expensive guaranteed price program.
However, for two reasons such an expensive anti-distortive guaranteed price system may be economical in the long run. Firstly, costs and benefits of anti-distortive guaranteed price programs do not only consist of public cash payments and costs of administrative services on the one hand and increased farmer's surplus and increased foreign exchange savings on the other. On the contrary. We also have to take into account the long-term general equilibrium effects.

To a large extent a government by implementing such a system, invests in a learning process entailing important real and pecuniary economies of scale. The former applies, in the first instance, to the cumulative effect on the farmer's skills in allocating capital and labour on his farm (with the multiplying effects we mentioned earlier in section 3.1.1.2).

Secondly, as argued below, we are convinced, that, when a guaranteed price reaches a so-called distortion threshold, production levels will increase at an accelerated rate.

In figure 24 we have tried to demonstrate our point with the help of the neo-classical toolkit.

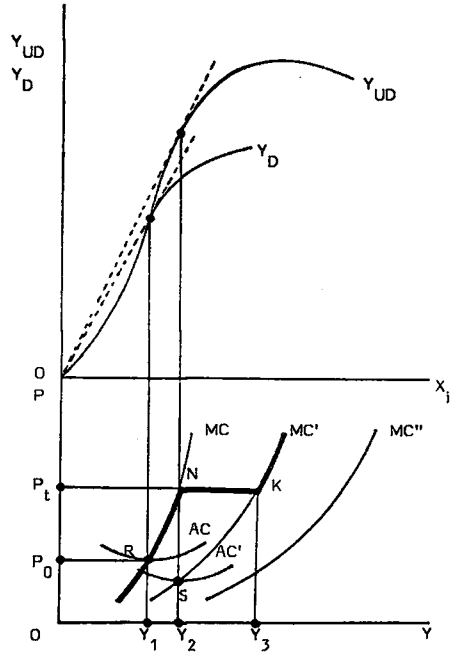


Figure 24. Effects of an Anti-Distortive Guaranteed Threshold Price

We depicted in the upper graph two production curves, $Y_D = f(X_i)_D$ and $Y_{UD} = f(X_i)_{UD}$, the distorted production function and the undistorted production function respectively.

MC (marginal costs), above AC (average costs), is the short term supply curve of the distorted production.
Suppose a guaranteed price drives supply up to N where Y_2 will be offered. The profit made at this price P_t enables farmers to purchase more of the expensive production factor X_k.

In our case, this implies:
1) to exceed the opportunity costs of the farmers own labour
2) to be able to pay the high wage of farm labour.

The use of more X_k pushes the production function upwards to Y_{UD} which causes an increase in supply from Y_2 to Y_3. A further price increase will enhance production at a higher rate since MC' is more elastic than MC due to improved efficiency (vide section 3.4.1).
To conclude, a guaranteed price that equals or exceeds the threshold price P_t will bring about two effects:
1) an almost immediate production increase from Y_2 to Y_3 (very high elasticity of supply in the range NK)
2) an increased elasticity of supply beyond K (MC' as compared to MC).

In the longer run the multiplying effects we mentioned above will result in a supply-shift from MC' to MC''.

6.3.2 Partial Equilibrium Effects of a Guaranteed Threshold Price System

6.3.2.1 Methodology and Assumptions

The methodology can best be introduced with the help of an illustration of the partial equilibrium framework. This has been depicted in figure 25. We repeat, our intended ex-ante analysis does not take in to account the many general equilibrium implications we described in section 3.1.1.2.
The approach may provide to the policy maker only an initial insight into the possible effects of a successful anti-distortive

price policy.

Our assumptions are rather optimistic in the sense that the analysis presumes, inter alia, an efficient administrative system with prompt payments to farmers as well as an economically efficient response by farmers.

As can easily be seen, figure 25 is similar to the lower graph in figure 24.

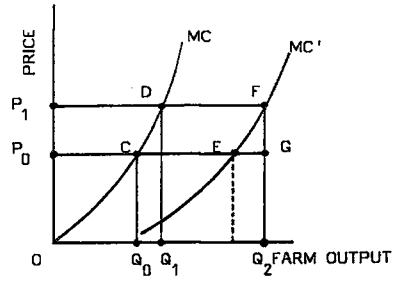


Figure 25. The Threshold Price Concept in a Partial Equilibrium Framework

As far as quantification of our threshold price concept is concerned, three crucial elements to the analysis have to be estimated first, viz.:

(i) the current price-elasticity of supply
(ii) the cost incidence of farm labour distortion
(iii) the production incidence of farm labour distortion.

(i) The Current Price-Elasticity of Supply

For the approximation of the current supply elasticities we used the yearly data from 1973 onwards (vide table A).

To the actual computation we applied two further restrictions. First, we took into account only subsequent years exhibiting both a price and a production increase.

A second restriction concerns the a-priori knowledge of farmers with regard to the price. From discussions with farmers we learnt that in some years they were in fact unaware of the price to be paid. We decided to exclude these years as well. The remaining price and production data were substituted in the following formula:

$$\frac{\log Q_1 - \log Q_0}{\log P_1 - \log P_0}$$ (vide fig. 25)[5]

The partial welfare effects concerning each category of agricultural production are estimated for the lowest and the highest computed elasticity, viz.:

copra : 0.33 and 0.43
cocoa : 0.08 and 1.53
coffee : 0.26 and 0.90
milk : 0.26 and 1.57

(ii) The Cost Incidence of Farm Labour Distortion

The cost-incidence of farm labour distortion is represented in figure 25 by the area Q_0Q_1DC. Q_0Q_1DC equals the additional costs of production necessary to increase supply from Q_0 to Q_1.

At this point the threshold price P_1 is paid and supply becomes completely elastic untill Q_2 is reached.

From the survey results we know the average current expenditure on hired farm labour and equipment, i.e. the area OQ_0C.

The labour- and equipment costs with respect to undistorted farm production are respectively approximated by low and high world averages[6], i.e. the area OQ_1D.

The distorted and undistorted cost estimates together with the respective yield estimates are depicted in table 13.

Table 13 Yield- and Cost of Production Estimates under Distorted and Undistorted Conditions

	Average Survey Results		Undistorted World Averages	
			Low	High
Copra				
yield lbs/acre	178		1500	2500
acreage	13			
equipment ($TT)	4687		10000	20000
farm labour (mhrs/acre)	15		50	100
no. of farmers	7000			
Cocoa				
yield (lbs/acre)	374		800	1500
acreage	11			
equipment ($TT)	2971		10000	20000
farm labour (mhrs/acre)	14		50	100
no. of farmers	2000			
Coffee				
yield (lbs/acre)	102		1000	2000
acreage	6			
equipment ($TT)	5421		10000	20000
farm labour (mhrs/acre)	2		50	100
no. of farmers	4000			
Milk	high producers	low producers		
yield (kg/cow)	3448	2334	3000	6000
cows	12.5	7.8		
machinery ($TT)	20754	4500	idem	idem
acreage	12.2	9.1		
farm labour (mhrs/10 cows)	0	0	100	200
no. of farmers	80	250		

The level of the guaranteed threshold price can now be computed from the following identities:

$$Q = CP^{e_1},$$

$$OQ_0C = \frac{1}{1 + \frac{1}{e_1}} P_0Q_0 \text{ and}$$

$$OQ_1D = \frac{1}{1 + \frac{1}{e_1}} P_1Q_1 .$$

It follows that $\frac{P_1}{P_0} = \left[\frac{Q_1}{Q_0}\right]^{\frac{1}{e_1}} \longrightarrow \frac{P_1Q_1}{P_0Q_0} = \left[\frac{Q_1}{Q_0}\right]^{1+\frac{1}{e_1}}$.

Therefore, $\frac{P_1}{P_0}$ can be approximated by

$$\left[\frac{OQ_1D}{OQ_0C}\right]^{\frac{\frac{1}{e_1}}{1 + \frac{1}{e_1}}}$$

It is important to note that the geometric representation of a partial equilibrium framework like figure 25 does not apply to absolute measures of costs and production as given in table 13.

For, although $P_0 Q_0$ could be found directly from the survey results, $P_1 Q_1$ was unknown to us. The areas OQ_0C and OQ_1D do not equal the sum of costs of farm labour and equipment, but we assumed for the sensivity analysis that they would possess a similar proportional relationship with these costs.

Further, we assumed that 200 manhours equal 30.000 $TT (i.c. 20% higher than an annual industrial salary because of a presumed social preference for industrial work).

P_0 equals the 1983 world market price, except for milk where we maintain the 1981- guaranteed price. The elasticity with respect to MC´ is estimated at 1.5 MC.

(iii) The Production Incidence of Farm Labour Distortion

The production incidence is the difference between undistorted world yield averages and the average yields according to the survey results.
In figure 25 this is depicted by the distance $Q_2 - Q_0$.

6.3.2.2 Sensitivity Analysis

The sensitiviy analysis contains four options for each category of agricultural production, viz,:

A. e_1 = low , low undistorted world yield average
B. e_1 = low , high " "
C. e_1 = high , low " "
D. e_1 = high , high " "

With respect to each of these four options the following six elements are computed, viz.:

(1) $(\frac{P_1}{P_0} - 1) \times 100\%$ - the necessary price increase to reach the guaranteed threshold price

(2) Direct Government Cost ($TT) - the deficiency payments measured at the undistorted production levels, i.e. $P_1 P_0 GF$

(3) Change in Farmer's Surplus ($TT) - $P_1 P_0 EF$

(4) Change in Foreign Exchange Savings ($TT) - Q_0Q_2GC

(5) Cost/Benefit Ratio (i) - (4) / (2)

(6) Cost/Benefit Ratio (ii) - (3) / (2)

Copra (P_0 = 0.53 $TT/lb)

	A e_1 = 0.33 1500 lbs/acre	B e_1 = 0.33 2500 lbs/acre	C e_1 = 0.43 1500 lbs/acre	D e_1 = 0.43 2500 lbs/acre
(1) P_1/P_0 (%)	138	301	125	264
(2) Direct Gov. Cost (mil $TT)	100	362	90	318
(3) Farmer's Surplus (mil $TT)	82	272	72	228
(4) Foreign Exchange (mil $TT)	64	112	64	112
(5) C/B (i)	0.64	0.31	0.71	0.35
(6) C/B (ii)	0.82	0.90	0.80	0.72

Cocoa (P_0 = 2.29 $TT/lb).

	A e_1 = 0.08 800 lbs/acre	B e_1 = 0.08 1500 lbs/acre	C e_1 = 1.53 800 lbs/acre	D e_1 = 1.53 1500 lbs/acre
(1) P_1/P_0 (%)	223	514	65	116
(2) Direct Gov. Cost (mil $TT)	90	388	26	88
(3) Farmer's Surplus (mil $TT)	84	350	17	75
(4) Foreign Exchange (mil $TT)	22	57	22	57
(5) C/B (i)	0.24	0.15	0.85	0.65
(6) C/B (ii)	0.93	0.90	0.65	0.85

Coffee (P_0 = 3.05 $TT/lb)

	A e_1 = 0.26 1000 lbs/acre	B e_1 = 0.26 2000 lbs/acre	C e_1 = 0.90 1000 lbs/acre	D e_1 = 0.90 2000 lbs/acre
(1) P_1/P_0 (%)	401	768	191	319
(2) Direct Gov. Cost (mil $TT)	293	1124	140	467
(3) Farmer's Surplus (mil $TT)	225	804	99	267
(4) Foreign Exchange (mil $TT)	66	139	66	139
(5) C/B (i)	0.23	0.12	0.47	0.30
(6) C/B (ii)	0.77	0.72	0.71	0.57

Milk (P_0 = 1.47 $TT/kg)

	A e_1 = 0.26 3000 kg/cow	B e_1 = 0.26 6000 kg/cow	C e_1 = 1.57 3000 kg/cow	D e_1 = 1.57 6000 kg/cow
High Producers				
(1) P_1/P_0 (%)		127		49
(2) Direct Gov. Cost (mil $TT)		11.2		4.4
(3) Farmer's Surplus (mil $TT)		9.7		3.0
(4) Foreign Exchange (mil $TT)		3.8		3.8
(5) C/B (i)		0.34		0.86
(6) C/B (ii)		0.87		0.68
Low Producers				
(1) P_1/P_0 (%)	176	325	65	103
(2) Direct Gov. Cost (mil $TT)	15.2	56.0	5.6	35.2
(3) Farmer's Surplus (mil $TT)	12.7	43.9	3.6	18.9
(4) Foreign Exchange (mil $TT)	1.9	10.5	1.9	10.5
(5) C/B (i)	0.13	0.19	0.34	0.30
(6) C/B (ii)	0.84	0.78	0.64	0.54

From the sensitivity analysis, based on variation in both the magnitude of the labour distortion and the magnitude of the elasticity of supply, two general conclusions may be inferred. First, a combination of low elasticity of supply with large labour distortion requires an extremely high threshold price.

This is demonstrated by the cases of copra B, cocoa B, coffee and milk B (low producers).

Conversely, the lowest threshold prices are found for all C cases, i.e. a combination of high initial elasticity of supply and relatively little labour distortion.

Secondly, the cost/benefit ratios are almost solely determined by the magnitude of the elasticities of supply.

For, in all cases we note that a higher elasticity entails larger foreign exchange savings as compared to direct government cost, i.e. C/B (i).

Accordingly we note that a lower elasticity increases the direct benefit to the farmers. This is because the lower elasticity enhances the ratio $\frac{P_1P_0E^{\cdot}F}{P_1P_0G\,F}$, i.e. C/B (ii).

In terms of financial efficiency, hence C/B (i), and accepting only more realistic lower supply elasticities (i.e. the cases A and B), the four categories of guaranteed threshold price systems can be ranked in the following order:

1. copra
2. milk
3. cocoa
4. coffee

The figures from the relevant sensitivity analyses speak for themselves. In a more dynamic context, however, it will be clear that when the world market price P_0 exhibits a declining trend this will depress C/B (i) accordingly.

The same will be true, mutatis mutandis, for an increasing world market price.

NOTES

1. 1975 is not included with respect to cocoa and coffee due to its extreme beneficial climatical conditions.
2. The 1980- guaranteed price for copra and milk was belatedly established.
3. That is, when new guaranteed prices were established.
4. Another possibility is to pursue a conservative industrial labour policy.
5. $E = \frac{dq}{dp} \cdot \frac{p}{q} = \frac{d(\ln q)}{d(\ln p)} \simeq \frac{d(\log q)}{d(\log p)} = \frac{\log q_1 - \log q_0}{\log p_1 - \log p_0}$
6. Largey based on: 'Agricultural Compendium for Rural Development in the Tropics and Subtropics; Elseviers Scientific Publishing Company, Amsterdam, 1981.
7. I.e. reduced imports of dairy products and dairy substitutes.

APPENDIX 1

THE NORMALIZED RESTRICTED PROFIT FUNCTION APPROACH

Introduction

The existence of a dual correspondence between profits on the one hand and input demand and output supply functions on the other hand has often been introduced in textbooks on mathematical economics as Hotelling's lemma.(1)
Hotelling's lemma or the derivative property is the following proposition:
let y (p,c) be the firm's supply function and let x_i (p,c) be the firm's demand function for factor i, then

$$Y(p,c) = \frac{\delta\pi(p,c)}{\delta p} \text{ and } X(p,c) = -\frac{\delta\pi(p,c)}{\delta c_i}, i = 1,\ldots,m,$$

when the derivatives exist, and when $c \gg 0$ and $p > 0$.(2)
$\pi(p,c)$ is a profit function with the usual conditions(3) and is assumed to be differentiable with respect to output price p and input price c at the point $(p ; c) \gg 0$.
Hence, for a profit maximizing firm, output supply and input demand can be determined by differentiating the profit function with respect to the respective prices.
This finding is of utmost importance to empirical economic analysis. Because, assuming profit-maximizing behaviour, output supply- and input demand elasticities can now be estimated without direct reference to the mutually dependent (4) physical quantities of output and variable inputs.

The profit function of a firm can be described as:

$$\pi(p,c) = \max \left(p.y(x) - \sum_{i=1}^{m} c_i x_i\right) .$$

When some inputs are held fixed, e.g. land and other capital,

we have the restricted profit function (RPF):

$\pi(p,c,z) = \max \ (p.y(x,z) - \sum_{i=1}^{m} c_i x_i)$, where z represents the vector of fixed inputs.

When both sides of the equation are deflated or normalized by the output price p, we have the normalized restricted profit function (NRPF):

$\pi^* = \max \ (y^*(x,z) - \sum_{i=1}^{m} c_i^* x_i)$.

π^* is often employed in stead of $\pi(p,c,z)$, because it is more convenient to work with π^*.

Samuelson [5] was the first economist who analysed normalized restricted profit functions. The concept has been further refined by Gorman[6], Mc. Fadden[7], Diewert[8], Jacobsen[9], Sheppard[10], and Lau.[11]

The pioneers in employing the NRPF approach in empirical analysis of agricultural production in developing countries were Lau and Yotopoulos[12].

Our application of the concept (vide Part Two) is based on their work.

A full theoretical review of the concept would lead us way beyond the scope of this appendix. Since we are more interested in empirical applications we shall restrict ourselves to the methodological foundations of the NRPF approach as applied in our analysis. Below, we shall, starting from a Cobb-Douglas type of production function, demonstrate the derivation of the NRPF, the input demand functions, the test hypotheses, and the various elasticities. In order to keep the main argument clear we have put the proofs of theorems and other mathematical derivations that interrupt the main argument in footnotes.

The Derivation of the NRPF and its Properties

Following Lau (op.cit., 1979, pp.190-191) we start from a Cobb-

Douglas type of production function with variable inputs only. This function is given by

$$Y = \prod_{i=1}^{m} X_i^{\alpha_i}, \; i = 1,\ldots m, \qquad (1)$$

where $\mu = \sum_{i=1}^{m} \alpha_i \; (< 1)$, because Y is assumed to be with decreasing returns in X and homogeneous of degree μ in X.

The first-order condition for a maximum is

$$\frac{\alpha_i \; Y}{X_i} = c_i \; , \; i=1,\ldots,m, \qquad (2)$$

where c_i represents the normalized unit price of the ith variable input (note that both sides of (2) have been divided by p). It can be proven[13] that a production function is homogeneous of degree k in X if and only if the corresponding normalized profit function is homogeneous of degree -(k/1-k) in c.

Since Y is homogeneous of degree k in X, and if we denote the normalized profit function by G, then we have

$$Y = (1 - \mu)^{-1} G \qquad (3)$$

Equation (2) can now, by substituting (2) and using a dual transformation[14], be written as,

$$\frac{\alpha_i (1-\mu)^{-1} \; G}{-\delta G / \delta c_i} = c_i \; , \quad i=1,\ldots,m \qquad (4)$$

Integrating over c_i , i=1,...,m, gives

$$G(c) = K^* \prod_{i=1}^{m} c_i^{-\alpha_i (1-\mu)^{-1}} \qquad (5)$$

where K^* is a constant of integration.

Since K^* may also be determined for initial conditions we have for c_i =1 in equation (2), $X_i = \alpha_i Y$, i=1,...,m.

Substituting this into equation (1) we have

$$Y = \prod_{i=1}^{m} X_i^{\alpha_i} = \prod_{i=1}^{m} \alpha_i^{\alpha_i} \; Y^{\alpha_i} \; . \qquad (6)$$

Rearranging,

$$Y = \left(\prod_{i=1}^{m} \alpha_i^{\alpha_i}\right)^{1/(1-\mu)}$$

$$= (1-\mu)^{-1} G(1)$$

$$= (1-\mu)^{-1} K^*.$$

Thus, $G(1) = (1-\mu)\,Y = (1-\mu)\,(\prod_{i=1}^{m} a_i^{a_i})^{1/(1-\mu)}$ and for all c_i, $i = 1, \ldots, m$,

$$G(c) = (1-\mu) \prod_{i=1}^{m} \left(\frac{c_i}{a_i}\right)^{-a_i(1-\mu)^{-1}}. \tag{7}$$

To extend this result to a Cobb-Douglas production function with fixed inputs Z and a constant term A, we have

$$Y = A \prod_{i=1}^{m} X_i^{a_i} \prod_{i=1}^{n} Z_i^{\beta_i}. \tag{8}$$

It can be proven[15] that when $Y = F(X)$ and $\pi^* = G(c)$ represent a production function and its conjugate normalized profit function respectively, that if

$$Y = A\,F(X) \rightarrow \pi^* = A\,G(c/A).$$

Applying this theorem to equations (7) and (8) we have,

$$\pi^* = G(c,Z) = A \prod_{i=1}^{n} Z_i^{\beta_i} (1-\mu) \prod_{i=1}^{m} \left(\frac{c_i}{A \prod_{i=1}^{n} Z_i^{\beta_i} a_i}\right)^{-a_i(1-\mu)^{-1}} =$$

$$= A^{(1-\mu)^{-1}} (1-\mu) \left(\prod_{i=1}^{m} \left(\frac{c_i}{a_i}\right)^{-a_i(1-\mu)^{-1}}\right) \cdot \left(\prod_{i=1}^{n} Z_i^{\beta_i(1-\mu)^{-1}}\right). \tag{9}$$

Taking natural logarithms of equation (9), we have

$$\ln \pi^* = \ln A' + \sum_{i=1}^{m} a_i' \ln c_i + \sum_{i=1}^{n} \beta_i' \ln Z_i, \tag{10}$$

where $A' = A^{(1-\mu)^{-1}} (1-\mu) (\prod_{i=1}^{m} a_i^{a_i(1-\mu)^{-1}})$, $a_i' = -a_i(1-\mu)^{-1} < 0$,

$i = 1, \ldots, m$, and $\beta_i' = \beta_i(1-\mu)^{-1} > 0$, $i = 1, \ldots, n$.

As can easily be seen, equation (10) is precisely the estimating equation we used in our empirical analysis (vide table 5).

The derived input demand functions are given by Hotelling's lemma (vide above), i.e.,

$$X_i = -\frac{\delta \pi^*}{\delta c_i}, \; i = 1, \ldots, m. \tag{11}$$

Multiplying both sides of equation (11) by $-c_i/\pi^*$ gives

$$-\frac{c_i X_i}{\pi^*} = \frac{\delta \ln \pi^*}{\delta \ln c_i}, \; i = 1, ..., m, = a_i' . \qquad (12)$$

Equation (12) represents the input demand function we used for our estimation (vide table 5).

The crucial assumption of profit maximization can be tested simply by the coefficients of variable inputs since they appear in both equations, i.e. (10) and (12). Hence,

H_0 : $\alpha_i'(10) = \alpha_i'(12)$, $\forall$ i=1,....,m.

The test concerning the assumption of constant returns to scale is less straight forward. It can be proven, however, by using Euler's theorem that a production function is homogeneous of degree one in all inputs if and only if the NPRF is almost homogeneous of degree one in its fixed inputs.(16)

Therefore, $H_0 : \sum_{i=1}^{n} \beta_i' = 1.$

The various elasticities we applied in our ex-ante analyses are derived as follows.

Equation (12) in natural logarithms gives

$$\ln X_i = \ln (-a_i') + \ln \pi^* - \ln c_i, \; i = 1, ..., m. \qquad (13)$$

Hence the input demand elasticities are given by

$$\frac{\delta \ln X_i}{\delta \ln c_i} = \frac{\delta \ln \pi^*}{\delta \ln c_i} - 1 = a_i' - 1 \; (< 0).$$

The input demand elasticity with respect to the price of output is given by

$$\frac{\delta \ln X_i}{\delta \ln p} = \frac{\delta \ln X_i}{\delta \ln c_i} \cdot \frac{\delta \ln c_i}{\delta \ln p} = -1.(a_i' - 1) \; (> 0); \text{ that } \frac{\delta \ln c_i}{\delta \ln p} \text{ equals } -1$$

follows directly from the properties of the profit function

(vide footnote [3]).

The output responses with respect to one specific input X_j and input price c_j can be computed as follows.

Output is given by $Y = \pi^* + c_j X_j$
$= \pi^*(1 - a_j')$ vide equation (12).

The output elasticity with respect to the price of one specific input is given by

$$\frac{\delta \text{ In } Y}{\delta \text{ In } c_j} = \frac{\delta \text{ In } \pi^*}{\delta \text{ In } c_j} = a_j' \ (< 0).$$

The output elasticity with respect to one specific input is given by

$$\frac{\delta \text{ In } Y}{\delta \text{ In } X_j} = \frac{\delta \text{ In } Y}{\delta \text{ In } c_j} \cdot \frac{\delta \text{ In } c_j}{\delta \text{ In } X_j} = a_j' \cdot (a_j' - 1)^{-1} \ (> 0).$$

The own-price supply elasticity is given by

$$\frac{\delta \text{ In } Y}{\delta \text{ In } p} = \sum_{i=1}^{m} \left(\frac{\delta \text{ In } Y}{\delta \text{ In } c_i} \cdot \frac{\delta \text{ In } c_i}{\delta \text{ In } p}\right) = \sum_{i=1}^{m} - a_i' \ (> 0).$$

NOTES TO APPENDIX 1

1. Hotelling, H.,' Edgeworth's Taxation Paradox and the Nature of Demand and Supply Function' , Journal of Political Economy, Vol. 40, 1932, pp. 577-616.
2. Proof: suppose (y^*, x^*) is a profit-maximizing supply-demand plan at prices (p^*, c^*).
   Define the function: $g(p,c) = \pi(p,c) - (p.y^* - c.x^*)$.
   Since the plan (y^*, x^*) is the best plan at prices (p^*, c^*), the function g reaches a value of zero at (p^*, c^*).
   The first - order conditions for a minimum are:

$$\frac{\delta g(p^*, c^*)}{\delta p} = \frac{\delta \pi(p^*, c^*)}{\delta p} - y^* = 0$$

$$\frac{\delta g(p^*, c^*)}{\delta c_i} = \frac{\delta \pi(p^*, c^*)}{\delta c_i} + x_i^* = 0, \quad i = 1, .., m.$$

   Since this is true for all p^* and c^*, we have the derivations in the text.
3. Properties of the profit function:
   (i) nondecreasing in p, nonincreasing in c (proof is obvious)
   (ii) homogeneous of degree 1 in (p,c)
      proof: the composition of costs and returns will not be changed multiplying the costs and returns by some factor t
   (iii) convex in (p,c)
      proof (vide also p. 81):
      (a) the profit will go down at decreasing rate if the price of an input rises; because as this input becomes more expensive and other prices stay unchanged, the profit-maximizing firm will shift away from it and use other inputs
      (b) the profit will go up at increasing rate if the price of an output rises; because as this output becomes more profitable, the profit-maximizing firm will shift towards the more profitable output
   (iv) continuous in (p,c), at least when $p > 0$ and $c \gg 0$ (proof follows from iii).

4. These functions thus obtained can now be explicitly written as functions of variables that are usually considered to be determined independently of the firm 's behaviour. Hence they are exogenous variables.

   If, however, these exogenous variables vary little from firm to firm (e.g. in the case of price regulations or non - competitive markets) the resulting lack of variation decreases the applicability of the NRPF-approach considerably (vide also e.g. Varian, 1978, op.cit., pp. 125-126). We believe to a certain extent that in our case (vide table 5) the lack of variation in input prices hampered the establishment of a good fit.

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6. Gorman, W.M., 'Measuring the Quantities of Fixed Factors', in ' Value, Capital and Growth: Papers in Honour of Sir John Hicks' (Ed.J.N. Wolfe), Aldine, Chicago, 1968, pp. 141-172.
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9. Jacobsen, S.E., 'Production Correspondences', Econometrica, Vol.38, 1970, pp. 754-770.
10. Sheppard, R.W., 'Theory of Cost and Production Functions', Princeton University Press, Princeton, N.J., 1970.
11. Lau, L.J., 'A Characterization of the Normalized Restricted Profit Function', Journal of Economic Theory, Vol. 12, 1976, pp. 131-163;

    Lau, L.J., 'Applications of Profit Functions', in Contributions to Economic Analysis; 'Production Economics: A Dual Approach to Theory and Applications', North-Holland Publishing Company, Amsterdam, 1979, pp. 133-216.
12. Lau, L.J., and Yotopoulos P.A., 'A Test for Relative Efficiency and Application to Indian Agriculture', American Economic Review, Vol. 61, March 1971, pp. 94-109;

Lau, L.J., and Yotopoulos P.A., 'A Test for Relative Economic Efficiency: Some Further Results', American Economic Review, Vol. 63, March 1973, pp. 214-223;

Lau, L.J., and Yotopoulos P.A., 'Profit, Supply and Factor Demand Functions', American Journal of Agricultural Economics, Vol. 54, Feb. 1972, pp. 11-18;

Lau, L.J., et. al., 1976, ibidem.

13. Proof:

By Euler's theorem for homogeneous functions we have

$$\sum_{i=1}^{m} \frac{\delta Y}{\delta X_i} X_i = kY \qquad (14)$$

Applying the dual transformations (vide next footnote) equation (14) becomes

$$-\sum_{i=1}^{m} c_i \frac{\delta G}{\delta c_i} = k(G - \sum_{i=1}^{m} c_i \frac{\delta G}{\delta c_i}).$$

$$\text{Hence, } \sum_{i=1}^{m} c_i \frac{\delta G}{\delta c_i} = -\frac{k}{(1-k)} G. \qquad (15)$$

By applying the dual transformations, the production function can be written as

$$Y = (G - \sum_{i=1}^{m} c_i \frac{\delta G}{\delta c_i}). \qquad (16)$$

Substituting equation (15) into (16) gives

$$Y = G + \frac{k}{1-k} G = (1-k)^{-1} G.$$

Q.E.D.

14. As stated earlier, the NRPF-approach is based on the dual correspondency between the production function of a profit maximizing firm and its conjugate NRPF.

The dual transformations can be explained (vide \Lau, op. cit., 1979, pp. 142-147) with the help of the Legendre transformation. Consider the production function

$$Y = (X_1, .., X_m; Z_1, ..., Z_n). \qquad (17)$$

The Legendre transformation of Y is defined as

$$T_i = \frac{\delta Y}{\delta X_i}, \quad i = 1, .., m. \tag{18}$$

The production function Y is assumed to be locally strongly concave in the variable inputs X, so that the transformation is non-singular and hence invertible.

X_i can now be expressed in terms of T_i and Z_i.

$$X_i = h_I(T_1, .., T_m; Z_1, .., Z_n), \; i = 1, .., m. \tag{19}$$

A Legendre's dual transformation of Y can be defined as follows

$$g(T_1, ..., T_m; Z_1, ..., Z_n) = \sum_{i=1}^{m} h_i(T, Z)T_i - Y(h_1(T, Z), ..., h_m(T, Z); Z) . \tag{20}$$

Equation (20) leads to the important dual relations between Y and G.

$$\frac{\delta g}{\delta T_i} = \sum_{j=1}^{m} \frac{\delta h_j}{\delta T_i} T_j + h_i - \sum_{j=1}^{m} \frac{\delta Y}{\delta X_j} \cdot \frac{\delta h_j}{\delta T_i}, \quad i = 1, .., m. \tag{21}$$

$$\frac{\delta g}{\delta Z_i} = \sum_{j=1}^{m} \frac{\delta h_j}{\delta Z_i} T_j - \sum_{j=1}^{m} \frac{\delta Y}{\delta X_j} \cdot \frac{\delta h_j}{\delta Z_i} - \frac{\delta Y}{\delta Z_i}, \quad i = 1, .., n. \tag{22}$$

Substituting now equation (18) and (19) we have the following dual transformations

$$\frac{\delta g}{\delta T_i} = h_i = X_i ; \quad \frac{\delta g}{\delta Z_i} = -\frac{\delta Y}{\delta Z_i} . \tag{23}$$

Under the assumption of profit maximization we have

$$\frac{\delta Y}{\delta X_i} = c_i ,$$

hence by equation (18) $T_i = c_i$.

Equation (20) may, by applying the dual transformations and substituting $T_i = c_i$, be written as:

$$g = \sum_{i=1}^{m} c_i X_i (c, Z) - Y (X_1 (c, Z), .. , X_m (c, Z) ; Z) \qquad (24)$$

Equation (24) equals the negative of the NRPF, or - G(c,Z).

Summarizing, we have found the following dual relations

$$\frac{\delta g}{\delta c} = \frac{\delta g}{\delta T} = X ; \frac{\delta g}{\delta Z} = -\frac{\delta Y}{\delta Z} \text{ and } \frac{\delta G}{\delta c} = -X ;$$

$$\frac{\delta G}{\delta Z} = \frac{\delta Y}{\delta Z} .$$

Referring to the text, it will be seen easily that

$$\frac{a_i(1-\mu)^{-1} G}{X_i} \text{ equals } \frac{a_i(1-\mu)^{-1} G}{-\delta G/\delta c_i}$$

15. Proof:

$$\begin{aligned} \pi^* &= \max \ (AF(X) - c X) \\ &= A \max \ (F(X) - \frac{c}{A} X) \\ &= AG(c/A). \end{aligned}$$

Q.E.D.

16. Proof:

By Euler's theorem we have

$$\sum_{i=1}^{m} \frac{\delta Y}{\delta X_i} X_i + \sum_{i=1}^{n} \frac{\delta Y}{\delta Z_i} . Z_i = kY . \qquad (25)$$

By a dual transformation equation (25) becomes

$$-\sum_{i=1}^{m} c_i \frac{\delta G}{\delta c_i} + \sum_{i=1}^{n} \frac{\delta G}{\delta Z_i} . Z_i = k(G - \sum_{i=1}^{m} c_i \frac{\delta G}{\delta c_i}) . \qquad (26)$$

If Y is homogeneous of degree k = 1, equation (26) simplifies to $\sum_{i=1}^{m} \frac{\delta G}{\delta Z_i} . Z_i = G .$

Hence, Y is homogeneous of degree 1 if and only if the NRPF is almost homogeneous of degree one in Z.

Q.E.D.

ON ECONOMIC SURPLUS

Since its invention by the French engineer Dupuit in 1844[1] the concept of economic surplus has caused a great deal of academic controversy.

Basically, the debate has taken place in two rather distantly related contexts. On the one hand empirical economists who were not particularly concerned with the possible theoretical caveats of the concept, studied its usefulness to public cost benefit analysis.[2]

On the other hand many theorists expressed doubts as to whether the concept would provide an exact measure of welfare changes.[3]

In this appendix we shall review the three basic difficulties in measuring welfare changes by economic surplus, viz:

(i) the fundamental difficulty of measuring changes in utility
(ii) the difficulty in the aggregation of economic surplus over goods and services
(iii) the difficulty in the aggregation of economic surplus over individuals.

Although, consumer's surplus refers to demand prices and economic rent (producer's surplus) to supply prices, both welfare measures are basically symmetrical.[4] Therefore, what will be said below with respect to consumers, demand curves and consumer's surplus, applies by analogy also to owners of factors of production, supply curves and economic rent.

(i) The Fundamental Difficulty of Measuring Changes in Utility

Dupuit defined his concept of consumer's surplus as the difference between the sacrifice which the purchaser would be willing to make in order to get it and the purchase price he has to pay in exchange.

He analysed the question of subsidization towards the costs of constructing a bridge and found that a consumer will be usually

willing to pay more for a good than he is actually paying. Dupuit proposed that this 'excess satisfaction' could be measured by the triangle below the demand curve and above the price line.

Some 70 years later, Marshall introduced the concept of consumer's surplus, together with that of producer's surplus, to the English speaking world.(5)

He viewed consumer's surplus as 'the excess of the price which he (i.e. a consumer) would be willing to pay rather than go without the thing, over that which he actually does pay' (Marshall, 1920, p.124).

Marshall's approach differs from Dupuit in that he recognized the problem that utility gained from an increased expenditure on one good because of a price decrease of that good, cannot be seen independently from the decreased expenditure on other goods. He found that this decreased expenditure on other goods would in fact raise the marginal utility of money, which would in turn reduce the reliability of the Dupuit - triangle as a cardinal utility - index. To overcome this theoretical complication, Marshall assumed the marginal utility of money to be approximately constant for movements along the demand schedule.

The reason for this assumption will be explained below when we depict the various measures of consumer's surplus in an indifference map.

Some 20 years later, Hicks redefined the concept by using an ordinal system of indifference curves.(6) With further clarification by Henderson(7) four additional measures of consumer's surplus were distinguished:(8)

1. Compensating variation (CV) is the amount of compensation, paid or received, that will leave the consumer in his initial welfare position following the change in price if he is free to buy any quantity of the commodity at the new price.
2. Compensating surplus (CS) is the amount of compensation, paid or received, that will leave the consumer in his initial welfare position following the change in price if he is constrained to buy at the new price the quantity he would have bought at

that price in the absence of compensation.

3. Equivalent variation (EV) is the amount of compensation, paid or received, that will leave the consumer in his subsequent welfare position in the absence of the price change if he is free to buy any quantity of the commodity at the old price.
4. Equivalent surplus (ES) is the amount of compensation, paid or received, that will leave the consumer in his subsequent welfare position in the absence of the price change if he is constrained to buy at the old price the quantity he would have bought at that price in the absence of compensation.

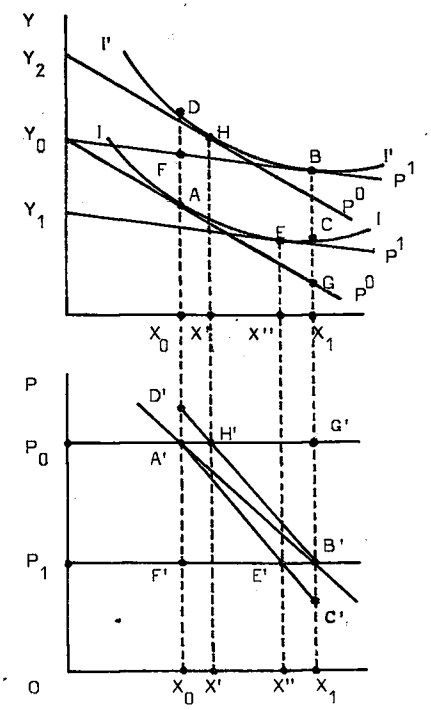
Hicks also analysed the relationship of these four measures to the more readily computable measures of Paasche and Laspeyres variations.

The Paasche variation (PV) is the amount the consumer would have to be paid to have just enough money to buy the new bundle of goods at the original prices.

The Laspeyres variation (LV) is the amount of compensation that could be taken from the consumer while leaving him just able to buy the original bundle of goods he bought before the change.

The fundamental difficulty of measuring utility can be explained best by measuring the seven distinguished consumers' surpluses with the help of an indifference map and corresponding demand curves.

These two diagrammatic representations are depicted below in the upper and lower graph[9] respectively.



In the upper graph the Y-axis represents the amount of money, and the X-axis the quantity of the commodity in question (assuming a normal good).

The initial price of the commodity is represented by the slope P^0 and the new price, assuming a price fall, by the slope of P^1. Since the amount of money is depicted along the Y-axis the various consumers' surpluses are measured as distances parallel to the Y-axis.

In the lower graph the demand schedules are derived from the indifference map in the upper graph. It follows that the various consumers' surpluses are represented here by areas.

From the definitions it can be seen that : CV = $Y_0 Y_1$, CS = BC (distance between II and I'I' at X_0), EV = $Y_0 Y_1$, ES = AD (distance between II and I'I' at X_0); PV = BG, and LV = AF.

The ordinary demand curve (ODC) through A´B´ in the lower graph is derived from an offer curve through AB in the upper graph.

The ODC gives the quantity that a utility maximizing consumer with a given income level will demand at each price.

Marshallian surplus (MS), as derived from the ODC, equals $P_0A´B´P_1$. That the MS may not represent 'true' surplus from a price change to a consumer, can now be demonstrated by derivation of the Hicksian compensated demand curve (HCDC). The HCDC depicts the quantity a consumer will demand at each price, assuming his income is adjusted so that he remains on his original indifference curve II. This can be shown in the upper graph by a movement from A to E along indifference curve II. Hence the curve A´É in the lower graph represents the HCDC from the starting point A´which refers to A on the indifference curve II.

When the price is P_0 a marginal price decrease benefits the consumer by $P_0A´$. As the price drops continously from P_0 to P_1, the total amount that could be taken from him while leaving him just as well off without the price decrease is just the area $P_0A´E´P_1$.

Hence, CV equals the area under the HCDC and between the two prices.

Since by definition the income effects of CV are zero, CV represents an exact measure of the welfare changes in question.

The HCDC indicates solely the substitution effect of a price change, whereas the ODC reflects both the substitution and the income effects. For this reason MS always contains the danger of over- or understating the 'true' surplus (depending on whether the commodity in question is a normal or an inferior good).

For completeness sake: $EV = P_0H´B´P_1$, $CS = P_0A´E´P_1 - E´B´C´$ (10) , $ES = P_0H'B'P_1 + A´D´H´$ (11), $LV = P_0A´F´P_1$, and $PV = P_0G´B´P_1$.

If the income effect is zero then the indifference curves are

parallel at any quantity demanded. In consequence, all demand curves will then coincide, and the Hicksian and Marshallian surpluses will be equal.

A further theoretical improvement on Marshall's theory was the finding that a constant marginal utility of money is not sufficient to ensure a zero income effect. Because, in addition, the marginal utilities would have to be independent and the marginal utility of the commodity in question would have to be changing. To ensure that MS is accurate for a price change, the marginal utility of money has to be constant with respect to all prices. It is not the constancy in marginal utility of money as income increases that matters, but the constancy in marginal utility of money as prices change.[12]

Although CV and EV may represent exact measures of changes in welfare a major drawback is that they are per se unobservable (for the indifference curves are unknown).

Nevertheless, it can be argued that the error by using MS in applied welfare analysis in stead of the correct measures CV or EV will be insignificant in most cases.

First, inter alia, Willig (1976)[13] and later Seade (1978)[14] have shown that under certain conditions, MS can be used to approximate CV and EV.

Secondly, for normal goods we have $PV \geqslant EV \geqslant MS \geqslant CV \geqslant LV$. It can be demonstrated by using the Taylor series' approximations of the various measures as given by Hicks[15] that in practice these differences may appear to be quite small.[16] It is clear that when the ODC is linear MS equals 1/2 (PV + LV).

Thirdly, and perhaps most important, if (like we have done) for the purpose of cost/benefit analysis only relative welfare changes are approximated by surplus ratio's (MS/Δ direct government cost, or economic rent/Δ direct government cost), the resulting bias is likely to be negligible as compared to inaccuracies due to statistical problems. This argument is based on the principle that when a yard-stick is biassed one can more accurately say e.g. a is twice as long as b, than equals 4 cm and b 2 cm.

As far as, the concept of economic rent is concerned, Mishan introduced, in analogy with the ODC and HCDC, ordinary and compensated supply curves (OSC and CSC)[17].

Again, the sufficient condition for Mishan's four measures (i.c. CV, CS, EV and EV; this time refering to the factor owner, his initial and subsequent welfare position, and the quantity supplied) to be equal and the OSC and the CSC to coincide, is that the indifference curves of the factor owner are parallel at any given quantity of the commodity in question.

Mishan has also made perfectly clear that the surplus, approximated by the area above the supply curve and below the price line, results from the owner-ship by the producers of fixed factors of production[18].

Hence, it says basically nothing about the welfare of owners of firms. For this reason Mishan urged economists to get rid of the Marshallian notion of producer's surplus and have it replaced by economic rent, which may refer to rent of a short-run fixity of some factor of production, rent of land, rent of entrepreneurial ability, etc.

The major problems in measuring welfare changes by economic surplus relate to the aggregation of economic surpluses over different commodities and individuals. These problems will be briefly discussed below, in (ii) and (iii) respectively.

We conclude our discussion on the basic difficulty in measuring changes in utility with the help of economic surplus by emphasizing that the utmost care is needed when dealing with e.g. wage goods (consumers) / monocultures (factor owners) and large price changes. This is because, from the above discussion and graphs it will be understood that the inaccuracy, in using MS in stead of CV or EV, is an increasing function of the proportion of income spent (consumer) / earned (factor owner) and the magnitude of the price change.

(ii) The Difficulty in the Aggregation of Economic Surplus over Goods and Services

The problem is, how to measure the change in economic surplus if the prices of more than one commodity are to change?
Already at first glance, it will be seen, that if production/consumption of one good is dependent to that of an other, supply/demand of the second good generally will not be unaffected as the price of the first good changes.
We stated generally, because this does not hold if e.g. all the commodities of concern have an income elasticity equal to unity. Hence, economic surplus of two or more goods can be measured accurately by the sum of the respective areas only if the goods are entirely independent.
A further problem is the issue of path dependency.[19] Path dependency refers to the problem that the final surplus also depends on which path of price changes is followed. For instance, we can decrease the price of coffee first, then the price of tea, then the price of coffee again, etc. Each path will entail a different outcome in the change of aggregated economic surplus.
Several authors[20] have argued, however, that the income effects will probably offset each other so that, while the measure of economic surplus may be path dependent, the bias involved will be small for most price changes.
Anyway, we feel that in addition to our previous remarks concerning the magnitude of the price changes and the proportion of income spent or earned, a third element of caution in measuring welfare change by means of economic surplus has to be taken into consideration when adding up surpluses over goods or services that are highly interdependent.

(iii) The Difficulty in the Aggregation of Economic Surplus over Individuals

The problem is, can we use the sum of economic surpluses as

a measure of welfare change for a group of consumers/factor owners as a whole?

Theoretically speaking, a gain or loss in welfare from a price change will never be the same for each individual. Interpersonal utility comparison is per se impossible. However, we are not interested so much in exact aggregated utility measures. What we need to know is, whether the assumption can be made, when an aggregated economic surplus is positive, that the gainers can theoretically compensate the losers and that the welfare change will then be at least a potential Pareto improvement. Boadway [21] found by his well-known paradox that a positive aggregated economic surplus could be thought of where the gainers cannot compensate the losers and still be better off themselves. His idea is based on the possibility that this compensation between gainers and losers may change the equilibrium set of price bundles. An important corollary to applied welfare analysis is, that when a major commodity or group of commodities is to be analysed, a compensation between gainers and losers might affect all prices in such a way that the direction of the net welfare change becomes uncertain.

For this reason, a fourth restriction to applied surplus analysis is that the value of the goods or services in the aggregated welfare analysis, as compared to total GNP, should not be too large.

NOTES TO APPENDIX 2

1. Dupuit,J., 'De la Mesure d'Utilité des Travaux Publics', Annales des Ponts et Chaussées, Paris, 1844 (translation into English by e.g. R.H. Barback, International Economics Papers, 1952).
2. Vide e.g. section 3.1.2.1
3. Vide e.g.:
   Samuelson, P. and Swami, S.,'Invariant Economic Index Numbers and Canonical Duality: Survey and Synthesis', American Economic Review, Vol. 64, September 1974;
   Little, I.M.D., 'A Critique of Welfare Economics', Oxford, 1960; and McKenzie, G.W. and Pearce, I.F., 'Exact Measures of Welfare and the Cost of Living', Review of Economic Studies, October 1976, Vol. 43, pp. 465-468.
4. Mishan, E.J., 'Rent as a Measure of Welfare Change', American Economic Review, Vol. 49, June 1959, p. 394.
5. Marshall, A., 1910, ibidem.
6. Hicks, J.R., 'The Rehabilitation of Consumer's Surplus', Review of Economic Studies, Vol. 8, 1940-1941.
7. Henderson, A., ' Consumer's Surplus and the Compensating Variation', Review of Economic Studies, Vol. 8,1940-1941
8. Hicks, J.R., 'The Four Consumers' Surpluses', Review of Economic Studies, Vol. 11, Winter 1943.
   Hicks, J.R. 'The Generalized Theory of Consumer's Surplus', Review of Economic Studies, Vol. 13, 1945-1946.
9. For a more detailed diagrammatic representation, vide e.g. three excellent surveys on which this appendix is largely based:
   Currie, J.M., et. al., 'The Concept of Economic Surplus and Its Use in Economic Analysis', The Economic Journal, Vol. 81, No. 324, December 1971, pp. 741-799;
   Patinkin, D., 'Demand Curves and Consumer's Surplus', in Carl Christ et. al., 'Measurement in Economics: Studies in Mathematical Economics and Econometrics in Memory of Yehuda Grunfeld', Stanford University Press, 1963;
   Yew-kwang Ng., 'Welfare Economics', Macmillan, London, 1979,

pp. 85-110.

10. The little triange E ′B ′C ′ represents the loss to the consumer by having to stick to the constrained quantity at C, in fact he prefers X ″at E.
11. ES exceeds EV by the little triangle A ′H ′D ′ because this time at the old price P^{O} the consumer prefers X ′at H.
12. Vide e.g. Currie, J.M., et. al., op. cit., p. 751.
13. Willig, R.D., ' Consumer's Surplus without Apology', American Economic Review, Vol. 66, September 1976, pp. 589-597;
    Willig, R.D., 'Consumer's Surplus without Apology: Reply', American Economic Review, Vol. 69, 1979, pp. 469-474.
14. Seade, J., 'Consumer's Surplus and Linearity of Engel Curves', The Economic Journal, Vol. 88, September 1978, pp. 511-523.
15. Hicks, J.R., 'Consumers' surplus and Index Numbers', Review of Economic Studies, Vol.9, 1942, pp. 126-137.
16. Cory, D.C., et. al., 'Use of Paasche and Laspeyres Variations to Estimate Consumer Welfare Change', Agricultural Economics Research, Vol. 33, No. 2, April 1981, pp. 1-6.
17. Mishan, E.J., 1959, ibidem.
18. Mishan, E.J., 'What is Producer's Surplus?', American Economic Review, Vol. 58, December 1968, pp. 1269-1282.
19. Vide e.g. Silberberg, E., ' Duality and the Many Consumer's Surpluses', American Economic Review, vol. 62, 1972, pp. 942-952.
20. Vide e.g. Yew-kwang Ng., op. cit., pp. 95-96 ; and Patinkin, D., op. cit., pp. 100-103.
21. Boadway, R., 'The Welfare Foundations of Cost-Benefit Analysis', The Economic Journal, Vol. 84, December 1974, pp. 926-939

TABLE A TRINIDAD AND TOBAGO - COPRA, COCOA, COFFEE AND MILK, PRODUCTION AND PRICE 1970 - 1981

YEAR	COPRA		COCOA		COFFEE		MILK	
	production 1000 kg	TT$/ 1000 kg	production 1000 lbs	TT$/ 1000 lbs	production 1000 lbs	TT$/ 1000 lbs	production 1000 litres	TT$/ 1000 litres
1970	11,191	402.60	13,697	720	5,075	610	7,264	270
1971	12,449	422.32	8.305	580	8,584	690	8,359	240
1972	12,544	422.32	16,628	570	7,275	640	10,302	240
1973	11,800	510.40	6,971	760	5,989	790	7,236	360 *
1974	6,679	510.40	9,173	1,160	4,276	880	7,279	450 *
1975	8,907	990.00 *	11,581	1,290	8,871	880	7,741	570 *
1976	9,106	990.00 *	7,163	1,300	5,888	1,160	6,319	570 *
1977	9,008	1,188.00 *	7,374	1,880	6,434	1,620	5,868	660 *
1978	7,367	1,188.00	7,491	2,110	5,510	2,190	5,927	660 *
1979	6,838	1,188.00	5,793	2,110	5,505	2,280	6,253	660 *
1980	4,417	1,661.36 *	5,248	2,180	4,937	1,940	5,492	1,250 *
1981	5,207	2,753.77 *	6,934	2,260 *	5,364	2,130 *	7,082	1,470 *

* Guaranteed prices

TABLE B TRINIDAD AND TOBAGO - TOMATOES, CABBAGES, SWEET POTATOES AND DASHEEN, PRODUCTION AND PRICE 1970 -1981

YEAR	TOMATOES		CABBAGES		SWEET POTATOES		DASHEEN	
	production 1000 kg	TT$/ 1000 kg	production 1000 kg	TT$/ 1000 kg	production 1000 kg	TT$/ 1000 kg	production 1000 kg	TT$/ 1000 kg
1970	4,047	900	3,191	570	1,486	380	4,318	210
1971	6,348	930	3,661	670	1,411	450	4,364	230
1972	9,020	1,060	5,727	840	1,391	350	4,773	200
1973	9,205	1,010	6,136	660	1,425	570	4,864	370
1974	10,688	990	7,057	600	2,636	510	5,000	370
1975	9,586	1,450	6,648	880	2,545	680	4,909	460
1976	6,710	2,270	4,654	1,170	2,545	710	5,000	620
1977	8,182	2,360	6,136	1,540	2,614	1,150	5,682	770
1978	7,841	3,310	6,239	1,790	2,568	1,190	5,625	950
1979	8,011	3,520	6,034	2,140	2,227	1,740	5,114	1,260
1980	7,500	5,230	5,779	3,090	2,168	1,850	4,659	1,660
1981	7,295	5,820	5,625	2,200	2,068	1,820	4,545	2,040

TABLE C TRINIDAD AND TOBAGO - ROOT CROP FARM DATA, 1983
FARMERS WORKING 40 HOURS AND MORE WEEKLY

No.	ACREAGE	EQUIPMENT TT$	FERTILIZER TT$	LABOUR TT$	CHEMICALS TT$	RETURNS TT$
1	200	620	380	660	260	7500
2	75	36	200	350	-	2100
3	200	170	145	-	-	1800
4	100	595	200	460	150	3500
5	100	100	-	70	-	250
6	100	375	-	120	40	1000
7	100	13	-	120	-	1000
8	100	1085	40	-	30	100
9	25	750	-	110	-	750
10	50	205	-	120	40	1000
11	75	296	-	105	-	900
12	50	73	200	400	140	2400
13	100	115	400	1100	120	9000
14	33	427	160	200	125	2000
15	300	544	240	180	160	1500
16	100	135	-	120	-	1000
17	200	695	120	400	120	2500
18	100	290	-	420	-	3000

No.	ACREAGE	EQUIPMENT TT$	FERTILIZER TT$	LABOUR TT$	CHEMICALS TT$	RETURNS TT$
19	50	337	90	105	-	900
20	100	1000	75	-	-	800
21	50	235	30	300	-	500
22	25	-	45	40	-	485
23	25	808	160	800	-	2000
24	50	1325	140	300	-	1400
25	25	140	-	120	-	1000
26	50	275	140	180	-	1455
27	100	-	-	145	-	447
28	500	25301	400	-	80	12000
29	150	41995	200	625	140	2520
30	400	25300	430	1800	400	10780
31	200	41995	600	1700	480	15000
32	300	18000	320	1100	400	9600
33	300	72	400	1000	130	9000
34	700	39150	560	-	480	4800
35	500	16135	-	-	-	1200
36	300	1577	450	-	-	10000

TABLE C CONTINUED

No.	ACREAGE	EQUIPMENT TT$	FERTILIZER TT$	LABOUR TT$	CHEMICALS TT$	RETURNS TT$
37	100	49	270	-	200	4500
38	150	60	100	100	40	1000
39	500	22250	-	-	-	8000

TABLE D TRINIDAD AND TOBAGO - VEGETABLE FARM DATA, 1983
FARMERS WORKING 50 HOURS AND MORE WEEKLY

No.	ACREAGE	EQUIPMENT TT$	SEED TT$	PRICE/SEED TT$/LB	FERTILIZER TT$	PRICE/FERTILIZER TT$/ 100 LBS
1	50	176	240	160	34	75
2	100	4125	400	80	2400	60
3	400	273	-	-	100	100
4	100	650	80	160	72	72
5	200	2990	800	40	1120	55
6	200	-	400	20	1200	50
7	50	2998	875	35	400	50
8	50	9550	55	110	33	50
9	100	17670	500	100	300	60
10	200	4800	240	60	2080	45
11	100	2800	60	120	214	60
12	150	30000	150	100	1500	64
13	100	1320	180	80	1200	55
14	50	7160	113	45	-	-
15	100	17750	70	140	820	51
16	100	35607	256	128	300	50

TABLE D CONTINUED

No.	ACREAGE	EQUIPMENT TT$	SEED TT$	PRICE/SEED TT$/LB	FERTILIZER TT$	PRICE/FERTILIZER TT$/100 LBS
17	50	1550	60	120	6	60
18	500	6150	210	120	310	55
19	300	9700	300	100	620	50
20	100	2425	23	140	90	56
21	100	-	45	140	150	55
22	200	1900	90	140	129	55
23	150	1155	14	140	24	56
24	150	31200	75	90	102	50
25	75	270	68	88	8	55
26	300	3004	40	120	26	55
27	50	70	40	40	-	-
28	200	179900	200	20	440	49
29	600	315	59	59	30	60
30	800	1825	500	30	3000	45
31	700	3507	50	100	8	53
32	500	177	10	100	-	-
33	250	215	80	80	-	-
34	600	100100	622	62	800	55

TABLE D CONTINUED

No.	ACREAGE	EQUIPMENT TT$	SEED TT$	PRICE/SEED TT$/LB	FERTILIZER TT$	PRICE/FERTILIZER TT$/100 LBS
35	50	17800	80	80	6	64
36	100	517	60	60	24	80
37	300	-	-	-	12	83
38	200	60	-	-	6	60
39	300	112	40	120	15	55
40	1100	68000	400	40	4480	55
41	75	133000	100	60	600	55
42	50	1300	40	400	40	80
43	3000	-	-	-	600	50
44	100	1670	15	75	50	83
45	600	4200	3600	60	3600	50
46	400	118	60	300	14	55
47	25	105	-	-	-	-
48	200	2000	240	60	650	55
49	75	70	50	100	6	65

TABLE D TRINIDAD AND TOBAGO - VEGETABLE FARM DATA, 1983
FARMERS WORKING 50 HOURS AND MORE WEEKLY

No	CHEMICALS $TT	LABOUR $TT	WAGE $TT/HOUR	PRICE OUTPUT $TT/LB	RETURNS $TT	PROFIT $TT
1	384	120	120	0.70	1190	412
2	2000	1600	27	1.50	198000	191600
3	160	900	150	1.25	1725	565
4	150	800	100	2.00	5000	3898
5	2160	3000	75	1.00	20000	12920
6	2000	600	25	1.50	16000	11800
7	800	6801	40	1.00	10000	7245
8	40	520	130	2.00	7300	6077
9	1350	810	48	3.00	19290	16033
10	1000	3800	42	1.00	46000	38880
11	240	1000	200	1.00	7560	6046
12	5000	1575	26	0.70	11865	3640
13	600	800	100	1.00	14300	11520
14	470	2000	50	1.00	12600	10018
15	518	1120	150	0.50	10000	7472
16	900	7000	119	3.00	27000	18544

TABLE D CONTINUED

No.	CHEMICALS $TT	LABOUR $TT	WAGE $TT/HOUR	PRICE OUTPUT $TT/LB	RETURNS $TT	PROFIT $TT
17	90	700	700	0.75	1500	644
18	1632	3750	125	0.80	9600	3698
19	1680	5200	128	1.00	12000	4200
20	855	960	160	2.00	5000	3073
21	140	160	177	1.00	3000	2505
22	600	320	177	1.00	6600	5461
23	170	225	188	0.35	595	162
24	200	230	144	1.00	6900	6293
25	40	500	83	0.35	350	-
26	720	240	100	0.70	7000	5974
27	770	-	-	0.50	9000	8190
28	-	-	-	1.00	20000	19360
29	-	116	116	0.30	6000	5795
30	1000	540	60	0.28	89600	84560
31	-	300	150	1.00	500	142
32	80	-	-	0.40	4410	4320
33	90	-		1.50	750	580
34	3600	-	-	1.50	15000	9978

TABLE D CONTINUED

No	CHEMICALS $TT	LABOUR $TT	WAGE $TT/HOUR	PRICE OUTPUT $TT/LB	RETURNS $TT	PROFIT $TT
35	-	-	-	1.00	1940	1854
36	-	-	-	2.00	3600	3516
37	4	-	-	1.80	540	524
38	25	525	130	0.89	600	44
39	40	700	54	2.50	3750	2925
40	1250	7600	95	0.65	39000	17270
41	480	1504	62	1.00	96000	93316
42	40	700	120	1.00	4000	3180
43	300	3600	120	2.50	16550	12050
44	22	270	450	1.00	7000	6645
45	2000	-	-	15.00	269700	260500
46	170	170	170	1.50	1500	1086
47	10	-	-	0.20	60	50
48	675	776	78	1.00	18990	16649
49	12	250	125	1.00	1000	682

TABLE E TRINIDAD - DAIRY FARM DATA, 1983

FARMERS PRODUCING MORE THAN 20.000 KG MILK IN 1982

No.	HOURS/WEEK	FERTILIZER TT$	CONCENTRATE FEED no. 25kg-bags	ACREAGE IMPROVED PASTURE	CALVING RATE	PRODUCTION KG
1	84	560	1,460	15	82	45,000
2	56	600	1,040	14.5	72	52,750
3	56	60	1,040	0	60	29,000
4	56	0	1,040	0	44	36,000
5	56	336	1,040	0	56	36,500
6	56	300	780	0	50	13,600
7	84	600	1,560	16	82	63,500
8	35	400	1,040	10	43	18,900
9	56	480	1,040	19	78	60,000
10	54	0	720	0	45	37,800
11	56	100	1,260	20	76	59.000
12	56	150	1,200	19	71	37,037
13	56	0	960	0	10	21,794
14	56	0	960	18	42	42,727
15	24	0	334	0	62	24,000
16	56	288	576	20	63	50,616
17	56	300	780	24	54	40,500

TABLE E CONTINUED

No.	HOURS/WEEK	FERTILIZER TT$	CONCENTRATE FEED no. 25kg-bags	ACREAGE IMPROVED PASTURE	CALVING RATE	PRODUCTION KG
18	56	0	1,560	0	55	47,260
19	77	0	1,300	16.5	73	81,030
20	70	90	260	0	43	40,000
21	56	30	780	17	70	37,000
22	70	600	1,040	0	40	40,516
23	56	120	1,860	20	80	81,000
24	56	300	416	0	64	40,290
25	20	0	1,300	0	54	48,360
26	56	360	520	19	35	31,750
27	56	600	390	19	44	27,300
28	70	0	520	0	61	30,750
29	56	180	390	19	35	31,750
30	56	0	600	21	57	57,720
31	50	0	720	22	67	26,936
32	56	275	1,440	21	39	53,280
33	56	0	720	20	46	40,515
34	56	180	720	27	33	49,950
35	56	0	1,200	20	51	43,771

TABLE E CONTINUED

No.	HOURS/WEEK	FERTILIZER TT$	CONCENTRATE FEED no. 25kg-bags	ACREAGE IMPROVED PASTURE	CALVING RATE	PRODUCTION KG
36	28	40	480	20	74	50,643
37	56	0	360	23	50	18,518
38	56	300	960	20	60	26,936
39	56	0	1,440	20	49	53,690
40	56	200	480	10	63	50,500
41	56	2,000	1,440	13	85	30,300
42	56	1,020	840	14	37	33,670
43	56	1,200	2,160	14.5	74	67,340
44	56	3,200	720	10	56	26,936
45	56	0	1,920	0	31	44,155
46	56	0	1,200	2	44	23,310
47	49	0	600	0	52	17,760
48	56	1,520	1,440	10	56	71,040
49	56	900	720	5	27	30,303
50	56	800	1,200	16	67	37,000
51	56	1,800	360	0	47	20,202
52	56	2,700	1,020	22	33	26,936

TABLE E CONTINUED

No.	HOURS/WEEK	FERTILIZER TT$	CONCENTRATE FEED no. 25kg-bags	ACREAGE IMPROVED PASTURE	CALVING RATE	PRODUCTION KG
53	56	1,440	730	7	41	27,000
54	56	3,000	300	15	76	31,700
55	56	1,600	520	4	52	40,500
56	63	2,400	1,524	15	77	56,000
57	70	14,400	1,920	34	65	18,900
58	56	0	720	20	53	33,670
59	56	1,200	2,600	10	79	64,800
60	56	2,900	910	9	76	54,000
61	56	2,160	1,092	17	46	31,750
62	56	720	1,040	8	78	27,375

TABLE F TRINIDAD - DAIRY FARM DATA , 1983

FARMERS PRODUCING LESS THAN 20.000 KG MILK IN 1982

No.	FENCING $TT	HOURS/WEEK	CALVING RATE	PRODUCTION KG
1	0	56	54	9,855
2	0	80	22	22,477
3	0	56	27	10,950
4	0	56	29	7,300
5	0	56	30	3,000
6	750	56	44	19,800
7	95	56	52	23,310
8	1900	80	31	31,080
9	105	56	43	14,000
10	0	56	58	31,000
11	0	64	42	18,000
12	0	40	33	18,200
13	0	56	32	13,600
14	0	56	38	13,000
15	400	60	40	13,600
16	2000	70	41	30,000
17	450	56	61	27,000

Samenvatting en beleidsaanbevelingen van het proefschrift "The Economics of Agricultural Subsidies" vertaald in het Nederlands.

Deel Een

1. Landbouwsubsidies zijn gedefinieerd als een door de overheid geïnduceerde wijziging van relatieve prijzen van goederen, diensten en produktiefactoren in de landbouwsector.
   Deze veranderingen in landbouwprijzen kunnen het gevolg zijn van een groot aantal verschillende overheidsmaatregelen variërend van directe overdrachtsbetalingen tot handelspolitieke maatregelen. Door een verdere indeling in specifieke categorieën van landbouwsubsidies zijn toepasbare definities afgeleid.

2. Landbouwsubsidies zijn economisch gerechtvaardigd wanneer door afwezigheid van overheidsbemoeienis de algemene welvaart zou afnemen. Ze zijn verdedigd op drie gronden, t.w.: de aanwezigheid van binnenlandse distorsies, instabiele prijzen en het zgn. infant-industry argument.

3. Binnenlandse distorsies zoals monopolie, milieuverontreiniging en andere externe effecten kunnen theoretisch weggenomen worden door een subsidie-beleid in de richting tegengesteld aan die van de distorsie.

4. Grote schommelingen in voedselprijzen hebben een verwoestend effect op de volkshuishouding. Geringe prijsveranderingen daarentegen, zijn nodig voor maximale winstvorming en afstemming van het aanbod op de vraag.
   Het kernprobleem bij de bepaling van een juiste landbouwprijspolitiek is, hoe grote prijsschommelingen voorkomen kunnen worden zonder de functie van de prijs als marktsignaal te ondermijnen.

5. Het "infant-industry" argument kan niet voldoende verdedigd worden met argumenten die berusten op de theorieën van Mill, Bastable

Kemp and Meade.
In overeenstemming met moderne evenwichtstheorie zou protectie gebaseerd moeten zijn op de aanwezigheid van dynamische interne welvaartseffecten, met andere woorden: de diffuse welvaartsvergrotende effecten die het gevolg zijn van het leerproces van de geprotegeerde industrie.

6. Naast de beoogde effecten sorteren subsidies ook ongewenste effecten. Oneigenlijk gedrag van gesubsidieerden leidt vaak tot welvaartsverlies. Voorts kan de welvaart in niet-gesubsidieerde sectoren dalen ten gevolge van een reallocatie van kapitaal en hulpstoffen naar de gesubsidieerde sectoren.

7. Theoretisch kunnen verstoringen en sectoreffecten van landbouwsubsidies het best worden bepaald d.m.v. macro-economische modellen. Tot op heden echter is de geïntegreerde modelmatige aanpak niet erg succesvol geweest, dit voornamelijk vanwege het ontbreken van de noodzakelijke statistische gegevens.

8. De meting van welvaartseffecten van landbouwsubsidies, vooral in ontwikkelingslanden, is doorgaans gebaseerd op partiële evenwichtsanalyse.
De schatting van elasticiteiten en van veranderingen in economisch surplus heeft grote analytische waarde, omdat hiermee antwoorden gegeven kunnen worden op ex-ante vragen, over wie het meeste voordeel heeft van de subsidie en over de financiële doelmatigheid van een produktieverhogende subsidie.

9. De onnauwkeurigheid van de schatting van de welvaartsveranderingen d.m.v. verschillen in economisch surplus is een toenemende functie van: het percentage van het individueel inkomen dat verdiend c.q. besteed is aan het betreffende goed; de omvang van de geïnduceerde prijsverandering; de onderlinge afhankelijkheid van de desbetreffende goederen waaruit de surpluseenheid is samengesteld; de verhouding van de waarde van de samenstellende

goederen t.o.v. die van het totale bruto nationaal produkt.

10. Directe landbouw-inkomenssubsidies zijn meer gericht tegen de symptomen dan tegen de fundamentele oorzaken van inkomensverschillen. Wanneer echter het voornaamste politieke oogmerk is de landbouw-inkomens te garanderen, dan vormen directe landbouw-inkomenssubsidies het meest geëigende middel, omdat een dergelijk beleid minder verstorend en tevens veel goedkoper is dan een beleid dat inkomens garandeert d.m.v. directe landbouw-input- of directe landbouw-outputsubsidies.

11. Directe landbouw-outputsubsidies, bezien binnen een partieel evenwichtsmodel, zijn ofwel indirecte overdrachtsbetalingen (i.c. belastingen) van consumenten aan boeren zonder extra welvaartsverliezen voor de consumenten, ofwel directe overdrachtsbetalingen van consumenten aan boeren of overheid met extra welvaartsverliezen voor de consumenten.

12. In het algemeen zal het onzeker zijn of boeren voordeel zullen hebben van een stabilisatie van outputprijzen. Wel zullen waarschijnlijk door een dergelijk beleid de consumenten meestal een welvaartsverlies lijden (vooropgesteld dat er geen sprake is van grote schommelingen van voedselprijzen).

13. Gesteld werd, dat de oprichting van actieve verkoopbureaus evenals een grondige analyse van markten in ontwikkelde landen door deskundigen uit ontwikkelingslanden effectiever kunnen zijn bij het stimuleren van landbouwexport dan de instelling van landbouw-exportsubsidies.

14. Wanneer directe landbouw-inputsubsidies niet vergezeld gaan van verbeterde landbouw-technieken, zal de verschuiving van de landbouw-aanbodcurve hooguit evenwijdig zijn en met resulterende netto sociale lasten.

15. Het verbruik van landbouw-inputs wordt bepaald door een groot aantal verschillende factoren die aan de inputvraag- en aanbodzijde een rol spelen. Een landbouw-inputsubsidie daarentegen, beïnvloedt slechts enkele van deze factoren en bovendien tot op zekere hoogte op onvoorspelbare wijze.

Deel Twee

16. De empirische raming van de welvaartseffecten van landbouwsubsidies is buitengewoon moeilijk wanneer een groot aantal subsidie-programma's gelijktijdig wordt uitgevoerd. Om deze reden is een juiste vaststelling van de "subsidy-mix" inzake de financiële doelmatigheid in het bereiken van de doelstellingen alleen mogelijk, wanneer het totaal aantal steunmaatregelen beperkt is.

    Een tweede reden om met landbouwsubsidies op beperkte schaal te beginnen is gelegen in het feit dat de meeste nieuwe subsidieprogramma's lijden aan administratieve kinderziektes. De kosten van deze kinderziektes kunnen nu zo laag mogelijk gehouden worden door subsidie-programma's zo veel mogelijk te laten profiteren van de ervaring opgedaan bij vroegere programma's.

17. Voor de bepaling van de optimale "subsidy-mix" in een dynamische context zijn statistische gegevens omtrent de betreffende subsidies onontbeerlijk. Hierom is het ook aan te bevelen een deel van het toegewezen subsidiebudget te bestemmen voor de verzameling en verwerking van deze statistieken.

18. De empirische studie van arbeids-distorsies in de landbouwsector van Trinidad en Tobago heeft laten zien hoe met behulp van geschatte produktiefuncties een onderscheid gemaakt kon worden tussen landbouwproduktie met deze distorsie en die zonder deze distorsie.

19. Gesteld werd, dat landbouwsubsidie-programma's alleen succesvol

kunnen zijn als producenten streven naar een zo hoog mogelijke winst en dientengevolge rationeel reageren op geïnduceerde veranderingen van relatieve prijzen. Een praktische methode om een prijsrespons te meten wanneer men alleen de beschikking heeft over een dwarsdoorsnede van agrarische gegevens, is de genormaliseerde beperkte winstfunctie (NRPF) benadering.

20. Een ernstige beperking van de "NRPF"-aanpak is dat deze benadering niet kan worden toegepast wanneer de landbouwprijzen gefixeerd zijn. Hierbij kan worden opgemerkt dat bij rigide landbouwprijzen een optimale respons op subsidie toch twijfelachtig is.

21. Elasticiteiten die indirect zijn ontleend aan de "NRPF" zijn betrouwbaarder dan die welke direct zijn afgeleid van uit-één-vergelijking bestaande produktiefuncties. Zowel het teken alswel de relatieve grootte van de desbetreffende elasticiteiten kunnen bij de beide methodes niettemin overeenstemmen.

22. De empirische analyse laat zien dat de landbouw-inputsubsidies geen effect hadden op het verbruik van inputs door akker- en tuinbouwproducenten. Afgezien van monopolie in het aanbod van landbouw-inputs, konden fundamentele administratieve gebreken die ten grondslag lagen aan de mislukking van het subsidieprogramma geïdentificeerd worden.

23. In de ex-ante analyse van een subsidie op kunstmest werd geraamd dat de schaduwprijs van de besparing in deviezen door het subsidiëren van uitsluitend locaal geproduceerde kunstmest relatief hoog zou zijn geweest.

24. De berekende ontleding van de produktiewaarde van akker- en tuinbouwgewassen in een prijs- en een hoeveelheidscomponent leverde steun op voor een prijsstabilisatie-programma dat voordelig zou zijn voor de producenten.

25. In de ex-ante analyse van landbouw-outputsubsidies werd het concept van garantiedrempelprijzen geïntroduceerd. Binnen het raam van een partieel evenwichtsmodel werd een sensitiviteitsanalyse uitgevoerd om de relatieve financiële doelmatigheid van een aantal, tegen de distorsie gerichte, garantiedrempelprijzen te kunnen vaststellen.

Personalia van promovendus:

Geboren 17 oktober 1948 te Haarlem;
Tropische Landbouw te Deventer, 1966-1967, 1969-1971;
Economie te Groningen, 1973-1977;
Ontwikkelingseconomie te Wageningen, 1976-1977;
Doctoraal keuzevakken: statistische analyse, methoden en technieken van economisch onderzoek, methodologie;
Wetenschappelijk medewerker landbouwstatistieken van het C.B.S. (steekproeven, prognoses), 1978-1980;
Beleidsmedewerker Directie Marktordeningsvraagstukken van het Ministerie van Landbouw en Visserij, 1981-1982, 1984-1985;
Research fellow en lecturer bij het Department of Agricultural Economics van de University of the West Indies, 1982-1984.

Achtergrond van het promotie-onderzoek:

Het promotie-onderzoek werd voorbereid te Trinidad en Tobago in bovengenoemde periode en hield verband met een door de plaatselijke overheid ingesteld onderzoeksproject naar de effecten van de (omvangrijke) landbouwsubsidies.
Het onderzoek heeft voorts geprofiteerd van de aanwezige kennis van de E.G.-landbouwsubsidies.