ASSESSING THE COMPARATIVE ADVANTAGE OF PAKISTAN'S OILSEED AND EDIBLE OIL INDUSTRY

by

Amir Mahmood

A thesis
presented to the University of Manitoba
in fulfillment of the
thesis requirement for the degree of
Ph.D
in
Economics

Winnipeg, Manitoba

ISBN 0-315-76767-7

ASSESSING THE COMPARATIVE ADVANTAGE OF PAKISTAN'S OILSEED AND EDIBLE OIL INDUSTRY

BY

AMIR MAHMOOD

A thesis submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

DOCTOR OF PHILOSOPHY

I hereby declare that I am the sole author of this thesis.

I authorize the University of Manitoba to lend this thesis to other institutions or individuals for the purpose of scholarly research.

Amir Mahmood

I further authorize the University of Manitoba to reproduce this thesis by photocopying or by other means, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

Amir Mahmood

ABSTRACT

This study evaluates the economics of indigenisation of Pakistan's oilseed and edible oil industry and estimates its comparative advantage. Specifically, this thesis examines issues such as: the comparative advantage of the oilseed production, the comparative advantage of edible oil production on the basis of oilseed processing technologies, the determinants of Pakistan's comparative advantage in the production of oilseed and edible oil, and the financially profitability of oilseed and edible oil production.

To empirically estimate the comparative advantage of Pakistan's oilseed and edible oil industry, the study develops oilseed and edible oil sector models based on the Domestic Resource Cost (DRC) criterion. To estimate these models the thesis provides a procedure, first to break down the total cost of producing a unit of oilseed or edible oil into traded and non-traded cost components, second to evaluate traded and non-traded inputs as well as the outputs at their shadow prices, and third to estimate shadow prices of land, labour, capital, and foreign exchange.

Our research shows that Pakistan exhibits a comparative advantage in the production of oilseeds. With the exception of cottonseed, the comparative advantage of all the oilseeds

depends on per acre yields and the international farm-gate prices. For cottonseed, the comparative advantage is more sensitive to changes in the price of cotton lint than the international farm-gate price of cottonseed. The comparative advantage of all the oilseeds is relatively insensitive to changes in shadow prices of the domestic productive factors and traded cost component.

The edible oil producing sector exhibits a comparative advantage in the production of cottonseed and rapeseed/mustard oil which is independent of the choices that govern oilseed extraction techniques. There also exists a comparative advantage in the production of sunflower and soybean oil through solvent technology. Production of sunflower oil through expeller technology shows a comparative disadvantage. With the exception of cottonseed oil, the comparative advantage of edible oil production through solvent technology is sensitive to changes in oilseed yields, oil recovery rates, and international edible oil prices. Given depressed international prices of palm oil, Pakistan's future comparative advantage in edible oil production will depend on the country's commercial policy towards palm oil imports.

This thesis concludes that indigenisation of oilseed and edible oil industry is an economically efficient way of saving foreign exchange. The benefits of indigenisation of the oilseed and edible oil production would be enhanced by improving oilseed yields and assuring an economic environment in which oilseed growers will expand production.

ACKNOWLEDGEMENTS

Towards the completion of this thesis a number of individuals and institutions have been generous in offering their whole-hearted help and support. To them I would like to extend my appreciation and thanks.

I am highly indebted to my thesis advisor, Professor Henry Rempel, for encouraging me to undertake this research and providing me valuable suggestions and expertise at all stages of this study. I am also profoundly greatful to my other thesis committee member, Professor John Grey, for his guidance in the organization and the writing of this thesis. I am greatly benefited from his important suggestions towards the improvement of this study.

I am thankful to my external examiners, Dr. M. Ghaffar Chaudhry of Pakistan Institute of Development Economics, and Professor Gary Johnson of the Department of Agriculture Economics, for making valuable suggestions.

I would also like to express my gratitude to Agriculture Canada, Pakistan Institute of Development Economics, and the Department of Economics, for providing me necessary assistance and support to complete this study.

I would also like to express my appreciation to Professor John Loxley, Head, Department of Economics, University of Manitoba, for his encouragement and support during the course of this study.

Finally, I would like to express my sincere appreciation to my wife, Shahina, and to my three young children, Umayr, Taaha, and Lina, for their patience, support, and understanding during my years as a graduate student. To end, I wish to express my deep love and appreciation to my family and to my mother, Apaji, for their enormous contribution towards my success.

CONTENTS

LIST OF TABLES

Chapter I

INTRODUCTION

Food deficit problems in the developing countries pose serious constraints on their future development and economic growth. Pakistan has been facing a serious challenge to address the food deficit problem in the edible oil sector of its economy for the past two decades. The domestic production of the edible oil has risen from 210,000 tons in 1970-71 to 400,000 tons in 1987-88. On the other hand, in order to meet the growing demand, the edible oil imports have risen from 82,000 tons in 1970-71 to 961,000 tons in 1987-88 [Sharif:1989]. Table 1 highlights the trends in domestic production of edible oil and growing significance of imports to meet the domestic requirements.

Any attempt to solve the food deficit problem in the long term will be a fruitless exercise if it overlooks the root causes of the problem. In Pakistan, the food deficit problem in the oilseeds and edible oil sector has now turned into a major crisis, with serious implications for the rest of the economy. In order to understand the nature of Pakistan's edible oil problem there is a serious need to analyze the various dimensions of the present problem.

TABLE 1

Domestic Production & Edible Oil Import

Year	Domestic Production	Import	Import as % of Total Availability
1970-71	210	82	28.1
1971-72	252	70	27.8
1972-73	252	72	22.1
1973-74	236	171	41.9
1974-75	220	198	47.4
1975-76	184	270	59.5
1976-77	175	285	62.0
1977-78	212	298	58.4
1978-79	183	361	66.4
1979-80	228	439	65.8
1980-81	246	471	67.6
1981-82	260	624	72.6
1982-83	275	657	72.5
1983-84	200	857	81.1
1984-85	262	684	72.8
1985-86	340	825	72.3
1986-87	371	740	66.6
1987-88	400	961	70.6

Source: Sharif, Mohammad. "Edible Oils Supply and Demand Situation in Pakistan", Ministry of Food and Agriculture, Government of Pakistan, Islamabad, 1989.

Edible oil is an essential ingredient in cooking in Pakistan and throughout South and South East Asia. In Pakistan a large proportion of total edible oil supply is in the form of vegetable ghee, a solid cooking fat. The most common practice of making vegetable ghee is from a mixture of indigenous cottonseed oil and imported soybean and/or palm oil. The consumption of refined liquid cooking oil is low but is growing among the more educated and wealthier, owing to its lower health risks.

Pakistan's total edible oil consumption, according to the Office of International Cooperation and Development [1984:7], has risen dramatically, from 414,0000 metric tons in 1973/74 to about 1,175,000 tons in 1985/86, an increase of 184 per cent over eleven years. In per capita terms, availability of edible oil has risen steadily since the 1970s. Per capita availability of edible oil has risen from 6.3 kilograms in 1979/80 to 11.2 kilograms in 1987/88. Since 1987-88, per capita availability of edible oil has been on the decline and reached to a figure of 9.78 kg/per capita/year in 1989-90 [Economic Survey:1990]. Although these estimates point towards an increase in the per capita consumption of edible oil in Pakistan since early 1970's, the per capita consumption of edible oil is still low when compared to developed nations and other developing countries.

While the consumption of edible oil in Pakistan has been increasing at a rate of 7 per cent per annum since 1980, domestic production has increased at an annual rate of only 2 per cent. This situation has resulted in a widening consumption-production gap in the Pakistan's edible oil sector.

For the past several years, with stagnant production levels and rapidly increasing demand, Pakistan has been importing edible oil in order to bridge this food sub-sector deficit. In 1987-88, Pakistan met 70 percent of its edible oil consumption requirements through imports [Sharif:1989]. While the total import volume has risen by 285 percent from 1977- 78 to

1987-88, from 249,000 metric tons to 961,000 metric tons, the import bill has risen to 277 %, from U.S. $148 million to U.S. $411 million during this time period. [World Bank: 1989].

Bridging this food sub-sector deficit with imports poses a serious balance of payment problem for Pakistan's economy. Given the present state and performance of the domestic oilseeds and edible oil sector, it is quite likely that Pakistan will become increasingly dependent on edible oil imports. According to an estimate by the United States Agency for International Development (USAID) [1985:8], the import figure may rise to 2.6 million tons by 1994, costing U.S. $2.4 billion in terms of foreign exchange. Foreign exchange costs of this magnitude not only drain the country's scarce foreign exchange reserves but also cause enormous problems for the balance of payments. An adverse balance of payment position has the potential to seriously affect the structure as well as performance of the economy.

The extent of foreign exchange drain, apart from the volume of edible oil imports, depends on edible oil prices in the international market. According to a F.A.O.[1986.9] estimate, international edible oil prices will rise by at least 30 percent in the next five to ten years. This increase in the edible oil prices in the international market will cause the balance of payment position to deteriorate further.

Pakistan's liberal edible oil imports, a major item on the country's import list, has further increased its foreign debt. The external debt has risen from U.S. $ 10 billion in 1980 to U.S. $ 17 billion in 1988. This is 45.6 percent of the country's Gross Domestic Product (GDP). Debt service ratio increased from 14.8 percent in 1981 to 24.7 percent of the GDP in 1988. Debt service payments, which totaled U.S.$ 855 million in 1980, rose to U.S. $ 1,818 million in 1988, worsening the country's foreign exchange reserve position [World Debt Tables:1990].

The ablity to finance an increasing level of edible oil imports, to a large extent, depends on Pakistan's ablity to generate foreign exchange. About 90 percent of the Pakistan's export earnings relies on the world demand for its primary commodities, i.e., cotton and rice and agro-based manufactures [ADB:1990]. Adverse world demand conditions and production problems or unfavourable world prices for these primary commodities, can seriously limit Pakistan's foreign exchange earning capacity. The strain on foreign exchange reserves is even more severe because 85 per cent of the domestic edible oil supply relies on the seed cotton crop. An adverse demand and/or supply shock to cotton export may further limit the domestic edible oil supply. This can lead to more imports of edible oil and places further pressure on the country's balance of payments position.

Pakistan's ablity to generate foreign exchange, and thus adequately service the balance of payments, becomes more important due to the volatile nature of foreign exchange inflow, which is a function of workers remittances, and the geo-political nature of foreign loans and aid. In 1982-83, foreign exchange earned through remittances was 10 percent higher than merchandise export earnings and it financed 51 percent of country's merchandise import. It has been argued that an inflow of foreign remittances has helped the labour exporting countries to finance liberal food imports; this may also be true for Pakistan. Any future reduction in the foreign exchange earnings through this channel will not only adversely effect the balance of payment position but also undermine the overall structure of the economy. Under these conditions a rapidly growing food gap in the edible oil sector and attempts to bridge this gap through imports will have serious repercussions for rest of the economy.

Though a skillful implementation of trade management techniques, e.g., future trading, hedging, buffer stock and counter trading, may lessen the burden of the growing import bill to some extent in the short run. Any long run solution to the food deficit problem in the edible oil sector will remain in the form of an expansion of domestic oilseed and edible oil production. An increase in the domestic production will save scarce foreign exchange resources by curbing the import levels of edible oil.

However, any long-term solution of the present problem, in terms of increasing the domestic production of edible oil must consider the question of existing as well as future comparative advantage of the oilseed and edible oil industry. This in turn will determine the extent of present and future efficiency with which the industry can save foreign exchange through domestic production. If the domestic oilseed and edible oil industry exhibits a comparative advantage in the production of oilseed and edible oil then an expansion of the industry will not only save foreign exchange but it will also contribute to GDP and welfare of the society. Moreover, if the increased production of oilseeds results from the use of previously unproductive lands then a policy of indigenisation will also contribute to the efficient use of country's scarce resources.

The quest for indigenisation of a domestic industry, however, will lose its economic appeal if it suffers from a comparative disadvantage not only in the present but also in the future. In that case, an expansion of the domestic industry, to reduce dependence on imports, will be an inefficient way of saving the foreign exchange. A policy of indigenisation under these conditions can only be advocated on socio-political grounds, where foreign exchange saving is not the major policy goal. However, if the foreign exchange saving is the most compelling reason for the indigenisation policy then a country is better served importing the commodity in question.

To empirically estimate the comparative advantage of Pakistan's oilseed and edible oil industry we use the Domestic Resource Cost (DRC) criterion. There have been a number of efforts to devise practical measures of comparative advantage. The most advocated and widely applied method is the use of Domestic Resource Cost (DRC) criterion to empirically estimate comparative advantage. The practical use of this concept has great appeal owing to its potential to quantify comparative advantage as well as the efficiency with which domestic resources are utilized to save or earn a unit of foreign exchange. The DRC concept is particularly useful where the official exchange rate, prices of the traded and non-traded goods and the prices of the domestic primary factors are distorted [Krueger:1975; Warr:1983; Naqvi and Kemal:1983; Nishimizue and Page:1986].

The comparative advantage is measured by estimating the DRC coefficient for a tradeable commodity. The DRC coefficient is the ratio of domestic cost of production, measured at shadow prices, to net foreign exchange savings, measured in domestic currency at the shadow exchange rate. If the DRC coefficient is less than one, i.e, the net foreign exchange savings through the domestic production exceeds its domestic cost, then domestic production is an efficient way of saving foreign exchange and the industry exhibits comparative advantage. Comparative disadvantage exists if the DRC coefficient is greater than one.

Another way to estimate comparative advantage is to compare the ratio of domestic cost (measured at shadow prices) to net foreign exchange savings (measured in foreign currency at the official exchange rate) with the shadow exchange rate. If the resulting DRC coefficient is less than shadow exchange rate then the domestic production is an efficient way of saving foreign exchange and the given industry exhibits comparative advantage. In the present study, we estimate the comparative advantage of Pakistan's oilseed and edible oil industries using the above two expression for comparative advantage.

1.1 OBJECTIVES OF THE STUDY:

The present study evaluates the economic rationale of indigenisation of Pakistan's oilseed and edible oil industries by estimating its comparative advantage using the DRC methodology. Among other factors, the major force governing the policy of indigenisation is the potential for foreign exchange savings. Hence, in the light of above argument, it is important to look at the question: What will be the domestic resource cost of saving foreign exchange through a policy of indigenisation or import substitution. More specifically, the present study is an attempt to answer questions, such as, whether Pakistan has the comparative advantage in the production of oilseeds?[1] Does Pakistan exhibit

[1] The analysis will take into account the oilseed crops which include: cottonseed, rapeseed/mustard, soybean, and sunflower, grown under irrigated as well as rainfed condi-

comparative advantage in the production of edible oils?[2] What are the factors which determine the extent of Pakistan's comparative advantage (or disadvantage) in the production of oilseed as well as edible oils? Among the given oilseeds, which oilseed exhibits the highest level of comparative advantage or disadvantage? How do various oilseeds and edible oils rank on the basis of comparative advantage? To what extent does the comparative advantage of edible oils depends upon the nature of oilseed processing technology? What is the impact of using fallow land for oilseed production on the comparative advantage of oilseed and edible oils.

The issue whether Pakistan has the comparative advantage in the production of oilseeds and edible oils is important for the society. For a private producer of oilseed or edible oil, it is the financial profitability which determines the decision to produce oilseeds or edible oils. The present study, therefore, will also address the following questions: (a) is it financially profitable for the Pakistani farmers to grow oilseeds? (b) what is the level of financial profitability in the production of the edible oils? (c) what are the factors which determine the level of financial profitability in the production of oilseeds as well as edible oils? (d) what is the impact of choice of oilseed processing

---

tions.

[2] The edible oils include:cottonseed oil, rapeseed/mustard oil, sunflower oil and soybean oil.

technique on the financial profitability of the edible oils?

Answers to the above questions will have far-reaching implications for the growth of Pakistan's oilseed and edible oil sector. For example, if the country exhibits a comparative advantage in the production of edible oils then the policy thrust has to be on the expansion of edible oil production to reduce the growing import bill. Similarly, an investigation regarding what determines the extent of comparative advantage in oilseed and edible oil production will help in identifying the underlying determinants of comparative advantage.

1.2 FORMAT OF THE STUDY:

Chapter 2 reviews the literature on the Domestic Resource Cost (DRC) criterion and establishes the theoretical base for the DRC methodology. The review on literature discusses the theoretical and empirical contributions in the context of DRC criterion.

Chapter 3 provides an overview of Pakistan's economy including the oilseed and edible oil sector. The purpose is to determine the importance of the oilseed and edible sector in the context of Pakistan's economy. This chapter will be divided into three sections. Section 1 describes the structure of Pakistan's economy. The existing economic structure, the share of various sectors in the national economy, and structural changes in the economy are highlighted in this section. The contribution of various sectors of the economy in country's economic development are examined. This section also highlights the broad policy environments under which this structural change took place. Section 2 analyzes the trends of major macro economic variables and their implications for the economy. Special emphasis is placed on the issue of balance of payments, debt, and Pakistan's potential to generate foreign exchange for edible oil and other imports. Section 3 focuses on the nature of edible oil crisis in Pakistan. In particular this section examines: (a) the nature of oilseed and edible oil problem in Pakistan; (b) determinants of existing production-consumption gap; and (c) structure as well as performance of the oilseed processing industry.

Chapter 4 provides the theoretical foundations for this study. A series of models are developed to study Pakistan's comparative advantage in the production of oilseeds and edible oils. Models concerning the financial profitability of the oilseed as well as edible oil production are also presented in this chapter.

Chapter 5, which deals with the estimation procedure for DRC coefficients, consists of three major sections. Section 1 deals with the decomposition of total cost of production into its tradeable and non-tradeable cost components. Second 2 outlines the procedures used to evaluate traded as well as non-traded material inputs and outputs at their economic or shadow prices. Section 3 estimates the shadow prices of labour, capital, land, and foreign exchange.

On the basis of our theoretical framework and estimation procedure, Chapter 6 provides and discusses the estimation of the following:

(a) Comparative advantage of oilseeds, as reflected by their respective domestic resource cost (DRC) coefficients.

(b) Comparative advantage of the edible oils, on the basis of alternative oilseed processing technologies.

(c) Ranking of the oilseeds according to comparative advantage.

(d) Ranking of edible oils according to comparative advantage.

(e) Sensitivity analysis regarding the comparative advantage of oilseeds.

(f) Sensitivity analysis regarding the comparative advantage of edible oils.

(g) Estimation of financial profitability of oilseeds.

(h) Estimation of the financial profitability of edible oils on the basis of alternative oilseed processing technologies.

(i) Sensitivity analysis regarding the financial profitability of oilseeds and edible oils.

Chapter 7 provides the conclusions and policy implications drawn from the study.

Chapter II

DOMESTIC RESOURCE CRITERION: A REVIEW OF THE LITERATURE

2.1 INTRODUCTION

The Domestic Resource Cost (DRC) criterion has been an effective tool to measure the social opportunity cost of domestic resources of earning or saving foreign exchange [Bruno:1967], [Krueger:1972], [Bhagwati and Srinivasan:1978], [Kirkpatrick, Lee and Nixon:1984] Findlay [1971]. Pearson [1976], argues that the DRC coefficient or ratio is a measure of the social opportunity cost, in terms of domestic resources employed by an activity, of earning or saving foreign exchange.

The first systematic development of the DRC criterion is associated with Bruno [1967], whose original intent was to use this criterion as a "normative" ex ante measure of comparative advantage. Bruno [1972], however, argued that it is difficult to deny the potential of the DRC criterion as ex post measure of the opportunity cost incurred by an economy to operate its existing trade related activities. Bruno [1967], attempts to devise an investment criterion for the planning of the external sector, which can provide some quantitative expression to the underlying principles of comparative advantage.[3] According to Bruno [1967],

> It would pay to promote export of an industry if the real benefits of foreign exchange earned are greater than the real cost of production in terms of opportunity cost foregone. Similarly for expansion or setting up of an import substituting industry, it pays to promote import substitution in a particular industry if the real benefits in terms of foreign exchange cost saved is greater than the real cost of production in terms of opportunity cost foregone [Bruno, 1967:99-100].

In particular as a guiding rule, Bruno [1967], calls for the establishment or expansion of only those activities for which the DRC coefficient, i.e, the ratio of domestic cost, measured in domestic currency at the shadow prices, to net foreign exchange savings, expressed at the official exchange rate in the foreign currency, is below or at most equal to the accounting (shadow) exchange rate. Defined as such, this criterion is nothing but,

> An expression of the comparative advantage principle. The opportunity cost of foreign exchange [shadow exchange rate] gives the relevant efficiency norm with which the efficiency of individual industries is compared [Bruno, 1967:102].

---

[3] Balassa and Schydlowsky [1968], however, preferred the use of Effective Rate of Protection (ERP) as a measure of static comparative advantage and a criterion for resource allocation. Where, the ERP is defined as the percentage excess of domestic value added obtainable because of protection over value added in a free trade situation. Krueger [1972], Bruno [1972], and Bhagwati and Srinivasan [1978], however, reject Balassa and Schydlowsky [1968] claim. For a detailed discussion on the debate between ERP and DRC criterions and the superiority of DRC criterion as measure of comparative advantage, see Balassa and Schydlowsky [1968], [1972], Findlay [1971] Krueger [1972], Bruno [1972], Pearson [1976], Bacha and Taylor [1971,1973], Schydlowsky [1984], and Bhagwati and Srinivasan [1978].

2.2 DOMESTIC RESOURCE COST CRITERION: THE MEASUREMENT

Bruno [1967], derives the DRC of a unit of foreign exchange for a domestic activity by first estimating the "net benefits" of the project.[4] Where the net benefit of a domestic project j, NBj, can be expressed as:

$$NBj = \sum_{i=1}^{n} Aij \quad Pi \quad + \sum_{s=1}^{m} Fsj \quad Vs \qquad (1)$$

Where,

Aij = coefficient for n commodities in terms of input or outputs, where i = 1, 2, 3,........n
Pi = shadow or accounting prices for the commodities
m = number of primary factors
Fsj = coefficient for s primary factors, where s = 1, 2,...m
Vs = shadow or accounting price for the primary factors, Where s = 1, 2, 3, ...,m
(the positive coefficient in the above formulation will represent an output and negative coefficient an input of the commodity or factor of production).

Now, assuming that the first primary factor is foreign exchange,measured in foreign currency, we can express (1) as:

$$NBj = F1j \; V1 \; + \sum_{s=2}^{m} Fsj \; Vs \qquad \sum_{i=1}^{n} Aij \quad Pi \qquad (2)$$

Where,

V1 = accounting or shadow exchange rate (SER)
F1j = foreign exchange coefficient

But,
F1j = Uj - Mj

Where,
Uj = marginal revenue, in terms of foreign exchange, from the commodity in question

---

[4] Given that Bruno [1967], uses the social opportunity costs or shadow prices for his analysis "net benefits" can also be implied as net social benefits or net social profitability, as expressed by Pearson [1976] and Warr [1983].

(fob price for export and cif price for import substitutes)

Mj = import requirements for the production of unit of the commodity in terms of foreign exchange

Substituting for F1j V1, (2) can be expressed as:

$$NBj = (Uj - Mj) SER + \sum_{s=2}^{m} Fsj\ Vs + \sum_{i=1}^{n} Aij\ Pi \qquad (3)$$

Now, instead of estimating NBj in (3), and determining whether the net benefits (or net social profitability) of the project is positive or negative, an alternative way is to select any primary factor, e.g., foreign exchange (which appears on the right hand side of the above equation) and compare the implied return to that factor with its corresponding shadow price. According to Bruno,

> This is often done with respect to the factor capital and is equivalent to the use of the " rate of return " criterion. The DRC criterion is nothing but an application of this idea to the factor foreign exchange [Bruno, 1972:19].

The DRC per unit of foreign exchange, which is simply the opportunity cost of earning or saving a unit of foreign exchange, in terms of domestic resources can be found by setting NBj = 0 in (3) and solving for SER. Hence, the domestic resource cost per unit of foreign exchange for the project j can be given as:

$$DRCj\ (direct) = \frac{\left(\sum_{s=2}^{m} Fsj\ Vs + \sum_{i=1}^{n} Aij\ Pi \right)}{Uj - Mj} \qquad (4)$$

The first term in the numerator of DRCj is the <u>direct</u> value added of domestic factors, e.g., labour, capital, and land, evaluated at corresponding shadow prices or opportunity cost. The second term is the accounting value of the domestic nontraded commodity inputs, being used in the production of j's output. The denominator shows net foreign exchange earned or saved. It is the "international free trade value added". Thus ratio DRCj measures the domestic resource cost per unit of foreign exchange.

The above measure of DRC per unit of foreign exchange (or simply the DRC ratio), is based on " direct input analysis" whereby the domestic resource cost is expressed in terms of direct inputs of the commodities and primary factors. This measure is labeled as <u>direct</u> DRC per unit of foreign exchange.[5]

The DRC ratio, however, can also be expressed in an equivalent manner. According to this measure, all the implied costs of a project are expressed in terms of direct and indirect contribution of the primary factors (in the sense of Leontief input-output system). Whereas these primary factors are evaluated at their shadow prices as above. Now one can represent net benefits of a project as:

$$NBj = (Uj - \bar{M}j)\ SER + \sum_{s=2}^{m} \bar{F}sj\ Vs \qquad (5)$$

Where,

[5] See Bruno [1967: 88- 116 and 1972: 16:33] for numerical example and theoretical treatment.

$\bar{M}j$ = total (direct plus indirect) unit import requirements for the production of the commodity in jth activity

$\bar{F}sj$ = total (direct plus indirect) quantity of sth domestic factor employed in the jth activity (the absolute value of $\bar{F}sj$ will always be grater than Fsj, as $\bar{F}sj$ includes direct plus indirect contributions)

The domestic resource cost per unit of foreign exchange, which in the present case is usually labeled as the <u>total</u> DRC ratio as opposed to the <u>direct</u> DRC ratio, can be determined as before. The total DRC per unit of foreign exchange can be given as:

$$DRCj\ (total) = \frac{\sum_{s=2}^{m} \bar{F}sj\ Vs}{Uj - \bar{M}j} \qquad (6)$$

Once again the numerator in DRCj corresponds to net domestic resource cost. Whereas the denominator is the net foreign exchange earned (in case of exports) or saved (for import substitutes). Moreover, all the factor costs, incurred directly or indirectly in producing intermediate inputs of the jth activity are divided into foreign and domestic components.

The two measures, the **direct** and the **total** measures of estimating DRC per unit of foreign exchange are equivalent if one uses the correct evaluation procedure.[6]

[6] Bruno [1967:91-103] makes use of a numerical example to demonstrates that (4) and (6) are equal if one uses the accurate shadow prices.

> Either we look at the direct cost structure of a unit produced [direct DRC ratio or (4)] or we look at its cost structure in terms of primary factors of production when both direct and indirect inputs are taken into account [total DRC ratio or (6)], since we use correct prices throughout the two methods should yield the same result [Bruno, 1967:97].

Comparing (5) and (6) one gets the following expression.

$$\frac{NBj}{Uj - \bar{M}j} = SER - DRCj \qquad (7)$$

According to Bruno [1967], as net foreign exchange earned (or saved) i.e., the numerator on the left hand side of (7), should always be positive, one obtains the following relationships.

$NBj = 0$	implies that	$DRCj = SER$
$NBj < 0$	implies that	$DRCj > SER$
$NBj > 0$	implies that	$DRCj < SER$

The above relationships imply that one can accept or reject an export or import substituting project depending on whether DRCj is greater or less than the shadow exchange rate.

Realizing that foreign exchange costs comprise not only imported raw materials but also imported capital equipment, Bruno [1967], breaks down capital cost component into domestic and foreign expenditures. Hence (6) can be expressed as:

$$DRCj = - \frac{\sum_{s=2}^{m-1} Fsj\ Vs + \bar{K}j\ W'r}{(Uj - \bar{M}j + \bar{U}j\ r)} \qquad (8)$$

Where,

$\bar{K}j\ W'$ = total (direct plus indirect) domestic part of the capital stock, measured in domestic currency

$\bar{U}j$ = total (direct plus indirect) foreign part of the capital stock, measured in foreign currency.

r = real rate of interest

In his latter contribution, Bruno [1972] down plays the need for equation (7). Instead he stresses that the portion of the capital stock that is itself imported need to be included under net import requirements in the denominator of (6), and the domestic capital should be included in the numerator. Similarly one should treat all the primary factors on the same lines.

Bruno's [1967] treatment of DRC criterion presupposes the existence of a full programming model and an accurate and detailed input-output table for the economy. This implies that given the above set of information one can easily get the required shadow prices of the primary factors and also estimate the total primary input coefficient for various commodities. But one needs to acknowledge that in reality it is difficult to have an ideal set of conditions as outlined above. However, the great potential of the DRC criterion lies in the fact that the,

> full rationale [of DRC criterion] can be followed by approximation even when the underlying theoretical framework cannot be given full empirical content [Bruno, 1967:108].

According to Bruno [1967] the DRC criterion usually requires the shadow prices of labour and capital. Market prices of these factors can be used to reflect the true social costs. However, if the markets of these factors are distorted, then it is necessary to use trial accounting or shadow prices as suggested by Tinbergen [1955].[7] Similarly, in the absence of an input-output framework, computation of indirect coefficient can be approximated by calculating the most important primary factor e.g., an import component, using partial iterative methods.[8]

Bruno [1967] considers the DRC criterion as a net measure in the sense that if a project generates benefits other than foreign exchange e.g., employment creation, learning effects, domestic sales of by-product, etc., then these benefits will be subtracted from the corresponding cost elements. Similarly, his treatment of net benefits (NB) incorporates the above point.

Unlike Bruno [1967], Pearson [1976] explicitly incorporates the external effects of a project in the computation of DRC ratio and net benefits of the project. Pearson [1976], however, terms net benefits (NB) of a project as net social profitability (NSP).

---

[7] According to this method first one analyzes a project with given accounting or shadow prices and then revises these prices intuitively, on the basis of the over all analysis of factor demand and supply [Bruno, 1967:108].

[8] For example if a project uses imported crude oil then whenever electric power appears as a cost item, one should isolate that part of the cost (of power) which originates in the derived demand for crude oil. Similarly one should also separate the foreign cost component of the power plant itself. Bruno [1967:108].

Pearson's [1976], treatment of the DRC ratio and NSP of a project are based on Bruno's [1967] work. However, he attempts to refine these concepts by introducing: i) a measure of net external benefits or cost by a project to the remainder of the economy (E); and ii) a measure of total (direct plus indirect) value of repatriated earnings of foreign owned factors of production employed by the project in question (r), measured in foreign currency. This includes the repatriated portion of the direct foreign cost and indirect foreign factor costs. Following Bruno's [1967] line of reasoning, the DRC per unit of foreign exchange of a project j (DRCj) and the net social profitability (NSPj) can be expressed as follows:

$$NSPj = (Uj - \bar{M}j - Rj)\ SER - \sum_{s=2}^{m} Fsj\ \bar{V}s + Ej \qquad (9)$$

and

$$DRCj = \frac{\sum_{s=2}^{m} Fsj\ \bar{V}s - Ej}{Uj - \bar{M}j - Rj} \qquad (10)$$

It is easy to demonstrate that the introduction of the above refinements by Pearson [1976] do not affect Bruno's [1967] earlier results. One still comes up with the results where,

$$NSPj \ \begin{matrix} > \\ = \\ < \end{matrix} \ 0 \ \text{ implies that } \ DRCj \ \begin{matrix} < \\ = \\ > \end{matrix} \ SER$$

Hence,

> an activity is socially profitable if its DRC ratio [DRCj], which measures its efficiency in

> transforming domestic resources into foreign exchange, is less than the shadow price of foreign exchange [Pearson, 1976:324].

Warr [1983], also confirms the validity of the observed relationship among DRC ratio, NSP criterion and SER, as demonstrated by Bruno [1967] and Pearson [1976]. However, he argues that the observed relationships do not imply that the ranking of a set of mutually exclusive projects, according to the DRC criterion, will also give similar ranking in terms of social profitability. According to Warr [1983], the above problem does not arise if the criterion is to accept all the projects for which DRC < SER. However, problem arise when more than one set of a class of mutually exclusive projects fulfills this criterion, as a choice must be made among these projects.

In order to support the above claim, Warr [1983] demonstrates that under certain conditions a ranking of mutually exclusive projects on the basis of DRC ratios does not corresponds to the ranking based on the net social profitability criterion. In the case of two mutually exclusive projects, A and B, he shows that DRCa < DRCb. According to DRC criterion, therefore, one should prefer project A, as its DRC ratio is less than that of project B. However, as Warr [1983] shows, the above preference of project A over project B is based on a wrong ranking in terms of net social profitability criterion. As on the basis of net social profitability criterion NSPa < NSPb, under given conditions.[9]

Although in a theoretical sense the DRC ratio and NB or NSP of a project are considered similar concepts, Bruno [1967, 72] prefers the use of DRC ratio over NB criterion. He argues that the DRC criterion must be used whenever the foreign exchange costs (direct or indirect) are a significant cost component of the project under consideration. This is especially true when the official exchange rate does not reflect the opportunity cost of the foreign exchange, which is usually the case in most developing countries. Under these circumstances, where one has knowledge of the shadow prices of other primary factors such as labour and capital, one should use the DRC ratio rather than the NB criterion to compare various projects. Since the latter is highly sensitive to the valuation of the foreign exchange, the DRC ratio is also preferable to NB criterion as it explicitly measures the comparative advantage.

Pearson [1976] also contrasts the suitability of the DRC and NSP criterions. However, he makes a distinction between ex post and ex ante measures of the DRC ratio in this regard. In case of ex post analysis of costs of distortions, the NSP criterion is preferable to the DRC criterion. The DRC ratio is subject to a systematic bias if domestic factor costs are counted as foreign costs or the foreign costs are

[9] This reversal of ranking occurs only when the two projects have different net foreign exchange earnings under given conditions as outlined by Warr. For more details see Warr [1983:304-5].

taken as domestic costs.[10] The inclusion of foreign costs as domestic costs will understate the DRC ratio, if the true value of this ratio is greater than the shadow price of the foreign exchange. Similarly, it will overstate the DRC ratio if the true value of DRC ratio is less than the shadow price of the foreign exchange. One can avoid this problem by using a particular formulation of NSP which does not depend on the decomposition of total costs into domestic and foreign components.[11]

Also in the ex post sense the NSP criterion is preferable to DRC criterion in instances where trade distorting policies are in effect and the computations are in terms of domestic currency. Under this set of conditions the estimation of the NSP of a project is straightforward and quite simple. On the other hand the estimation of the DRC ratio is tied up with the foreign exchange rate, as the DRC ratio depends upon the choice of foreign exchange rate being selected to convert net foreign exchange earned or saved, from domestic to foreign currency. [Pearson, 1976:329].

---

[10] The bias arises when one uses some rough methods to breakdown the total cost of a project into domestic and foreign components. Bruno [1967:113-114] is the first to point out such possibility and its implications for the DRC ratio.

[11] According to this formulation,

$$NSPj = \sum_{i=1}^{n} Aij\ Pi - \sum_{s=1}^{m} Fsj\ Vs$$

Pearson [1976:325].

In the ex ante analysis of alternative investment projects the DRC criterion is preferable to the NSP criterion. The advantage of using the DRC ratio lies in the fact that in ranking the alternative socially profitable projects,

> The DRC ratio does not depend on the choice of the shadow price of the exchange rate [Pearson, 1976:329].

One, however, may disagree with the above argument as it is the ranking of alternative projects based on DRC ratio which is invariant to shadow price of foreign exchange and not the DRC ratio itself. Pearson [1976], however, acknowledges that

> In a DRC analysis, the shadow price of foreign exchange ultimately has to be introduced in order to provide a cut-off point for project selection (where the DRC ratio of the least socially profitable project is just less than the [shadow] exchange rate [Pearson, 1976:329].

2.3 DRC COEFFICIENT AND THE CUT-OFF RULE

Like Bruno [1967], Pearson [1976] also calls for a cut-off rule for project selection. The rule requires a comparison between shadow price of foreign exchange and the DRC ratio under consideration. For Pearson [1976], in instances whereby one believes that trade distorting policies are going to continue, the shadow price of the foreign exchange should incorporate the resulting misallocation of resources. However, in the case of free-trade, where one assumes that the trade-distorting policies will be removed, the shadow price of foreign exchange must reflect the equilibrium exchange rate.

Bacha and Taylor [1973] also support the claims that the DRC criterion is a perfect method to rank an investment project in a disequilibrium economy. For them the DRC ratio simply reveals the exchange rate for the activity under consideration. In other words the DRC criterion,

> amounts to computing the exchange rate at which a project becomes competitive in the world market if its domestic material inputs are valued in domestic prices [Bacha and Taylor, 1973:27].

According to this view an analysis of export promoting and import substituting activities in terms of DRC criterion will give rise to a range of exchange rates which provide the upper and lower limits for the exchange rate, perceived to be correct by the planner. In economies with overvalued official exchange rates, the DRC ratio of import substituting projects will be comparatively higher than that of export promoting projects. Under these circumstances the planner's exchange rate should fall in between the average of import substituting and export promoting project's exchange rates i.e., the DRC ratios.

Thomas [1982], while commenting on the cut-off rule to select desirable projects, argues that the DRC ratio above the equilibrium exchange rate suggest inefficiency in transforming domestic resources into foreign exchange. Whereas a DRC ratio below the equilibrium exchange rate shows efficiency. Also in situations where the DRC ratios differ for various activities, an activity with a low DRC ratio is more efficient in saving or earning a unit of foreign exchange than one with a high DRC ratio. For Thomas [1982], this logic can be used to rank various activities or sectors according to comparative advantage.

Similarly, Schydlowsky [1984], argues that by using DRC ratios for various sectors one can rank them according to comparative advantage. However, sometimes it is appropriate to divide these activities in terms of those with comparative advantage and those with comparative disadvantage, by selecting a cut-off point. In order to define a cut- off point, Schydlowsky [1984] emphasizes that the DRC ratio is a measure of domestic welfare cost of producing a unit of foreign exchange. Hence it is desireable to undertake an activity if the welfare value of foreign exchange is at least as large as the welfare cost of producing it, as in such activity one has the comparative advantage. Now, given that the welfare value of a unit of foreign exchange is simply the shadow price of foreign exchange, Schydlowsky [1984] concludes:

> A country will have a comparative advantage in all those activities in which the domestic resource cost of production, taken at shadow prices, is less than or equal to shadow price of foreign exchange [Schydlowsky, 1984:445].

Bruno [1967, 1972], Pearson [1976], and others argue that one only requires knowledge of the shadow price of the foreign exchange in order to provide the cut-off point, and not for ranking of the various projects according to DRC criterion. Warr [1983] however, challenges this view. Warr [1983], demonstrates that under certain circumstances one requires knowledge of the shadow price of foreign exchange not only to provide an appropriate cut-off point but also to rank various projects according to DRC criterion. Hence the empirical advantage of DRC criterion, as postulated by Bruno [1967, 1972], and reaffirmed by others, loses its attraction.

2.4 DRC CRITERION: THE EMPIRICAL EVIDENCE

2.4.1 Tile Production: Israel

In order to demonstrate the empirical potential of the DRC criterion Bruno [1967] shows how this criterion has been applied in practice in an analysis to determine the profitability of a tile-producing project in Israel. The analysis deals not only with the profitability of the existing plants but also their extension. The analysis, in particular, considers three key questions: a) whether the existing plant, whose extension is being considered, is socially profitable; b) whether the excess demand be satisfied from imports or from the expansion of the domestic productive capacity and; c) whether it is socially profitable to expand productive capacity to promote exports.

The first step in the estimation of the DRC ratio of the existing plant involves an analysis of the existing cost structure of the plant at full capacity (it is assumed that the plant produces 10 million units at full capacity in the year in question). The total cost of the plant are then decomposed into domestic and foreign exchange costs.[12] Where the foreign exchange costs are valued at the official exchange rate. An attempt has been made to evaluate the domestic costs at their social prices rather than that of private costs, e.g., indirect taxes or subsidies are deducted from the calculations. Similarly water inputs are valued at real supply cost rather than at their subsidized market prices. Apart from the capital stock, where only the direct foreign exchange component is separated, foreign exchange costs should include both direct as well as indirect inputs. Where labour is valued at the market prices the shadow price of capital was assumed to be fixed at 8 percent rate of interest, for both domestic as well as imported equipment. Due to inadequate information there is no attempt to break down the indirect domestic inputs in terms of contribution of the primary factor inputs. According to Bruno [1967], this will result in a bias to the extent:

[12] Total cost is the sum of total variable costs and total fixed costs. Here the total variable costs include, raw material, packaging, auxiliary materials, power, water and fuel, repairs and maintenance, wages and salaries (including fringe benefits) and miscellaneous. The total fixed costs include, capital (at 8 per cent interest and profits), depreciation, and overheads. [Bruno, 1967:111].

> that the indirect capital does not receive an average profit of 8 per cent and to the extent that actual wages and salaries do not reflect the opportunity cost of labour [Bruno, 1967:110].

After calculating the total full capacity production costs of the plant in the domestic currency, at 1965 prices, Bruno [1967] obtains the following data in terms of per unit cost of production.

Foreign cost per unit of output = IL 0.0716 or U.S. 2.39 cents
Domestic cost per unit of output = IL 0.1035
Total cost per unit of output = IL 0.1751

Now if the cif price is 5 cents per unit, the net foreign exchange saved per unit will be simply, 5-2.39 = 2.61 i.e., the foreign exchange value of the commodity minus its foreign exchange cost component. The DRC coefficient, which is a ratio of domestic resource cost to net foreign exchange saved, can then be calculated as:

$$DRC = \frac{0.1035 \text{ (in domestic currency)}}{0.0261 \text{ (in foreign currency)}} = 3.95 \text{ IL/\$}$$

According to Bruno [1967], the resulting DRC ratio is close to the existing real rate of foreign exchange (shadow exchange rate) of 3.50 IL/$ and well under the future exchange rate of 5.0 IL/$ or more.[13]

[13] Here Bruno [1967] makes an interesting point: if one uses the usual rate of profit criterion with foreign exchange valued at the official exchange rate, the project will show a net loss.

If the project is meant to meet the export demand, then there is need to use the fob price (4 cents per unit) rather then the cif price (which is given as 5 cents per unit). For Bruno [1967] the difference in the above prices is due to transportation costs. Now the value of the net foreign exchange will be 4.0-2.39 = 1.61 cents per unit, and the DRC per unit of foreign exchange will be:

DRC = 0.1035 IL/0.161 $ = 6.43 IL/$

Given that the DRC ratio is higher than that of the real exchange rate of 3.5 IL/$ or even the future expected real rate of 5.0 IL/$, the project is clearly not profitable.[14]

Bruno [1967] then deals with the question of increasing the productive capacity of the project from 10 million to 13 million units. As this is an expansion of the existing project and not the creation of a new project, there is going to be some cost saving both in terms of fixed costs as well as in the variable labour cost (as part of the labour force is in the form of fixed cost and also there is an element of expected increase in the labour productivity). Other variable cost elements are valued at 30 percent higher level. This corresponds to the proposed increase form 10 to 13 million units in the new project. While estimating the DRC ratio as above, results indicate that the proposed expansion

---

[14] However, as Bruno [1967] points out, "if there were excess capacity in the industry it would pay to export the surplus, since in that case we would have to make the calculation only for the variable part of the production cost." [Bruno, 1967:112].

is quite profitable, as the DRC ratio is much less than that of the real rate of foreign exchange, due to low marginal costs.

While answering the question that whether the creation of this additional productive capacity is socially profitable if the sole purpose of the project is to promote export, Bruno [1967] demonstrates that it is still worthwhile to take up the project. This result implies that it is socially profitable to expand the productive capacity even further for the export market.

At the end of his analysis Bruno [1967:113-15] makes the following observations: a) ideally speaking one needs to break down the complete cost structure of a project in terms of physical units (in terms of direct and indirect primary factor inputs cost involved in each of the commodity inputs), and also an accurate estimate of relevant accounting (shadow) prices for various factors. However, in the absence of such information the rationale of the DRC criterion can still be followed and applied; b) the above analysis of the project is only a single period analysis. However, in some cases it may be important to conduct the analysis for each production period in the planning horizon, which may not be possible due to lack of information; c) the accuracy of the DRC analysis largely depends on the breakdown of costs into domestic and foreign components. Any error of specification will introduce a bias, which will over or understate the DRC ratio under consideration, depending upon the direction of this bias; d) the analysis assumes that price elasticity for a given commodity is infinite, but this may not be the case. If the price elasticity is infinite then one needs to estimate the marginal revenue rather than the average revenue, which, according to Bruno [1967], may be a difficult task. One way to address the commodity price issue is to estimate the DRC ratios under alternative assumptions regarding future world prices and hence examine the responsiveness of the results to changes in the future world prices; and e) it is also important to understand that a project may generate benefits other than foreign exchange. For example a project may generate benefits to the economy such as, by-products, labour training, employment, and positive sociological or political effects. In principle, an analysis according to DRC criterion should incorporate these benefits as well as related costs.

2.4.2 Export Protection and Import Substitution:Turkey

Based on the data regarding prices and costs of over 60 manufacturing firms, gathered through a survey in 1965, Krueger [1966] makes use of the DRC criterion in order to estimate the ex post measure of cost of protection in export as well as import substituting industries in the Turkish economy. In order to derive a measure of DRC per unit of foreign exchange, she makes the following assumptions: a) production costs are constant within the relevant range of output and the average cost of production, at full capacity, is equal to the marginal cost of additional output if new plants are built; b) domestic factor prices correctly reflect the actual resource costs; c) all cost estimates are based on full capacity levels; and d) industries under consideration exhibit infinite foreign demand elasticities.

Krueger [1966], estimates the DRC ratios for various activities by,

> taking the Turkish sale price ex factory of the product, subtracting the cif value of imported direct and indirect inputs per unit of output, [domestic value added], and dividing that estimate of cost by the estimate of international value added [Krueger, 1966:474].

Krueger [19660, derives international value added by subtracting the cif price of direct and indirect imported inputs (this includes depreciation of foreign equipments and import portion of the inputs purchase from other firms), from the cif price of the imported final output. In cases where one is dealing with exports, the cif price of the imported inputs is subtracted form the fob price of the final good, in order to get the international value added. Hence one can symbolize the above measure of DRC per unit of foreign exchange for the export or import substituting industry as follows,[15]

---

[15] Krueger [1966], however, does not explicitly express the DRC ratio in this manner.

$$DRCj1 = \frac{P_j^d - M_j}{P_j^w - M_j}$$

Here DRCji measures the domestic resource cost, in Turkish Liras i.e., TL, of \$1.00 of international value added. Where,

p_j^d = ex-factory sale price of the product produced by the activity j (price received by the firm net of any production tax)
M_j = cif value of imported direct and indirect input per unit of output.
P_j^w = cif price of the imported final good.

Initally Krueger [1966] estimates the DRC ratios for various export and import substituting industries on the basis of above formula, i.e., according to DRCj1. However, in order to address the concerns regarding the treatment of duties, taxes, interest, profit differentials and the accuracy of market factor prices as a true reflection of opportunity costs, Krueger [1966] makes adjustments in the above measure. On the basis of these adjustments, Krueger [1966] comes up with various alternative measures of DRC ratios, which can be outlined as follows:

DRCj2 ; In this measure all duties paid by a firm on imported inputs are subtracted from estimation of DRCj1.

DRCj3 ; This measure is derived by subtracting all other tax payments from the estimates of DRCj2.

DRCj4 ; This measure makes adjustment for any rent in the profitability of a good in Turkey, by recalculating what the price of the good would have been with 20 percent return on fixed investment, net of duties. Hence DRCj2 is the appropriate measure to undertake this adjustment.

DRCj5 ; This measure is derived under the assumption that debt capital also yield a 20 per cent rate of return. This exercise is carried out by dropping out actual interest costs from the unit cost estimates in DRCj4, and then adding an interest charge which is equal to 20 per cent rate of return on debt capital, at full capacity level.

According to Krueger [1966], the above alternative measures of DRC ratios are open to criticism as they assume that market prices of domestic factors truely reflect their opportunity costs.

> In particular, it is widely held that in less developed countries the price of labour is higher, and the yield on capital is lower, than would be the case with optimal resource allocation [Krueger, 1966:474].

In order to address the above concerns, Krueger [1966] tests the sensitivity of her results by re-estimating DRCj5, under the assumption that the shadow price of labour is 25 per cent below its market price and the rate of return on capital is 30 per cent. Hence, one can get another measure of DRC ratio, i.e., DRCj6, which is simply the re-estimation of DRCj5 under the new assumptions regarding shadow prices of capital and labour.

Krueger [1966] argues that, depending on whether one takes the market prices as a true reflection of the shadow prices, either DRCj5 or DRCj6 can be considered as an accurate measure of DRC per unit of foreign exchange. As the sensitivity analysis shows, it hardly matters whether one ranks the domestic industries according to DRCj5 or DRCj6, as the ranking of the industries stays almost the same.

However, the absolute values of DRC ratios are responsive to the above measures. For example in case of electric cable industry, an import substituting industry, the DRC ratio according to DRCj5 is 34.90 TL/$. But if one uses DRCj6, the DRC per unit of foreign exchange changes to 46.00 TL/$. Same is true for almost all the export as well as import substituting industries in the sample.

Although Krueger [1966] ranks various export as well as import substituting industries using the DRC criterion, unlike Bruno [1967], her analysis does not assume any shadow price of foreign exchange in order to determine the social profitability of an industry i.e., there is no cut-off rule. Nevertheless, Krueger [1966:476] makes an interesting point that,

> In a free-trade economy with an equilibrium exchange rate and no distortions, most of the import-substituting firms examined above would be contracting and the export firms expanding.

However, the above argument is hardly valid in practice as due to distortions resulting from foreign exchange control the export as well as import substituting firms face different incentives.

To make her point Krueger [1966] contrasts the actual rate of returns enjoyed by the export as well as import substituting firms to the rate of return that would be realized with free trade and without duties, with full capacity utilization, at alternative exchange rates. The results indicate that a large number of firms with the highest rate of return under free trade, would be those which have the lowest DRC ratio, at any exchange rate.[16] In reality, however, the two most profitable firms, i.e., firms with the highest rate of return, are those with the highest DRC ratios. Moreover these firms will not make any profit under free trade conditions even at a quite higher exchange rate e.g., any exchange rate up to TL27=1$, whereas the official exchange rate is only 9TL=1$.

[16] In fact there Krueger [1966:476-77] uses three alternative exchange rates: i) 9TL = 1$, ii) 18TL = 1$ and iii) 27TL = 1$.

As Balassa and Schydlowsky [1968] point out, owing to protection the domestic industries enjoy excess profits, which overstate the extent of domestic value added in these industries. To adjust for such a bias, Bruno [1967] as well as Krueger [1966] exclude any profit that exceeds a desirable (or reasonable) rate of return on fixed capital investment, in their estimation of DRC ratios. But as Balassa and Schydlowsky [1968] argue, the assumption of a uniform rate of return or profit in all industries is debatable because this assumption excludes the influence of inter-industry differences in entrepreneurship and risk. Moreover, the choice of rate of return on fixed capital is quite arbitrary. For Bruno [1967] a rate of return of 8 per cent is reseasonable, whereas for Krueger [1966] this figure is 20 per cent.

Bruno [1967] as well as Krueger, [1966] recognize the existence of overvalued exchange rates in the developing countries, and therefore emphasize the need for having a real or equilibrium exchange rate.[17] Balassa and Schydlowsky [1968], however, disagree with the above position and argue that,

---

[17] In case of Israel, Bruno [1967:110] suggest that real exchange rate is 3.50 IL/$, as compared to the official rate of 3.00 IL/$. Though Krueger [1966:469] does not specify a particular value for real or equilibrium exchange rate, she maintains that in the presence of exchange control the equilibrium or real exchange rate is not known. So under these circumstances the alternative is to estimate the DRC of foreign exchange.

> there are infinite number of "equilibrium" rates, each corresponding to a different configuration of trade, monetary, and fiscal policies. Thus if there is no unplanned reserves loss and/or capital movements, the existing exchange rate can be taken as the equilibrium rate for the domestic polices followed [Balassa and Schydlowsky, [1966 :359].

Pack [1971] also criticizes the DRC criterion as presented by Bruno [1967] and others. For Pack [1971] the criterion fails to incorporate the element of uncertainty, as unexpected changes in the world prices of either imported inputs or output can change the DRC ratio.[18] According to Pack [1971:80],

> These variations are particular important for projects in which both the value added per unit in foreign exchange and the CDA [DRC] are low. To choose such a project, over one that has a higher CDA [DRC] as well as higher value added in dollars [foreign exchange] may prove costly, since small price variations could completely eliminate the value added in the former, raising its CDA [DRC] to infinity.

This implies that in case of an import substituting industry, international price fluctuations can pose serious problems if an industry with low DRC ratio is now subject to a higher DRC ratio due to a decline in the international price of the product which it produces.

Higher DRC ratios, according to Pack [1971], do not necessarily imply an inherent comparative disadvantage which a country may suffer in case of a particular industry. It is quite possible that DRC ratios are higher owing to the exis-

[18] In stead of using the term DRC, Pack [1971] calls it CDA, i.e., Cost of Dollar Added by the domestic resources. [Pack, 1971:79].

tence of a particular type of market structure which is not efficient. This inefficiency is largely due to the existence of duplication of small-scale projects, and a failure to undertake large-size projects in those fields where potential for substantial economies of scale exist.

Pack [1971] concludes that although there is no doubt in the usefulness of DRC criterion as a measure of static comparative advantage, there is always a possibility that overtime the changing structure of an economy will result in changes in the relative efficiencies of the various domestic industries, and this will require new estimates for DRC ratios.

2.4.3 Export Promotion and Import Substitution: Chile

In an empirical study related to the Chilian economy Bacha and Taylor [1973], use the DRC criterion, as put forward by Bruno [1967] and Krueger [1966], to estimate the comparative costs to the economy of reallocating resources to either export or import substitution in the various sectors of the economy. Their estimates of DRC ratios are based on two different assumptions regarding costs. The first assumption, which they consider theoretically incorrect, is that domestic costs can be represented by domestic value added net of indirect taxes and the foreign capital costs are negligible. In the case of the alternative (or second) assumption, which they consider theoretically correct but empirically difficult, is that the domestic costs consist of payments to labour plus a normal gross rate of return to the domestic capital. Foreign costs include both intermediate imports and a gross rate of return to foreign capital.

Bacha and Taylor's [1973] empirical treatment of DRC criterion differ in the sense that instead of ranking various export as well as import substituting industries according to their DRC ratios, they prefer to rank them in terms of shadow prices of these industries. Where the shadow price of an industry is simply the ratio of DRC per unit of foreign exchange to the official exchange rate. In other words shadow price of an industry j can be given as,

$$SPj = DRCj/OER$$

Where,

Spj = shadow price of industry j
DRCj = DRC per unit of foreign exchange in j
OER = official exchange rate

Based on the alternative assumptions regarding the costs, Bacha and Taylor [1973] estimate two sets of shadow prices for the various industries.[19]

Bacha and Taylor's [1973] results, which are based on the 1962 input-output table, make use of the following assumptions while estimating two sets of shadow prices for various sectors or industries: a) the cost structure of of domestic production in a sector is the same, whether it involves

[19] In particular, " the two shadow prices are ratios of the costs of producing U.S. 1 $ of foreign exchange according to the 1962 technology of the ODEPLAN input-output (in users prices) to the 1962 exchange rate" [Bacha and Taylor, 1973:131].

import substitution or export promotion. However, the international value of goods which substitute imports or meant for export may vary; b) the export subsidy provides an adequate index for the difference between domestic and fob prices of exportable products; and c) the estimates of tariff rates on final goods provide the difference between domestic and cif prices of importables.

While estimating the DRC ratio under the assumption that domesic costs consist of labour payment and a normal rate of return to the domestic capital, Bacha and Taylor [1973] further assume that the rate of return to the domestic capital is 20 per cent. Whereas, total labour payments include employer contributions to pension funds.

The empirical findings by Bacha and Taylor [1973] confirm earlier findings by Krueger [1966] where import substitution is, on the average, more costly than that of export promotion in terms of foreign exchange costs. On the basis of their findings Bacha and Taylor [1973:134] conclude that,

> there is room for export expansion with a domestic to foreign cost ratio [i.e., DRC ratio] not exceeding 1.25-1.5 times the nominal exchange rate ... On the other hand, much additional import substitution should show a domestic/foreign cost ratio [DRC ratio] at least two times the nominal exchange rate, with cost running far higher in certain sectors.

In particular, they observe that under free trade conditions the exchange rate will rise from its official exchange rate level. This will make export as well as import substituting projects, which now cost 1.2 -1.5 times the official exchange rate, profitable at existing prices. Hence they call for the use of free-trade exchange rate (equilibrium exchange rate) as a shadow price of foreign exchange, which according to Bacha and Taylor [1973] is 51 per cent higher than that of the official exchange rate.[20]

Bacha and Taylor [1973:146], conclude that,

> exportation and substitution of imports should be protected only up to the point where they cease to be competitive in foreign markets when their tradeable costs and returns are valued at the equilibrium exchange rate which is about 1.3 times the current exchange rate.

2.4.4 Comparative Advantage: Zambia

Nziramasanga [1974], estimates DRC ratios for various projects in the manufacturing sector and then contrast these results with DRC ratios resulting from the proposed expansion in the copper mining industry, in the context of Zambian second national development plan.[21] Nziramasanga [1974], uses the DRC criterion to determine which project is an efficient way of earning or saving foreign exchange at the given exchange rate.

---

[20] For the detailed discussion on the derivation of the equilibrium exchange rate, see Bacha and Taylor [1973:139-146].

[21] Nziramasanga [1974] estimates the DRC ratios using Bruno's formula of deriving DRC ratio i.e., equation (6).

The study assumes that each project is competing with the others for scarce capital (as most financing in this case will come from the government). Projects are ranked in terms of their efficiency of earning or saving foreign exchange.[22] The study also computes the present value of expected future earnings and costs, over a period of ten years using a discount rate of 10 per cent, and use these information to estimate the DRC ratios for that period of time.

In order to estimate the DRC ratios for the copper mining industry, Nziramasanga [1974] evaluate labour at its opportunity cost which is based on labour costs in comparative employment in the manufacturing sector. Foreign exchange earnings are taken as the difference between export revenues and payments to foreign factors of production. While the total domestic costs are derived using an input-output framework. In the case of DRC ratios in the manufacturing projects, Nziramasanga [1974] assumes that production take place at full capacity levels and a unit cost of import truely reflect its shadow price.

[22] For Nziramasanga [1974], although there is no theoretical basis to rank projects like this, as any project for which DRC<SER should be accepted. However, ranking can be justified if we assume that there will be no change in the relative prices of products with the execution of the projects. He makes this assumption by taking prices of imports as accounting prices, and by assuming fixed input-output coefficients. On the same point see, Bruno [1972:31-32].

The results of Nziramasanga's [1974] study indicate that, for Zambia, copper mining is the most efficient way of earning foreign exchange, at the current exchange rate. The results also indicate that natural resource-based industries are more efficient in terms of earning foreign exchange than that of the consumer goods oriented projects, as the former have lower DRC ratios than the latter.

Nziramasanga [1974], observes that the domestic production of textiles, industrial fabrics, and explosives is very inefficient in terms of earning foreign exchange. The reasons for high DRC ratios in these projects include: a) relatively high labour cost as compared to the trading partners, b) limited market size,[23] c) use imported inputs in local production, and d) limited market for the by-products.

In order to test the sensitivity of his results Nziramasanga [1974] assumes a shadow wage rate which is at least four times lower than the previously assumed wage rate. The basis for this lower value of the shadow wage rate is the underlying assumption that for the new projects labour is available from the rural areas at that particular cost. The results of this exercise indicate that DRC ratios for most of the project falls. However, there are certain projects for which the DRC ratio remains the same. In some other cases although the DRC ratio falls these projects remain

[23] One reason for limited market is the fact that demand for local products is not high, as consumer do not consider domestic product, i.e., cloth, a good substitute for the imported one.

inefficient in terms of earning or saving foreign exchange. Given that the cost of producing tradeable products also include costs other than labour costs, Nziramasanga [1974] makes an interesting observation,

> the major portion of production costs in the manufacturing projects consists of imported intermediate inputs and loan repayments on foreign capital. The DRC [ratio] should thus be sensitive to changes in production methods and also to different loan repayment arrangements, especially for the large projects [Nziramasanga, 1974:6].

Nziramasanga's [1974] study also point the shortcomings of the DRC criterion. The estimation of DRC ratio, on the basis of an input-output framework, assumes fixed coefficient and takes into account only the direct and indirect input costs. This practice ignores the potential benefits resulting from lower unit costs, final demand linkages, and technological linkages.[24]

2.4.5 <u>Comparative Advantage of Automobile Industry: India</u>

Krueger [1975] makes an important contribution by analyzing a single industry in the context of domestic resource cost of import substitution in the Indian automobile assembly and ancillary industry. Krueger [1975] estimates the DRC ratios of various products produced by some 29 firms belonging to this industry. The analysis is based on a 1968-69 survey of

---

[24] One benefits from the final demand linkages when factor incomes resulting from an increase in the production level increases the demand for a locally produced product. Technological linkages arises when a new project effects the costs and/or benefits of other projects [Nziramasanga, 1974:8-9].

the Indian automobile and assembly and ancillary industry.

For Krueger [1975] the DRC criterion allows one to contrast the social cost of earning or saving a unit of foreign exchange in a particular domestic industry. According to this, when the DRC ratio is low:

> there is presumptive evidence that the industry should be expanded; when the cost [DRC ratio] is high, it is evident that the industry should not be expanded unless there are strong reasons for believing that costs will decrease over time [Krueger, 1975:83].

Krueger 's [1975] estimates of DRC ratios for the various firms are based on the following assumptions, which according to her provide the best estimates of DRC ratios under given circumstances. Specifically, Krueger [1974] assumes that: a) the rate of return on capital is 20 per cent; b) the shadow wage rate is the same as the market wage rate; and c) the estimates are based on actual capacity utilization.

The results reveal a wide variation in the DRC ratios for the various firms, which though belong to the same industry. For Krueger, [1975] foreign exchange can be saved by channelling resources to the firms with the lowest DRC ratios, as they are efficient in terms of saving the foreign exchange. The range of DRC ratios in the industry ranges from very low to very high.

In order to test the sensitivity of her results Krueger, [1975] performs sensitivity analysis by re-estimating the DRC ratios under alternative assumptions about the shadow wage rate, shadow rate of return on capital and capacity utilization. The new estimates of DRC ratios based on the alternative assumptions that: a) firms operate at 100 per cent capacity[25] b) rate of return on capital is 10 per cent; c) rate of return on capital is 30 per cent; and d) the shadow wage rate is zero. The sensitivity analysis shows that the estimates of DRC ratios are little affected by choice of assumption. As Krueger [1975:] concludes:

> estimates of domestic resource cost are relatively unaffected by different assumptions, increasing the shadow rate of return on capital raises all domestic resource costs but affects the ordering [ranking of the firms] very little.

Krueger [1975] also tests four hypothesises regarding the determinants of variation in the DRC ratios of the firms under consideration. These hypothesises relate to: a) infant industry arguments and time considerations; b) economies of scale and indivisibilities; c) relative factor intensities; and d) x-inefficiency. Krueger's multiple regression analysis results reveal that there is no statistically significant relationship between the first three factors, i.e., from (a) to (c), and the estimates for DRC per unit of for-

[25] These estimates are based on the assumptions that each product's output can be expanded to full capacity with no change in total capital, depreciation, administrative cost or overhead. However, material costs, the wage bill and inventory carrying will rise proportionally. [Krueger, 1975:94].

eign exchange.[26] However, the degree of x-inefficiency which exists among the various firms in the sample proved to be highly significant in explaining differences in the DRC ratios among the various firms. For Krueger [1975:110],

> the large variations in "x-efficiency" in the automobile ancillary industry are the results of profit-maximizing behaviour by entrepreneures who find that rewards are relatively greater for allocating scarce time to keeping production going rather than to cost minimization in the traditional sense, and that any produced output can be sold [Krueger, 1975:110].

To devise some criterion for the selection of import substituting projects Krueger [1975] also argues for the need for a "cut-off rule". Realizing the existence of overvalued exchange rates in developing countries, according to Krueger [1975] all the firms in the industry should be protected to the point at which the DRC ratios exceed the official exchange rate by a certain percentage. In other words one should add foreign exchange premium to the official exchange rate to arrive at the shadow exchange rate.

Specifically, Krueger[1975] comes up with three sets of cut-off points which are derived under the assumptions that DRC ratio exceeds the official exchange rate by: i) 50 per cent; ii) 100 per cent; and iii) 200 per cent. The DRC ratios which satisfy the above assumptions, then work as cut-off marks for the project selection, or for determining the efficiency of a given firm. Hence, working under the above

---

[26] The multiple regression analysis is based on a cross section study of 32 firms in the industry under consideration. [Krueger, 1975:103-06].

three alternative assumptions regarding excess of DRC ratio over the official exchange rate, Kruger [1975] analyzes the firms in the sample under three alternative assumptions regarding the cut-off point. On the basis of above analysis Krueger [1975], concludes that foreign exchange can be saved under all three situations if one uses these cut-off points as a criteria for project selection.

2.4.6 Comparative Advantage: Ghana

In order to select a cut-off point Steel [1976], following Bacha and Taylor's [1973] approach, compares the DRC ratio to an "appropriate" foreign exchange rate. Where this appropriate exchange rate is simply a range from the official exchange rate to one representing a 50 per cent higher value of foreign exchange. Firms with DRC ratios greater than this range are considered as inefficient, i.e., the opportunity cost of domestic resources exceeds the value of foreign exchange earned or saved. Viewed from this angle the:

> DRC [ratio] also represents the exchange rate at which domestic value added could compete with imports without protection [Steel,:1976].

Steel [1976], while using domestic resource cost concept as an efficiency criterion, with the help of primary data analyzes as to how efficiently domestic resources are being used to save the foreign exchange in Ghana's import substituting manufacturing firms during 1967-68. His estimates for

DRC ratios are based on the assumptions that:[27] a) the opportunity cost of capital is 15 per cent, which is the gross rate of return expected from new investment, under normal conditions; b) the shadow price of labour is the same as the market price; and c) the world demand as well as supply for commodities under consideration are infinitely elastic.

Apart from estimating the DRC ratios for various import substituting firms under the above assumptions, on the basis of actual capacity utilization, Steel [1976] contrasts these estimates with those which are based on the assumption of full capacity operation. The comparison between two sets of DRC ratios shows that the percentage of efficient firms (firms which qualify the cut-off rule) increases by three fold if one assumes full capacity. Similarly the percentage of inefficient firms declines to almost 50 percent when production estimates are recalculated at full capacity operation.[28]

Steel [1976] compares the above estimates of DRC ratios to those when capital costs are treated as sunk cost, rather than variable costs of operating existing plants. In case of

---

[27] Steel's [1976] formula for DRC ratio corresponds to one suggested by Bruno [1967]. For reference see equation (6).

[28] Full capacity, as defined by Steel [1976:269] is " the realistic maximum level at which the firm would operate over a continued period of time if there were no restrictions in terms of demand or availability of inputs, (at existing prices). It is thus closer to the concept of " optimum output " then to theoretical maximum capacity".

both actual as well as at full capacity assumptions, once one assumes capital cost as sunk cost the resulting DRC ratios fall and consequently the number of efficient firms increases to a great extent.

Recognizing the presence of minimum wage as well as urban unemployment Steel [1976] re-estimates the DRC ratios, assuming that actual labour cost overstate its opportunity cost. Reducing the labour costs by 50 per cent for unskilled workers and 25 per cent for skilled and semi- skilled workers changes the DRC ratios of the firms or their ranking very little. However, the percentage of the firms whose DRC ratios meet the acceptance criterion remains unchanged.

Like Krueger [1966], Steel [1976] also makes use of multiple regression analysis to test various hypothesises regarding the determinants of DRC ratio among the various firms. Among these hypothesises are: a) size of a firm; b) labour/capital ratio; c) capacity utilization; d) type of good and production; and e) type of ownership.

According to Steel [1976] the DRC ratios are sensitive to size of the firm and labour/capital ratios, at actual as well as at full capacity operation. Steel [1976] shows there exists a negative relationship between size of the firm and the DRC ratios. In other words there is a trade off between employment effects, because of large firm size, and efficient utilization of resources. The negative relationship between labour/capital ratio and DRC ratio confirms the common belief that developing countries have a comparative advantage in relatively labour-intensive production methods. Steel [1976:279] argues that the domestic policies,

> which favour substitution of capital for labour are likely to bias production toward activities which are less competitive at world prices than those relatively intensive in low-cost labour.

Steel [1976] does not find any statistically significant relationship between firms producing capital, intermediate or consumer goods and the DRC ratio. However, he does observe a highly significant relationship for the final stage assembly, e.g., making of cosmetics by mixing and bottling imported oils, essences, and powders, and high DRC ratio. In terms of relationship between type of ownership, e.g., international, expatriate etc., and DRC ratio, Steel [1976] does not find any statistically significant relationship.

Finally, Steel [1976] finds that capacity under utilization is one of the major determinants of higher DRC ratios among the various firms. The results indicate a statistically significant negative correlation between capacity utilization and the DRC ratio. According to Steel [1976], it is the control on foreign exchange which results in the underutilization of the existing capacity. The foreign exchange controls influence the capacity utilization in two major ways: a) by limiting the crucial imported inputs, as foreign exchange is not available at the official exchange rate; and b) by creating a situation whereby firms profits are protected so they are less concerned to produce at minimum cost output level, i.e., at full capacity level.

Given the impact of capacity utilization on the DRC ratios, Steel [1976] suggests that emphasis should be placed on raising the capacity utilization of selected industries rather than a small increase in the capacity utilization of all the industries. The utilization of full capacity, according to Steel [1976], have far reaching implications in terms of reduced costs and lower prices. Moreover, if an industry faces an elastic demand for its output, then the increase in quantity demanded can address the problem of limited market size in relation to capacity. Steel [1976:276] however, cautioned that:

> in the long run, investment need to be controlled more closely to avoid building capacity beyond foreseeable market size and to make sure that sufficient raw material will be available.

2.4.7 Comparative Advantage of Colombian Economy

In order to examine the performance of the Colombian economy Hutcheson and Schydlowsky [1982], estimate the DRC ratios for various sectors of the Colombian economy. Realizing that with a high level of unemployment, the market price for labour overstates its true opportunity cost, Hutcheson and Schydlowsky [1982] re-estimate DRC ratios under three alternative shadow prices of labour; 0.4, 0.5, and 0.6 of the market wages. For capital, three alternative shadow prices of capital are assumed; 1.2, 1.5, and 2.0 of the market price of the capital.

Hutcheson and Schydlowsky [1982] observe that sectoral DRC ratios do not exhibit much differences at the market prices, however, these estimates become much more dispersed as the shadow prices differ from their corresponding market prices.

Hutcheson and Schydlowsky [1982] make a valuable contribution by making a distinction between the DRC estimates in the short run (when the capital cost can be regarded as sunk, as production capacity is already there), and the same estimates in the long run (when the new investment is required). Their short and long run estimates utilizes the alternative shadow prices of capital and labour.

The results reveal that in the long-run, the sectoral DRC ratios lie between zero and twice the official exchange rate. Whereas, in the short-run the sectoral DRC ratios lie between zero and the offical exchange rate. From this result Hutcheson and Schydolsky [1982] conclude that resources can be utilized more efficiently, in terms of earning or saving foreign exchange, in the short-run than in the long-run.

Like others, Hutcheson and Schydlowsky [1982] argue that to determine whether production of a particular sector should be expanded or not, the criterion is to compare a DRC ratio with the shadow price of foreign exchange. However, they do not calculate or assume any specific value for the shadow price of foreign exchange, instead they compare the short-run DRC ratios for various sectors with the official exchange rate. In most instances, the DRC ratios are less than the offical exchange rate, especially when one assumes that the shadow price of labour is less than its market price. Given that in the Colombian case the official exchange rate is considered to be less than the shadow exchange rate, Hutcheson and Schydlowsky [1982:154] conclude that,

> since the shadow price of foreign exchange is above the exchange rate [official] it is reasonable to conclude that in almost all sectors of the economy the marginal social utility of additional output would have exceeded the marginal social cost of the factors used.

2.4.8 DRC Estimates of Manufacturing Sector:Pakistan

To measure the extent of inefficiency which exists in the Pakistani manufacturing sector, Naqvi and Kemal [1983] estimate DRC ratios at firm as well as at the industry level. Their study is based on a sample survey of 750 firms, representing 90 industries in 1981- 82.[29] For Naqvi and Kemal [1983] the DRC ratio measures the efficiency with which domestic resources are converted to save or earn a unit of foreign exchange, and is defined as

$$DRC = DR/VAW$$

[29] Apart from the sample survey the study also make use of PIDE 1975-76 input-output tables, to separate nontraded, primary, and traded inputs. [Naqvi and Kemal, 1983:10].

$$\text{or} \quad DRC = \frac{\text{value of domestic resources employed in an industry, at shadow prices}}{\text{value added at world prices}}$$

For empirical estimation the DRC ratio is defined as:

$$DRC = \frac{\text{(shadow) return of capital + employment cost at shadow wages + cost of primary inputs into the production of non-traded inputs}}{\text{net value added at world market prices.}}$$

To estimate the DRC ratios for various processing industries Naqvi and Kemal [1983] make specific assumptions regarding shadow prices of capital as well as labour. In one variant of the DRC estimates the shadow price of capital is assumed to be 10 per cent, while in the second variant the shadow price of capital is taken as 20 per cent. However, for both variants of DRC estimates, the study assumes that the shadow wage rate of skilled workers are similar to that of the market wage rate. For unskilled workers, it is assumed that shadow wage rate is equal to the wage of an unskilled worker in those activities which are not subject to any wage regulations.

In order to select a specific cut-off point, in term of efficiency or comparative advantage, Naqvi and Kemal [1983] compare domestic cost, evaluated at shadow prices, to net international value added at the world market prices or going foreign exchange rate. The comparative advantage exists if the net international value added is greater than the domestic cost, i.e, the DRC coefficient is less than one.[30]

The empirical findings of Naqvi and Kemal [1983] reveal that on the basis of DRC criterion, the industries range from highly efficient to those that are highly inefficient. To examine the determinants of DRC ratio the study estimates the DRC ratios by: a) size; b) location; c) stage of processing; and d) market orientation.

The findings indicate that on the average, the DRC ratios for small and medium size industries are relatively lower compare to the overall average of DRC ratio for all industries.The opposite is the situation in the case of large-sized industries. But the range for inter-industry variations, in terms of the DRC coefficients, is large for all sizes of industries. The results also indicate that most of the industries located in the economically backward areas of the country are inefficient. However, areas which are economically better off also have a large number of industries which are inefficient. Naqvi and Kemal [1983] also estimate the DRC ratios by stage of processing. This exercise reveals that on the average the capital goods industries are the least inefficient industries: the industries related to construction input are the most inefficient in the whole group of industries. Once again the inter-industry variation

---

[30] According to this "one <u>rupee</u> worth of domestic resources transforming into one <u>rupee</u> of worth of foreign exchange resources becomes the cut-off point [Naqvi and Kemal, 1983:4].

is high at all levels of processing. The estimates of DRC ratios by market orientation give rather interesting results. According to these results, the export-oriented industries are the most inefficient group of industries in terms of DRC criterion. The dispersion of DRC ratio within this group of industries is quite large, indicating that highly efficient export-oriented industries co-exist with highly inefficient industries. The most efficient industries in this group are those which are characterized by Naqvi and Kemal [1983] as "export -oriented and import competing". Naqvi and Kemal [1983], also estimate the Implicit Effective Rates of Protection, (IEPR), for the firms and industries under consideration.[31] The intent is to make a comparison between the estimates of DRC ratios and IEPRs, in order to know that whether it is the efficient or inefficient industries that are being protected by the government.

2.5 DRC CRITERION AND THE DYNAMICS

The DRC is a static concept, measuring only static comparative advantage. It fails to identify forces which shape existing patterns of comparative advantage, or the future course of comparative advantage.

[31] IEPR estimates the percentage difference between value added at domestic prices and the value added at world prices by relating the impact of domestic protection on the prices of final output and inputs to the value added by an activity [Naqvi and Kemal, 2:1983].

To address this problem Nishimizue and Page [1986] examine the sources of changes in the DRC estimates, by postulating that a change in the DRC ratio over time depends on: a) changes in factor use, i.e., factor cost effects; b) relative price changes, i.e., terms of trade changes; and c) changes in total factor productivity (TFP).[32]

According to Nishimizue and Page [1986], any increase in factor cost, measured at shadow prices, ceteris paribus, will increase the DRC ratio of a domestic activity. On the other hand, an improvement in the terms of trade, i.e., a rise in world price of the product relative to world price of its intermediate inputs, will lower the DRC ratio for the activity, implying an improvement in terms of comparative advantage. Similarly, an improvement in the total factor productivity (TFP), ceteris paribus, will lower the DRC ratio for the activity under consideration, under certain conditions, and hence improve the position of the activity in terms of comparative advantage.[33]

---

[32] Where TFP is defined as " the changes in output levels controlling for changes in input levels, or alternatively as the change in unit cost controlling for changes in input prices." Nishimizue and Page [1986:241] For an excellent summary of the related literature, see Caves, Christensen and Diewert [1982].

[33] For Nishmizue and Page [1986] under competitive trading conditions and without any distortions, any change in the DRC ratio of an activity over time will only depend on the difference in rates of TFP changes between the world and the domestic economy, i.e, the improvement in the DRC ratio will be equal to the difference between the improvement of domestic TFP over the world TFP, in a given time period. [Nishimizue and Page, 1986:243].

On the basis of their theoretical treatment, Nishimizue and Page [1986] analyze the factors influencing the changes in the annual average DRC ratios, in the context of the Thailand's industrial sector. The factors which are held responsible for changes in the annual rates of DRC ratios are: a) factor cost effect; b) terms of trade effect; c) factor proportions effect; e) total factor productivity effect; and f) price competitive effect, which is simply the sum of factor cost effect and the terms of trade effect.

Nishimizue and Page's [1986] results indicate that changes in price competitiveness and total factor productivity are the two major determinants of changes in DRC ratios over time. In most of the Thailand's industries it is the changes in the total factor productivity which are responsible for changes in the DRC ratios. For example, Nishimizue and Page [1986] observe that in case of light industries, e.g., food processing, printing and publishing, etc., a major reason for achieving higher comparative advantage is due to improvements in total factor productivity. In particular they observe that,

> where a disadvantageous price competitiveness effect is present, strong TFP performance is observed to offset it. Differential rates of productivity growth between Thailand and its trading partners thus appear to be the driving force behind improvements in dynamic comparative advantage [Nishimizue and Page, 1986:245].

Nishimizue and Page [1986] also note that in case of heavy industries, e.g., chemical products, iron and steel, etc., productivity deterioration is widespread. In few instances the decline in total factor productivity was more than enough to offset any advantageous price competitiveness effect, resulting in a net deterioration in terms of comparative advantage over time.

Focusing on the performance of nine import substituting industries, Nishimizue and Page [1986] observe that three of them were experiencing declining DRC ratios over time, with improvements in terms of total factor productivity. Whereas another six industries, which are subject to increasing DRC ratios over time, were experiencing deterioration in total factor productivity. Hence on the basis of above sample of nine industries,

> infant industry argument for protection, based on improvements in total factor productivity and international competitiveness, are only supported empirically in a minority of the sectors.... [Nishimizue and Page, 1986:246].

In general, Nishimizue and Page [1986] conclude that the domestic industries which produce exports or import substitutes, with very little protection, experience favourable total factor productivity change and an improvement in their international competitiveness as compared to those industries which produce "protected or non-competing import substitutes" [Nishimizue and Page, 1986:246].

Teitel and Thoumi [1986] also point out the static nature of the DRC criterion. They argue that the criterion fails to incorporate the dynamic benefits, which a project may generate over a period of time. For example the dynamic benefits of a project, such as an increase capacity utilization, economies of scale, and "learning by doing" effects are not incorporated in the DRC criterion. For Teitel and Thoumi [1986], what is required is the knowledge of changes in the DRC ratios over time. As a study of the evaluation of DRC ratios over time will incorporate the above mentioned dynamic aspects of the DRC criterion.

Similarly, Schydlowsky [1984] emphasizes the importance of dynamic analysis in the context of DRC criterion. As the future ranking of the domestic industries, according to DRC criterion, will be different than that of their present ranking. For Schydlowsky [1986] this change in the ranking will occur owing to the following reasons: a) changes in the international prices of the goods; b) learning by doing effects; c) changes in the domestic shadow prices; and d) changes in technology. According to Schydlowsky [1984:446], the simplest way to incorporate the above dynamic aspects of the DRC criterion is to perform,

> a static calculation for each relevant time period and then to take the weighted sum of the annual calculations, using the social time preference discount rate as weights.

In the light of the above argument, a dynamic version of the DRC criterion based on present value estimation can be presented as follows:

$$\text{Dynamic DRC ratio} = \sum_{t=0}^{t=n} \frac{1}{dt} \frac{(\text{LHRSt} \times \text{Wt} + \text{KHRSt} \times \text{Rt} + \ldots\ldots)}{(\text{Net foreign exchange earned})t}$$

Where,

LHRSt = man -hours of labour per unit
KHRSt = man -hours of capital per unit
W = cost of labour
R = cost of capital
dt = social time preference discount rate
t = time period, year

According to the above formulatation then the present value DRC ratios can be ranked as before. Whereas this ranking will now reveal the comparative advantage over the given planning period. For Schydlowsky [1984], the resulting DRC ratios are then,

> comparable to the average shadow price of foreign exchange for the period, thus allowing separation between the group of activities in which the country has comparative advantage and those in which it has comparative disadvantage [Schydlowsky, 1984: 446].

Responding to the criticism regarding static nature of the DRC criterion, Bruno [1972] argued that this criterion is quite general to incorporate a situation related to multi-period dynamic framework. For Bruno [1967:113]:

> it might be important in certain cases, to conduct the analysis for each production period in the planning horizon and to use the relevant rate of discount to bring the stream of future costs and benefits to their present equivalent. This may be particularly important when the shadow prices of the various primary factors are expected to take different paths over the future planning horizon.

In the light of Bruno's [1967] above argument it seems clear that Schydlowsky's [1984] formulation of a dynamic version of the DRC criterion is simply a restatement of Bruno's [1967] position in this regard.[34]

---

[34] Nziramasanga [1974] is the first to use Bruno's [1967]

2.6 DRC CRITERION AND THE AGRICULTURE SECTOR

2.6.1 Agricultural Output: Zambia

Nziramasanga [1974] estimates the DRC ratios for Zambian agricultural output. The purpose of this exercise is to estimate the comparative advantage of maize, rice, sorghum, oilseeds, raw sugar, vegetables and beef output.

To compute the DRC ratios for the agriculture, the study takes capital expenditures as projected in the Zambian second development plan. The capital cost used includes the interest payment on loans from the World Bank at 6 per cent. The accounting prices for agricultural products are assumed to be equal to the cif prices of imports from the major sources of supplier.[35] The indirect costs are derived from the 1969 inter-industry matrix of the Zambian economy. The direct costs include direct subsidy to the farmers for the purchase of fertilizer. Agriculture labour is evaluated at its market price. Nziramasanga [1974] comes up with a DRC ratio for the planned agriculture sector which is 0.60. This low DRC ratio, according to Nziramasanga [1974], for the planned agriculture output suggests that the country can benefit by allocating more resources in this sector, given that the externalities in the agriculture sector, e.g.,

---

vision of dynamic DRC criterion, by estimating the DRC ratios for the Zambian economy over a period of ten years. For further discussion in this regard see Nziramasanga [1974].

[35] In this particular instance the price for maize is based on import from Rhodesia (now Zimbabwe) while the price for beef is a weighted average of imports form Kenya and Australia. [Nziramasanga, 1974:3].

equitable distribution of income between urban and rural populations are added incentives in this regard. Another factor which supports the above conclusion is the fact that there is greater chance of increasing the productivity of the agriculture sector compared to other sectors of the economy. Nziramasanga [1974] argues that agricultural productivity can be increased further by using high yielding inputs such as fertilizer and using domestically produced agricultural machinery. He concludes that:

> the sector with the largest increase in world market prices or with increasing productivity in the domestic sector would enjoy the lowest DRC and provide the best development opportunities [Nziramasanga, 1974:7].

The agricultural products under consideration, according to Nziramasanga [1974], under given conditions meet the above propositions.

2.6.2 Rice: Philippine

Herdt and Lacina [1976] use the DRC criterion to evaluate the possibilities of increasing the rice production under alternative production systems in the context of the Philippines economy. The study evaluates four alternative production methods to increase rice production. One production alternative makes use of additional land while other three alternatives depend on increasing the rice production by raising the yield.

Herdt and Lacsina [1976] decompose total production cost into foreign and domestic components. Inputs such as fertilizer, which are domestically produced but tradeable, are treated as foreign costs as additional requirements for fertilizer are subject to import. Non-traded inputs and added local costs of traded inputs are decomposed into domestic and foreign costs. Like Nziramasanga [1974], Herdt and Lacsina [1986] also treat government input subsidies as domestic costs. Depreciation is treated as a traded or non-traded input depending on whether the fixed capital is domestic or foreign. Realizing the difficulty of isolating input costs in terms of foreign and domestic costs, Herdt and Lacsina [1976] follow a procedure suggested by Akrasance [1974], to address this problem.[36]

For labour costs, Herdt and Lacsina [1976] assume that the shadow price of the family labour is the same as the market wage rate for labour. The shadow price of land is assumed to be equal to the existing rental rates and earnings in alternatives crops. The shadow price of capital is equated with three alternative rates. These rates are 12 per cent, 15 per cent, and 20 per cent.[37] Similarly, they

---

[36] This technique amounts to a careful accounting and identification of the origin of costs as either domestic or foreign. Manufacturer's and customs records provide the basic information for this calculation. [Herdt and Lacsina, 1976:217]. Also where domestic cost components contains imported inputs, Herdt and Lacsina [1976] treat them as indirect (foreign) costs.

[37] These rates are in relation to long -term capital investment, i.e., capital equipment, tractors, and irrigation system needed for the rice production. Herdt and Lacsina

use alternative interest rates of 12, 20, and 40 per cent for short-term loans for purchased farm inputs.

Herdt and Lacsina's [1976] treatment of marketing costs is very explicit as they calculate domestic cost per unit by adding domestic production cost per unit to the domestic marketing cost per unit. Similarly any imported element in the marketing costs is added to the per unit import cost of rice.[38]

According to Herdt and Lacsisna's [1976] estimates, in the case of all the four alternative systems, the DRC ratio is less than the shadow price of foreign exchange. Which, according to them, means that the Philippines has a comparative advantage in the rice production, irrespective of the production methods. Herdt and Lacsina [1976] show that changing the assumptions regarding the shadow prices of land and capital has little effect on the above results. There is only one case where they observe that DRC ratio, based on higher shadow price of capital and land, exceeds the shadow price of foreign exchange.

[1976] develop budgets for all the systems to get an estimate for cost per hectare.

[38] The initial steps in the rice marketing, e.g., drying and storage, are assumed to be performed on the large-scale farms. For the small farms Herdt and Lacsina assume that these tasks are completed in the context of overall rice marketing system [Herdt and Lacsina, 1976: 227].

Herdt and Lacsina [1976] also perform sensitivity analysis by estimating the elasticities of DRC ratios with respect to various parameters, assuming a 10 per cent change in the selected parameters. The results of this analysis show that the DRC estimates, for all four production systems, are relatively insensitive to the shadow prices of land, capital and foreign exchange. However, these estimates are highly sensitive to crop yield and the cif price of imported rice. As the crop yield as well as the cif price of imported rice are subject to large fluctuations, Herdt and Lacsina [1976] emphasize their significance in terms of their effect on the DRC ratios.

Herdt and Lacsina [1976] argue that given the fact the DRC estimates are sensitive to world rice prices and these prices are subject to large swings, it is not possible to prove that a policy of self-sufficiency in rice production is economically inefficient without knowing the nature and trends of long-term rice prices in the world markets.

Herdt and Lacsina [1976] consider DRC criterion a powerful tool to examine comparative advantage and efficiency. They, however, emphasize the need to take into account those factors which this criterion ignores, such as employment effects, income distribution, concentration of economic power, and other implications for the economic agents participating in the rice economy.

2.6.3 Rice: U.S.A.

Mears [1976] estimates the DRC ratios for the five major rice producing areas in the United States of America.[39] The DRC ratio is defined as:

> the social opportunity cost of earning a unit of foreign exchange by producing rice for export [Mears, 1976:144].

Mears [1976] calculates the DRC ratio as follows:

$$\text{DRC ratio} = \frac{\text{domestic resource cost, at shadow prices}}{\text{value added, at world prices}}$$

The distinguishing feature of the Mears's [1976] study is that he also attempts to estimate the private profitability, the social profitability, financial export cost, and the social export cost of rice.[40]

Mears [1976] recognizes the fact that computation of DRC ratios requires knowledge of the shadow prices of land, labour, capital and foreign exchange. As the labour market in the U.S.A. is relatively competitive he takes the market

---

[39] These five areas are : Northeast Arkansas, Southeast Louisiana, California, the Mississippi delta, and East Texas. [Mears, 1976:140]

[40] Where,

Private profitability = Domestic value added, at actual market prices - (Factor costs,except capital,at market prices + Indirect taxes, at actual market prices)

Net Social Profitability = Value added, at world market prices -Domestic Resource cost, at shadow prices

Mears [1976:146] measures Net Social Profitability using both official as well as shadow exchange rate. Given that official exchange rate is the same as the shadow exchange rate, both measures are identical wage rate as a true reflection of the opportunity cost of labour. Mears [1976] calculates the shadow price of land by computing the social profitability of the next best alternative crop. In this case he uses the social profitability of safflower in California and soybean elsewhere. For the shadow price of capital Mears [1976] uses the "prime loan" interest rate as the shadow price.

To incorporate the impact of petroleum quotas and the U.S. price controls, the study uses a weighted average nominal protection coefficient of 0.67 to estimate shadow prices of indirect petroleum products inputs.[41] Mears [1976] does not use similar shadow price adjustments for urea fertilizer, as its production usually requires domestic natural resources, such as natural gas or nitrogen. Similarly no adjustments are made in the case of farm equipment as it has zero nominal tariff.

Mears [1976] estimates the DRC ratios and also compares the social profitability of rice production to its private profitability. Similarly a comparison is made between the social and the financial cost of exporting U.S. rice.[42]

---

[41] For a detail discussion on this point see Baldwin [1974].

[42] The results are in terms of two varieties of rice: a) Grade No. 2 long grain rice, a particular variety used for commercial sale ; and b) Grade No. 5 medium grain rice, a typical rice quality used in concessional sale under PL 480. [Mears, 1976:145-76].

The results indicate that all the five major rice producing areas of the U.S. have comparative advantage in producing both varieties of rice. To get an index of comparative advantage Mears [1976] follows the usual procedure of comparing DRC ratio with the shadow price of foreign exchange. In all the cases he finds that the DRC ratios are less than the shadow price of foreign exchange, i.e., the ratio of DRC ratio to shadow exchange rate is less than unity.

When one compares the DRC ratios of the five areas with the corresponding figure of social export cost, the ranking of these areas according to both measures remains the same. For example, Mears [1976] shows that Texas has the greatest comparative advantage and least social export cost whereas, California has the least comparative advantage and the highest social export cost. However, when one judges the export cost in terms of financial cost rather than social cost, the ranking is reversed. Now California faces the lowest financial export cost and Texas faces relatively higher financial export cost. The change in ranking is due to the use of market rather than shadow price of land. This result has serious implications for the rice economy as the:

> differences between social and financial ECs [financial export costs] indicate that the supply response of the U.S. rice farmers does not necessarily confirm the criteria for social profitability efficiency [Mears, 1976:149].

To support the above claim Mears [1976] argues that it is possible for the U.S. farmers to produce rice for export at a profit, even though such production is socially inefficient.[43] To see the sensitivity of the DRC ratios to variation in rice yield and prices of important inputs, i.e., capital , labour, land, and fertilizer, like Herdt and Lacsia [1976], Mears [1976] also estimates the DRC elasticities. The results indicate that the DRC ratios are insensitive to fertilizer prices. However, these ratios are sensitive to land price variations. In particular the sensitivity to land price values is more significant in those rice producing areas where the opportunity cost of land is a major component of total farm budget. Similarly, the sensitivity of the land price values is relatively not that significant where the opportunity cost of land is low and hence it is small portion of a farm budget. According to Mears [1976:153]:

> this land parameter can fluctuate widely, reflecting the volatility of safflower and soybean prices upon which these land values depend

Mears [1976] also observes that the DRC ratio shows greater sensitivity towards labour costs than that of the capital costs. The analysis also show a very high level sensitivity of the DRC ratio to changes in rice yield and world rice prices. Hence, in this respect Mears's [1976] results are similar to that of Herdt and Lacsina [1976]. Like Herdt

---

[43] For example " if the border price of Grade NO.5 [rice] had declined to $300 an average California rice farmer would continue to have found it profitable to produce for export with EC [financial] of $297, while from social view point such action would have been inefficient because the social EC is $335 [Mears, 1976:149].

and Lacsina [1976], Mears [1976] also emphasises the importance of world rice prices, given the fact these prices are subject to wide fluctuations. As results indicate that a relatively large increase in the world rice price lowers the DRC ratio to a large extent, giving a comparative edge to the U.S. rice farmers.

Mears [1976] also estimates the sensitivity of the DRC ratio to change in the rice-fertilizer border price ratios and finds that the DRC ratio is more responsive to fluctuations in the price of rice than that of price of fertilizer. Hence according to him the results indicate that:

> small percentage increases (decreases) in the border price of rice will rapidly increase (decrease) the international comparative advantage of U.S. rice, while very large percentage movements in the border price of urea [fertilizer] will be required to make even relatively small changes in international comparative advantage [Mears, 1976:156].

2.6.4 Rice: Thailand

Sukharomana's [1983] study, which is in the context of Thailand's rice economy differs from Herdt and Lacsina [1976], and Mears [1976], in the sense that he makes estimate of DRC ratios, according to level of farm mechanization being used in the production of rice.[44]

---

[44] These mechanization levels, for the rainfed areas, are: animal only, animal and four-wheel tractor, animal combined with power tiller and tractor, and power tiller and tractor. For the irrigated areas the mechanization levels are: animal and small four-wheel tractor, animal and two-wheel tractor, two-wheel tractor only, animal combined with two-wheel tractor and small four-wheel tractor,

For Sukharomana [1983] the DRC ratio in case of rice production is simply:

> the social cost of primary inputs used divided by the net-foreign exchange earned. The net foreign exchange earned is defined as the difference between the border value of output and the value of tradeable inputs at border price [Sukharomana, 1983:62].

Sukharomana [1983] assumes that the social prices of primary or nontradeable inputs, such as land labour and capital is the same as their corresponding market prices. For imported and tradeable inputs he assumes their border prices truly reflect the shadow prices. Sukharomana [1983] measures the DRC ratio for rice production as follows:

$$DRC = \frac{\sum_{i=2}^{n} Pi\ Qi}{P1\ Q1 - \sum_{j=n+1}^{m} Pj\ Qj\ .\ SER}$$

Where,
P's are the social prices
Q's are the amounts
SER = shadow exchange rate
P1 = shadow price of the output, i.e., cif price in case of impot substitutes
Q1 = quantity produced of the output
i = 2 ,.....n , refers to primary and nontradeable inputs
j = n +1 ,..... m, refers to the traded inputs

According to Sukharomana [1983], the DRC ratio, is a reflection of comparative advantage in rice production in Thailand if its value is less than the shadow price of foreign exchange.

---

small four-wheel tractor, two-wheel tractor combined with small four-wheel tractor [Sukharomana, 1983:63].

The results indicate that DRC ratio for rice production is higher for rainfed areas than for irrigated areas. The lower DRC ratio for irrigated areas, according to Sukharomana [1983], is due to the higher yields. This is true for all levels of farm mechanization, except for a group of farmers using power tiller. The rainfed areas's farmers are subject to comparative disadvantage at all levels of farm mechanization

To examine the determinants of the DRC ratios, Sukharomana [1983] analyses the effect on DRC ratio of: a) different levels of farm mechanization; b) opportunity cost of land; and c) rice yield. The results reveal that the elasticities of DRC ratios with respect to farm mechanization, e.g., tractor, rice thresher, water pumps, etc., and opportunity cost of land are positive. This result means that the domestic resource cost per unit of foreign exchange increases with an increase in the machine use and the opportunity cost of the land. However, the elasticity of DRC ratio with respect to machine use is less than that for the land.

The mechanization elasticity of DRC ratio for the irrigated area farmers, using small four-wheel tractors, is lower than the farmers using two-wheel tractors. For Sukharomana [1983] this result is owing to the fact that the small four-wheel tractors have lower opportunity cost as well as lower work hours per hectare. In those instances where the land is prepared with a combination of tractor and animal power, the mechanization elasticity of DRC ratio is lower for those farmers who use machines. This is true for both irrigated and rainfed areas farmers. Sukharomana's [1983] results also indicate that rice yield effect on the DRC ratio is stronger than mechanization effect.

Sukharomana's [1983] findings in terms of elasticity of DRC with respect to rice yield confirm earlier results of Herdt and Lacsina [1976], and Mears [1976]. Sukharomana [1983] finds that the elasticity of DRC ratio with respect to rice yield is negative. This result implies that, other things being equal, an increase in the rice yield reduces the DRC ratio.

2.7 CONCLUSIONS

Our review of the literature concludes that the DRC criterion provide a quantitative expression to underlying principles of comparative advantage by measuring the social opportunity cost of domestic resoures of saving or earning foreign exchange. The DRC criterion is useful both as an ex ante measure of comparative advantage and as ex post measure of cost of protection. The practical appeal of the DRC concept lies in its application to a wide range of situations. The DRC criterion, for example, can be applied to measure the comparative advantage of projects, industries, sectors, and overall economy. The DRC criterion is also a useful tool for an international and regional comparison of comparative advantage.

Theoretically, the DRC coefficient is a net measure of comparative advantage. For example, if a project generates benefits other than foreign exchange (e.g., employment creation, and learning effects) then these benefits need to be subtracted from the corresponding costs. In practice, as our review indicates, it is difficult to incorporate such external effects in the estimation of the DRC coefficients. Existence of external social benefits and costs then may distort the degree of comparative advantage as revealed by the DRC coefficients.

One of the major criticism of DRC criterion is that it is a static concept, which measures the degree of existing comparative advantage at a given time. Therefore, the DRC criterion fails to incorporate dynamic factors, such as, economies of scale, and "learning by doing" effects, and changes in future factors and product prices, which can influence future pattern of comparative advantage. We conclude, however, that the DRC criterion has the flexibility to adequately accommodate above concerns through: (a) sensitivity analysis and (b) estimating the DRC coefficients for future production periods and then using an appropriate social discount rate to arrive at the present value of future stream of benefits and costs.

From our review of the literature, we conclude that the task of assessing the comparative advantage of Pakistan's oilseed and edible oil industries can be done by using the DRC criterion. Drawing on this review of literature, Chapter 4 formulates the DRC models for the Pakistan's oilseed and edible oil industry that address the objectives of the present study.

Chapter III

PAKISTAN'S ECONOMY AND THE OILSEED AND EDIBLE OIL SECTOR

Pakistan emerged as an independent country after the partition of British India in 1947. At the time of independence there were doubts regarding the economic viability of Pakistan. The areas that became part of Pakistan in 1947 were considered as the poorest in the British India [Mustafa:1988]. The Pakistan's economy in 1947 was predominately agriculture, with 85 percent of the population living in the rural areas. More than 50 percent of GDP originated from the agriculture sector. The manufacturing sector was contributing only 7 percent of GDP. Foreign trade was insignificant and the country lacked the basic infrastructure, i.e., roads, railways, telephone, telegraph, and postal services. The country also lacked skilled human capital and economic and financial institutions [Mustafa:1988].

At very early stages of independence, the Pakistani planners saw systematic planning as a key to the problem of economic development and growth. Systematic development planning in Pakistan began with the arrival of foreign advisers in 1954. The Planning Board of Pakistan made arrangements according to which the Ford Foundation made a grant to finance the cost of a group of foreign advisers, recruited and supervised by the Graduate School of Public Administration of the Harvard University. None of the advisers who came first had planning experience in developing countries [Waterston:1963].

The First Five Year Plan (1955-60) saw GDP growth of 3.1 percent [Government of Pakistan:1984]. However, most of the Plan's objectives regarding employment, health, and education failed to materialize. The Plan's target of food self-sufficiency also was not accomplished [Johnson:1979].

During the Second and the Third Five Year Plan period, 1960-70, the economy witnessed a high growth rate in GDP. During the 1960's the focus was on policy support for the agriculture sector with a series of incentives for private investment in the industry. The growth rate of GDP touched 6.8 percent per year and 6.7 percent per year for the Second and the Third Plan. The annual growth rate of the agriculture sector rose from 3.8 percent per year during the Second Five Year Plan to 6.3 percent per annum during the Third Plan period. Similarly, growth rate in the manufacturing sector rose from 5.2 percent per annum during the Second Plan period to 11.7 percent per annum in the Third Plan period [GOP:1983].

The growth of the Pakistan's economy slowed during the non- plan period (1970-77). During this period the GDP grew at an annual rate of 4.2 percent. Agriculture as well as industrial sector showed a rather poor performance. The agriculture sector, during that period, grew at an annual rate of 1.7 percent, as compared to an annual growth rate of 6.3 percent during the Third Plan period. Similarly, the manufacturing sector grew at an annual rate of 3.5 percent as compared to the growth rate of 8.1 percent during the Third Plan period [GOP:1983]. The poor performance of the economy during the non-plan period can be attributed to, among other things, the 1971-war with India, the break up of the country, the 1973-74 oil shock, nationalization of the industries, and floods.

Following the pattern of planned development in the 1960's, the military regime which came into power in 1977, launched the Fifth Five Year (1978-83) and Sixth Five Year (1983-88) Plans. The major objective of these plans were to achieve high growth targets while privatizing the national economy.During 1980-88 the economy grew at an annual rate of 6.5 percent. Where the agriculture sector grew at an annual rate of 4.3 percent, the comparable figure for the manufacturing sector was 8.1 percent per year [ADB:1990].

3.1 THE STRUCTURE OF PAKISTAN'S ECONOMY:

The structure of Pakistan's economy has changed over the years. At the time of independence more than 50 percent of its GDP originated in the agriculture sector. The manufacturing contributed only 7 percent [Mustafa:1988]. By 1965, the agriculture sector share in the GDP had dropped to 40 percent. The comparable figures for industrial and services sectors were 20 and 40 percent respectively. Within the industrial sector, the manufacturing sector contributed 14 percent to the GDP [World Bank:1990]. The share of agriculture sector in the GDP has been on the decline. By 1988 the share of agriculture sector in the GDP declined to 26 percent. Whereas, the share of industrial and services sector risen to 24 and 49 percent respectively [ADB:1988].

3.1.1 Issues in the Agriculture Sector

Though the share of the agriculture sector in the national income has fallen, its importance for the national economy remains significant. The growth and performance of the agriculture sector is crucial for the strength of Pakistani economy due to the fact that in the case of Pakistan : (a) higher agriculture production is essential to provide food for rapidly increasing population at affordable prices; (b) growth of the industrial sector based on the health of the agriculture sector which provides raw material for the industrial sector; (c) the agriculture exports are the main source of foreign exchange earnings; and (d) agriculture sector is the major source of employment in the country [GOP:1988a]. The Agriculture sector in Pakistan accounts for 26 percent of the GDP, employs 50 percent of the labour force, and provides 70 percent of the foreign exchange earnings [GOP:1987].

There are two cropping seasons in Pakistan: Kharif, April-November, and Rabi, November-April. The major Kharif crops are cotton, rice, maize, millets, sorghum, and sugarcane. Whereas, wheat, oilseeds, gram, and barley are the major rabi crops. Out of total area of over 79 million hectares, 30 million is considered to be suitable for cultivation. Of the cultivable area of 30 million hectares, 21 million hectares is actually being cultivated [GOP:1989].

About 24 percent of the cultivated area in Pakistan is termed as the **barani** (rainfed) area, where rest of the cultivated area is served by controlled irrigation. [GOP:1988a] In the **barani** areas crop production takes place without controlled irrigation. Crop production in these areas rely entirely on moisture received directly from the rains. The average yields on barani, for major crops, are considerably lower than the yields achieved by the average farmers in the irrigated areas [Mahmood:1990].

The agriculture sector in Pakistan has performed relatively better over the last decade. During 1980-88 the agriculture sector in Pakistan has maintained an average growth rate of 4.3 percent per year. As compared to Pakistani experience, the comparable figures for other neighbouring countries, such as India and Sri Lanka are 2.3 and 2.7 per cent per year [World Bank:1990]. However, given an increased demand for food due to rapid population growth and rising income, agriculture production lags behind the desired growth rate of 6 percent [Rempel:1990].

The crop sector is the major contributor of GNP in the agriculture sector. Over 68 percent of GNP in the agriculture sector comes from the crop sector. Comparable figure for the livestock and fishing sectors is 30 and 1 percent respectively. Forestry contribute less than 1 percent to GNP in the agriculture sector [GOP:1988a].

A focus on the crop sub-sector of Pakistan's agriculture reveals that food crops contribute just over 53 percent to value added of all major crops, with wheat's share of more than 30 percent. In the fibre crops category, cotton's share in the value added of major crops is over 30 percent. Among other crops, rapeseed/mustard and sesame contribute only 1.10 and 0.11 percent respectively [GOP:1989].

The index of total agriculture production in Pakistan, using 1979-81 as a base, has risen from 81 in 1975 to 135 in 1988. Where the livestock production index has risen from 84 to 142, the crop sector production index has risen from 79 to 132 during this time period [USDA:1989]. Pakistan's performance in terms of growth rate of value added in the agriculture sector is among the highest in Asia. In 1989, the growth rate of value added in the agriculture sector was estimated to be 6.1 percent.The comparable figures for India, and China are 2 and 4.5 percent respectively [ADB:1990].

Although Pakistan has made progress in terms of growth of its agriculture sector, the productivity of this sector remains a fundamental weakness. Average yields of Pakistani farmers are still far less than their potential yields. With the result, there exist large gaps between actual and potential yields. There are said to be various socio-economic and technological constraints causing lower yields for Pakistani farmers. Table 2 depicts the yield trends during the past decade.

TABLE 2

Crop Yield Trends In Pakistan

Crop	(Kg/hectare) 1979	1988	% Change
Wheat	1566	1787	+ 14
Barley	715	767	+ 7
Maize	1256	1372	+ 9
Millet	503	758	+ 51
Rice	2466	2739	+ 11
Sorghum	582	605	+ 4
Groundnut	1226	1176	- 4
Rapeseed	594	698	+ 18
Soybean	378	444	+ 17
Sunflower	624	833	+ 33

Source:[FAO:1988], [USDA:1989].

Table 2 illustrates, with the exception of groundnuts the crops yields has risen overtime. For most crops, however, the existing crops yields are still less than the average yields levels achieved by similarly placed countries. Table 3 presents an inter-country comparison of crop yields.

The yield comparison, as illustrated in Table 3 confirms the common belief that for many crops the yields achieved by the Pakistani farmers are less than the yields achieved by the other Asian or neighbouring countries farmers. With the exception of groundnut, Pakistani crops yields are considerable lower than the crop yields achieved by China for example. A yield comparison with India indicates that, with the exception of maize, millet and rice, the Indian yield per-

TABLE 3

Inter-country Yield Comparisons

(Kg./Hectare) 1988

Crops	Pakistan	China	India	Asia
Wheat	1787	3017	1939	2241
Barley	767	3030	1385	1821
Maize	1372	3728	1271	2773
Millet	758	2291	531	778
Rice	2739	5334	2412	3426
Sorghum	605	3502	688	963
Groundnut	1176	1075	1995	1246
Rapeseed	698	1134	756	947
Soybean	444	1447	714	1354
Sunflower	833	1368	N.A	1018

Source:[FAO:1988], [USDA:1989].

formance is better than the Pakistani experience. Similarly, Pakistani crop yields are also lower than the average crop yields achieved in Asia.

Given that the total cropped area in Pakistan has almost remained stagnant over the past few years, it is unlikely that increased crop production can be brought by increasing the cropped area. Pakistan's hope of a breakthrough in the agriculture sector lies in bridging the gap between potential and actual farm yields, by eliminating the constraints causing this gap.

3.2 THE EXTERNAL SECTOR:

During 1980-88, Pakistan's economy grew on an average of just under 7 percent per annum. This period, however, also witnessed increasing external imbalances [ADB:1990]. Pakistan's external sector is considered one of the major structural weakness of the economy [Mustafa:1988]. The causes of Pakistan's present external sector problem lies in: (a) a level of current account deficit which is difficult to sustain; (b) an extremely narrow export base; (c) dependence and volatility of foreign exchange earned through workers' remittances; (d) a low level of domestic savings; (e) budget deficit; (f) rapidly increasing debt service payments; and (g) rapidly increasing edible oil import.

One of the striking characteristics of Pakistan's external sector is its growing current account deficit. Pakistan's current account deficit for the period of 1981-89, on average, is U.S $ 997 million per year. Pakistan's current account deficit which stood U.S. $ 724 in 1987 rose to U.S. $ 2,000 million in 1990. [ADB:1990]. A major factor causing the large current account deficit is the existence of large trade deficit. Table 4 illustrate trends in Pakistan's merchandise trade.

TABLE 4

Pakistan's Merchandise Trade Trends

(Million $)

Year	Export	Export Growth (%)	Import	Import Growth (%)	Trade Balance
1981	2730	6.3	5656	3.9	-2926
1982	2341	-14.2	5744	1.6	-3403
1983	2877	22.9	5592	-2.6	-2715
1984	2480	-13.8	6234	11.5	-3754
1985	2648	6.8	5878	-5.7	-3230
1986	3191	20.5	5971	1.6	-2780
1987	3938	23.4	6254	4.7	-2316
1988	4405	11.9	7012	12.1	-2607
1989	4638	5.3	7299	4.1	-2661

Source: [ADB:1990].

Table 4 indicates that the merchandise trade deficit was greater than the export earnings during 1981-82 and 1984-85. While export earnings have risen from U.S. $ 2,730 million in 1981 to U.S. $ 4,638 million in 1989, spending on imports, during the same duration, have risen from U.S. $ 5,656 million to U.S. $ 7,299 million . The export earnings have risen at an average rate of 7.67 percent per annum during 1981-89, with a variation of a negative growth of 13.8 percent in 1984 to a growth rate of 23.4 in 1987. Expenditures on merchandise imports, on the other hand, has risen at an annual average rate of 3.5 percent per annum during 1981-89, with a variation of negative growth of 5.7 in 1985 to a growth of 12.1 percent in 1988.

Pakistan's growth rate of merchandise export during the 1980's compares favorably with 6.4 and 7.1 percent for Southeast Asia and South Asia, respectively [ADB:1990]. Similarly, an export performance comparison with middle-income, lower-middle-income, and low-income countries shows that Pakistan's export sector has performed better than these economies, during 1980-88 [World Bank:1990].

Although Pakistan's growth performance has been impressive, its export base is narrowly defined, dominated by rice, cotton and agro-based manufacturers. Owing to Pakistan's narrow export base,there is significant yearly fluctuations in export receipts. At present, about 90 percent of Pakistan's export earnings comes from primary agricultural products and agro-based manufactures [ADB:1990]. With an export to GDP ratio of 10-11 percent, dependence on few agricultural products makes Pakistan's external sector vulnerable to external shocks. Following table illustrate Pakistan's export structure.

TABLE 5

Pakistan's Export Structure

(1988)

Items	Value ($ million)	Share (%)
Primary Agriculture	1857	33.0
Rice	350	7.3
Fish	113	2.3
Cotton	776	16.1
Cotton Textile	2007	41.7
Cotton Yarn	577	12.0
Cotton Fabrics	481	10.0
Household Linen	323	6.7
Clothings	516	10.7
Leather Manufactures	499	10.4
Woolen manufactures	256	5.3
Other Manufactures	456	9.5
Total	4809	100.0

Source: [ADB: 1990]

Even though Pakistan's export earnings have risen over the years, the merchandise trade deficit has remained unchanged due to rising import bill. Pakistan's major import items include, capital goods, crude oil, petroleum products, fertilizer, edible oil, and tea. Capital goods constituted about 40 percent of Pakistan's import bill in 1987-88. The share of major imports were about 23 percent, while the comparable figure for category of other imports were 47 percent. The structure of Pakistan's major imports is illustrated in the following table. This table, however, does not take into account the share of capital goods and other imports which constitute about 77 percent of Pakistan's total import bill [World Bank:1989].

TABLE 6

Pakistan's Major Imports

Items	(1987-88) Value ($ million)	Share (%)
Crude Oil	509	30.0
Petroleum Products	468	27.6
Edible Oil	411	24.2
Fertilizer	180	10.6
Tea	127	7.6
Total	1695	100

Source:[World Bank:1989].

While excluding capital goods imports, as Table 6 indicates, crude oil and petroleum products constitute Pakistan's major import. Even with increase domestic production of crude oil Pakistan has to import 67 percent of annual crude oil requirements [GOP:1989]. Over the decade,1977-78 to 1987-88, the largest percentage increases both in volume and value was edible oil. Table 7 shows changes in the volume, value and unit value for the major imports, during 1977-78 to 1987-88.

TABLE 7

Changes in Import Structure

1977/78-1987/88 (%)

Items	Volume	Value	Unit value
Crude Oil	+15	+49	+30
Petroleum Products	+138	+20	+26
Fertilizer	+49	+73	+16
Edible Oil	+286	+198	-28
Tea	+48	0	-32
Average	+37	+68	+25

Source:World Bank:1989].

Table 7 reveals, the period of 1977/78 to 1987/88 has witnessed a sharp rise in the import of edible oil. The import of edible oil has risen both in terms of volume as well as in terms of value during the said time period. The edible oil import bill has risen, inspite 28 percent drop of in the unit value of edible oil. The major cause of this rising import bill for edible oil is the growing production-consumption gap in the domestic edible oil sector of the economy.

Apart from an adverse trade balance, an other factor which has contributed to Pakistan's deteriorating current account balance is continuous decline in inflow of worker's remittances from overseas. Since the early 1970's, workers remittances from the Middle East have been a major source of Pakistan's foreign exchange earnings. During 1982/83 and 1983/84, foreign exchange earnings through remittances exceeded from earnings through merchandise export. From US $ 136 million in 1972-73, remittances from overseas reached to peak figure of US $ 2,886 million in 1982- 83. At this peak remittances were 10 percent higher than merchandise export earnings and financed 51 percent of Pakistan's merchandise import bill. Similarly, 97 percent of the deficit on the merchandise trade balance was covered by the remittance earnings in 1982-83. Workers remittances from overseas have continuously declined since then. By 1987-88, remittances from abroad dropped to US $ 2,013 million, and financed only 29 percent of the merchandise import [GOP:1989]. This decline in the remittances has had significant adverse impact on Pakistan's current account balance.

Another factor which has been contributing to Pakistan's mounting current account deficit is its increasing debt service payments. These debt service payments are the outcome of Pakistan's external debt liability. Pakistan's total external debt has risen from US $ 10 billion in 1980 to US $ 17 billion in 1988. There are various factors which might have contributed to the growth of Pakistan's external debt, including: (a) the continuing growth in the trade deficit; (b) the increase level of debt service payment; (c) the increased level of budget deficits financed through borrowing abroad; and (d) the low level of domestic savings. Pakistan's gross domestic savings, as percent of GDP is among the lowest in Asia. While the domestic saving rate for low income countries in 1988 stood at 24.4 percent of GDP, the comparable figure for Pakistan was only 13 percent. Foreign borrowing to finance yearly budget deficit has also contributed to the Pakistan's growing debt. Pakistan's budget deficit which has been growing at a rate of 7.1 percent of GDP since 1981, reached to a peak level of 8.2 percent in 1988 [ADB:1990]. Table 8 highlights the growth of Pakistan's external debt, interest payments, and total debt service over past few years.

TABLE 8

Pakistan's External Debt and Service Payment

($ million)

Year	Total External Debt	Long-Term Debt	Interest Payment	Total Debt Service
1980	9941	8530	362	855
1981	10534	8607	320	835
1982	11637	9498	417	844
1983	11930	9520	488	1310
1984	12125	9753	506	1185
1985	13362	10597	498	1417
1986	14886	11829	582	1646
1987	16692	13490	614	1800
1988	17010	14027	652	1818

Source:World Debt Tables:1990].

Table 8 indicates, Pakistan's total external debt has risen at an average of US $785 million per year during 1980-88. During this period, interest payments, on long and short-term debt, inclusive of IMF charges, have risen from US $ 362 million to US $ 652 million. Total debt service which is the sum of principal repayments plus interest payments on total external debt have risen from US $ 855 million in 1980 to US $ 1,818 million in 1988. Total external debt as a percentage of Gross National Product (GNP) stood at 45.6 percent in 1988 [World Debt Tables:1990].

Pakistan's debt service ratio, the ratio of total debt service to export of goods and services including workers' remittances, has risen from 14.8 percent in 1981 to 24.7 percent in 1988 [ADB:1990]. During the same period the interest service ratio, the ratio of total interest payments to exports of goods and services including remittances, from 6.8 percent in 1980 to 8.9 percent in 1988. This period also witnessed a deterioration in Pakistan's international reserve position. International reserves which, in 1980, were enough to meet import requirements for 12 weeks declined to a level where they could only meet 6 weeks of import requirements by 1988 [World Bank:1990].

Not only has the volume of Pakistan's total external debt has risen over time, the average terms of borrowing have also worsen. Table 9 compares the average terms of new borrowing commitments for Pakistan in 1980 and 1988.

TABLE 9

Average Terms of New Commitment

Terms	1980	1988
Interest (%)	4.4	5.2
Maturity (Years)	29.7	23.1
Grace Period (Years)	6.5	6.3
Grant Element (%)	47.6	36.4

Source:[World Debt Tables:1990].

Table 9 indicates, there has been an upward movement in the interest rates. There has been a drop in terms of duration of the loan maturity, grace period, and the proportion of the grant element in foreign capital inflow. The proportion of grant element in total foreign capital inflow has declined by over 11 percentage points from 1980 to its 1988 levels.

3.3 PAKISTAN'S OILSEED AND EDIBLE OIL CRISIS

One of the major reason for Pakistan's growing dependence on imported edible oil is production-consumption gap in the oilseed and edible oil sector of its economy. It has been argued that the increase in the demand for the edible oil is due to population growth, income growth, increased urbanization and a change in tastes and preferences from animal ghee to vegetable ghee and vegetable oil. Apart from these non-price determinants of increasing level of domestic edible oil consumption, the market prices for vegetable ghee increased much slower than the general price level leading to a decline in real price of vegetable ghee. According to one estimate by the Food and Agriculture Organization of the United Nations (FAO) [1986:9], the vegetable ghee price, in real terms, increased by only 26 percent between 1975/76 and 1983/84. During the same period wheat and sugar prices increased by 73 per cent and 80 per cent respectively; the wholesale price index went up by 101 per cent. According to another estimate, from 1980-81 to 1986-87, the average wholesale prices of ghee, in real terms, have fallen by 24 percent [Mahmood:1990]. Hence lower prices, in real terms, since 1980-81 have encouraged consumers to spend a higher proportion of additional income on relatively cheaper vegetable ghee. One estimate by the Office of the International Cooperation and Development [1984:651], reveals that the decline in vegetable ghee real prices has accounted for approximately half the growth in ghee consumption in Pakistan.

Although liquid cooking oil prices are not controlled by the government, the government influences this market through official cooking oil sales. Mustard and rapeseed oils are not subject to government control but their prices remain close to vegetable ghee prices.

For Pakistan, a distinction is made between traditional and non-traditional sources of edible oil. Traditional oils include cottonseed, rape/mustard seed, sesamum and groundnut oil. Non-traditional oils include sunflower, soybean and safflower oil. According to an estimate, the traditional oils account for 98 per cent of the domestic edible oil production. Cottonseed accounts for 85 percent of the domestic production. Non-traditional oils contribute about one to two percent in the domestic supply of edible oils. With the present level of consumption-production gap, the domestic oilseed and edible oil sector has been able to satisfy only one fifth of the domestic demand.

An overview of the Pakistan's oilseeds sector reveals that the production levels have remained low over the past one decade. Two major factors for low oilseeds production levels in Pakistan are said to be low yield and a relatively small area under oilseeds crops. According to estimates of the Office of the International Cooperation and Development [1984:76-80], Pakistan's oilseed yields are lower than the already low levels of developing nations. For some non-traditional oilseeds, the yield gap between Pakistan and the developed countries is more than 50 per cent.

There are said to be various factors which may explain the existing yields of oilseeds and the relative smaller area under these crops. These include inappropriate varieties of oilseeds, low quality oilseeds, insufficient use of required agricultural inputs, low plant population per unit of area, lack of plant protection, lack of pest control and inadequate extension services.

Crop yield and areas under the crop are influenced by market price uncertainties, price incentives and relatively profitablity of competing crops. During the past ten years, the farm-gate prices of sugarcane and wheat have been rising along with the wholesale price index. This has resulted in a more than fifty per cent increase in the production of wheat as well as sugarcane. The poor response of the oilseeds sector may be due to the fact that oilseeds prices to the growers have lagged far behind than that of the competing crops, i.e., wheat and sugarcane. Moreover, as the relative prices of vegetable ghee and edible cooking oil have fallen, as compared to that of major staple foods, farmers have realized that staple food crops are more attractive than the oilseeds. This situation has led to not only less production of oilseeds but fewer incentives for oilseed's farmers to adopt modern and improved techniques.

Among the major factors which has led to edible oil crisis in Pakistan is the interaction of inconsistent import and domestic controlled prices of oilseeds and edible oils and vegetable ghee. At a time when international prices of edible oil were higher than the domestic prices, the Government policy of not raising domestic prices to international levels discouraged potential oilseeds growers. This led to stagnation of the domestic production, and consequently higher edible oil imports. Similarly, when the international prices were lower than the domesic prices, no protection was granted to the domestic oilseeds and edible sector. In the absence of effective protective tariffs, imported edible oil was landed at relatively lower prices, reinforcing the existing production constraints faced by the domestic oilseeds and edible oil sector and encouraging more imports [Mahmood:1991].

The domestic price structure of oilseeds and edible oil sector has also resulted in illegal export of cooking oil and vegetable ghee to neighbouring India, as a consequence of the price disparities between the two countries. Hence scarce Pakistani foreign exchange resources are being used to subsidized consumption in India.

Other factors which might have aggravated the present edible oil crisis in Pakistan are said to be: the supply of edible oil to Pakistan under the U.S. PL-480 program, marketing constraints, inefficiencies in the domestic processing industry, and lack of policy emphasis on the significance of by-products and by-product industries in the overall performance of oilseed and edible oil sector of Pakistan's economy.

A factor which might have played a counter productive role for the solution of present crisis is said to be the supply of edible oil under U.S. PL-480 program to Pakistan. It has been argued that the PL-480 program not only enhanced the government dependence on this program as a short term solution to the edible oil crisis, but it also constrained the growth of non-traditional oilseeds.

A strong government role in the oilseed and edible oil sector has led serious marketing inefficiencies. The lack of an efficient oilseed and edible oil market not only raised the marketing costs but also lessened the degree of price competitiveness in the marketing sector.

Along with increase domestic oilseed production, the expansion of edible oil production depends on the processing efficiency of the edible oil extraction industry. The following section discusses the structure of Pakistan's oilseed processing industry and various issues affecting the performance of this industry.

3.3.1 Structure of Oilseed Processing Industry

There are three common methods of oilseeds extraction which are being used in Pakistan. These methods are, kohlus, expellers and modern solvent plants.

Village Kohlu **Kohlu** is the traditional oxen-driven village oilseed expeller, with approximate crushing capacity of 25 Kg. per day to 40 Kg. per day. According to one estimate there are 15,000 to 20,000 kohlus operating in the rural Pakistan [Manzoor and Saeed:1988]. According to another estimate the number of kohlus operating in Pakistan are in the range of 9,000 [FAO:1986]. These kohlus process rapeseed and mustard for village consumption, recovering about 75 percent of the extractable oil from the rapeseed, [Office of the International Cooperation and Development, 1984:233]. The oil recovery rate, however, may vary from 20 to 30 percent [Manzoor and Saeed:1988]. In addition to oil the kohlus produce rapeseed and mustard cake, used as a source of animal feed.

Mechanical Expeller:

Over time the mechanical expellers are replacing the kohlus. There are two types of expeller in Pakistan. Small expellers, with average capacity of 7 to 60 tons of oilseed per day. Second, large expellers with average crushing capacity of 100 tons or more of oilseed per day [Mahmood:1990]. The total installed crushing capacity of expellers is about 3.5 million tons of oilseeds annually. However, there is 49 percent of excess capacity among expellers.[45] According to one estimate, over 90 percent of the cottonseed and about 10 percent of the rapeseed/mustard seed is processed through this method. The oil recovery rates vary from 33 percent for rapeseed and mustard seed to 11 percent for cottonseed. There is no extraction of soybean or sunflower oils using this method, however, it is estimated that for sunflower the oil recovery rate is 27 percent [see Appendix 7].

[45] F.A.O., op.cit., Annex 5, Appendix 1, table 1

Solvent Extraction

The third oilseed processing technique in Pakistan is the solvent extraction. which extract between 17 to 38 percent of oil, depending on the nature of oilseed. For example, in case of cottonseed the oil recovery rate averages 17 percent. whereas, for rapeseed and mustard the oil recovery rate is 38 percent. For sunflower and soybean the oil recovery rates are 36 and 14 percent respectively. One of the major by-products of this extraction technique is the oilseed meal [See Appendix 7]. Out of solvent crushing capacity of about 400,000 tons, only 40 percent is utilized for cottonseed, rice bran, and rape cake processing.

3.3.2 Performance of the Industry: Problems and Prospects

It has been argued that if all cottonseed, rapeseed and mustard seed crushed by the kohlus and expellers were instead processed by more efficient solvent plants the annual edible oil imports could be reduced by 70,000 tons [Office of the International Cooperation and Development:1984]. However, there are various reasons why kohlus and expellers process the entire rapeseed and mustard crops and why the expellers process 90 percent of the cottonseed. First, the location of Kohlus and expeller plants is ideal for consumers as well as producer, in terms of convenience and lower transportation costs. Secondly, although the expellers are inefficient, in terms of lower extraction rates, they are cost effective as compared to more modern and efficient solvent plants. The solvent plants have high extraction rates but the value of the increased oil production does not offset the transportation and processing costs.

For expellers the low extraction rates overestimate the relative inefficiency of the this technique of oilseed extraction. Expeller operators deliberately leave high oil content in the cake, for which they get a premium price. Given the fact that total revenue for the processer depends not only on the market price of oil but also on the prices for meal and cake, at prevailing prices of the crude edible oil and the by-products they find it profitable not to maximize oil extraction. Another reason for keeping the production of edible oil low has been the price disparity between industrial and edible crude oil. The oilseed processors find it more profitable to sell their output as industrial oil rather than edible oil for human consumption. Again it is the price structure of the oilseed and edible oil sector which not only limits the domestic supply of edible oil but also gives a biased view on the relative technical inefficiency of the expeller extraction.

Pakistan's oilseeds and edible oil sector is also constrained by the inefficiencies in the edible oil refining sector. The refining industry buys oil from importers as well as from domestic crushers. The final products, after processing, are sold as vegetable ghee and as cooking oil. The major reasons for inefficiencies in the edible oil refining are said to be, failure to achieve economies of scale, short production run, lack of vertical integration, inappropriate plant size, and inappropriate location of the existing refining facilities.

3.4 SUMMARY

The argument for self-sufficiency in edible oil has become increasingly important as result of the drop in the level of foreign remittances since 1983, high crude oil prices, increasing levels of debt service payment, and depletion of foreign exchange reserves. Edible oil imports have risen by about three times over the decade, 1977-78 to 1987-88. In value terms, the edible oil import bill has doubled. Edible oils are now among Pakistan's major imports. Almost 70 per-cent of the domestic edible oil requirements are met by imported edible oil

An overview of different dimensions of the Pakistan's oilseed and edible oil crisis reveals that, among other con-straints, the interaction of an inconsistent domestic and import price policy is one of the key factors in the making of this crisis. Domestic and import price polices in the oilseed and edible oil sector have encouraged consumption and discouraged domestic production. These policies have also lead to low extraction rates, processing and marketing inefficiencies and encouraged illegal export to India. The result is high imports levels and an increasing drain of foreign exchange.

Chapter IV

THE DRC MODELS FOR OILSEED AND EDIBLE OIL INDUSTRY

4.1 INTRODUCTION

This chapter lays down the theoretical foundations to empirically estimate the comparative advantage of Pakistan's oilseed and edible oil sector, utilizing the Domestic Resource Cost (DRC) criterion. The chapter is divided into three sections. Section 1 deals with the oilseed as well as the edible oil sector models, based on the DRC criterion. To test the financial profitability of oilseed as well as edible oil production, the financial profitability models for oilseed and edible oil sectors are also presented in this section. Section 2 consists of definition of the variables used in the construction of the above models. The last section discusses the theoretical basis as well as relationships embodied in the models.

4.2 THE DRC MODEL FOR OILSEED PRODUCING SECTOR

The DRC models of the oilseed and edible oil producing sectors, presented in this chapter, relies on a simple ratio of the domestic cost of producing a unit of a tradeable output, j, to the net foreign exchange saving (in case of import substitution) or net foreign exchange earning (in case of export promotion), involved in the production of a tradeable commodity, j. Where the per unit domestic cost is measured in the domestic currency at shadow prices, the net foreign exchange saving or earning involved in the production of j is expressed in domestic prices using a shadow or official exchange rate. In a situation where the domestic production of j does not involve any net external social benefits and production of by-products, the DRC per unit of foreign exchange in the production of j can be represented as:

DRCj = DCj/NFeSj.

Where:

DCj = domestic cost of producing a unit of j, measured in the domestic currency at shadow prices.

NfeSj = net foreign exchange saving or earnings, measured in domestic currency at the official exchange rate.

The net foreign exchange savings, NFeSj, is the difference between the per unit world price of j, Pj, and the international value of imported input requirements per unit of Mj, i.e., NFeSj= Pj-Mj. If DRCj<1 then this result implies that the industry producing j exhibit comparative advantage in the production of j and the production of j is efficient in terms of saving or earning the foreign exchange. If, however, DRCj>1 then this result will imply that the industry or activity under consideration faces comparative disadvantage in the production of j.

An alternative way to represent the DRC ratio is to express the net foreign exchange saving in foreign currency at the official exchange rate and then compare the resulting figure for DRC ratio with the shadow exchange rate(SER). If DRCj > SER, this implies that the industry in question has a comparative disadvantage in the production of commodity, j. If DRCj < SER, then the industry has a comparative advantage in the production of j.

A. The DRC Model for the Oilseed Sector

$$DRCxi = \frac{DCxi - VNTBxi - NTDsxi}{[Pxi + TDsxi + VTBxi] - Mxi} \qquad (A.1)$$

$$DCxi = Wu.Luxi + Ws.Lsxi + q.Kxi + r.Dxi \qquad (A.2)$$

$$NDCxi = DCxi - VNTBxi - NTDsxi \qquad (A.3)$$

$$NFeSxi = [(Pxi + TDsxi) + VTBxi)] - Mxi \qquad (A.4)$$

$$DRCxi = NDCxi/NFeSxi \qquad (A.5)$$

$$DRC1xi = \frac{NDCxi}{NFeS1xi} \gtreqless 1 \qquad (A.6)$$

$$DRC2xi = \frac{NDCxi}{NFeS2xi} \gtreqless SER \qquad (A.7)$$

B.III

$$DRCxi = f[DCxi,\ VNTBxi,\ NTDsxi,\ Pxi,\ Mxi,\ TDsxi,\ Mxi, VTBxi,\ OER,\ SER] \qquad (A.8)$$

$$Edcxi > 0,\ Evtbxi > 0,\ Emxi > 0 \qquad (A.9)$$

$$Evntbxi < 0,\ Epxi < 0,\ Etdsxi < 0,\ Evtbxi < 0 \qquad (A.10)$$

$$Entdsxi,\ Eoer < 0,\ Eser < 0$$

B. The DRC Model for the Edible Oil Producing Sector

The above model deals with the question of comparative advantage in the production of oilseeds. The existance of comparative advantage in the production of oilseed alone, however, may or may not lead to comparative advantage in the production of edible oil. Therefore, for an overall oilseed and edible oil economy, it is important to estimate the extent of comparative advantage or disadvantage in the production of edible oils.

We construct the DRC model for the edible oil sector for two oilseed sources; domestic and imported. First, we assume that the domestic edible oil processing industry uses imported oilseeds for the production of edible oils. This possibility will arise only if the country exhibits comparative disadvantage in the production of oilseeds and, therefore, it is cheaper to import the oilseeds. Second, we assume that the domestic edible oil processing industry uses domestically produced oilseeds. This will be the case when the domestic oilseeds production exhibit comparative advantage. Under this condition, the DRC model for the edible oil sector will estimate the comparative advantage of an integrated edible oil industry, by incorporating cost of producing oilseed, at the farm level, and cost of processing the oilseed. The resulting DRC coefficient then can be termed as joint DRC coefficient. The DRC model for the edible oil sector will estimate the comparative advantage of edible oil production on the basis of expeller as well as solvent oil-seed extraction technologies.[46]

B. The DRC Model for the Edible Oil Sector Using Imported Oilseed

$$DRCOxi = \frac{DCOxi - VNTBOxi - NTsOxi}{[POxi + TDsOxi + VTBOxi] - MOxi} \quad (B.1)$$

$$DCOXI = Wu.LuOxi + Ws.LsOxi + q.KOxi \quad (B.2)$$

$$NDCOxi = DCOxi - VTBOxi - NTsOxi \quad (B.3)$$

$$NFeSOxi = [POxi + TDsOxi + VTBOxi] - MOxi] \quad (B.4)$$

$$DRCOxi = NDCOxi/NFeSOxi \quad (B.5)$$

$$DRCO1xi = \frac{NDCOxi}{NFeSO1xi} \gtrless 1 \quad (B.6)$$

$$DRCO2xi = \frac{NDCOxi}{NFeSO2xi} \gtrless SER \quad (B.7)$$

$$DRCOxi = f(DCOxi, VNTBOxi, POxi, TDsOxi, VTBOxi, Moxi, NTsOxi, OER, SER,) \quad (B.8)$$

$$Edcoxi > 0, Emoxi > 0, \quad (B.9)$$

[46] The DRC model for edible sector is equally applicable to determine the comparative advantage of edible oil production through kohlus, we, however, do not have the relevant information to estimate the above model on the basis of village-level kohlu technology, which is used to process rapeseed/mustard.

Evntboxi < 0, Epoxi < 0, Etdsoxi < 0, Evtboxi < 0 (B.10)

Entsoxi

C. Joint DRC Model for Edible Oil Sector Using Domestic Oilseeds

$$JDRCOxi = \frac{(DCxi + DCPxi) - (VNTBxi + VNTBOxi + NTsOxi)}{(POxi + TDsOxi + VTBxi + VTBOxi) - (Mxi + MPxi)} \quad (C.1)$$

$$JNDCOxi = (DCxi + DCPxi) - (VNTBxi + VNTBOxi + NTsOxi \quad (C.2)$$

$$JNFeSOxi = (POxi + TDsOxi + VTBxi + VTBOxi) - (Mxi + MPxi) \quad (C.3)$$

$$JDRCOxi = JNDCOxi/JNFeSOxi \quad (C.4)$$

$$JDRCOxi = \frac{JNDCOxi}{JNFeSOxi} \begin{matrix} > \\ = \\ < \end{matrix} 1 \quad (C.5)$$

$$JDRCOxi = \frac{JNDCOxi}{JNFeSOxi} \begin{matrix} > \\ = \\ < \end{matrix} SER \quad (C.6)$$

C.II

$$JDRCOxi = f(DCxi, DCPxi, VNTBxi, VNTBOxi, POxi, TDsOxi, NTsOxi, VTBxi, VTBOxi, Mxi, MPxi) \quad (C.7)$$

$$JEdcxi > 0, JEdcpxi > 0, JEmxi > 0, JEmpxi > 0 \quad (C.8)$$

$JEvntbxi < 0$, $JEvntboxi < 0$, $JEpoxi < 0$, $JEtdsoxi < 0$

$JEvtbxi < 0$, $JEvtboxi < 0$, $JEntsoxi$ (C.9)

4.2.1 Financial Profitability Model

The Oilseed Producing Sector

The existance of comparative advantage in the production of a commodity, as indicated by the DRC, does not necessarily lead to commercial or financial profitability. For example, even though Pakistan exhibits a comparative advantage in the production of oilseeds, it may not be in individual farmer's interest to grow oilseeds. Oilseed growing may be financially unprofitable or other crops may be financially more profitable. Therefore, it is important to estimate the extent of financial or commercial profitability in the production of the oilseed crops. The financial profitability model make use of financial or market prices rather than shadow or economic prices. We estimate the financial profitability of producing edible oil through expeller as well as solvent processing technologies.

Oilseed Producing Sector:

$$PROFTxi = TRxi - TCxi \quad (1)$$

$$TRxi = PFkg \cdot YLac \quad (2)$$

$$TCxi = Cxiac \quad (3)$$

$$PROFTxi = PFkg \cdot YLac - Cxiac \quad (4)$$

The Edible Oil Producing Sector:

$$PROFTo = Pfo + BPVo - TCo \qquad (5)$$

$$TCo = SR \cdot Cskg + PC \qquad (6)$$

4.3 DEFINITION OF THE VARIABLES

DRC1xi = ratio of net domestic cost of oilseed production at shadow prices to net foreign exchange savings (expressed in domestic currency at the shadow exchange rate).

DRC2xi = ratio of net domestic cost of oilseed production at shadow prices to net foreign exchange savings (expressed in foreign currency at the official exchange rate).

DRCO1xi = ratio of net domestic cost of edible oil production at shadow prices to net foreign exchange savings (expressed in domestic currency at the shadow exchange rate).

DRCO2xi = ratio of net domestic cost of edible oil production at shadow prices to net foreign exchange savings (expressed in foreign currency at official exchange rate).

JDRCO1xi = ratio of joint net domestic cost of producing oilseed and edible oil at shadow prices to net foreign exchange savings (expressed in domestic currency at the shadow exchange rate).

JDRCO2 xi = ratio of joint net domestic cost of producing oil seed and edible oil at shadow prices to net foreign exchange savings (expressed in foreign currency at official exchange rate).

DCxi = direct and indirect domestic cost of producing oilseed, xi,(xi= 1,2,...n) measured in domestic currency at shadow prices, Rs./40Kg.

DCOxi = direct as well as indirect domestic cost of producing edible oil from oilseed, xi, (xi= 1,2,..n) measured in domestic currency at shadow prices, Rs./ton.

DCPxi = direct as well as indirect domestic cost of processing a unit of oilseed, xi, measured in domestic currency at shadow prices, Rs./ton.

Wu = shadow wage rate for unskilled urban and rural worker, Rs./day.

Ws = shadow wage rate for skilled worker, Rs./day

Luxi = direct plus indirect unskilled labour requirements in the production of xi, labour days.

Lsxi = direct plus indirect skilled labour requirements in the production of xi, labour days.

q = shadow price of capital.

Kxi = direct plus indirect capital requirements in the production of xi, Rs./40 kg.

r = shadow price of land, Rs./acre.

Dxi = land requirement in the production of xi, acre.

VNTBxi = value of non-traded by-products from the production of xi, Rs./40 kg. of oilseeds.

VNTBOxi = Value of non-traded by-products from the production of edible oil derived from oilseed xi, Rs./ton of oil.

Pxi = cif price of oilseed,xi, measured in domestic or foreign currency at official or shadow exchange rate, Rs/40 kg. or $/40 kg.

POxi = cif price of edible oil type xi, measured in domestic or foreign currency at shadow or official exchange rate, Rs./ton or $/ton.

TDsxi = traded portion of the distribution cost due to import of xi, measured in domestic or foreign currency at official or shadow exchange rate, Rs./40 kg. or $/40 kg.

NTDsxi = non-traded portion of the distribution cost due to import of oilseed,xi, measured in domestic currency at shadow prices.

TDsOxi = traded portion of the distribution cost due to import of edible oil type xi, measured in domestic or foreign currency at official or shadow exchange rate, Rs./ton or $/ton.

NTsOxi = non-traded portion of the distribution cost due to import of edible oil, xi, measured in domestic currency at shadow prices.

Mxi(t) = cif value of imported inputs required to produce oilseed, xi, measured in foreign or domestic currency at official or shadow exchange rate, Rs/40 kg. or $/40 kg.

MOxi = cif value of imported inputs required to produce edible oil type xi, measured in foreign or domestic currency at official or foreign exchange rate, Rs./ton or $/ton.

MPxi = cif value of imported inputs required to process a unit of oilseed, xi, measured in foreign or domestic currency at the official or shadow exchange rate, Rs./ton or $/ton

VTBxi = value of tradeable by-product in the production of xi, measured in domestic or foreign currency at official or shadow exchange rate, Rs./40 kg. or $/40 kg.

VTBOxi = value of tradeable by-products in the production of edible oil from oilseed type xi, measured in domestic or foreign currency at official or shadow exchange rate, Rs./ton or $/ton.

SER = shadow exchange rate, Rs./U.S.$.

NDCxi = net domestic cost in the production of oilseed, xi, measured in domestic currency at the shadow prices, Rs./40 kg.

NDCOxi = net domestic cost of producing edible oil from oilseed, xi, measured in domestic currency at the shadow prices, Rs./ton.

JNDCOxi = net domestic cost of joint production and processing of oilseed, xi, measured in domestic currency at the shadow prices, Rs./ton.

NFeS1xi = net foreign exchange savings from the domestic production of oilseed, xi, measured in domestic currency at shadow exchange rate, Rs./40 kg.

NFeSxi2 = net foreign exchange savings from the domestic production of oilseed, xi, measured in foreign currency at official exchange rate, $/40 kg.

NFeSO1xi = net foreign exchange savings from the domestic production of edible oil, measured in domestic currency at shadow exchange rate, Rs./ton

NFeSO2xi = net foreign exchange savings from the domestic production of edible oil, measured in foreign currency at shadow exchange rate, $/ton.

JNFeSO1xi = net foreign exchange savings from joint domestic production and processing of oilseed, xi, measured in domestic currency at shadow exchange rate, Rs./ton.

JNFeSO2xi = net foreign exchange savings from joint production and of oilseed edible oil, measured in foreign currency at official exchange rate, $/ton.

Edxi = DRC elasticity with respect to DCxi.

Evtbxi = DRC elasticity with respect to VTBxi

Emxi = DRC elasticity with respect to MXi.

Evntbxi = DRC elasticity with respect to VNTBxi.

Entdsxi = DRC elasticity with respect to NTDsxi

Epxi = DRC elasticity with respect to Pxi.

Etdsxi = DRC elasticity with respect to TDsxi.

Evtbxi = DRC elasticity with respect to VTBxi.

Eoer = DRC elasticity with respect to OER.

Eser = DRC elasticity with respect to SER.

Edcoxi = DRC elasticity with respect to DCOxi.

Emoxi = DRC elasticity with respect to MOxi.

Evntboxi = DRC elasticity with respect to VNTBOxi.

Entsoxi = DRC elasticity with respect to NTsOxi.
Epoxi = DRC elasticity with respect to POxi.

Etdsoxi = DRC elasticity with respect to TDsOxi.

Evtboxi = DRC elasticity with respect to VTBOxi.

JEdcxi = joint DRC elasticity with respect to DCxi.

JEdcpxi = joint DRC elasticity with respect to DCPx.

JEmxi = joint DRC elasticity with respect to Mxi.

JEmpxi = joint DRC elasticity with respect to Mpxi.

JEvntbxi = joint DRC elasticity with respect to VNTBxi.

JEvntboxi = joint DRC elasticity with respect to VNTBOxi.

JEpoxi = joint DRC elasticity with respect to POxi.

JEtdsoxi = joint DRC elasticity with respect to TDsOxi.

JEvtbxi = joint DRC elasticity with respect to VTBxi.

JEvtboxi = joint DRC elasticity with respect to VTBOxi.

PROFTxi = per acre profit in the production of given oilseed, Rs./acre.

TRxi = per acre total revenue in the production of given oilseec Rs./acre

TCxi = Per acre total cost in the production of given oilseed, Rs./acre.

PFkg = Per kg. financial price of oilseed, Rs./kg.

Ylac = per acre oilseed yield, kg./acre

Cxiac = per acre cost of oilseed production, Rs./acre

PROFTo = per M.T. profit in the production of given edible oil, Rs./ton.

Pfo = per M.T. financial price of given edible oil, Rs./ton.

BPVo = value of by-products per M.T. edible oil, Ras./ton.

TCo = per M.T. cost of edible oil production, Rs./ton.

SR = Seed requirement per M.T. of edible oil in Kg, kg/ton.

Cskg = per kg. cost of seed, Rs./kg.

PC = processing cost per M.T. of edible oil production, Rs./ton.

4.4 THE OILSEED SECTOR: EQUATIONS A.1 TO A.10

Equations (A.1) and (A.5), measure the DRC per unit of foreign exchange savings, in the domestic production of a unit of oilseed crop xi.[47] In terms of Equation A.1, the first term on the right hand side of the numerator measures the domestic cost of producing a particular type of oilseed in a given amount. This measure is expressed in terms of domestic currency and evaluated at shadow prices. The domestic cost of producing xi is measured by as Equation A.2. Equation A.2 measures the sum of primary factors cost in the production of xi, evaluated at their respective shadow prices.

The production of oilseeds, i.e., xi, may also result in the production of tradeable as well as non-tradeable by-products. The second item in the numerator of Equation A.1, VNTBxi, measures the value of non-traded by-products, resulting from the production of xi. We measure these benefits in the domestic currency at shadow prices. In order to get a net measure of domestic cost of xi, we subtract the value of non-traded by-products and non-traded cost of distributing imported oilseeds from the domestic cost of xi. The numerator of the right hand side of (A.1), thus, becomes the measure of net domestic cost of producing a unit of oilseed ,xi, which can also be expressed by (A.3).

[47] In the context of our study by a unit of oilseed we imply 40 Kg. of oilseed crop xi.

The denominator of Equation A.1 measures the net foreign exchange savings measured in domestic currency at the shadow exchange rate. While the denominator of Equation A.5 measures the net foreign exchange savings expressed in foreign currency at official exchange rate. The net foreign exchange savings can be represented by Equation A.4.The first term in the denominator of Equation A.1 is the cif price of a unit of oilseed, xi. The domestic production of xi, will result in saving of foreign exchange savings, equal to the cif price of the oilseed, xi. This foreign exchange saving is, however, not the only source of foreign exchange saving. The domestic production of oilseed,xi, will also result in foreign exchange savings from two other channels: (a) the traded portion of the distribution cost arising from import of the oilseed, TDxi, and ; (b) the value of traded by-products, VTBxi.

In the case of distribution cost, the conventional approach to the DRC criterion assumes that there are no costs involved in terms of port charges, labour, and transporting of the imported commodity from port to the point where it competes with the domestic output. But clearly these are real costs and in the case of bulky commodities these costs may be significant in relation to their cif values. Therefore, there is need to take into account the distribution cost. We, however, make a distinction between traded and non-traded portion of the distribution cost. The non-traded portion of distribution cost is expressed in terms of the contribution of the primary factors and subtracted from the domestic cost in the numerator of Equation A.1.

By adding : (a) the traded portion of the distribution cost of oilseed xi, that is, TDsxi, and ; (b) the traded value of the by products of oilseed xi, that is, VTBxi, to the cif price of the oilseed xi, we get the gross measure of foreign exchange savings in the domestic production of oilseed xi. The domestic production of oilseed, involve the use of tradeable as well as non-traded inputs. In some cases, the production of the non-traded inputs requires the contribution of the traded inputs. In order to get a net measure of foreign exchange savings we need to subtract the value of direct as well as indirect tradeable inputs, Mxi, from the gross foreign exchange savings.

The denominator of Equation A.1 A.1 and Equation A.5 then provide us with net foreign exchange savings per unit of domestic production of oilseed xi. The ratio of net domestic cost to the net foreign exchange gives us the DRC per unit of foreign exchange savings resulting from the domestic production of xi. This ratio or coefficient is given by DRC1xi DRC2xi in the left hand side of the numerator of Equation A.1 and Equation A.5 respectively.

There are two alternative ways to express the comparative advantage in the production of xi. First, we represent the net foreign exchange savings in the domestic currency and see whether the resulting DRC coefficient is greater, equal or less than unity, as represented by Equation A.6. If the DRC coefficient is less than unity then this implies a comparative advantage in the production of the oilseed, xi. A DRC coefficient greater than unity implies a comparative disadvantage in the production of oilseed xi.

Second, we express the net foreign exchange savings in terms of foreign currency at the official exchange rate and compare the resulting DRC coefficient with the shadow exchange rate, as given by Equation A.7. If the DRC coefficient is less than the shadow exchange rate then this result imply that comparative advantage exists in the domestic production of oilseed xi. But if the DRC coefficient is greater then the shadow exchange rate then there exists comparative disadvantage in the production of oilseed xi.

4.4.1 Sensitivity Analysis: The Oilseed Sector

It is possible that the domestic cost of producing oilseed, xi, may significantly rely on the values of certain variables, such as shadow price of labour, land, and capital. In order to see to what extent our estimates of DRC coefficients are sensitive to these variables we perform a sensitivity analysis. To undertake this analysis we reestimate Equations A.1 to A.7, and compare these results with our original results. Apart from prices of land, labour, and capital the above variables, the DRC coefficients may also be sensitive to other factors such as the crop yield, the cif price of oilseeds, and tradeable material cost. The sensitivity analysis also takes into account the impact of these variables on the DRC coefficients.

To analyze the responsiveness of the DRC coefficients of oilseeds with respect to various parameters of the model we estimate the elasticities of the DRC coefficients with respect to these parameters of the model. The DRC elasticity is defined as the percentage change in the DRC coefficient caused by a one percent change in the value of the relevant parameter of the model. The analysis will be based on the functional relationship given by Equation A.8 and A.9.

On a priori grounds we assume that the elasticity of DRC coefficient for oilseed, xi, with respect to DCxi, and Mxi is positive. For example, an increase in the domestic cost of producing an oilseed, DCxi, will lead to an increase in the DRC coefficient for xi, and vice versa. Hence, an increase in the domestic cost of production, holding other variables constant, will lead to deterioration in the comparative advantage of a given oilseed crop. Similarly an increase in the tradeable cost of the domestic production, Mxi, will also lead to the same outcome.

Similarly, we postulate that the DRC elasticity of oilseeds with respect to VNTBxi, Pxi, TDsxi, and VTBxi is negative. For example, keeping other variables constant, an increase in the cif price of a unit of oilseed xi, will lead to a decrease in the DRC coefficient, improving the comparative advantage position of a given oilseed crop.

A variable which plays an importent role in determining the extent of comparative advantage in the production of oilseed but do not appear explicitly in the formulation of the model is the per acre yield of oilseed xi. An increase in the crop yield, other things being equal, will lower the DRC ratio and thus enhances the degree of competitiveness of the given oilseed crop. In order to see the responsiveness of DRC ratio with respect to crop yield we will also estimate the relative measure of elasticity.

4.5 THE DRC MODEL FOR EDIBLE OIL SECTOR: IMPORTED OILSEEDS

In this model we estimate the domestic resource cost of producing of a unit of edible oil, assuming that the domestic oilseed crushing industry uses imported oilseeds. We treat oilseed like other other tradeable inputs in the production of edible oil.

The edible oil model is constructed along the lines parallel to that of oilseed model. Equation B.1 as well as B.5

measures the DRC per unit of foreign exchange saving in the production of a unit of edible oil. In terms of Equation B.8, the numerator measures the net domestic cost of producing a unit of edible oil from a given type of oilseed, xi. Given that a unit of edible oil is jointly produced with its by-product, e.g., meal, oilseed cake, industrial oil,etc, we subtract the value of non-traded by-products from the gross measure of the domestic cost of producing a unit of edible oil. We measure the net domestic cost of producing edible oil in terms of domestic currency at shadow prices as before.

The denominator of Equation B.5 is a measure of net foreign exchange saving, that is, the difference of gross foreign exchange saving and the foreign exchange cost involved in the production of edible oil. The gross foreign exchange saving is represented by the sum of cif price of unit of edible oil plus the traded portion of the distribution cost and the value of tradeable by-products. The foreign exchange cost is simply the sum of direct plus indirect value of tradeable inputs used in the production of a given unit of edible oil. The net foreign exchange savings are measured in domestic or foreign currency at the official of shadow exchange rate.

Equation B.6 estimates the comparative advantage in the production of edible oil from a given type of oilseed, xi. In this measure the net foreign exchange savings are in domestic currency and a comparative advantage depends on whether the DRC ratio is less than one. On the other hand in Equation B.7 the DRC coefficient is compared with the shadow exchange rate. In this measure, however, the net foreign exchange savings are evaluated at the official exchange rate and expressed in foreign currency.

4.6 SENSITIVITY ANALYSIS: THE EDIBLE OIL SECTOR

The sensitivity analysis for the edible oil model follows the same procedures as in the oilseed model. In order to evaluate the sensitivity of the DRC coefficients of edible oils, we will re-estimate the edible oil model assuming different values for the various parameters of the model. To identify the dependence of DRC coefficient on the cost of the primary factors, we will re-estimate the DRC coefficients under different assumptions, regarding the shadow prices of the primary factors.

Th estimation of elasticities for the edible oil model we use Equation B.9 and B.10. This analysis based on a functional relationship, given by Equation B.8. Equations B.9 and B.10 point that elasticity of the DRC ratios of edible oils with respect to DCOxi and MOxi is positive. This implies that an increase in the domestic cost or foreign cost, other things being equal will lead to a decrease in the DRC coefficient or comparative advantage. Whereas, the DRC elasticity of edible oils with respect to VNTBOxi, POxi, TDsOxi, NTsOxi, and VTBOxi is negative. For instance, assuming all other variable as constant, decrease in the cif price of edible oil, MOxi, will translate into a higher DRC ratio and, hence, a deterioration in the comparative advantage position. An increase in the cif price of the edible oil, on the other hand, will lead to an improvement in the comparative advantage position.

4.7 THE DRC MODEL FOR AN INTEGRATED EDIBLE OIL SECTOR

Equations C.1 to C.6 measure the joint domestic resource cost (JDRC) per unit of foreign exchange savings in the domestic production of a unit of edible oil from oilseed, xi. The first two terms on the right hand side of the numerator measures the domestic cost involved in the production of oilseed plus its processing. The remaining two terms on the right hand side of the numerator measure the value of non-traded by-products resulting from the production and processing of oilseeds. To arrive at the net domestic cost of both producing and processing oilseed, we subtract the value of the by-products from the gross measure of the domestic cost. The resulting net domestic cost of producing and processing a unit of oilseed is represented by Equation C.2.

The denominator of Equation C.1 measures the net foreign exchange savings resulting from the joint production of oilseed as well as its processing into edible oil. The value of tradeable inputs involved in the joint production of oilseed and edible oil are subtracted from the gross foreign exchange savings to derive the net foreign exchange savings from the joint production of oilseed and edible oil. The net foreign exchange savings from the joint production of oilseed as well as edible oil is given by Equation C.3. Hence, Equation C.1 and and C.4 both measures the joint DRC per unit of foreign exchange.

Once again we make use of two alternative ways to express comparative advantage in the joint production of oilseed and edible oil. In Equation C.5 we express the net foreign exchange savings in domestic currency and compare whether this ratio is greater, equal or less than unity, in order to determine the comparative advantage of the joint activity. Alternatively, in Equation C.6 we express the net foreign exchange savings in foreign currency and compare the resulting joint DRC ratio with the shadow exchange rate to determine comparative advantage.

4.8 SENSITIVITY ANALYSIS OF AN INTEGRATED EDIBLE OIL INDUSTRY

We postulate that the elasticities of joint DRC coefficient, JDRCOxi, with respect to DCxi, DCPxi, Mxi, and MPxi are positive. For example, we postulate that an increase in the domestic processing of oilseed or an increase in the traded cost of oilseed production will increase the joint DRC coefficient and thus lowering the extent of comparative advantage. On the other hand we expect that the elasticity of joint DRC coefficient with respect to VNTBxi, VNTBOxi, POxi, TDsOxi, VTBxi, NTsOxi. and VTBOxi will be negative, as given by Equation C.8.

To examine the dependence of joint DRC coefficient for edible oils on various parameters of the model, we will re-estimate Equations C.1, C.4, C.5 and C.6 on the basis of different set of assumptions regarding these variable. This analysis will also study the responsivesness of joint DRC coefficients with respect to the changes in shadow prices of the productive factors.

4.9 SUMMARY

This chapter provide a theoretical foundation for the assessment of comparative advantage in Pakistan's oilseed and edible oil industry, using DRC coefficients for various oilseeds and edible oils. The salient features of the oilseed and edible oil models include: the estimation of DRC coefficients of various oilseeds; the estimation of the DRC elasticities of oilseeds with respect to various parameters of the oilseed model; the estimation of the edible oil sector model under two different assumptions of oilseed sources; the estimation of DRC coefficients for various edible oils on the basis of expeller and solvent technologies; and the estimation of the DRC elasticities of edible oils with respect to various parameters of the edible oil model.

To access the commercial profitability of the oilseed and edible oil production, we also construct financial profitability models for both oilseed and edible oil. The financial profitability models will be used: to access the financial profitability of producing various oilseeds; to estimate the financial profitability of edible oil production for expeller and solvent extraction technologies; and to estimate the elasticities of the parameters of the financial profitability model.

Chapter V

PROCEDURES FOR ESTIMATING THE DOMESTIC RESOURCE COST MODELS

The procedure to estimate the DRC coefficients, as outlined in chapter 4, involve three basic and essential steps: a) decomposition of the total cost of producing a unit of the tradeable commodities, oilseed and edible oil, into foreign and domestic cost components; b) estimation of of traded as well as non-traded goods at their economic or shadow prices; and c) evaluation of the productive factors , such as labour, land, capital, and foreign exchange, at their shadow prices.

5.1 DATA SOURCES: OILSEED PRODUCTION

The estimation of the DRC coefficients for oilseed crops require data on : (a) the input requirements to produce each of the various oilseed crops; (b) per unit costs of the inputs (c) yields per acre and ; (d) output prices of the various oilseed crops. For cost of production data and yields we use crop budgets prepared by the FAO for the year 1987 [FAO:1986]. The crop yields used are those achieved by the good, but not the best farmers. The FAO input requirements are based on the research recommendations and generally accepted farming practices. The FAO estimates ignore fixed costs, land costs, and overhead cost, including management cost. For fixed costs of land and overhead production cost, estimates of the Agricultural Prices Commission of Pakistan (APC) for the same year, 1987, are used. We derived the relevant output prices from the Oil World [Oil World:various issues]. A complete set of cost of production, yield, and price data is provided in Appendix 1.

5.2 SHADOW PRICING OF PRODUCTIVE FACTORS

The estimation of the DRC coefficients require the evaluation of the primary factors at their shadow prices. In Pakistan, as in most developing countries, market prices of the productive factors such as, labour, land, capital, and foreign exchange do not reflect the opportunity cost of these factors to the society. The divergence between the market prices and economic prices arises from existing distortions in the factor markets. Under these circumstance, the social opportunity cost of the productive factors should measure the cost to the society in terms of output foregone when the productive factors are moved from their best alternative use. In estimating the domestic resource cost, the contribution of productive factors is expressed in terms of shadow prices, as the shadow prices reflect the social opportunity cost of the productive factors in terms of foregone output in alternative uses [Balassa : 1977].

5.2.1 Shadow Prices of Labour

There are various formulations for estimating shadow wage rates, depending on the situation and intended application of the shadow price of labour. For example, Galenson and Leibenstein [1955], and Dobb [1960], consider that the market wage rate is equal to the shadow wage rate. On the other hand, Lewis [1954], and Khan [1951], argue that the shadow wage rate is equal to zero. Harberger [1971], while discussing the social opportunity cost of labour argues that the shadow wage rate is simply the supply price of labour. The procedure to estimate shadow wage rate as advocated by Little and Mirrless [1974] has been widely used in developing countries, including Pakistan. Their formulation of the SWR is close to that of UNIDO [1972]. The difference between the above two approaches is due to selection of different numeraire. While Little and Mirless [1974], take saving as their numeraire, expressed in foreign exchange, UNIDO [1972], uses consumption, measured in domestic currency, as numeraire. According to Little and Mirrless [1974], the shadow wage rate can be given as follows:

$$SWR = m + (w - m) - (w - m)/s$$

Where,

w = wage paid to a labour in his new job.

m = foregone output, i.e., marginal product of labour.

$1/s$ = social value of current consumption in terms of current savings.

The first term on the right hand side is marginal product of labour. The next two terms measure the net social cost of increase in consumption, in terms of savings.[48]

5.2.2 Shadow Wages in Pakistan: An Overview

In estimating shadow prices for Pakistan, Little and Mirless [1968], and S.R. Khan [1975], conclude that the shadow price of labor was one half the market wage. In a latter study, for Pakistan, Little, Squire, and Durdag [1979], identify a shadow wage close to the market wage. Khan [1979] and Malick [1986], conclude that for skilled labour the market wage properly reflects its shadow wage or marginal revenue product. In their view skilled labour in Pakistan is scarce, especially following a large scale migration of Pakistani workers to the Middle East. In estimating effective protection rates and domestic resource costs for Pakistan's large-scale manufacturing sector, Naqvi and Kemal [1983] also take the market wage as equal to the shadow wage.

---

[48] As argued by Little and Mirless [1974], given that w>m, as workers consume all their incomes, society will provide them with extra consumption which is equal to c-m. However, this extra consumption at the part of workers posses a social cost in terms of a decline in the savings. As society evaluates s units of consumption to 1 unit savings, the net social cost of extra consumption in terms of saving is thus given by the last two terms of the right hand side in the above equation.

In estimating shadow prices of different goods and services for Pakistan, Ahmed, David, and Stern [1988], estimate shadow wage rate at 90 percent, values for the shadow wage rates reflect different assumptions about domestic labour market conditions.

Lawrence [1978] estimates shadow wage rate for rural labour. He makes a distinction in shadow wage rates between the peak and off-peak seasons, taking the market wage a true reflection of the shadow wage for rural workers during the peak season. For the off-peak season he estimates the shadow wage at 50 percent of the market wage. According to Balassa [1977], during the off-peak season the majority of rural workers are unemployed, therefore there will be no loss to the society or to national output if an additional rural worker is hired in the off-season. However, where rural workers are engaged in off-farm productive activities, which cannot be performed during the peak-season, Balassa [1977] considers one-half of the market or peak-season wage as the off-peak season shadow wage.

In estimating the shadow wage rate for the agricultural unskilled labour, M. Z. Khan [1979], follows Balassa [1977], taking the marginal product of rural labour during the off-peak season as one-half of the market wage rate in the peak-season. The shadow wage rate for agricultural labour is then a weighted average of marginal product of labor in the two seasons. M.Z Khan [1979], estimates the shadow wage rate, for rural worker, as between 31 percent and 46 percent of the market wage rate in 1975.[49] Little, Squire, and Durdag [1979], estimate shadow wage rates for unskilled rural worker by making use of social prices as opposed to the efficiency prices, used by M. Z. Khan [1979]. They estimate the shadow wage for rural worker at 75 percent of the market wage rate [Little, Squire, and Durdag:1979]. For urban public sector and unskilled worker there figures are 80 and 65 percent respectively [Little, Squire, Durdag:1979].

5.2.3 <u>Shadow Wage Rate: Estimation</u>

In estimating the domestic resource costs for various oilseeds and edible oils, we use the market wage to reflect the shadow wage rate for skilled workers. We argue that the market wage adequately reflects the value of marginal product. For unskilled rural worker, we follow, Balassa [1977], Gotsch and Brown [1981], and M.Z. Khan [1979]. We use a weighted average of marginal product of labour taking that peak season marginal product of labour is equal to market wage and the off-peak season marginal product of labour as one-half of the peak-season wage rate. The SWR, thus, can be determined by using the following formula.

---

[49] The lower range of the shadow wage rate is based on the assumption that slack season marginal product of labour is zero. While the higher range of the shadow wage rate suggests that slack season marginal product of labour is one-half of the peak-season marginal product of labour.

$$SWR = \frac{Wp + a.\ Wp}{2}$$

Where,

SWR = shadow wage rate

Wp = peak-season wage rate (peak-season marginal product)

a.Wp = off-peak wage rate

a = 0.5

From our cost of production data, the wage rate is Rs. 25 per day for 1987. Using above formula, we estimate the SWR at 18.75 for unskilled farm and urban labour. The ratio of market to SWR comes to be 0.75. Multiplying this ratio to the direct and indirect labour requirements for oilseed production, we derive the labour cost, evaluated at the shadow prices.

5.2.4 Shadow Pricing of Capital in Pakistan: An Overview

In the present study, the shadow price of capital or social opportunity cost of capital reflects the foregone marginal productivity of capital. Several studies have estimated the marginal productivity of capital in Pakistan. These include studies by Little, Squire, and Durdag [1979], Guisinger [1979], Weiss [1979], and Z .A. Khan [1979]. The analysis by Little, Squire, and Durdag [1979], Guisinger [1979], and Weiss [1979] is based on social prices. Z. A.

Khan [1979], estimates the marginal productivity of capital on the basis of efficiency prices. The above studies resulted in different estimates of the marginal productivity of capital. The differences in their estimates result from different methodologies and from the use of different data sets.

Little, Squire and Durdag [1979], for example, estimate the marginal productivity of capital as 6 percent. This estimate is based on the data of the Board of Industrial Management (BIM) firms (firms nationalized by the government in 1972). Guisinger [1979], however, questions the use of BIM data to estimate the marginal productivity of capital in the public sector. As the BIM data does not truely reflect the public sector as a whole. Moreover, shadow price of capital thus derived may diverge significantly from the marginal productivity of capital in the private sector. Under these conditions, as argued by Guisinger [1979], planners may not make use of such estimates for the shadow price of capital. To overcome these problems, Guisinger [1979], uses the public as well as private large scale manufacturing firms data to estimate marginal productivity of capital, in terms of average return to capital in manufacturing sector of Pakistan for 1975-76. Guisinger [1979], estimates the opportunity cost, expressed at border prices of 1975-76, at 15 percent, well above the value of 6 percent derived by Little, Squire and Durdag [1979].

Weiss [1979], adopts an opportunity cost of capital in the range of 10-12 percent. Weiss [1979], however, does not provide any theoretical rationale for selecting this range for the marginal productivity of capital. His estimates are derived solely from his discussions with the Pakistan Government. Following the methodology advocated by Balassa [1977], Z. A. Khan [1979], calculates the marginal productivity of capital from a weighted average of the returns on equity and debt capital. He uses profit rates to represent the return on equity, and the rates of interest on loans to measure the rate on debt capital.

5.2.5 Shadow Price of Capital: Estimation

To estimate the shadow price of capital, we follow the procedure adopted by Z. A. Khan [1979], and by Balassa [1977], and estimate the shadow price of capital as a weighted average of return on equity and debt capital. The weights are the proportions in which equity and debt capital is used for new investment [Balassa:1977]. The rate of return on debt capital is measured by the interest rate on loans and the rate of return on equity capital is measured by the profit rate. During 1987, the weighted average of the schedule bank advance rate was 11.20 percent. Adjusting for inflation of 5.4 percent in 1987, yields a real rate of interest of 5.8 percent.

We do not have estimates for the profit rate in the public or private sector. M. Z. Khan {1979], estimates on the profit rate are based on 1975-76 data for industrial firms registered with Karachi Stock Exchange. Mahmood and Sahibzada [1986], base their estimates for social rates of return in Pakistan's manufacturing industry on the Census of Manufacturing Industries data for 1980-81. Mahmood and Sahibzada [1986], estimate social rate of returns using social values, but they also provided market price data which can be used to estimate private rates of return in manufacturing sector. The private rate of return or profit rate in the manufacturing sector comes to 35 percent. We take this 1980-81 profit rate. This is reasonable assumption as 1980-81 was a normal year. After adjusting for inflation of 5.4 percent, the adjusted real profit rate comes to be 29.6 percent.

Now, given the debt equity ratio of 70-30 [M. Z. Khan:1979], we can use the following formula to estimate the shadow price of capital:

$$q = \{ a \cdot Pr + b \cdot Ir \}$$

Where,

q = shadow price of capital

a = proportion of equity capital in total investment

Pr = profit rate, adjusted for inflation

b = proportion of debt capital in total investment

Ir = real interest rate

Substituting the values in the above formula, we will get:

$$q = \{ .30 \times 29.6 + .70 \times 5.8 \}$$
$$= 13.23$$

This formula estimates the shadow price of capital for the industrial sector. To determine an economy wide shadow price of capital, we need to determine the marginal productivity of capital or shadow price of capital in the agriculture sector. In the absence of reliable detailed estimate on the marginal productivity of capital in the agriculture sector, we will use the average social rate of return of 18.6 percent on agriculture projects [M. Z. Khan:1979]. An economy wide shadow price of capital will be simple average of shadow price of capital in the agriculture and manufacturing sectors of the economy, which comes to 15.92, rounded to 16 Percent.

5.2.6 Shadow Pricing of Foreign Exchange:

The Shadow Exchange Rate (SER) is the opportunity cost of foreign exchange to the society, expressed in domestic currency.In many developing countries the Official Exchange Rate (OER) is a poor indicator of the opportunity cost of a unit of foreign exchange, due to under or over valuation of the domestic currency. In Pakistan, the use of a Standard Conversion Factor (SCF), the ratio of official to shadow exchange rate, in both project and policy evaluation indicates the difference in official and shadow exchange rates. Little,Squire, and Durdag [1979], estimate the SCF at 0.91 for 1975-76. Khan [1979] uses a figure of 0.95 for the SCF.

The SCF and SER are closely related as follows:

$$SER = 1/SCF \, . \, OER \qquad \text{-------- (a)}$$

$$\text{or} \quad SCF = OER/SER \qquad \text{-------- (b)}$$

As argued by Squire and van der Tak [1975],

> the SCF translates domestic prices into border prices expressed in units of the domestic currency, and division by the OER expresses the result in units of foreign exchange. The SER combines these two steps.

The SCF is estimated by taking the ratio of the value of all exports and imports at border prices to their value at domestic prices, [Squire and van der Tak:1975], [Mashayekhi:1980], [Gittinger:1982], [Little and Mirrlees:1972], [Amachree:1988],and [Scott:1974]. The SCF formula, in its simplest form, can be given as:[50]

$$SCF = \frac{M + X}{(M + Tm) + (X - Tx)} \qquad (c)$$

Where,

M = cif value of imports

X = fob value of exports

Tm = net value of taxes on imports

Tx = net value of taxes on exports

[50] This simple formula is used by Little, Squire, and Durdag [1979], to calculate SCF for Pakistan.

$$SER = OER \times \frac{e.X\,(1-tx) + n.M\,(1+tm)}{e.X + n.M} \qquad (f)$$

This formulation of SER is similar to the one advocated by Balassa [1974]. Balassa [1974] describes this formulation as " second-best" shadow exchange rate. It is a "second-best" SER on the assumption that the existing trade distortions will be continued during the lifetime of the project [Balassa:1974, 77].[51] If we assume that import and export elasticities of demand are both unity, the formula for SER as given by (f) is then equivalent to that one given by (d). Following this simplified formula, as given by (d), shadow exchange rate (SER) for Pakistan is derived in table 10.

---

[51] The need will arise to estimate the "first-best" SER if we assume that trade distortions will be removed by the time of implementation of the project. However, as demonstrated by Balassa, the information requirements to estimate the two exchange rates is the same. For more details on these and other variants of shadow exchange rates, see Balassa [1974,77], Bacha and Taylor [1973], Harberger [1969], and Schydlowsky [1968].

TABLE 10

Shadow Exchange Rate for Pakistan: 1984/85-1986/87

	(Billion Rupees at Current Prices) 1984/85	1985/86	1986/87	1987/88
1.Imports (M)	89,778	90,946	92,431	111,382
2.Exports (X)	37,979	49,592	63,355	78,445
3.Net Taxes on Imports (Tm)	22,882	28,353	33,089	35,020
4.Net Taxes (Subsidies) on Exports (Tx)*	489	844	275	3,240
5.OER	15.15	16.14	17.18	17.60
6.SCF	0.85	0.83	0.83	0.85
7.SER	17.82	19.49	20.70	20.56
8.SER/OER	1.18	1.21	1.20	1.168

* For 1985/86, the subsidies on exports were Rs. 844 billion higher than taxes on exports. Therefore, this amount represent net subsidies which is plus item.

Source:(1-5) Pakistan Economic Survey: 1988-89; (6-8) calculated by the author.

5.2.7 Shadow Pricing of Land:

The shadow price of land is its opportunity cost in its best alternative use. The best alternative uses, however, vary from one region or locality to another and from one set of farmers to another. Balassa [1977], Herdt and Lacsina [1976], and Gittinger [1982], identify three possible alternatives to estimate the opportunity cost of farmland: (a) the opportunity cost of land will be zero if there is no alternative use of the land or if there is a single possible crop; (b) if there exist an established market for land then the rental value of the land will provide the opportunity cost of land; and (c) in cases where possibilities exist to grow alternative crops and the market for land is subject to distortions, then the opportunity cost of land will be equal to the returns to land in alternative crops. These returns are based on economic or shadow prices rather than the financial prices. As proposed by Balassa [1977], if the alternative crops are tradeable crops, the difference between world market price of the product and sum of world market cost of inputs and the opportunity cost of capital and labour, will reflect the lands opportunity cost.

In the present study, we are dealing with more than one oilseed crop, which may or may not compete with other alternative crops. For example, in Baluchistan province, soybean can be grown in place of cotton. However, in Baluchistan it can also be grown on the fallow land or on flood plains. In the Punjab, sunflower and soybean can be grown in the fallow lands but these oilseed crops have the potential to replace cotton. Any rabi oilseed crop will compete with wheat. Sunflower can replace late sown wheat in the Punjab. In Sind province, soybean and sunflower can be grown in the fallow land but these crops have the potential to replace cotton. Similarly, rapeseed/mustard will compete with wheat. In the North West Frontier Province, non-traditional oilseed crops, i.e., soybean, sunflower, can be grown on the fallow lands but these oilseed crops can also replace maize and sugarcane[52] Under the conditions, when:(a) an oilseed crop is or can be grown on fallow as well as non-fallow land; and (b) a single oilseed crop can replace more than one type of non-oilseed crop in various regions of the country, it will inappropriate to estimate the shadow price of land by determining the net returns from alternative crops.

We estimate the shadow price of land under the following two alternative assumptions: First, we assume that the shadow price of land is zero. This assumption implies that the farmers grow or will grow oilseed crops at the fallow land, which does not have any alternative productive use. Thus the opportunity cost of land is zero. Second, we assume that market land rent provides a good approximation of the opportunity cost of land.

5.2.8 Conversion Ratios for the Productive Factors

On the basis of our analysis of of shadow prices of the productive factors, we can derive the "conversion ratios" for labour, capital, and foreign exchange. These "conversion ratios" will be used to determine the cost of the productive factors at social prices. The conversion ratio is defined as the ratio of shadow price of productive factor to its market price. In order to evaluate a productive factor at shadow prices, we multiply the conversion ratio of a productive

[52] For more details on cropping patterns in the context of oilseed production, see FAO [1986].

factor to its value at the market prices. The following table illustrate the conversion ratios for, labour, capital, and foreign exchange.

TABLE 11

Conversion Ratios for the Productive Factors

Factors	Conversion Ratio
1. Labour.A	0.75
3. Capital.A	1.16
7. Foreign Exchange	1.168

5.3 COST DISTRIBUTION AND SHADOW PRICES: AN OVERVIEW

In the calculation of DRC coefficients for oilseeds and edible oils, there are not many complexities involved in estimating of cost of directly imported inputs. The problem, however, arises in the case of non-traded inputs which use traded inputs into their own production.

In both the DRC and cost-benefit literature, there is a dispute in what constitute nontraded inputs. For example, Bruno [1972], considers all locally produced inputs as non-tradeable. Pearson [1976], on the other hand, defines a locally produced input as tradeable if the country in question also imports some of the good. He treats a domestically produced input as non tradeable if the country does not import the good in question. The inputs defined as nontradeable in this way are then decomposed into their tradeable and nontradeable cost components, by working backward on input-output relationship. The traded portion of nontradeable inputs is then simply considered as traded cost component.

Gittinger [1982], terms the nontraded inputs which involve import content as "indirectly traded items" and calls for treating the domestic cost component as nontraded item but the imported component as a traded cost. For Corden [1966], traded inputs used directly or indirectly in the production of a nontraded good are lumped with tradeable inputs employed directly in the production process. Whereas, the direct as well as indirect domestic factor cost component, i.e., value added, of nontraded good is lumped with the primary inputs employed directly in the processing activity. The treatment of non-traded inputs as suggested by Pearson [1976] and Gittinger [1982], is in line with Corden's [1966] argument.

Empirical studies on the DRC criterion do not follow any set rules in the treatment of domestically produced inputs. In studies of the DRC of rice production in Philippines, Thailand and Taiwan, the domestically produced inputs which are tradeable are treated as traded inputs, under the assumption that incremental output will be imported. The added local costs of the traded inputs are decomposed into domestic and foreign cost components. The domestic nontraded inputs which include traded inputs are also decomposed into domestic and indirect foreign costs. Similarly, depreciation is decomposed into domestic and foreign cost depending on the origin of the fixed capital.[53]

In the DRC studies in Pakistan by carried out by Gotsch and Brown [1980], Azhar and Mahmud [1981], Ali [1983], Naqvi [1983], Sattar [1985], and Appleyard [1987], the total cost of production is divided into its traded and nontraded cost components. The nontraded cost component is then further divided into tradeable and nontradeable or domestic value added. Azhar and Mahmud [1981], and Ali [1983], treat domestically produced tradeable inputs, fertilizer, as non-traded inputs and then decompose the non-traded cost into traded and non-traded cost components. None of the above studies used input-output analysis in the decomposition of tradeables and nontradeables. Naqvi and Kemal [1983], use an input-output table of Pakistan's economy to decompose non-traded inputs into traded and primary inputs.[54]

---

[53] For actual breakdown of the cost items see Herdt W. Robert. and Lacsina A. Teresa [1976], Akrasanee, Narongchai and Wattananukit, Atchana [1976], Prearson R. Scott, Monke Eric, and Akrasanee Narongchai, [1976], Wu Kung-Hsien Carson and Mao Yu-Kang [1976].

[54] See PIDE input-out table for the Pakistan's Economy [1985].

In Pakistan, the major costs for producing traditional as well as non-traditional oilseeds include the costs associated with the farm inputs: tractor services, bullock, seed, fertilizer, pesticides, irrigation (canal water and tubewells), labour, land, management, transportation, and interest. Our own decomposition of these farm input costs into traded and non-traded cost components follows Corden [1966], Pearson [1976], Little and Mirless [1972], Naqvi [1983], and Appleyard [1987].

Under this approach the total cost of an input is decomposed into traded and non-traded cost components depending upon the composition of traded and non-traded cost in the total cost of an input. For example, an input could be : a) tradeable; b) non-tradeable; c) tradeable as well as non-tradedable d) tradeable and non-tradeable, but where the production of non-tradeables involve some tradeable cost. The above possibilities can be represented with the help of following system of equations.

A:

$$Ci = a\ Ci \qquad ,(a = 1)$$

B:

$$Ci = b\ Ci \qquad ,(b = 1)$$

C:

$$Ci = a\ Ci + b\ Ci \qquad ,(a + b = 1) \text{ and } 1 > a,b < 0$$

d:

$$Ci = a\ Ci + Ci\ (a' + b') \qquad ,(a + a' + b' = 1) \text{ and } 1 > a,a',b' < 0$$

Where,

Ci = total input cost.
a = traded cost as a percent of total cost.
b = non-traded cost as percent of total cost.
a' = percentage of traded cost in the production

of non-tradeable.
b′ = percentage of non-traded cost in the production of non-tradeable.

The estimation of the DRC coefficients is based on distortions-free shadow or economic prices, rather than on market prices. The input as well as output prices in Pakistan, like many developing countries, are subject to distortions. [Naqvi and Kemal:1983]. These distortions include, taxes, tariff protection, subsidies, overvalued exchange rate, non-tariff distortions, etc,. With the presence of these distortions the market prices diverge from their economic prices. The transformation from market prices to economic prices involves adjustments for price distortion for traded as well as non-traded inputs and primary factors of production.

In the case of traded or tradeable inputs, the conversion of market prices into shadow or efficiency prices involve the valuation of traded or tradeable goods at their border prices, cif, for imports and fob, for exports, expressed in domestic currency at the official or shadow exchange rate, [Bruno: 1967], [Perarson:1976], [Little and Mirrless:1974], [Gittinger:1982], [Mashayekhi:1981], [Amachree:1988], [Sahibzada and Mahmood:1986]. As emphasised by Little and Mirrless [1974], and Gittinger [1982], these border prices need to be adjusted to reflect domestic distribution costs. If the commodity in question is imported or importable then the cif price, plus distribution cost at the shadow prices will become the shadow price of the good in question. On the other hand if the good under consideration is exportable then its shadow price will be the fob price minus the distribution cost at the shadow prices, [Ahmed et, al., 1988]. The distribution cost, however, could include traded as well as non-traded cost components. The inclusion of distribution cost into our analysis will, therefore, change the system of equations, a to d, as follows:

A':

$$Ci = a\ Ci + Dt$$

B':

$$Ci = b\ Ci + Dnt$$

C':

$$Ci = a\ Ci + B\ Ci + (Dt + Dnt) \quad ,(0<Dt,Dnt<1) \text{ and}$$

$Dt+Dnt=1$

D':

$$Ci = a\ Ci + b\ Ci + Ci\ (a' + b') + (Dt+Dnt) \text{ Where,}$$

Dnt = non-traded distribution cost.

Dt = traded distribution cost.

Ci = total input cost

a = traded cost as a percent of total cost

b = non-traded cost as a percent of total cost

a′ = percent of traded cost in the production of non-tradeables

b′ = percent of non-traded cost in the production of non-tradeables

In the above formulation, Equation A′ states that input plus the distribution cost involve only tradeables. Equation B′, assumes that both costs are non-tradeables. Equation C′, assumes that the distribution cost of tradeable input involves tradeable as well as non-tradeable inputs. These non-tradeable inputs, however, do not require any tradeable inputs for their production. Equation D′ assumes that the production of non-tradeable inputs also require some tradeable inputs. Here, we will make a simplifying assumption that the non-traded cost of distribution can not be further decomposed into traded and non-traded inputs.

In the case of non-traded inputs, the indirect primary inputs in the production of an oilseed crop are lumped together with primary inputs directly engage in the production of an oilseed crop. The evaluation of direct plus indirect domestic factors used in the production of a oilseed crop will be based on their respective shadow prices. In the present study the non-tradeable domestic factors employed in the production of oilseed crops include: labour, management, capital, interest on domestic capital, and land. For simplicity, we will treat management as a part of direct labour cost and interest on domestic capital, as a component of direct capital.

5.4 COST DECOMPOSITION AND EVALUATION AT SHADOW PRICES

5.4.0.1 Tractor Cost:

Tractor cost includes fixed cost, i.e., depreciation, investment, and repair costs, and variable costs, i.e., fuel, lubricant, and labour costs. The tradeable portion of the tractor operation includes the cost of tractor services, that is fixed cost, plus the fuel cost for an hour of operation. The non-tradeable cost is the labour cost involved in the tractor operation. From the cost of production data, the cost involved in preparing an acre of land is Rs. 90/acre, an hour of tractor operation [FAO:1986]. This cost of tractor operation, however, is an overstatement of existing cost of an hour of tractor operation. Cost of production data of Agricultural Prices Commission [APC:1988] estimates this cost to be Rs. 60 per hour of tractor operation. A farm-level survey of the rain-fed areas of Pakistan confirms the APC estimates [Mahmood:1990]. Hence we will use the APC figure of Rs. 60 as the cost of an hour of tractor operation. This cost also includes the labor cost involved in the tractor operation.

A budget, regarding the cost of tractor operation in Pakistan prepared by Hannah [1987, 1988], shows that fixed cost associated with an hour of tractor operation is Rs. 40.87/hour. The fuel cost for one hour of tractor operation are estimated to be Rs. 6.93/hour. Hence, the sum of fixed as well as fuel cost of an hour of tractor operation are come to Rs. 47.80/hour, which is a tradeable item. Now by subtracting this amount from the total cost of Rs. 60, of one hour of tractor services provide us labour plus rental costs. We treat the labour plus rental cost, which is 20 percent of the tractor cost, as non-traded labour cost. Hence, 80 percent of the tractor operation cost is the tradeable cost while remaining 20 percent is the non-tradeable labour cost.

Appleyard [1987], arbitrary assign 2/3 of the tractor cost to fuel, 1/4 to cost of renting and residual to labour. Azhar and Mahmud [1981], and Mubarik [1983], subtract labour cost from the market rental rates to arrive at the capital and traded component on the tractor cost. Mubarik [1983], after subtracting the labour cost from the market rent, assumes that tractor cost are 100 percent tradeable. Sattar [1985], take 85 percent of the tractor cost as tradeable, 15 percent as non-traded costs.

The tradeable portion of the tractor operation includes the cost of tractor services itself plus the fuel cost for an hour of tractor operation. As mentioned earlier, the total cost of tractor operation, net of labour, is estimated to be Rs. 47.80/hour, of which Rs. 40.87/hour is the cost of tractor services and Rs. 6.93/hour is the cost of the fuel at the rate of Rs. 3.85 per liter. This implies that an hour of tractor of operation will require 1.8 liter of fuel. To estimate the shadow price of tractor operation, net of labour cost, we need to estimate the shadow prices of fuel as well as tractor operation.

The market price of the fuel, i.e., high speed diesel, includes custom duties and development charges at the rate of Rs. 1.08 per liter. To calculate the economic price of the fuel, we subtract the custom duties as well as development charges from the market price. To arrive at the shadow price of the fuel we also need to adjust the per unit fuel prices for the distribution cost, which is given by Rs. 0.37 per liter or Rs. 0.67 per hour of operation. The distribution cost, however, consist of traded as well as non-traded cost components. But we do not know the proportion in which this cost component is divided into tradeable and non-tradeable costs. In order to decompose the distribution cost of fuel we assume that 49 percent of the distribution is tradeable, remaining 51 percent is the non-tradeable domestic cost.[55] Of the total distribution cost 42 % is the labour and 9 % is the domestic capital cost. The tradeable portion of the distribution cost, Rs. 0.18 per liter is added to the per liter cif price of the fuel to arrive at the shadow price of the tractor fuel, which comes to Rs. 2.95 per liter. As it takes 1.8 liter of fuel to operate tractor for one hour, per hour fuel costs are then Rs. 5.31. Given that 42 % of the distribution cost is domestic labour cost, the

---

[55] In the absence of any information regarding the composition of distribution cost, the present decomposition ratio is the same which we have estimated for oilseeds and have used for other inputs such as fertilizer.

domestic labour comes to Rs. 0.16 per liter or Rs. 0.29 per hour of fuel cost. As 9 % of the total distribution cost is domestic capital cost, the domestic capital cost comes to Rs. 03 per hour of fuel cost.

Now, we determine the shadow price of tractor services, net of labour and fuel costs. According to Appleyard [1977], the major distortion in the case of tractor is an import surcharge of 10 percent on the imported tractors. Appleyard, hence, adjusts the market price of tractor operation by deducting 10 percent of the import price from the domestic price of the tractor. A study by NDFC [1986], however, shows that apart from the import surcharge on the imported tractors there exist domestic markup on the sale of the domestic tractors. According to this study the domestic price of the tractor is 20 percent higher than its import price. Hence, to arrive at the border price of the tractor operation we multiply the cost of an hour of tractor operation, Rs. 40.87/hour, with ratio of cif to domestic price of the tractor. The resulting cost of an hour of tractor operation at the shadow prices comes to Rs. 33.02/hour. By adding Rs. 5.31/hour, the fuel cost we get a figure for the total tradeable cost of Rs. 38.33/hour measured in economic prices.

5.4.0.2 Bullock Cost:

Generally, to prepare acre of land require one man day plus a bullock day. For bullock operation, the costs include labour cost and the cost of bullock itself and feed. We treat the entire bullock cost as non-traded cost and decompose this cost into domestic labour and capital cost component by subtracting a day of labour cost from the total bullock cost. This procedure is similar to the one followed by Appleyard [987]. According to FAO cost of production data, the bullock cost is estimated to be Rs. 40 per day. By subtracting a day of labour cost, i.e., Rs. 25/day, from the total cost, the daily cost of a pair of bullocks comes to Rs. 15 per day. However, the bullock cost, as estimated by the FAO data, is an underestimation of the actual cost incurred by the farmers.

According to Chaudhry [1986], per day bullock cost, net of labour cost, comes to Rs. 92/day. Our estimates, based on a farm-level survey of the barani areas, shows that the bullock cost, net of labour cost, to be Rs. 82.66/day during 1988-89.[56] We, therefore, use the estimates of bullock cost, net of labour, as provided by Chaudhry [1986]. The labour cost involved in the bullock operation is given as Rs. 25/day by FAO data and is treated as non-traded labour cost. The cost of bullock itself comes to Rs. 67/day, which we

[56] The survey was conducted during 1989 in the barani areas of Pakistan to evaluate the impact of a Canadian funded project on the rapeseed/mustard production.

treat as non-traded capital. Hence, 27 percent of the total bullock cost is considered as labour cost while remaining 73 percent as non-traded capital cost.

5.4.0.3 Seed Cost:

For the present study we assume that the use of that traditional as well as non-traditional oilseeds for sowing purposes is 100 percent tradeable cost. We make this assumption after deducting the cost of seed from total cost of the sowing operation.[57]

To arrive at the shadow prices of various oilseeds, we use cif prices of oilseeds. The data for these oilseed prices is collected from Oil World [1988]. The cif price of the oilseeds, however, are adjusted to reflect the tradeable portion of the domestic distribution cost. The non-traded portion of the distribution cost is subtracted from the domestic cost component, assuming that the domestic cost of distribution is equally divided into domestic labour and capital cost component.

To arrive at the distribution costs for various oilseeds, we update the relevant costs, provided by Appleyard [1987], to 1987 prices. The distribution costs provided by Apple-

[57] This assumption is necessary, as this exercise is meant to estimate the DRC coefficients for various types of oilseeds and by defination we can estimate the DRC coefficient of a commodity only if it is tradeable. Moreover, if the oilseeds are not used for planting purposes they will be used for the domestic production of edible oil, which is actually being imported.

yard [1987], include transportation handling costs. Table 12 provides the structure of the distribution costs.

TABLE 12

Structure of Distribution Costs

(1987- Rs./40Kg.)

	Total Cost	Traded Cost	Domestic Cost Capital	Domestic Cost Labour
1.Handling Costs	10.08	0	0	10.08
2.Transportation Cost	19.12	14.33	2.67	2.10
4.Total/40 Kg.	29.20	14.33	2.67	12.18

With above information and given the official exchange rate of Rs. 17.60, we can also derive the following:

Traded cost of distribution = $20.35/M.T
Capital cost of distribution = Rs. 66.5/M.T
Labour Cost of distribution = Rs. 304.50/M.T.

Source:Appleyard:1987 (adjusted to reflect 1987 prices).

By adding the tradeable portion of the distribution cost to the cif price of oilseed, we arrive at the international farm-gate or the shadow price of various oilseeds. The non-traded portion of the distribution cost will be subtracted from the domestic cost component of oilseed production. Table 13 estimates the shadow prices of various oilseeds.

TABLE 13

Shadow Prices of Oilseeds and Seed Cotton

Oilseed	(per ton) (1) Price (U.S.$)	(2) Price (Rs.)	(3) price/ 40 kg	(4) Dt/ 40 kg	(5) P*/ 40 kg
1.Soybean	209	3678.4	147.14	14.33	161.47
2.Sunflowerseed	205	3608.0	144.32	14.33	158.65
3.Rapeseed	180	3168.0	126.72	14.33	141.05
4.Cottonseed	119	2094.4	83.77	14.33	98.10
5.Seed Cotton					217.35

1.It is the 1987-88 cif price of per ton of oilseed, in U.S.dollars. World Oilseed Situation and Outlook, United States Department of Agriculture, December 1990. Cottonseed Price is taken from FAO Year Book Trade, vol 42 1988. It is U.S import value of Cottonseed. Seed cotton price is derived from Appendix 4.
2.The cif price expressed in terms of PAK Rs., using the official exchange rate of 1 U.S.$=17.60 Rs.
3.It is the cif price per 40 kg of oilseed.
4.Dt is the traded portion of the distribution cost.
5.P*, i.e., the international farm-gate prices. For cottonseed it is the international mill-gate price.

5.4.0.4 Irrigation Cost:

Irrigation costs imply water charges for using canal water to irrigate an acre of oilseed crop during a crop season. We will also cover the tubewell water cost for an acre of oilseed crop in this section. Chaudhry and Ashraf [1981], have provided a breakdown of cost of irrigation in terms of operation and maintenance cost, labour and capital cost for the major crops over a period of eleven years, from 1967-68 to 1977-78. According to these estimates, in 1977-78, 76 percent of the irrigation cost was made up of capital cost and remaining 26 percent of operation and maintenance or labour cost. Mubarik [1983], treats this capital cost of irrigation as tradeable by assuming that investment on irrigation network is carried out by foreign sources. In his study, Appleyard [1987] uses an updated figure for labour as well as capital cost of irrigation on the basis of earlier estimate of Chaudhry and Ashraf [1981]. According to Appleyard [1987], 74 percent of the toal cost of irrigation is capital cost while 26 percent is the labour cost. In the absence of the required information to update Appleyard's [1981] decomposition, in terms of labour and capital cost, we use his decomposition ratio to divide canal irrigation as well as tubewell irrigation cost into labour and capital cost. We will assume that 74 percent of the total cost of irrigation is tradeable capital cost and 26 percent is non-traded domestic labour cost.

For tubewell operation, we follow FAO [1986], where the tubewell cost at the market prices is evaluated at 20 percent less than its economic cost. We, therefore, adjust the market price of tubewell operation by multiplying it with the ratio of economic to financial cost of tubewell operation, as given by FAO [1986].[58]

---

[58] According to FAO [1986], the ratio of economic to the financial cost of irrigation is given by 1.2, multiplying this ratio with tubewell cost we get the shadow price for

For canal irrigation there is a common belief that the private or financial cost of canal irrigation grossly understate its economic cost. According to Appleyard [1987], the economic cost of canal irrigation is three times the financial cost of irrigation. Estimates by Chaudhry and Ashraf [1981], show that the economic cost of canal irrigation is four times higher than its private cost. Based on the above studies we take economic cost of irrigation as three times the private or financial cost. We multiply the private cost of irrigating an acre of a oilseed crop by three, and then decompose the resulting economic cost into domestic and foreign cost components. As outlined earlier, 74 percent of the irrigation cost is the foreign capital cost where 26 percent is the domestic labour cost. Therefore, we divide the economic cost of irrigation into traded and non-traded costs.

5.4.0.5 Fertilizer Cost:

In DRC studies on Pakistan's agriculture, Mubarik [1983] and Azhar and Mahmood [1981] treat fertilizer as a partially traded input. Urea, which is 100 percent domestically produced is treated as non-tradeable. The imported phosphatic fertilizer is treated as tradeable, while the domestically produced fertilizer is treated as non-tradeable and then decomposed into traded and non-traded cost components.

---

tubewell operation.

Pakistan, however, has been exporting domestically produced Urea and importing some of Phosphatic fertilizers [Pakistan Fertilizer Statics:1986]. We, therefore, consider it appropriate to treat domestically produced fertilizers being tradeable, as a portion of the domestically produced fertilizers is actually being traded. We, therefore, treat all types of fertilizers as as 100 percent tradeable.

The shadow price of fertilizers involves two steps. First, we determine the border prices of the fertilizers being used in the production of various oilseed crops. Secondly, we add the tradeable portion of the distribution cost to the border price of the fertilizer in question. The resulting figure will represent the international farm-gate price (shadow price) of fertilizer at the official exchange rate. We use the cif prices to arrive at the shadow prices of various types of fertilizers, including Urea. As Pakistan has been exporting as well as importing Urea in the past, we treat Urea as importable as consumption-production gap in the case of Urea will be met by imports.

Pakistan Fertilizer Statistics [1986], provides a detailed breakdown of distribution cost of various types of imported fertilizers. The distribution cost provided by the above source, includes administration cost, organization charges, interest payment etc., which may overstate the opportunity cost of imported fertilizer. We make use the distribution cost, as given in table 3 of this chapter to approximate the distribution cost for fertilizer and assume that the distribution cost is the same for all types of fertilizers.

Finally, we divide fertilizer distribution costs into its traded and non-traded portions. The tradeable portion of the distribution cost will be added to the cif price of the fertilizer, to arrive at the shadow price of fertilizers. The remining portion of the distribution cost i.e., the non-traded cost, will be divided into domestic labour and capital and then added to the direct labour and capital cost of producing oilseeds. Table 14 gives the shadow prices of various fertilizers.

5.4.0.6 Pesticides Cost:

Pakistan has been importing various types of pesticides to meet its domestic requirements. The import volume as well as prices of these pesticides have been on the rise for the past several years [Agricultural Statistics of Pakistan:1987-88]. We treat pesticide costs as 100 percent tradeable. Our treatment of pesticides cost follows Mubarik [1983], and Appleyard [1987]. Sattar [1985], however, assumes 85 percent of the plant protection cost as tradeable and 15 percent as non-tradeable. Presumably, his treatment of the plant protection cost is inclusive of labour involved

TABLE 14

Shadow Prices of Fertilizers

(1987)

FERTILIZER	(1) P $(fob)	(2) Fright $/ton	(3) P $(cif)	(4) P Rs.(cif)	(5) P/Kg	(6) Dt/Kg
1. SOP	163.61	25.83	189.45	3254.45	3.25	0.36
2. DAP	152.11	25.83	177.94	3056.88	3.06	0.36
3. TSP	120.92	25.83	146.72	2520.55	2.52	0.36
4. UREA	86.92	25.83	112.75	1934.79	1.93	0.36
5. Nitro-phos			121.07	2080.00	2.08	0.36
6. SSP			16.29	280.00	0.28	0.36

	(7) P*/kg.	(8) DLC/kg	(9) DKC/kg
1. SOP	3.61	0.30	0.06
2. DAP	3.42	0.30	0.06
3. TSP	2.88	0.30	0.06
4. UREA	2.29	0.30	0.06
5. Nitro-phos	2.44	0.30	0.06
6. SSP	0.64	0.30	0.06

(1).Pakistan fertilizer Statistics, Supplement, 1986-87. The cif prices for Nitrophos and SSP (16%) are arrived indirectly by subtracting the distribution cost from World Bank's economic prices given in FAO [1986].
(2).Ocean freight rates for wheat--from U.S. Gulf ports, Food Outlook,Statistical Supplement, June 1989, FAO
(3). (1)+(2)
(4). cif price at the official exchange rate.
(5). Price per kg. of fertilizer, in Rs.
(6). Traded portion of the distribution cost, Rs./kg.
(7). P*, Shadow Price of fertilizer,i.e., traded cost.
(8). DLC, labour cost of distribution.
(9) DKC, capital cost of distribution.

with this operation. If that is the case, then there is no difference between our treatment of the pesticides cost and that of Sattar [1985], as we consider pesticide cost net of labour.

Pakistan has been importing various types of pesticides over the years. However, data on unit import values of these pesticides is not available. Trade data covers only with the volume of pesticides import, [Agricultural Statistics of Pakistan]. One way to arrive at the traded cost, or shadow price, of pesticides is to:(a) first adjust the given financial cost of pesticides by multiplying it by the ratio of cif to market price of pesticides, this will provide us with the cif value of the given financial cost of pesticides and; (b) second, subtract the non-traded cost of distribution from the estimated cif value of pesticides. However, without information on cif prices of pesticides, we use the ratio of cif to market price of chemicals to arrive at the cif value of pesticides, assuming that this ratio is same as the one between cif to market price of fertilizer. According to Ahmed, Coady, and Stern [1988], such a ratio is equal to 0.75. We multiply this ratio with the given cost of pesticides and then subtract the non-traded portion of the distribution cost to arrive at the traded or shadow cost of pesticides in oilseed production. In the absence of any information regarding the domestic distribution cost of pesticides, we assume that ratio of world value of pesticide to domestic distribution cost is the same as the ratio of average distribution cost of all types of fertilizer to world price of fertilizer. Moreover, we assume that the domestic distribution costs is divided into domestic labour and capital cost component in same proportion as in the case of fertilizers.

5.4.0.7 Transportation Cost:

The transportation cost include: fuel cost; cost of vehicle, repair and maintenance cost, and labour cost. In the above list fuel, vehicle and repair and maintenance cost are treated as traded inputs, as Pakistan imports most of its fuel, vehicles and parts from abroad [NDFC:1986], [Pakistan Economic Survey:1988-89]. Manzoor and Saeed [1988], provide a detailed breakdown of transport cost in terms of its various components. We treat fuel, oil, tire, depreciation and maintenance material cost as traded cost. Interest cost is treated as capital cost. Labour cost involved in maintenance cost is added to the crew cost to arrive at the domestic non-traded labour cost. According to this composition, 75 percent of the transport cost is traded or foreign cost, 14 percent is capital and 11 percent is the labour cost.

5.4.0.8 Land, Labour, and Management Cost:

For the above three farm-inputs we treat them as 100 percent non-traded inputs. Labour cost, in this case, takes into account all the labour requirements, from land preparation to harvesting, needed for an acre of oilseed crop.

5.4.0.9 Interest Cost:

The interest cost in our cost of production estimates are based on per acre investment on tractor, seed, bullock, fertilizer, plant protection, irrigation, and labour associated with the application of the above farm-inputs. The interest cost is treated as domestic capital cost. Appendix 3 provides the interest costs for various oilseed crops.

5.5 OILSEED AND EDIBLE OIL PROCESSING COSTS:

Our cost of processing data is based on a firm-level survey of Pakistan's oilseed and edible oil industry conducted by Manzoor and Saeed [1988]. Their study provides information on both variable and fixed costs of processing oilseeds using expeller and solvent technologies. For the expeller extraction the study assumes that: a) 10 standard size expellers are installed in one unit; b) daily crushing capacity is 9.5 tons; c) annual input requirements are 15000 tons; d) the expeller unit operates 210 days a year; and e) the crushing cost remains constant for all kind of oilseeds. For the solvent technology the study by Manzoor and Saeed [1988] assumes that : (a) the plant operates 210 days a year; (b) the plant runs at 80 percent of full capacity; (c) daily processing capacity is 100 tons; (d) annual input requirement is 16800 tons of oilseed; and (e) the processing cost remains constant for all types of oilseeds

From processing cost data provided by Manzoor and Saeed [1988], we derive the cost of processing one ton of oilseed through both expeller and solvent technologies.

TABLE 15

Cost of Processing: Solvent Extraction:

Rs./Ton

Inputs	Solvent	Expeller
Electricity	122.62	92.85
Furnace Oil	70.83	63.09
Chemicals	12.50	0.00
Brokerage Fee	10.71	8.93
Skilled Labour	37.58	14.15
Unskilled Labour	8.25	3.11
Depreciation	63.69	5.95
Interest charges	250.39	187.50
Transport Cost	27.98	25.00
Repair/Maintenance	23.80	2.98
Total	627.91	403.56

Source:Manzoor and Saeed:1988

Table 15 provides the cost of production data on the basis of financial prices as opposed to the economic or shadow prices. Moreover, the above data do not provide information on the domestic and foreign cost composition of oilseed processing. To estimate the DRC ratios for edible oil production, we need to: a) decompose the total cost of processing of oilseed into domestic and foreign cost components; and b) evaluate the domestic and foreign cost components at their respective shadow prices.

Once again, inputs which are domestically produced but are tradeable are treated as tradeable. The non-tradeable inputs are decomposed into their domestic primary factor cost and foreign cost components.

Skilled as well as unskilled labour is treated as non-traded input and evaluated at the shadow wage rates, estimated earlier.[59] The shadow pricing of capital is not straight forward. Expeller units are locally manufactured and not tradeable but parts of solvent plants may involve imported machinery. As locally manufactured solvent plants are estimated to be one-quarter the cost of imported plants, we will assume that the existing solvent plants are domestically produced[60] [Manzoor and saeed:1988]. We treat both depreciation and interest cost as domestic capital costs and evaluate them at the shadow pric-

---

[59] As we have estimated:
a) shadow wage rate for unskilled worker = 0.75 of the market wage rate for unskilled worker; and
b) shadow wage rate for skilled worker = market wage rate for unskilled worker.

[60] Under existing solvent technology in Pakistan, expellers and solvent plants are complementary parts of the extraction process. In the first stage of processing oilseed is crushed by the expellers and then in the second stage of processing the pre-pressed oil cake is processed through solvent plants for additional oil recovery. [Manzoor and Saeed:1988].

es. In the case of brokerage fee, we consider it as a transfer payment and ignore it for DRC estimations.

As described for transport cost, 75 percent of this cost is traded; 14 percent is domestic capital cost; and 11 percent is the domestic capital cost. As both solvent and expeller plants are locally manufactured, we treat repair and maintenance cost as domestic cost. We assume that 40 percent of the repair and maintenance cost is labour cost, and remaining 60 percent is the materials or domestic capital costs.[61]

For furnace oil and chemicals, we treat them as tradeable. Pakistan imports a wide variety of chemicals and petroleum products. To estimate the economic cost of chemicals, we multiply the financial cost of chemicals by the ratio of cif price to the market price of chemicals. This accounting ratio for chemicals, determined by Ahmed, Coady, and Stern [1988], is taken as 0.75. Similarly, to arrive at the economic cost of furnace oil, we multiply the financial cost of furnace oil by its accounting ratio. In the absence of an accounting ratio for furnace oil, we use the accounting ratio for petroleum products, estimated to be 0.80 [Ahmed, Coady, and Stern:1988], as a proxy for furnace oil.

The import of both chemicals and furnace oil involves domestic distribution cost. In order to arrive at the shadow prices of the chemicals and furnace oil we need to add the traded por-

---

[61] This decomposition ratio is estimated by Manzoor and Saeed [1988] for maintenance portion of the vehicle operating cost.

tion of the distribution cost to the estimated cif values of these two inputs. The domestic cost components, labour and capital, are added to the domestic cost of processing oilseed. We take the distribution cost of fuel as a proxy for the distribution cost of furnace oil and chemicals.

Electricity is commonly treated as a non-traded input in the cost-benefit and DRC literature. However, in many developing countries electricity generation involve the use of imported materials such as, generating and transmission equipment and fuel [Gittinger:1982]. Thus, we need to isolate the foreign cost component in the total cost of electricity.

While estimating the ratio of value of total costs at shadow prices to the value of total cost at market prices for electricity Sahibzada and Mahmood [1986] provide a breakdown of electricity costs. According to this decomposition, 48 percent of the total cost is the domestic capital cost, 23 percent is the labour cost, 22 percent is the non-traded material cost, while 7 percent is the traded input cost. As our analysis is based in terms of labour, capital, land, and traded cost, we assume the non-traded material cost as capital cost. With this simplification, electricity cost is consist of 70 percent of capital cost, 23 percent labour cost and 7 percent foreign or traded cost.

On the basis of of above adjustments the cost of processing oilseeds, using expeller as well as solvent technology, are presented in Table 16.

TABLE 16

Cost of Processing

(Solvent) Inputs	Rs./ton (1)	Cost Composition (%) Foreign (2)	Labour (3)	Capital (4)
Electricity	122.60	8.58	28.19	85.82
Furnace Oil*	56.05	52.33	3.06	0.66
Chemicals*	10.6	9.98	0.51	0.11
Skill.labour	37.58	0.00	37.58	0.00
Unskill.Labour	8.25	0.00	8.25	0.00
Depreciation	63.69	0.00	0.00	63.69
Interest	250.00	0.00	0.00	250.00
Transport	27.98	20.98	3.07	3.91
Repair/ Maintenance	23.8	0.00	9.52	14.28
Total	600.55	91.87	90.18	418.47
(Expeller) Inputs				
Electricity	92.85	6.50	21.35	65.00
Furnace Oil*	50.46	47.12	2.75	0.59
Skill.labour	14.15	0.00	14.15	0.00
Unskill.labour	3.11	0.00	3.11	0.00
Depreciation	5.95	0.00	0.00	5.95
Interest	187.50	0.00	0.00	187.50
Transport	25.00	18.75	2.75	3.50
Repair/ Maintenance	2.98	0.00	1.19	1.79
Total	382.00	72.37	45.30	264.33

Source:(1)Based on Manzoor and Saeed [1988]; furnace oil and chemical values are being adjusted to reflect shadow traded cost.(2)-(4) are estimated by the author, using the procedures outlined above.

5.5.1 Shadow Prices of Edible Oils and By-Products

We treat all of the edible oils as 100 percent tradeable. For by-products, we assume that oilseed meal is tradeable. Oilseed cake, oil dirt, and hull are treated as non-tradeable. For the non-traded by-products we take market prices as reflecting their shadow prices.[62] To compute the shadow prices of edible oils, we use the cif prices for the edible oils. These prices in turn are adjusted by adding the tradeable portion of the domestic distribution cost of imported edible oils. The non-traded component of the distribution cost is then subtracted from the domestic cost of producing edible oil. We assume that the domestic distribution cost for various edible oils is the same as that calculated for the oilseeds.[63] The shadow prices of the edible oils are provided in Table 17.

---

[62] Market prices for the oilseed by-products are given in Appendix 10.

[63] The distribution cost for the oilseeds are provided in table 12 of this chapter.

TABLE 17

Shadow Prices of Edible Oils

(1987-88)

Edible Oils	Price(cif) $/M.T (1)	DT $/M.T (2)	Po $/M.T (3)	DLCo Rs./M.T (4)	DKCo Rs./M.T (5)
Soybean	443	20.35	463.35	304.50	66.75
Sunflower	449	20.35	469.35	304.50	66.75
Rapeseed	408	20.35	428.35	304.50	66.75
Cottonseed	585	20.35	605.35	304.50	66.75

Dt = Traded distribution cost per M.T.
Po = Shadow price of edible oil
DLCo = Distribution cost of labour/M.T
DKCo = Distribution cost of capital/M.T

Source: (1). World Oilseed Situation and Outlook, United States Department of Agriculture Foreign Agriculture Service, December 1990.
(2), (3) and (4). Table 3, Chapter 5.

5.6 SUMMARY

This chapter formulates the procedures to estimate the DRC coefficients for various oilseeds and edible oils. The procedure to estimate the DRC coefficients involve two steps: the decomposition of the cost of producing a unit of tradeable commodity into domestic and foreign cost and the estimation of shadow prices for traded and non-traded inputs (and outputs) and productive factors of production.

The decomposition of the cost of producing a unit of oilseed or edible oil into traded and non-traded cost. The domestically produced inputs which are tradeable are treated as traded inputs, assuming that incremental output is traded. The local distribution costs of traded inputs are decomposed into traded and non-traded cost components. The domestic non-traded inputs which embodied traded inputs are also decomposed into contribution of indirect primary inputs (land, labour, capital) and indirect traded costs. All traded inputs, used directly and/or indirectly, are lumped together as traded inputs. Similarly, direct as well as indirect contribution of primary factors is added to arrive at the non-traded cost of oilseeds or edible oil production.

The estimation of the DRC coefficients involves the use of distortion-free shadow prices due to imperfections in the product as well as factor markets. The shadow price of an imported input or output is arrived by adding the traded portion of the domestic distribution cost to the cif price of the input or output. If the good under consideration is exportable then the shadow price is calculated by subtracting the traded portion of the domestic distribution cost from the fob price. Similarly, the contribution of the productive factors, land, labour, capital, and foreign exchange, is evaluated at their prices.

Chapter VI

ESTIMATION OF THE DRC MODEL

The present chapter is based on: (a) the DRC model developed in chapter 4 and; (b) the methodology to estimate the model presented in chapter 5. This chapter is divided into two inter-related sections. The results regarding the estimation of the oilseed model are presented in section 1. Section 1 is divided into three sub-sections, which provide: (a) the DRC estimates for various oilseeds and their ranking according to comparative advantage; (b) sensitivity of the DRC estimates with respect to various parameters of the oilseed model; and (c) estimates of financial profitability of domestic oilseed production.

Section 2 of this chapter deals with estimation of the edible oil model. Section 2 considers the domestic production of oilseeds as well as their processing or extraction as a two-stage production process by an integrated industry. This section is also divided into three sub-sections. The first sub-section deals with the estimation of DRC coefficients or comparative advantage of the domestic production of various types of edible oils, i.e., cottonseed, rapeseed/mustard, sunflower, and soybean oil. This sub-section also ranks the edible oils on the basis of comparative advantage.

The second sub-section presents the sensitivity analysis of the edible oil model. The last sub-section discusses the financial profitability of the domestic edible oil production.[64]

The comparative advantage of the oilseeds as well as edible oils, as reflected by their respective DRC coefficients, is estimated on the basis of Appendix 6, 8, and 9. As explained in chapters 2 and 4, there are two ways to express the DRC coefficient or the index of comparative advantage. The comparative advantage of a commodity, in this case oilseed or edible oil, can be presented as a ratio of domestic cost (measured in domestic currency at shadow prices) to net foreign exchange savings (measured in domestic currency at the shadow exchange rate), i.e., DRC1. If the net foreign exchange savings, through the domestic production of oilseed or edible oil, is greater than the (net) domestic cost, then the resulting ratio, or DRC coefficient, will be less than one. This result implies that: (a) the domestic oilseed or edible oil production is an efficient way of saving the foreign exchange; and (b) the country exhibits a comparative advantage in the production of given oilseed or edible oil. A DRC ratio of greater than unity shows comparative disadvantage in the production of given oilseed or edible oil.

[64] The estimation of the edible oil model which treats the oilseeds like other tradeable inputs, evaluated at the international farm-gate prices, shows that the country exhibits a comparative disadvantage in the production of all types of edible oils. The results regarding the estimation of the edible oil model under this assumption, therefore, are not discussed here.

Alternatively, we can represent the extent of comparative advantage by comparing the ratio of domestic cost (measured in domestic currency at the shadow prices) to net foreign exchange savings (measured in foreign currency at the official exchange rate) with the shadow exchange rate, i.e., DRC2. In this instance the ratio of domestic cost to net foreign exchange savings measures the domestic resource cost of producing a unit of oilseed or edible oil, in terms of foreign exchange. Hence, the country will have comparative advantage if the domestic resource cost per unit of foreign exchange in the production of a unit of oilseed or edible oil is less than the shadow exchange rate. Therefore, the comparative advantage of a given oilseed or edible oil depends upon whether a given DRC coefficient is greater or less than the shadow exchange rate. If the DRC coefficient is less than the shadow exchange rate, then the production of a given oilseed is an efficient way of saving or earning foreign exchange and hence there exists comparative advantage in the production of an oilseed or edible oil. If this coefficient is greater than the shadow exchange rate the reverse is true.

6.1 COMPARATIVE ADVANTAGE OF OILSEEDS

Using the above two methods of estimating comparative advantage, we have estimated the the DRC coefficients for the oilseeds in Appendix 6, and have summarized the results in Table 18, in terms of DRC1 and DRC2.

TABLE 18

Domestic Resource Cost Ratios: Oilseeds

Oilseed	DRC1 (Ratio)	DRC2 (Rs./$)
Cottonseed	0.50 (1)	10.22 (1)
Soybean	0.51 (2)	10.61 (2)
Rapeseed/ Mustard	0.54 (3)	11.20 (3)
Sunflower (irrigated)	0.61 (4)	12.73 (4)
Sunflower (rainfed)	0.66 (5)	13.57 (5)
Seed Cotton	0.33	6.90

The figures in parenthesis denote the ranking of oilseed crops according to the comparative advantage.

As we see from Table 18, DRC1 for all the oilseeds crops,.i.e, sunflower(irrigated), rapeseed/mustard, sunflower (rainfed), soybean, and cottonseed is less than one. Also, DRC2 for all types of oilseeds is less than the shadow exchange rate of Rs.20.60, reflecting that domestic production of oilseeds is an efficient way of saving foreign exchange.

The ranking of various oilseed crops in terms of DRC coefficients, shows that cottonseed enjoys the maximum comparative advantage among the oilseeds crops under consideration. For cottonseed, the domestic resource cost of saving one US dollar, as reflected by DRC2, is Rs.10.22, whereas the shadow exchange rate is Rs.20.60. The domestic production of cottonseed, therefore, is more preferable option than its import for edible oil extraction.

As we notice from the above table, sunflower crop grown under rainfed conditions exhibits the smallest comparative advantage, as reflected by the DRC coefficients; DRC1 and DRC2. Sunflower grown under irrigated conditions, on the other hand, does better than the rainfed sunflower. Rapeseed/mustard, a traditional oilseed crop grown in Pakistan, comes after cottonseed and soybean.

The highest comparative advantage is enjoyed by cottonseed, as we observe in Appendix 6, is due to the relatively higher level of net foreign exchange savings (NFS) and the relatively lower domestic costs. Differences in comparative advantage for other oilseed crops are largely owing to differences in yield and import price.

6.1.1 Comparative Advantage of Seed Cotton

The comparative advantage of seed cotton crop, the source of cottonseed, is evident from its low domestic resource cost as reflected by DRC1 and DRC2 of this crop. While comparing with the cost of foreign exchange (shadow exchange rate) of Rs. 20.6, the DRC per unit of foreign exchange in seed cotton production is only Rs. 6.90. In terms of DRC1, the DRC coefficient is only 0.33, showing considerable comparative advantage in the seed cotton production.

The above result has an interesting implication for Pakistan's oilseed and edible oil economy. According to this result, the country may have to utilize the domestically produced cottonseed, irrespective of cottonseed position in terms of comparative advantage, as cottonseed is a by-product of seed cotton, which enjoys considerable comparative advantage.

6.1.2 Sensitivity Analysis: The Oilseed Model

To evaluate the sensitivity of the DRC coefficients, an exercise is undertaken to calculate elasticities of the DRC coefficients with respect to various parameters of the oilseed model. The purpose of the elasticity analysis is twofold: (a) to compare the relative importance of various parameters of the model in determining the comparative advantage, as reflected by the DRC coefficients; and (b) to analyze the sensitivity of the DRC coefficients with respect to changes in underlying assumptions regarding various parameters of the model.

The DRC elasticity, in the present context, is defined as the percentage change in the DRC coefficient caused by a one percent change in the value of the relevant parameter. To examine the effect of changes in underlying assumptions with respect to various parameters of the model, we have recalculated the DRC coefficients by assuming 10 percent changes in the relevant variables.

The DRC elasticities for the oilseeds, with respect to land, labour, and capital cost, shadow wage rate, shadow price of capital, international farm-gate price, shadow exchange rate, per acre yield, and traded or foreign cost, are presented in Table 19.

As evident from Table 19, the elasticities of DRC with respect to international farm-gate price, per acre yield and the shadow exchange rate are negative, implying that an increase in the value of these parameters will lower the DRC coefficients for the given oilseed crops. The elasticities of DRC with respect to foreign cost, as well as labour, land and capital cost are positive, indicating that an increase in the values of these parameters will increase the DRC coefficients for the oilseed crops. Similarly, the DRC elasticities with

TABLE 19

DRC Elasticities: The Oilseed Sector

Crops	Int. Price	Foreign Cost	Yield	SER	Land	Labour	Cost of Capital
Cottonseed.	-0.32	0.28	-0.83*	-0.91	0.11	0.35	0.52
Soybean.	-1.29	0.51	-1.45	-0.91	0.40	0.50	0.29
Rape/ Mustard.	-1.23	0.42	-1.39	-0.91	0.41	0.48	0.29
Sunflower (irri.)	-1.34	0.58	-1.48	-0.91	0.35	0.53	0.27
Sunflower (rainfed)	-1.26	0.47	-1.24	-0.91	0.47	0.39	0.28
Seed-Cotton.	-1.17	0.34	-1.34	-0.91	0.27	0.55	0.36

Crops	Shadow Price of Capital	Shadow Price of Labour
Cottonseed.	0.50	0.30
Soybean.	0.24	0.36
Rape/ Mustard.	0.25	0.34
Sunflower (irri.)	0.23	0.41
Sunflower (rainfed)	0.25	0.28
Seed-Cotton.	0.31	0.41

Int.Price = International farm-gate price
SER/OER = Shadow exchange rate/Official exchange rate
* a 1 percent increase in the seed cotton yield will lower the DRC coefficient of cottonseed by 0.83 percent.

respect to the shadow wage rate and the shadow price of capital are positive.

With the exception of cottonseed, the DRC coefficients for all other oilseed crops are sensitive to changes in the international farm-gate prices, with DRC elasticity exceeding one. Sunflower grown under irrigated conditions exhibits the greatest responsiveness to changes in the international farm-gate prices than any other oilseed crops under consideration. For irrigated sunflower, the DRC elasticity with respect to international farm-gate price is 1.34, implying that a 1 percent increase (decrease) in the international farm-gate price will lower (increase) the DRC coefficient by 1.34 percent.

In the case of cottonseed, the DRC elasticity with respect to international farm-gate price of cottonseed is only 0.32. Our analysis shows that the DRC coefficient for cottonseed is more sensitive to changes in the international price of cotton lint than a change in the price of cottonseed. For example, a 1 percent increase in the international price of cotton lint will lower the DRC coefficient of cottonseed by 0.89, i.e. the DRC elasticity of cottonseed with respect to international price of cotton lint is -0.89.

The DRC elasticities of the given oilseed crops, as well as the seed cotton crop, are not sensitive to the changes in the foreign or traded cost component of these crops. For all these crops the elasticity coefficient is quite low, ranging from 0.28, for cottonseed, to 0.58, for irrigated sunflower. This result implies that even a large increase in the foreign cost will not effect the relevant DRC coefficients significantly.

Our results indicate that per acre yield of the oilseed crops is one of the most important parameter which influences the DRC coefficient. With the exception of cottonseed, which is derived from seed cotton, the elasticity of DRC with respect to per acre yield for all other oilseed crops is greater than unity. The elasticity coefficient ranges from -1.48, for irrigated sunflower, to -1.24, for rapeseed/mustard. Given that cottonseed is derived from seed cotton, the DRC coefficient for cottonseed is affected by changes in seed cotton yield. Our results indicate that the DRC elasticity of cottonseed with respect to per acre yield of seed cotton is -0.83.,i.e., a one percent increase in seed cotton yield will lower the DRC coefficient for cottonseed by 0.83 percent.

A change in the shadow exchange rate affects the DRC coefficients of oilseed crops by changing the value of net foreign exchange savings through domestic production. As shown in the above table, the DRC elasticity with respect to shadow exchange rate is -0.91 for all the oilseed crops, i.e., a one percent increase in the shadow exchange rate will lower the DRC coefficient by 0.91 percent.

The DRC elasticities with respect to the opportunity cost of land ranges from 0.11, for the cottonseed, to 0.46, for the rainfed sunflower. According to this result, the DRC coefficient is relatively insensitive to changes in the opportunity cost of land. A relative low DRC elasticity for cottonseed is due to insignificance of land value in determining the DRC coefficient for cottonseed. The above result also implies that even a large changes in the opportunity cost of land will not affect the comparative advantage position of the oilseed crops.

With the exception of cottonseed, the sensitivity of the DRC coefficient with respect to labour cost is greater than that of capital cost of oilseed production. In the case of cottonseed, the DRC elasticity relative to labour cost is less than that of capital cost. This result is not surprising, as the production of cottonseed requires gining process and hence relatively more domestic capital. As a result, the DRC coefficient for cottonseed is relatively more sensitive to the capital cost than that of labour cost.

The sensitivity of DRC coefficient with respect to labour cost falls in the range of 0.35, for cottonseed, to 0.53, for irrigated sunflower. In the case of capital cost, the DRC elasticity lies between 0.27, for irrigated sunflower, and 0.52, for cottonseed.

The estimates of opportunity cost of labour as well as capital, among other things, depend upon the underlying assumptions regarding the shadow price of capital and labour. In order to analyze the responsiveness of DRC coefficients with respect to the shadow price of labour and capital, we have re-estimated the DRC coefficients, while assuming a 10 percent increase in the shadow price of capital and labour. The resulting estimates of DRC elasticities with respect to the shadow price of labour and capital are presented in table 2. According to these estimates, the DRC coefficients are relatively insensitive to changes in the shadow price of labour or capital.

The DRC elasticity with respect to the shadow price of labour or shadow wage rate is relatively inelastic for all oilseed crops, ranging 0.30 for cottonseed to 0.41 for irrigated sunflower. Hence, for example, a 10 percent increase in the shadow wage rate will increase the DRC coefficient for cottonseed by only 3 percent. Except for cottonseed, where the DRC estimates are more sensitive to changes in the shadow price of capital than labour, for all other oilseed crops the DRC elasticity with respect to shadow price of capital is less than that of shadow wage rate. Once again, this result is not unexpected, as cottonseed production requires a relatively capital intensive gining process.

From the above analysis it is evident that: (a) changes in the domestic cost of land, labour, and capital will not affect the DRC coefficients significantly; and (b) changes in the shadow price of labour and capital, i.e., the underlying assumptions regarding the opportunity cost of the domestic primary factors will not affect the values of the DRC coefficients significantly.

6.1.3 Comparative Advantage on Fallow Lands

The DRC coefficients estimated in Table 18, takes market land rent as equal to its opportunity cost. The opportunity cost of the land, however, will be zero if the oilseed production takes place on the fallow lands, with no alternative productive use. To incorporate this situation into our analysis, we have re-estimated the DRC coefficients for the oilseed crops, assuming that the opportunity cost of land is zero. The following table presents the DRC coefficients for the given oilseed crops and their ranking according to the comparative advantage.

TABLE 20

Comparative Advantage on Fallow Lands

Oilseed Crops	DRC1 (Ratio)	
Cottonseed	0.42	(5)
Soybean	0.31	(1)
Rapeseed/ Mustard	0.32	(2)
Sunflower (irrigated)	0.39	(4)
Sunflower (rainfed)	0.35	(3)
Seed Cotton	0.24	

From Table 20, it seems that the comparative advantage of the oilseed crops, including seed cotton, can be enhanced if these crops are grown on the fallow lands. Comparing these results with the DRC estimates made in the Table 18, it is evident that sunflower (irrigated as well as rainfed) will gain the most, in terms of comparative advantage, if grown on the fallow fields. The DRC coefficient for sunflower, grown under rainfed conditions, is now 0.35, compared to its previous level of 0.66. Similarly, the DRC coefficient for irrigated sunflower is now 0.40, which is 0.22 less than that of its original estimate of 0.62. Same trends are witnessed for other oilseed crops, including the seed cotton.

A re-estimation of the DRC coefficients, under the assumption that opportunity cost of land is zero, also changes the ranking of the oilseed crops according to the comparative advantage. For example, rapeseed/mustard will move from the third position to the second position, whereas soybean will move from second to first position. Cottonseed will move from first to fifth position, while rainfed sunflower will move from fifth to third position.

6.1.4 Commercial Profitability of Oilseed Production

Given that the DRC of oilseed production is less than the shadow exchange rate, or alternatively DRC coefficient is less than one, the country or society can gain, in terms of foreign exchange savings, by producing given oilseeds domestically. The production of oilseed, however, may or may not be in individual farmer's interest. It is safe to assume that the production of oilseed crops will take place as long as these crops bring profits to the farmers, given other things being constant. The following table presents profitability of the given oilseed crops, including seed cotton.[65]

TABLE 21

Commercial Profitability

Oilseed Crops	Profitability (Rs./40 kg.)	
Cottonseed	72.05*	(1)
Soybean	32.58	(3)
Rapeseed/ Mustard	37.58	(2)
Sunflower (irrigated)	24.61	(5)
Sunflower (rainfed)	26.68	(4)
Seed Cotton	66.68	

(The figures in the parenthesis depict ranking of the crops according to comparative advantage)
* Commercial profitability of cottonseed is from Appendix 1.

[65] For a detailed analysis of commercial profitability see Appendix 1.

From Table 21, excluding seed cotton, the commercial or private profitability is the highest in the case of cottonseed. Commercial profitability of rapeseed/mustard comes after cottonseed and is followed by soybean. Though there is not much difference between commercial profitability of sunflower crops grown under irrigated and that rainfed conditions, the profitability of rainfed sunflower is slightly greater as compared to irrigated sunflower. The higher profitability of rainfed sunflower is due to relatively low cost of producing sunflower on rainfed lands, which is more than enough to offset relatively higher yields enjoyed by the irrigated farmers.

6.2 COMPARATIVE ADVANTAGE OF THE EDIBLE OIL SECTOR

This section analyzes the comparative advantage of edible oil production in Pakistan, while using domestically produced oilseed.[66] This section, therefore, considers the domestic production of oilseed as well as their processing as an integrated activity. Based on the joint DRC model for the edible oil sector, outlined in Chapter 4, and estimation methodology, developed in Chapter 5, the estimation of DRC coefficients for cottonseed, soybean, sunflower, and rapeseed/mustard oil are estimated in Appendix 8. A summary of

[66] The analysis regarding the estimation of the DRC model for the edible oil industry, which uses the imported oilseeds, is not reported here. This analysis, however, indicates a comparative disadvantage in the production of all the edible oils under consideration.

these results is given in Table 22, which deals with the comparative advantage of producing edible oils through solvent technology.

TABLE 22

Comparative Advantage of Edible Oils: The Solvent Technology

Edible Oil	DRC1 (Ratio)		DRC2 (Rs./$)	
Cottonseed	0.42	(1)	8.63	(1)
Soybean	0.71	(4)	14.58	(4)
Rapeseed/ Mustard	0.49	(2)	10.08	(2)
Sunflower (irrigated)	0.68	(3)	14.05	(3)
Sunflower (rainfed)	0.72	(5)	14.80	(5)

The figures in parenthesis provide ranking of the edible oils according to comparative advantage.

From Table 22, we note that Pakistan has a comparative advantage in the production of above edible oils, as DRC1 in all cases is less than unity, i.e., the net foreign exchange savings exceeds the net domestic cost of domestic production.

Similarly, DRC2 (the domestic resource cost of producing a given unit of edible oil in terms of foreign exchange) is less than the shadow exchange rate of Rs.20.60. This makes the domestic production of edible oil, as opposed to its import, an efficient way of saving foreign exchange.

A ranking on the basis of comparative advantage, as depicted in Table 22, put the cottonseed, followed by rapeseed/mustard oil, on top of the list. Incidently both edible oils are derived from the traditional oilseed crops, i.e., cottonseed and rapeseed/ mustard. Sunflower oil derived from the irrigated crop comes at the third place after rapeseed/mustard oil. Soybean oil, produced from the indigenous seed, ranks at fourth place on the list. Sunflower oil, derived from rainfed sunflower crop, exhibits the least comparative advantage.

The above analysis is carried out under the assumption that the solvent processing plants are non-tradeable. This assumption enhances the extent of net foreign exchange saving, while increasing the net domestic cost of production at the same time. To examine the significance of the above assumption upon our results, we will relax this assumption and treat the solvent plants as tradeable.

As shown in Table 23, treatment of solvent processing plants as tradeable has a little impact on the DRC estimates. For example, the DRC coefficient for cottonseed (DRC1) is now 0.41, which is only 0.01 lower from the base line estimate of 0.42.

Treatment of solvent plants as tradeable, however, will lower the values of the DRC coefficients and, hence, improve the comparative advantage position of the domestically produced edible oils. This result implies that treatment of solvent plants as tradeable increases the import cost less than the corresponding decrease in the domestic cost.

TABLE 23

Comparative Advantage of Edible Oils: The Solvent Technology

(Solvent Plants as Tradeable)

Edible Oil	DRC1 (Ratio)	DRC2 (Rs./$)
Cottonseed	0.41	8.55
Soybean	0.70	14.46
Rapessed/ Mustard	0.47	9.71
Sunflower (irrigated)	0.67	13.75
Sunflower (rainfed)	0.71	14.56

6.2.1 Comparative Advantage and Palm Oil Imports

The above analysis, regarding the comparative advantage of the domestic edible oil production, exclude palm oil. Pakistan does not produce palm oil and therefore the above methodology cannot be applied. An international price comparison of various edible oils, however, illustrates that Palm oil is the cheapest source of edible oil [USDA:1990]. A price comparison of various edible oils in Pakistan shows that where the import cost (cif) for 40 K.g. of palm oil was Rs.280 in 1989-90, the domestic (wholesale) prices of rapeseed/mustard and cottonseed oils were Rs.615 and Rs.538 per 40 Kg [Economic Survey:1989]. As long as the international prices of palm oil are depressed, Pakistan's comparative advantage in edible oil production may depend on the exclusion of palm oil through prohibitive tariffs.

6.3 SENSITIVITY ANALYSIS: THE EDIBLE OIL SECTOR

To analyze the sensitivity of the DRC coefficients for edible oils, we have estimated the DRC elasticities with respect to various parameters of the edible oil model. The objective is to determine the relative significance of various variables in determining the comparative advantage of domestic production of edible oils. Such an analysis also examines the responsiveness of DRC coefficients with regard to changes in the underlying assumptions of various parameters of the edible oil model.[67]

---

[67] The DRC elasticity is defined as the percentage change in

In addition to the factors which determine comparative advantage of the oilseeds, the comparative advantage of the edible oils also depends upon factors such as, international prices of the edible oils, prices of by-products, oil recovery ratios, imports, labour, and capital cost of processing oilseeds, shadow wage rate, shadow price of capital and shadow exchange rate. In the case of cottonseed oil, its comparative advantage position is also affected by the price of cotton lint in the international market. Table 24 provides the DRC elasticities of edible oils with respect to various parameters of the edible oil model.

As indicated in Table 24, the DRC elasticities for the edible oils with respect to shadow exchange rate, international edible oil prices, international meal prices and oil recovery ratios are negative. This implies that an increase in the value of any one of the above parameters, given other things constant, will lower the DRC coefficients and thus enhance the comparative advantage of domestically produced edible oils.

The DRC elasticity with respect to shadow exchange rate is -0.91 for all the edible oils, indicating that a one percent increase in the shadow exchange rate will lower the DRC coefficients by 0.91 percent. The DRC elasticity with respect to international edible oil prices is -1.43 for sunflower oil,

---

the DRC coefficient caused by one percentage change in the value of a given parameter.

TABLE 24

DRC Elasticities: The Edible Oil Model (I)

	Edible Oils				
	Sunflower (irrigated)	Rapeseed/ Mustard	Sunflower (rainfed)	Soybean	Cottonseed
SER	-0.91	-0.91	-0.91	-0.91	-0.91
Int. Oil Price	-1.43	-1.07	-1.35	-1.41	-0.20
Int.Meal Price	-0.38	-0.45	-0.35	-0.98	-0.14
Recovery Ratio	-4.34	-3.24	-4.05	-10.11	-2.85
Import cost of Processing	0.013	0.01	0.01	0.005	0.001
Labour Cost of Processing	0.013	0.014	0.01	0.004	0.002
Capital Cost of Processing	0.087	0.095	0.077	0.035	0.019
Shadow Price of Capital	0.32	0.32	0.33	0.27	0.57
Shadow Wage Rate	0.46	0.36	0.34	0.41	0.34

derived from irrigated sunflowerseeed, which is the highest among the given edible oils. The DRC elasticities for other edible oils, i.e., rapeseed/ mustard oil, soybean oil, and sunflower oil derived from rainfed seed, indicate that fluctuations in the international edible oil prices will affect the comparative advantage position of these oils in a significant manner.[68]

The DRC elasticity with respect to international meal prices is relatively low. A relatively high elasticity coefficient for soybean oil, i.e., -0.99, makes the comparative advantage of this oil sensitive to fluctuations in the international meal prices.

Our analysis indicates that one of the major factors in determining the comparative advantage position of various edible oils is the oil recovery ratio.[69] This is indicated by relatively high values of DRC elasticities with respect to oil recovery ratios. Sensitivity to changes in the oil recovery ratio is the highest for soybean oil. In the case of soybean oil, a one percent increase in the oil recovery will lower the DRC coefficient by more than 10 percent. The efficiency of the processing technology, therefore, plays an important role in determining as well as enhanceing the comparative advantage position of the soybean oil. For sunflower oil, a one percent increase in the oil recovery ratio will lower the DRC coeffi-

---

[68] It is interesting to note that the comparative advantage of cottonseed oil is more responsive to changes in the international price of cotton lint than the international price of cottonseed oil. This is evident from the DRC elasticity of cottonseed oil with respect to international price of cotton lint, which is estimated to be -0.85.

[69] Oil recovery ratio is the percentage of the edible oil recovered from a given quantity of a oilseed.

cient by more than 4 percent. Similarly, the DRC elasticities indicate that the comparative advantage position of rapeseed/ mustard and cottonseed oil can be improved further by increase-ing the oil extraction rates.

The elasticity of DRC with respect to imports, labour, and capital cost is positive. Similarly, there is also a positive relationship between DRC coefficients for edible oils and changes in the shadow price of labour and capital. The sensitivity of DRC coefficients with respect to changes in imports, labour and capital cost of processing appears to be very low. In all three instances, the elasticity coefficient for the edible oils ranges from 0.001 to 0.087. For example, a one percent increase in import cost of processing cottonseed oil, given other things constant, will raise the DRC coefficient by 0.001 percent. These low estimates of DRC elasticities show that even large increases in the import, capital, and labour cost of processing edible oils will not affect the comparative advantage position of the edible oils in a significant manner.

The elasticities of DRC with respect to shadow price of capital range from 0.27 for soybean oil to 0.57 for cottonseed oil. A relatively high DRC elasticity for cottonseed oil is due to higher capital cost involved in the cottonseed oil production. Apart from capital cost of processing, the cottonseed oil production involves the capital cost of gining operation. Sensitivity to changes in the shadow wage rate ranges from 0.34 for cottonseed and sunflower oil, derived from rainfed sunflower seed, to 0.46 for sunflower oil, derived from the irrigated seed.

Given that the domestic edible oil production make use of the indigenous oilseeds, the comparative advantage of the edible oils also depends upon factors such as, per acre oilseed yields, and import, land, labour, and capital cost of oilseed production. Table 25 gives the responsivesness of DRC coefficients with respect to changes in the above variables of the edible oil model.

TABLE 25

DRC Elasticities: The Edible Oil Sector (II)

	Edible Oils				
	Sunflower (irrigated)	Rapeseed/ Mustard	Sunflower (Rainfed)	Soybean	Cotton-seed
Seed Yield	-1.41	-1.13	-1.32	-1.36	-0.78
Import Cost of Seed production	0.59	0.31	0.48	0.60	0.28
Labour Cost of Seed Production	0.49	0.40	0.36	0.42	0.34
Capital Cost of Seed Production	0.25	0.19	0.26	0.24	0.55
Land Cost of Seed Production	0.33	0.34	0.43	0.34	0.15

As revealed by Table 25, per acre oilseed yield is negatively related with the DRC coefficients for the edible oils. An increase in the oilseed yields, therefore, will improve the comparative advantage position of the edible oils, by lowering their DRC coefficients. The elasticity of DRC with respect to oilseed yields ranges from -1.41 for sunflower oil to -0.78 for cottonseed oil.[70] The DRC elasticity for sunflower oil derived from the rainfed sunflowerseed is -1.32, which stands after soybean oil, with DRC elasticity of -1.36. For rapeseed/mustard this figure is -1.13. The above results, with the exception of cottonseed oil, indicate that the DRC coefficients are relatively sensitive to changes in the per acre seed yields.

Our analysis shows a positive relationship between the DRC coefficients for edible oils and the import, labour, land, and capital cost of oilseed production. An increase in these cost components, other things being equal, will worsen the comparative advantage position of the edible oils. The DRC elasticity with respect to import cost of seed production varies from 0.60 for soybean oil to 0.26 for cottonseed oil. Except for cottonseed oil, the DRC elasticity with respect to labour cost is greater than that of capital. This implies that for cottonseed oil, the comparative advantage position of the edible oils is more sensitive to changes in labour cost than the changes in capital cost of oilseed production. The DRC elasticity of edible oils with respect to land cost of oilseed production is low and ranges from 0.43 for

---

[70] A one percent increase in the seed cotton yield will lower the DRC coefficient for cottonseed oil by 0.78 percent.

sunflower oil, derived from rainfed seed, to 0.15 for cottonseed oil.

6.3.1 Edible Oil Production and the Use of Fallow Lands

To examine the significance of oilseed production on fallow lands, we have re-estimated the DRC coefficients for edible oils. This analysis highlights the significance of the use of fallow lands and its impact on the comparative advantage position of the edible oils. Table 26 provides the DRC coefficients for edible oils estimated under the assumption that opportunity cost of land, for oilseed production, is zero.

As we see from Table 26, the production of oilseeds on the fallow lands increases the comparative advantage of the edible oils. For example, in the case of sunflower oil, derived from the rainfed sunflowerseed, the DRC coefficient is 43 percent less from the base line estimate. For soybean and rapeseed/mustard oil, the DRC coefficients are 34 percent lower than the base line figures. The same figure is 33 percent for the sunflower oil extracted from irrigated sunflowerseed. The decline in the DRC coefficient for cottonseed oil is relatively small as compared to the other edible oils. In the case of cottonseed oil, the DRC coefficient is now 15 percent less.

TABLE 26

Comparative Advantage of Edible Oil: Use Of Fallow Lands

Edible Oil	DRC1	
Cottonseed	0.36	(2)
Soybean	0.47	(5)
Rapeseed/ Mustard	0.32	(1)
Sunflower (irrigated)	0.46	(4)
Sunflower (rainfed)	0.41	(3)

The figures in parenthesis provide ranking of the edible oils according to the comparative advantage

The use of the fallow lands for the oilseed production also affects the ranking of edible oils in terms of comparative advantage. For example, Rapeseed/mustard oil, moves from second to first position in terms of its ranking according to comparative advantage, replacing the cottonseed oil which now stands at the second position. Soybean oil moves from fourth to the last position in the ranking. As seen from the above ranking, the sunflower oil extracted from the rainfed seeds moves from previously held fifth to third position. The sunflower oil derived from irrigated sunflowerseed declines to the fourth position.

6.3.2 Comparative Advantage of Edible Oil: Expeller Technology

The previous estimates of comparative advantage of edible oils are based on solvent extraction technology. The present analysis estimates the comparative advantage of edible oil, being produced through the expeller technology.[71] In the case of domestic production of sunflower and soybean oil there is no information available regarding the use of expeller technology for extraction purposes. For expeller extraction of sunflower oil, we, however, make use of oil recovery estimate provided by Zaidi [1984]. Table 27, which is based on Appendix 9, provides the DRC coefficients for cottonseed, sunflower, and rapeseed/ mustard oil.

A comparesion between the base line estimates of DRC coefficients for the edible oils, produced through the solvent technology (see Table 22), with the above estimates shows that: (a) a change in the extraction technology will not affect the comparative advantage ranking of the edible oils,[72] (b) the expeller technology will enhance the comparative advantage position of cottonseed and rapeseed/mustard oil, and (c) the

[71] The distinction between expeller and solvent technology is highlighted in chapter 3. In the case of Pakistan, in practice, it is the oilseed extraction through the expeller technology which processes bulk of the domestic cottonseed and to some extent the rapeseed/mustard. Most of the rapeseed/mustard in Pakistan is being processed by village level **Kohlus** (ox-driven expeller).

[72] This result does not take into account the soybean oil, for which there is no information regarding its extraction through expellers.

TABLE 27

Comparative Advantage of Edible Oils

(The Expeller Technology)

Edible Oil	DRC1 (Ratio)	DRC2 (Rs./$)	
Cottonseed	0.39	8.08	(1)
Rapeseed/ Mustard	0.42	8.73	(2)
Sunflower (rainfed)	1.34	27.54	(3)
Sunflower (irrigated)	1.36	28.00	(4)

country exhibits comparative disadvantage in the production of sunflower oil through expeller technology.

6.4 <u>FINANCIAL PROFITABILITY OF EDIBLE OIL PRODUCTION</u>

The analysis regarding the financial profitability of the edible oil production uses market rather than shadow prices for inputs as well as outputs. This analysis takes into account the financial profitability of the solvent as well as the expeller technology. The following table, which is based on Appendix 10, provides the results regarding the financial profitability of edible oils.

TABLE 28

Financial Profitability of Edible Oils

(Rs/Ton)

Technology	Edible Oil Sunflower	Rapeseed/ Mustard	Soybean	Cottonseed
Solvent	1683.20	6466.83	-5920.77	5142.68
Expeller	-1705.41	5493.41	N/A	6923.71

As Table 28 indicates, except for the soybean oil, the edible oil production through the solvent extraction is a financially profitable activity. The financial profitability of solvent extraction ranges from Rs.1683 per ton for sunflower oil to Rs.6467 per ton for rapeseed/mustard oil. As indicated by the Appendix 5, the highest profitability enjoyed by the rapeseed/ mustard oil is due to three factors: (a) relatively high oil extraction rate; (b) high rapeseed/mustard oil prices; and (c) low rape and mustard seed prices. As Table 28 indicates, the domestic production of soybean oil through solvent extraction is a highly unprofitable activity. The major reasons for the unprofitability of soybean oil is relatively: (a) low oil recovery rate; and (b) higher seed prices.

Our analysis also confirms a common belief that the production of sunflower oil using expeller technology is financially unattractive.[73] Table 28, however, indicates that the use of expeller technology for the production of cottonseed as well as rapeseed/mustard oil is financially attractive. Unlike solvent extraction, the production of cottonseed oil through the expeller technology is more profitable as compared to rapeseed/ mustard oil.

6.4.1 Financial Profitability: Sensitivity Analysis

The commercial profitability of the edible oil production depends upon factors, such as, oil recovery rates, price of seeds, value of by-products and market price of edible oils. In order to analyze the sensitivity of commercial profitability of edible oils, we estimate the elasticity of commercial profitability with respect to the above variables. This analysis, however, makes a distinction between expeller and solvent technology by estimating the elasticities on the basis of oil extraction technique. Table 29 provides the elasticities of commercial profitability of producing edible oil with respect to solvent technology.

As evident from Table 29, the elasticity of financial profitability with respect to oil recovery rate, meal prices, value of by-products, and edible oil prices is positive. An increase in the values of these variables will therefore increase the

[73] Estimates regarding the financial profitability of soybean oil through expeller technology are not available as there is no evidence about the use of expeller technology for soybean oil extraction.

TABLE 29

Elasticities of Profitability: Solvent Technology

Variables	Elasticities Sunflower	Rapeseed/ Mustard	Soybean	Cottonseed
Oil Recovery Rate	1.42	0.19	1.85	0.24
Seed Price	-7.01	-1.31	-4.82	-2.14
Meal Price	1.38	0.53	1.99	1.88
By-Product Value	1.76	0.55	2.05	1.70
Oil Price	6.62	1.85	1.88	1.55

profitability of the edible oils. The financial profitability of the edible oils, however, is negatively related with oilseed prices.

The responsiveness of financial profitability of domestic production of edible oils to changes in oil recovery rates ranges from 0.19, in the case of rapeseed/mustard oil, to 1.85, in the case of soybean oil. For soybean oil, for example, this result implies that a 1 percent increase in the oil recovery rate for soybean oil will increase its profitability by 1.85 percent. Changes in the oil recovery rate, however, have little impact upon the profitability of cottonseed and rapeseed/ mustard oil.

As evident from Appendix 10 oilseed cost is the major cost in the production of the edible oils. For example, oil seed cost constitutes 95 percent of the cost of producing sunflower oil. In the case of soybean, this figure is 98 percent. For rapeseed/mustard and cottonseed oils, seed cost represent 93 and 95 percent of the total cost respectively.[74] The sensitivity of the financial profitability with respect to changes in seed cost is the highest for sunflower oil, with an elasticity coefficient of -7.01. According to this result, a 1 percent increase in the market price of sunflowerseed lowers the financial profitability of sunflower oil by a little over 7 percent. Elasticity of financial profitability with respect to seed cost for other edible oils ranges from -1.31 for rapeseed/mustard oil to -4.82 for soybean oil.

The financial profitability of the edible oils is also determined by the value of by-products. As we see from Table 29, there exists a positive relationship between the value of by-products and the financial profitability of the edible oils. Except for the rapeseed/ mustard oil, the financial profitability of the edible oils is relatively sensitive to changes in the value of by-products. The elasticity coefficients in this case range from 0.55 for rapeseed/mustard oil to 2.05 for soybean oil. For cottonseed oil the elasticity coefficient is 1.70, whereas the same figure for sunflower oil is 1.76.

---

[74] See Appendix 10

Among the oilseed and edible oil by-products, oilseed meal is the major source of revenue with meal prices playing an important role in determining its value. The meal prices are positively related to the financial profitability of edible oil production. The elasticity of financial profitability for soybean oil with respect to soybean meal prices is the highest, followed by cottonseed, sunflower and rapeseed/mustard oil.

The market price of an edible oil is one of the key factors determining its financial profitability. As Table 29 indicates, the financial profitability of the edible oils is sensitive to changes in the market prices for edible oils, with elasticity coefficients greater than one. The elasticity of financial profitability for sunflower oil with respect to its market price is 6.62, i.e., a 1 percent increase in the market price of sunflower oil increases its profitability by 6.62 percent. The elasticity coefficients with respect to market price of edible oil are as follows: 1.88 for soybean oil; 1.85 for rapeseed/mustard oil; and 1.55 for cottonseed oil.

The financial profitability of edible oils produced through expeller technology depends on: (a) oil recovery rates; (b) seed prices; (c) value of by-products; (d) prices of oilseed cake; and (e) market prices of edible oils. We examine the impact of changes in the above variables upon the financial profitability of edible oils by estimating the elasticities of financial profitability with respect to these variables. Table 30 provides the elasticities coefficients based upon Appendix 10.

TABLE 30

Financial Profitability: Expeller Technology

Elasticities

Variables	Sunflower	Rapeseed/ Mustard	Soybean*	Cottonseed
Oil Recovery Rate	2.61	0.33	N.A.	0.81
Seed Price	-9.22	-1.77	N.A.	-2.45
Cake Price	1.82	0.61	N.A.	2.34
By-Product Value	1.93	0.65	N.A.	2.36
Oil Price	6.54	2.18	N.A.	1.15

*There is no evidence regarding the expeller production of soybean oil.

As Table 30 indicates, among the given edible oils, the financial profitability of sunflower oil is more responsive to changes in oil recovery rates than any other edible oils under consideration. For sunflower oil, the elasticity of financial profitability is 2.61, i.e., a 1 percent increase in the sunflower oil recovery rate will increase its profitability by 2.61 percent. Rapeseed/mustard oil is the least sensitive to changes in the oil recovery rates. For rapeseed/mustard oil the elasticity coefficient is 0.33, whereas the same figure for the cottonseed oil is 0.81.

The financial profitability of expeller extraction, like solvent technology, depends upon the seed cost of edible oil production. The elasticity of financial profitability with respect to seed prices ranges from -1.77 for rapeseed/mustard oil to -9.22 for sunflower oil. For cottonseed oil this elasticity coefficient is -2.45. Hence, a 1 percent increase in the seed price will lower the financial profitability of these edible oils by more than one percent.

The financial profitability of the edible oil production through expeller technology is also influenced by oilseed cake prices. As table 30 indicates, a 1 percent increase in the oilseed cake prices will increase the financial profitability of: cottonseed oil by 2.34 percent; rapeseed/mustard oil by 0.61 percent; and sunflower oil by 1.82. As we observe from table 30, similar trends emerge when we estimate the elasticity of financial profitability with respect to the value of all by-products, including the oilseed cake.

Table 30 also indicates that the financial profitability of the edible oils is positively related with market prices of the edible oils. The elasticity of financial profitability with respect to edible oil prices range from 6.54 for sunflower oil to 1.15 for cottonseed oil. For rapeseed/mustard oil, the elasticity coefficient is 2.18.

6.5 SUMMARY

The estimation of the oilseed model shows that Pakistan exhibits a comparative advantage in the production of cottonseed, rapeseed/ mustard, soybean and sunflowerseed. The results indicate that, except for cottonseed, the DRC coefficients for other oilseeds are sensitive to fluctuations in per acre yields and the international farm-gate prices. The DRC coefficient for cottonseed is more responsive to changes in the price of cotton lint than the international farm-gate price of cottonseed. The DRC coefficients for all oilseeds are relatively insensitive to changes in shadow prices of the domestic productive factors and traded costs.

The estimation of DRC model for the edible sector demonstrate Pakistan's comparative advantage in the production of cottonseed and rapeseed/mustard oil, using both expeller and solvent technologies. The comparative advantage also exists in the solvent production of sunflower and soybean oil. Production of sunflower oil through expeller technology, however, shows a comparative disadvantage. With the exception of cottonseed oil, the DRC coefficients for other edible oils are sensitive to changes in oilseed yields, oil recovery rates, and international edible oil prices. The use of fallow lands, for oilseed production, lowers the DRC coefficients for rapeseed/mustard, soybean oil, and sunflower oil drop by more than 30 percent.

The estimation of the financial profitability model for oilseed shows that all oilseed crops are financially profitable. Rapeseed/mustard and cottonseed production is financially more porfitable than newly introduced crops, soybean and sunflowerseed. The estimation of the financial profitability model for the edible oil sector shows that the production of rapeseed/ mustard and cottonseed oil is financially profitable, using both expeller as well as solvent technology. The production of soybean oil through solvent technology is, however, financially unprofitable. The sensitivity analysis shows that variables, such as oil recovery rates, oilseed prices, value of by-products, and edible oil prices significantly influence the financial profitability of solvent production of soybean and sunflower oil. The financial profitability of cottonseed and rapeseed/mustard oil, while sensitive to other variables, is insensitive to changes in the oil recovery rates.

Chapter VII

POLICY IMPLICATIONS AND CONCLUSIONS

7.1 INTRODUCTION

The present study has attempted to evaluate the economic rationale of indigenisation of Pakistan's oilseed and edible oil industry by estimating the comparative advantage of oil-seeds as well as edible oils. The study is important considering that Pakistan has been facing a serious challenge to address the food deficit problem in its edible oil sector. For many years, with rapidly increasing consumption and stagnant domestic production, the country has been bridging the Production-consumption gap through imports.

At present, Pakistan is meeting 70 percent of its edible oil requirements through imports, using scarce foreign exchange. With domestic production of oilseeds and edible oils lagging behind the rapidly increasing demand: increasing population, income, and urbanization will require even higher level of imported edible oils and thus further need of foreign exchange. Rising foreign exchange costs to finance edible oil import bill will pose enormous problems for Pakistan's external sector with serious implications for the structure as well as performance of the economy.

Pakistan's ability to finance the rising edible oil import bill depends upon the performance of its external sector. The external sector, however, has been under severe strains due to: (a) an ongoing current account deficit financed, partially, through foreign borrowings; (b) an extremely narrow export base; (c) volatility of foreign exchange earned through workers' remittances; (d) internal fiscal imbalances; and (e) rapidly increasing debt service payments. Pakistan's quest for self-sufficiency through indigenisation of its oilseed and edible oil industry, therefore, gains added significance in the presence of constraints faced by its external sector.

A policy towards indigenisation or self-sufficiency in the oilseed and edible oil industry should be pursued only if the industry exhibits a comparative advantage, i.e., domestic production of oilseed and edible oil is an efficient way of saving foreign exchange.

The most suitable technique to empirically estimate the comparative advantage is the use of domestic resource cost (DRC) criterion. We define comparative advantage of oilseed or edible oil production in two ways. First, as a ratio of domestic cost of oilseed or edible oil production, measured at shadow prices, to net foreign exchange savings, measured in domestic currency at the shadow exchange rate. If the resulting DRC coefficient is less than one then the production of oilseed or edible oil is an efficient way of foreign exchange saving and the industry exhibit comparative advantage in the production of oilseed or edible oil.

Secondly, we estimate the ratio of domestic cost (measured at shadow prices) to net foreign exchange savings (measured in foreign currency at the official exchange rate). The resulting DRC coefficient is then compared with the shadow exchange rate. If the DRC coefficient, thus derived, is less than the shadow exchange rate then the domestic production of oilseed or edible oil is an efficient way of saving foreign exchange and country exhibits comparative advantage in the production of oilseed or edible oil.

7.1.1 Methodology

In the context of objectives of this study and review of the relevant literature, the theoretical foundations for this study are lay down by constructing models based on DRC criterion. These models, i.e., oilseed and edible oil models, provide the theoretical basis to estimate Pakistan's comparative advantage in the production of oilseed as well as edible oil. The salient features of these models include: (a) estimation of DRC coefficients for oilseeds as well as edible oils and their ranking according to comparative advantage; (b) sensitivity of the DRC coefficients for oilseeds as well as edible oils with respect to various parameters of these models; (c) estimation of DRC coefficient for edible oils on the basis of oilseed processing technologies;

(d) estimation of financial profitability for oilseeds as well as edible oils and ranking of these oilseeds as well as edible oil on the basis of financial profitability.

To estimate the oilseed as well as edible oil models using the DRC criterion, the present study provides an elaborate procedure to: (a) decompose the total cost of producing of a given unit of oilseed or edible oil into traded and non-traded cost components; (b) value traded as well as non-traded inputs at their shadow prices; and (c) estimate shadow prices of land, labour, capital and foreign exchange.

7.2 CONCLUSIONS AND POLICY IMPLICATIONS

This thesis confirms Pakistan's comparative advantage in the domestic production of oilseeds, which include: cottonseed, soybean, rapeseed/mustard, and sunflower. This conclusion has an important implication for the Pakistan's economy as well as its oilseed and edible oil industry. This result implies that the use of domestically produced oilseeds is an economically efficient way of saving foreign exchange.

The sensitivity analysis shows that, with the exception of cottonseed, fluctuations in per acre oilseed yields and international farm-gate prices of oilseeds are the two most important variables in determining Pakistan's comparative advantage in the production of oilseeds. Given that there exists large gaps between actual and potential oilseed yields, there is room for improving present yield levels by removing economic as well as technological constraints face-ing oilseed growers. Higher oilseed yields will enhance the comparative advantage by reducing net domestic cost and raising the extent of net foreign exchange savings. A drop in the international prices of oilseeds will have a negative impact on the comparative advantage of oilseed production. We, however, conclude that given the strong comparative advantage position of the oilseeds, especially cottonseed, soybean, and rapeseed/mustard, a moderate drop in the international prices of oilseeds will not reverse our conclusions regarding the comparative advantage of oilseed production in Pakistan.

The comparative advantage of cottonseed, Pakistan's major oilseed crop, is relatively less sensitive to changes in seed cotton yields and international farm-gate prices for cottonseed. We conclude that the insensitivity of cotton-seed's comparative advantage towards cottonseed yields and international farm-gate prices is due to the fact that cot-tonseed is a by-product of seed cotton. The comparative advantage of cottonseed is more sensitive to the interna-tional prices of cotton lint than the price of cottonseed.

We conclude that cottonseed exhibits the highest degree of comparative advantage. The potential for a significant increase in the cottonseed production is, however, depends on domestic as well as world demand for cotton lint, as cot-tonseed is a by-product of seed cotton. Under these circumstance, instead of relying only on cottonseed for domestic edible oil supply, there is need to take necessary steps to stimulate the production of other oilseed crops, especially, rapeseed/mustard, soybean, and sunflower.

We conclude that changes in the price of tradeable inputs, such as agriculture machinery, fuel, fertilizer, pesticides, etc., given other things constant, will not affect the comparative advantage of the oilseeds significantly. This implies that Pakistan can maintain its comparative advantage position in the oilseed production even when there is increase in the price of imported inputs.

A relatively low sensitivity of comparative advantage of oilseeds with respect to the shadow price of labour and capital, points that the estimates of comparative advantage are less responsive to changes in the underlying assumptions regarding the opportunity cost of labour and capital. We, therefore, conclude that any estimation error regarding shadow price of labour and/or capital will have little impact on the comparative advantage position of the oilseeds.

On the basis of commercial profitability the traditional oilseeds, i.e., cottonseed and rapeseed/mustard, are more profitable than non-traditional oilseed crops such as sunflower and soybean. We conclude that one of the reasons for the sluggish growth of non-traditional oilseeds in Pakistan is due to their low financial profitability. The commercial profitability of rainfed sunflower is greater than that of irrigated sunflower. The higher profitability of rainfed sunflower is due to low production cost, which is more than enough to offset relatively higher yields enjoyed by the irrigated farmers. The promotion of sunflower, a cash crop, under rainfed conditions will not only help the country to increase its edible oil production, it will also assists in meeting the cash needs of the rainfed farmers.

This thesis also confirms Pakistan's comparative advantage in the production of all the edible oils through solvent technology. The traditional edible oils, cottonseed and rapeseed/mustard, enjoy higher comparative advantage than the non-traditional edible oils, such as soybean and sunflower. Pakistan also exhibits a comparative advantage in the production of rapeseed/ mustard and cottonseed oil through expeller technology. There exists, however, a comparative disadvantage in the production of sunflower oil through expeller technology.

This thesis indicates that the degree of comparative advantage in the production of cottonseed and rapeseed/mustard oils is higher through expeller technology as compared to the solvent technology. We conclude that Pakistan is better off by producing these two oils through cheaper and labour intensive expeller technology.

We conclude that fluctuations in oilseed yields, oil recovery rates, and international edible oil prices will have a pronounced impact on the comparative advantage of rapeseed/mustard, soybean, and sunflower oils. Improvement in per acre yields, oil recovery rates, and higher international edible oil prices will enhance the comparative advantage of these edible oils. Improvements in cottonseed yields or higher international prices for cottonseed oil, on the other hand, will have a minimum impact on the comparative advantage of the cottonseed oil. Any significant improvement in the comparative advantage of cottonseed oil will come mainly by raising the cottonseed oil recovery rates.

Our study concludes that changes in the cost of domestic primary factors, such as land, labour, and capital will have only a minor effect on the comparative advantage of the edible oils. Similarly, fluctuations in the prices of tradeable inputs will bring small changes in the DRC coefficients for the edible oils.

An integral part of solvent processing of oilseeds is the production of oilseed meal as a major by-product. We conclude that an increase in the international value of oilseed meal improves the comparative advantage position of the edible oils. With the exception of soybean oil, all other edible oils are relatively less sensitive to changes in the international meal prices. For soybean oil, the DRC elasticity with respect to international meal prices is close to one, implying that fluctuations in international meal prices will influence the comparative advantage of the soybean oil more than any other edible oil. The above conclusion, however, assumes that there is domestic demand for the local meal. A lack of demand for domestic meal will work as a disincentive for the solvent extraction of oilseeds.

In Pakistan, in the presence of land constraints, policy thrust has been to increase the oilseed production by utilizing fallow lands. We conclude that the use of the fallow land enhances the comparative advantage of the edible oils to a great extent. There are three main advantages of using fallow lands for oilseed production: (a) it improves the comparative advantage position of the edible oils; (b) it increases the production of oilseeds and thus edible oils without crowding-out any other crop; (c) it adds to the efficiency of resource utilization, by making use of otherwise unproductive fallow lands.

This thesis demonstrate that the production of cottonseed and rapeseed/mustard oil is financially profitable using both expeller as well as solvent technologies. At given input-out price structure and the state of the extraction technology, the production of soybean oil using solvent technology is, however, financially unprofitable. Hence, increase domestic production of soybean oil will depend, among other things, on future input-out price structure faced by the oilseed processor. Production of sunflower oil using the solvent technology is financially profitable but the level of profitability is far less as compared to cottonseed and rapeseed/mustard oil. We conclude that the extent of financial profitability of soybean and sunflower oil production through solvent technology depend on: oil recovery rates, oilseed prices, value of the by-products, and market prices for these edible oils.

In conclusion, this thesis has demonstrated that the expansion of domestic oilseed and edible oil production provides an efficient way of saving foreign exchange, as Pakistan exhibits a comparative advantage in the production of both oilseeds and edible oils. The success of Pakistan's indigenisation policy, however, depends on country's success in implementing a commercial policy which will protect the domestic oilseed and edible oil industry from depressed international palm oil prices and in expanding the oilseed production. A breakthrough in the domestic production of oilseeds is possible through: improving oilseed yields, utilizing fallow lands for oilseed production, and providing the economic conditions which encourage oilseed growers and processors to make use the country's comparative advantage in oilseed and edible oil production. Although the potential for cottonseed expansion is limited, as it is a by-product of seed cotton, a continuous thrust to increase the seed cotton yields is essential for the policy of indigenisation to succeed. Similarly, in order of priority, a renewed thrust on rapeseed/mustard production and promotion of sunflowerseed and soybean is essential to expand the domestic production of edible oil.

Appendix A

Appendix 1

Cost of Production, Yield and Output Prices

Seed Cotton

Inputs	Unit	Market Price	Input/ Acre
Tractor	Hour	60.00	6.07
Bullock	Day	40.00	3.24
Seed	Kg.	5.00	8.09
Urea	Kg.	2.60	70.82
SSP	Kg.	0.80	46.54
Nitrophos	Kg.	2.20	0
SOP	Kg.	1.00	46.54
Pesticide	Rupee	354.09	1
Irrigation	Rupee	36.42	1
Labour	Day	25.00	24.28
Interest	Rupee	125.97	1
Land	Rupee	320.00	1

Yield = 782.42 Kg./Acre OR 18.21 (40 Kg.)

Price = Rs. 4.86/Kg.

Revenue/Acre = Rs. 3460

Cost/Acre = Rs. 2245.634

Profit/Acre = Rs. 1214.37

Profit/40Kg. = Rs. 66.68

Profitability of Cottonseed

Given that 60 Kg. of seed cotton provides 40 of cottonseed and 20 Kg. of cotton lint, the financial profitability of 40 Kg. of cottonseed is derived as follows:

1. Cost of 60 Kg. of seed cotton	= Rs. 184.98
2. Transport cost/60 Kg. of cotton seed	= Rs. 5.49
3. Processing cost of 40 Kg. of cottonseed and 20 Kg. of cotton lint	= Rs. 77.23
4. Cotton Lint value/20 Kg.	= Rs. 244.75
5. Cost of cottonseed/40 Kg.	= 184.98 + 5.49 + 77.23 - 244.75
	= Rs. 22.95
6. Price of Cottonseed/40 Kg.	= 95.00
7. Profit/40 Kg. of cottonseed	= 95 - 22.95
	= Rs. 72.05

Source: 1. Appendix 1 (cost of seed cotton)
2. appendix 5
3. Appendix 4
4. Pakistan Agriculture Statistics, 1988.
5. Saeed and Manzoor, 1988.

Sunflower (Irrigated)

Inputs	Unit	Market Price	Input/ Acre
------	----	-----	------
Tractor	Hour	60.00	4.05
Bullock	Day	40.00	2.23
Seed	Kg.	10.00	2.02
Urea	Kg.	2.60	20.23
SSP	Kg.	0.80	0
Nitrophos	Kg.	2.20	70.82
SOP	Kg.	1.00	30.35
Pesticide	Rupee	91.05	1
Irrigation	Rupee	24.28	1
Labour	Day	25.00	18.21
Tubewell	Rupee	150.00	1.21
Interest	Rupee	101.80	1
Land	Rupee	320.00	1

Yield = 485.61 Kg./Acre OR 12.14 Kg.

Price = Rs. 4.25/Kg.

Revenue/Acre = Rs. 2063.84

Cost/Acre = Rs. 1765.032

Profit/Acre = Rs. 298.81

Profit/40 Kg. = Rs. 24.61

Rapeseed/Mustard

Inputs	Unit	Market Price	Input/ Acre
Tractor	Hour	60.00	2.83
Bullock	Day	40.00	1.82
Seed	Kg.	3.76	2.02
Urea	Kg.	2.60	30.35
SSP	Kg.	0.80	0
Nitrophos	Kg.	2.20	0
DAP	Kg.	3.00	60.7
SOP	Kg.	1.00	0
Pesticide	Rupee	70.82	1
Irrigation	Rupee	20.23	1
Labour	Day	25.00	14.97
Interest	Rupee	68.35	1
Land	Rupee	320.00	1

Yield = 485.61 Kg./Acre OR 12.14 (40 Kg.)

Price = Rs. 3.75 /Kg.

Revenue/Acre = Rs. 1821.035

Cost/Acre = Rs. 1364.855

Profit/Acre = Rs. 456.18

Profit/Acre = Rs. 37.58

Sunflower (Rainfed)

Inputs	Unit	Market Price	Input/ Acre
Tractor	Hour	60.00	2.02
Bullock	Day	40.00	1.62
Seed	Kg.	3.76	4.05
Urea	Kg.	2.60	50.58
SSP	Kg.	0.80	0
Nitrophos	Kg.	2.20	0
DAP	Kg.	3.00	50.58
SOP	Kg.	1.00	0
Labour	Day	25.00	10.12
Interest	Rupee	53.30	1
Land	Rupee	320.00	1

Yield = 485.61 Kg./Acre OR 8.09 (40 Kg.)

Price = Rs. 4.25/Kg.

Revenue/Acre = Rs. 1375.89

Cost/Acre = Rs. 1160.048

Profit/Acre = Rs. 215.84

Profit/40 Kg. = Rs. 26.68

Soybean

Inputs	Unit	Market Price	Input/ Acre
Tractor	Hour	60.00	3.24
Bullock	Day	40.00	1.62
Seed	Kg.	3.76	30.35
Urea	Kg.	2.60	30.35
Nitrophos	Kg.	2.20	50.58
SOP	Kg.	1.00	20.23
Pesticides	Rupee	121.40	1
Irrigation	Rupee	60.90	1
Labour	Day	25.00	14.57
Interest	Rupee	80.26	1
Land	Rupee	320.00	1

Yield = 485.61 Kg./Acre OR 12.14 (40 Kg.)

Price = Rs. 4.00 /Kg.

Revenue/Acre = Rs. 1942.44

Cost/Acre = Rs. 1546.94

Profit/Acre = Rs. 395.50

Profit/40 Kg = Rs. 32.58

Source: Cost of production, excluding land rent, prices, and yield data, [FAO:1986].

Land rent [Agriculture Prices Commission:1988]

Appendix 2

Cost Distribution

The following table, which deals with the decomposition of cost of producing oilseeds into foreign, domestic labour and domestic capital costs, is based on the results derived in chapter 5.

Input	Unit	FC	LC	KC
Tractor	Rs./Hour	38.33	12.49	0.03
Bullock	Rs./Day	0	25.00	67.00
Seed				
Soybean	Rs./Kg.	4.03	0.30	0.06
Sunflower	Rs./Kg.	3.97	0.30	0.06
Rapeseed/ Mustard	Rs./Kg.	3.53	0.30	0.06
Cotton-seed	Rs./Kg.	2.38	0.30	0.06
Seed-Cotton	Rs./Kg.	5.43	0.30	0.06

Input	Unit	FC	LC	KC
Fertilizer				
Urea	Rs./Kg.	2.29	0.30	0.06
N.phos	Rs./Kg.	2.44	0.30	0.06
SOP	Rs./Kg.	3.61	0.30	0.06
TSP	Rs./Kg.	2.88	0.30	0.06
DAP	Rs./Kg.	3.42	0.30	0.06
SSP	Rs./Kg.	0.64	0.30	0.06
Pesticides				
Soybean	Rs./Kg.	105.62	12.75	2.45
Sunflower	Rs./Kg.	76.21	9.14	1.76
Rapeseed/ Mustard	Rs./Kg.	48.98	5.09	1.13
Cotton	Rs./Kg.	308.05	37.17	7.17
Irrigation				
Cotton	Rs./kg.	80.85	28.40	0
Sunflower (irri.)	Rs./Kg.	53.90	18.94	0
Rapeseed/ Mustard	Rs./Kg.	44.91	15.78	0
Soybean	Rs./Kg.	135.20	47.50	0
Tubewell	Rs.	53.90	18.94	0

Labour	Rs./Day	0	25.00	0
Interest				

Soybean	Rs.	0	0	80.26
Sunflower (rainfed)	Rs.	0	0	53.30
Sunflower (irri.)	Rs.	0	0	101.80
Rapeseed/ Mustard	Rs.	0	0	68.35
Cotton	Rs.	0	0	125.97

Source: Chapter 5

Appendix 3

Decomposition of Total Cost of Oilseed Production

The division of total cost for each oilseed crop into land, labour, capital, and foreign cost is arrived by multiplying the input requirement per acre for each of the crop, from Appendix 2, with the decomposition ratios listed in appendix 3.

Seed Cotton (Rs./Acre)

Input	FC	LC	KC	LDC
Tractor	232.663	75.814	0.182	---
Bullock	0.000	81.00	217.080	---
Seed	19.254	2.427	0.485	---
Urea	162.178	21.246	4.249	---
SSP	29.786	13.962	2.792	---
SOP	168.009	13.962	2.792	---
Pesticide	281.260	6.380	6.380	---
Irrigation	80.850	28.400	----	---
Labour		607.000	----	---
Interest	----	-----	125.970	---
Land	----	------	----	320.00
Total	974.00	850.191	359.931	320.00

Sunflower (irrigated) (Rs./Acre)

Input	FC	LC	KC	LDC
Tractor	155.236	50.584	0.121	---
Bullock	----	55.75	149.410	---
Seed	8.019	0.606	0.121	---
Urea	46.327	6.069	1.213	---
N.phos	172.800	21.246	4.249	---
SOP	109.563	9.105	1.821	---
Pesticide	72.320	1.64	1.640	---
Irrigation	53.900	18.94	---	---
Labour		455.25	---	---
Tubewell	65.219	22.917	---	---
Interest	----	-----	53.300	---
Land	----	------	----	320.00
Total	683.386	642.107	211.876	320.00

Rapeseed/Mustard (Rs./Acre)

Input	FC	LC	KC	LDC
Tractor	108.473	35.346	0.085	---
Bullock	---	45.500	121.940	---
Seed	7.130	0.606	0.121	---
Urea	69.501	9.105	1.821	---
DAP	207.594	18.210	3.642	---
Pesticide	56.250	1.270	1.270	---
Irrigation	44.910	15.780	---	---
Labour		374.250	---	---
Interest	----	-----	68.35	---
Land	----	------	----	320.00
Total	493.86	500.067	197.229	320.00

Sunflower (Rainfed) (Rs./Acre)

Input	FC	LC	KC	LDC
Tractor	92.759	30.225	0.072	---
Bullock	---	40.500	108.540	---
Seed	16.078	1.215	0.243	---
Urea	115.828	15.174	3.035	---
DAP	172.984	15.174	3.035	---
Labour		253.000	---	---
Interest	----	-----	53.300	---
Land	----	------	---	320.00
Total	397.649	355.288	168.225	320.00

Soybean (**Rs./Acre**)

Input	FC	LC	KC	LDC
Tractor	124.189	40.478	0.097	---
Bullock	---	40.500	108.540	---
Seed	16.240	1.209	0.242	---
Urea	69.501	9.105	1.821	---
N.phos	123.415	15.174	3.034	---
SOP	73.030	6.069	1.213	---
Pesticides	99.25	2.250	2.250	---
Irrigation	135.200	47.500	---	---
Labour		364.250	---	---
Interest	----	-----	80.260	---
Land	----	------	---	320.00
Total	640.827	526.524	197.458	320.00

Source: Appendix 1 and 2.

Appendix 4

International Cottonseed, Cotton Lint and Seed Cotton Prices

The international prices for cottonseed, cotton lint and seed cotton are derived using the following methodology: First, international mill-gate price for cottonseed is derived by adding the unloading as well as transportation cost, from mill-gate to the port, to the import value figure. Given that cost of processing cottonseed is 15 % of the total gining cost,[75] we subtract this portion of the gining cost from mill-gate price to arrive at the international value of cottonseed, net of processing cost.

Similarly, we arrive at the international price of cotton lint with and without gining cost. Given that the value of 40 Kg. of seed cotton derived 2/3 of its value from cottonseed and 1/3 from cotton lint, we multiply these weights with the prices of cottonseed and cotton lint respectively to determine the international mill-gate value of 40 kg. of seed cotton. By subtracting farm to mill-gate transportation cost we arrive at the international farm-gate value of 40 Kg. of seed cotton.

Cottonseed:

Import Value ($/MT) = $ 119

[75] Source: South Asia Situation and Outlook Report, December, 1987.

Exchange Rate	= Rs. 17.60/U.S $
Import Value (Rs./MT)	= Rs. 2094.4
Import Value (Rs./40 Kg.)	= Rs. 83.77
Unloading Cost	= Rs. 10.08
Transport cost (Rs./40 Kg.)	= Rs. 15.46
Mill-gate Price (Rs./40 Kg.)	= 83.77 +10.08 +15.46 = 109.31
Value of cottonseed, net of processing cost (Rs. /40Kg.)	= Rs. 92.91

Cotton Lint

Export value ($/MT)	= $ 958.1
Export Value (Rs./MT)	= Rs. 16862.56
Export Value (Rs./40kg.)	= Rs. 674.50
Shipment and Transport (40 Kg.)	= Rs. 83.14
Mill-gate Price (Rs./40 Kg.)	= 674.5-83.14 = 591.36
Value of cotton lint, net of processing cost (Rs. Kg.)	= Rs. 469.69

Seed Cotton

World Price of seed cotton*	= 92.91 x 2/3 + 469.69 x 1/3
(Rs./40 Kg.)	= Rs. 221.015
Local Transport (Rs./40 Kg.)	= Rs. 3.66
International Farm-gate Price	= Rs. 221.015 - 3.66
(Rs. /40 Kg.)	= Rs. 217.35

Data Sources:

(1). Export value data, FAO Year Book, Vol.42, 199

(2). Exchange rate, Pakistan Economic Survey, 1988-89

(3). Cost of transport data, Appleyard [1987], after adjusting for inflation.

(4). Processing cost, Appleyard [1987], after adjusting for inflatior

(5). Import value data for cottonseed, Foreign Agriculture Trade of the U.S., 1989.

Appendix 5

Cost Breakdown for Cottonseed

In order to estimate the DRC coefficient for cottonseed we need to decompose the cost of producing 40 Kg. of cottonseed into domestic as well as foreign cost. The cost of producing cottonseed is derived from the production cost of seed cotton, as cottonseed is a by-product of seed cotton.

The cost of producing 40 kg. of cottonseed is derived by adding local transport, and processing cost to cost of producing 60 Kg. of seed cotton. From this cost is then subtracted the value of by-product, i.e., cotton lint, to arrive at cost of producing 40 Kg. of cottonseed. Given that 60 Kg. of seed cotton gives 40 Kg. of cottonseed and 20 Kg. cotton lint, the value of by-product is the same as the value of 20 Kg. of cotton lint.

Items	FC	LC	KC	LDC
1. Seed Cotton (Rs./60 Kg.)	80.230	70.032	29.648	26.359
2. Transport (Rs./60 Kg.)	4.11	0.600	0.770	---
3. Processing (Rs./60 Kg.)	14.67	9.27	53.29	---
4. Cotton Lint (Rs./20 Kg.)	-295.68			
Total	-196.669	79.902	83.708	26.359

Where,

FC = foreign cost

LC = labour cost

KC = capital cost

LDC = land cost

Sources:

(1). Seed cotton costs are derived from Appendix 3.

(2). Transport cost for seed cotton is derived from Appendix 4.

(3). This represent processing cost of 40 Kg. of seed cotton and 20 Kg. of cotton lint. Actual cost of processing is derived from Appendix 4 . However, it is assumed that this processing cost is divided into foreign, labour, and capital cost in the same proportion as the cost of expeller extraction, derived in chapter 5.

APPENDIX 6

DRC Coefficients for Oilseeds

Items	Unit	Sunf. (i)	Rapeseed/ Mustard	Sunf. (r)	Soybean	Cotton-seed*
FC	Rs/Ac	683.38	493.86	397.65	640.83	-196.67
LC	Rs/Ac	642.11	500.08	355.29	526.52	79.90
KC	Rs/Ac	211.88	197.23	168.23	197.46	83.70
LDC	Rs/Ac	320.00	320.00	320.00	320.00	26.60
YL	40Kg/Ac	12.14	12.14	8.09	12.14	1**
PMs	Rs/40Kg	158.65	141.05	158.65	161.47	98.10
DLC	Rs/Ac	148.108	148.108	98.698	148.108	12.20
DKC	Rs/Ac	32.049	32.049	21.357	32.049	2.64
NDC	Rs/40Kg	74.061	63.887	84.402	65.542	171.16
NFS1	Rs/40Kg	119.573	117.249	127.912	126.961	344.345
NFS2	U.S.$	5.815	5.702	6.221	6.175	16.748
DRC1	Value	0.62	0.54	0.66	0.51	0.50
DRC2	Rs/$	12.73	11.20	13.57	10.61	10.22

OER	Rs/$	17.60
SER	Rs/$	20.56
CRL	Value	0.75
CRK	Value	1.16

* For cottonseed, which is derived from seed cotton, the cost

of production data is derived form Appendix 4 and 5.

** For symmetry in the calculations of DRC coefficients for the oilseeds we assume cottonseed "yield" as equal to 1 or 40 kg.

Where,

FC = Per acre foreign or import cost

LC = Per acre labour cost

KC = Per acre capital cost

LDC = Per acre land cost

YL = Per acre yield

PMs = International farm-gate price of 40 kg. of seed

DLC = Labour cost of distributing imported seed

DKC = Capital cost of distributing imported seed

OER = Official exchange rate

SER = Shadow exchange rate

CRL = Correction factor for labour, i.e, ratio of shadow to market wage rate

CRK = Correction factor for Capital, i.e., shadow price of capital

NDC = Net domestic cost of producing oilseed

NFS1 = Net foreign exchange saving in the production of oilseed, measured in domestic currency at the shadow exchange rate

NFS2 = Net foreign exchange saving in the production of oilseed, evaluated at the official exchange rate in foreign currency

DRC1 = Domestic resource cost of producing oilseed, i.e, ratio of NDC (at shadow prices in domestic currency) to NFS (evaluated at the shadow exchange rate in domestic currency)

DRC2 = Domestic resource cost, i.e, ratio of NDC (measured at shadow prices in domestic currency) to NFS2 (evaluated at the official exchange rate in foreign currency)

The NDC, NFS1, NFS2, DRC1, and DRC2 is calculated as follows:

NDC = (LC x CRL + KC x CRK + LDC - DLC x CRL - DKC x LRK)/YL

NFS1 = (PMs x SER/OER) - (FC x SER/OER)/YL

NFS2 = (PMs - FC/YL)/YL

DRC1 = NDC/NFS1

DRC2 = NDC/NFS2

Source: FC, LC, KC, LDC, from Appendix 3.
YL from Appendix 1.
PMs from table 4, chapter 5.
DLC, DKC from table 3, chapter 5.
OER, SER, from table 1 chapter 5.
CRL, CRK, CRF from table 2, chapter 5.

Appendix 7

Oilseed/Edible Oil Extraction Rates

Solvent Extraction

(%)

Oilseed	Oil	Meal	Hull	Lint	Oil Dirt/ Soap Stock
1.Cottonseed	17	47	28	6	2
2.Sunflower	36	38	23	---	3
3.Rapeseed/ Mustard	38	59	---	---	3
4.Soybean	14	75	---	---	3

Sources

1. & 2. Saeed and Manzoor [1988].

3. Mahmood [1990].

4. Agriculture Prices Commission [1988].

Expeller Extraction

(%)

Oilseed	Oil	Cake	Oil Dirt
1.Cottonseed	11	89	1
2.Sunflower	27	70	3
3.Rapeseed/ Mustard	33	62	5

Sources:

1. Pakistan's Edible Oilseed Industry: 1974, p. 272.

2. Zaidi, I.A. S., [1984].

3. Mahmood [1990].

Appendix 8

DRC Coefficients for Edible Oils (Solvent Extraction)

Items	Unit	Sunf. (i)	Rapeseed/ Mustard	Sunf. (r)	Soybean	Cotton-seed*
---	------	------	-------	-------	-------	-------
FCs	Rs/M.T.	1407.29	1017.01	1228.83	1319.66	-4916.75
FCp	Rs/M.T.	91.87	91.87	91.87	91.87	91.87
LCs	RS/M.T.	1322.30	1029.82	1097.93	1084.27	1997.50
LCp	Rs/M.T.	90.18	90.18	90.18	90.18	90.18
KCs	Rs/M.T.	436.33	406.16	519.87	406.63	2092.50
KCp	Rs/M.T.	418.47	418.47	418.47	418.47	418.47
LDC	Rs/M.T.	658.98	658.98	988.87	658.98	659.00
YL	Kg/Ac	485.60	485.60	323.60	485.60	1*
Po	$/M.T.	469.35	428.35	469.35	463.35	605.75
DLCo	Rs/M.T.	304.50	304.50	304.50	304.50	304.50
DKCo	Rs./M.T.	66.75	66.75	66.75	66.75	66.75
RR	%	36	38	36	14	17
ML	Kg.	1055.56	1552.62	1055.56	5357.14	2764.71
Pml	$/Kg.	0.148	0.153	0.148	0.191	0.159
LNT	Kg.					352.94
Pl	Rs/Kg.					3.35
OD	Kg.	83.33	78.95	83.33	214.28	117.65
Pod	Rs/kg	1.60	1.60	1.60	1.60	1.60
HUL	Kg.	638.89	0	638.89	0	1647.06
Ph	Rs/Kg.	0.80	0.80	0.80	0.80	0.80
NTBP	Rs.	644.44	126.31	644.44	342.86	1505.88
TBPo	Rs.	2749.51	4180.93	2749.51	18008.57	12953.22

TBPs	Rs.	3211.93	4884.08	3211.93	21037.29	15131.72
NDC	Rs/M.T.	5594.04	5127.48	6312.18	13789.19	25708.58
NFS1	Rs/M.T.	8187.86	10457.18	8766.95	19444.94	61264.84
NFS2	$/M.T.	398.24	508.62	426.41	945.76	2979.81
DRC1	Value	0.68	0.49	0.72	0.71	0.42
DRC2	Rs/$	14.05	10.08	14.80	14.58	8.63

OER	Rs/$	17.60
SER	Rs/$	20.56
CRL	Value	0.75
CRK	Value	1.16
CRF	Value	1.168

* For cottonseed, which is derived from seed cotton, the cost data is interms of the production of 40 kg. of cottonseed.

** For symmetry in the calculations of DRC coefficients for the oilseeds we assume cottonseed "yield" as equal to 1 or 40 kg.

Where,

FCs = Per M.T. foreign or import cost of producing oilseed

FCp = Per M.T. foreign or import cost of processing edible oil

LCs = Per M.T. labour cost of producing oilseed

LCp = Per M.T. labour cost of processing edible oil

KCs = Per M.T. capital cost of producing oilseed

KCp = Per M.T. capital cost of processing edible oil

LDCs = Per M.T land cost of producing oilseed

YL = Per acre yield

RR = Edible oil recovery ratio

Po = International price of 1000 kg. of edible oil

DLC = Labour cost of distributing imported seed

DKC = Capital cost of distributing imported seed

ML = Meal

Pml = Price of meal

LNT = Lint

Pl = Price of lint

OD = Oil dirt

Pod = Price of oil dirt

HUL = Hull

Ph = Price of hull

NTBP = Value of non-traded by-product

TBPo = Value of traded by-product at OER

TBPs = Value of traded by-product at SER

OER = Official exchange rate

SER = Shadow exchange rate

CRL = Correction factor for labour, i.e, ratio of shadow to market wage rate

CRK = Correction factor for Capital, i.e., shadow price of capital

CRF = Correction factor for foreign exchange, i.e., ratio of shadow to official exchange rate

NDC = Net domestic cost of producing edible oil

NFS1 = Net foreign exchange saving in the production of edible oil measured in domestic currency at the shadow exchange rate

NFS2 = Net foreign exchange saving in the production of edible oil, evaluated at the official exchange rate in foreign currency

DRC1 = Domestic resource cost of producing edible oil, i.e, ratio of NDC (at shadow prices in domestic currency) to NFS (evaluated at the shadow exchange rate in domestic currency)

DRC2 = Domestic resource cost, i.e, ratio of NDC (measured at shadow prices in domestic currency) to NFS2 (evaluated at the official exchange rate in foreign currency)

The NDC, NFS1, NFS2, DRC1, and DRC2 is calculated as follows:

NDC = (LCs/RR + LCp - DLC) x CRL + (KCs/RR + KCp - DKC) x CRK + (LDC/RR) - (NTBP)

NFS1 = (Po x SER +TBPs) - (FCs/RR + FCp) x CRF

NFS2 = (Po + TBPo/OER) - (FCs/RR + FCp)/OER

NTBP = (OD x Pd + HUL x Ph)

TBPo = (ML x Pm x OER) + (LNT x P1)

TBPs = (ML x Pm x SER) + (LNT P1 x CRF)

DRC1 = NDC/NFS1

DRC2 = NDC/NFS2

DRC Coefficients for Edible Oils (Expeller Extraction)

Items	Unit	Sunf. (i)	Rapeseed/ Mustard	Sunf. (r)	Cotton- seed*
FCs	Rs/M.T.	1407.29	1017.01	1228.83	-4916.75
FCp	Rs/M.T.	72.37	72.37	72.37	72.37
LCs	RS/M.T.	1322.30	1029.82	1097.93	1997.50
LCp	Rs/M.T.	45.30	45.30	45.30	45.30
KCs	Rs/M.T.	436.33	406.16	519.87	2092.50
KCp	Rs/M.T.	264.33	264.33	264.33	264.33
LDC	Rs/M.T.	658.98	658.98	988.87	659.00
YL	kg/Ac	485.60	485.60	323.60	1*
Po	$/M.T.	469.35	428.35	469.35	605.75
DLC	Rs/M.T.	304.50	304.50	304.50	304.50
DKC	Rs./M.T.	66.75	66.75	66.75	66.75
RR	%	27	33	27	11
CK	Kg.	1944.44	1878.79	1944.44	8090.91
PcK	Rs/Kg.	1.20	1.80	1.20	2.00
OD	Kg.	111.11	151.51	111.11	90.91
Pod	Rs/Kg	1.60	1.60	1.60	1.60
NTBP	Rs.	3288.89	3624.24	3288.89	16327.27
TBPo	Rs.	0	0	0	0
TBPs	Rs.	0	0	0	0
NDC	Rs/M.T.	4734.21	2175.66	5691.72	25384.11
NFS1	Rs/M.T.	3476.51	5122.18	4248.63	64584.75
NFS2	$/M.T.	169.09	249.13	206.64	3141.28
DRC1	Value	1.36	0.42	1.34	0.39

DRC2 Rs/$	28.00	8.73	27.54	8.08

OER	Rs/$	17.60
SER	Rs/$	20.56
CRL	Value	0.75
CRK	Value	1.16
CRF	Value	1.168

Where:

CK = Oilseed cake per M.T. edible oil produced

Pck = Price per Kg. of oilseed cake.

The NDC, NFS1, NFS2, DRC1, and DRC2 is calculated as follows:

NDC = (LCs/RR + LCp - DLC) x CRL + (KCs/RR + KCp - DKC) x CRK + (LDC/RR) - (NTBP)

NFS1 = (Po x SER +TBPs) - (FCs/RR + FCp) x CRF

NFS2 = (Po + TBPo/OER) - (FCs/RR + FCp)/OER

NTBP = (CK x pck + OD x Pd + HUL x Ph)

DRC1 = NDC/NFS1

DRC2 = NDC/NFS2

Source: FCs, LCs, KCs, LDCs, YL are derived from Appendix [6].
FCp, LCp, KCp, are derived form table 7 ,chapter 5.
Po is from table 8, chapter 5.
DLCo and DKCo are from table 5 chapter 5.
RR, ML, LNT OD, HUL, and CK are derived using Appendix 7.
Pck, Ph and Pod are from appendix 10.

Pml, is from World Oilseed Situation and Outlook, United States, Department of Agriculture, Foreign Agriculture Services, December 1990.

Pl, is from table 8, chapter 5.

* Cottonseed cost is derived from Appendix 4 and 5.

Appendix 9

Financial Profitability

Solvent Extraction (Market Prices, 1987/1988)

Items	Unit	Sunflower	Rapeseed/ Mustard	Soybean	Cottonseed
PC	Rs/M.T.	627.91	627.91	627.91	627.91
RR	%	36	38	14	17
SR	Kg.	2777.78	2631.58	7142.86	5882.35
Ps	Rs/Kg.	4.25	3.21	4.00	1.87
SC	Rs.	11805.56	8447.37	28571.43	11000.00
TC	Rs.	12433.47	9075.28	29199.34	11627.91
Pmo	Rs/M.T	11150.00	12000.00	11150.00	8000.00
ML	Kg.	1055.56	1552.63	5357.14	2764.71
Pml	Rs/Kg.	2.20	2.20	2.20	2.20
LNT	Kg.	0	0	0	352.94
Pl	Rs/Kg.	0	0	0	3.35
OD	Kg.	83.33	78.95	214.28	117.65
Pod	Rs/Kg.	1.60	1.60	1.60	1.60
HUL	Kg.	638.89	0	0	1647.06
Ph	Rs/Kg.	0.80	0.80	0.80	0.80
BPV	Rs/M.T.	2966.68	3542.10	12128.57	8770.59
PROFT	Rs/M.T.	1683.20	6466.83	-5920.77	5142.68

PROFT = Pmo + BPV - TC

BPV = ML x Pml + LNT x Pl + OD x Pod + HUl Ph

TC = SR x Ps + PC

Financial Profitability (Expeller Technology)

(Market Prices, 1987/88)

Items	Unit	Sunflower	Rapeseed/ Mustard	Cottonseed
PC	Rs/M.T.	403.56	403.56	403.56
RR	%	27	33	11
SR	Kg.	3703.70	3030.30	9090.91
Ps	Rs/Kg.	4.25	3.21	1.87
SC	Rs.	15740.74	9727.27	17000.00
TC	Rs.	16144.30	10130.83	17403.56
Pmo	Rs/M.T.	11150.00	12000.00	8000.00
CK	Kg.	2592.59	1878.79	8090.91
Pck	Rs/Kg.	1.20	1.80	2.00
OD	Kg.	111.11	151.51	90.90
Pod	Rs/Kg.	1.60	1.60	1.60
BPV	Rs.	3288.89	3624.24	16327.27
PROFT	Rs/M.T.	-1705.41	5493.41	6923.71

PROFT = Pmo + BPV - TC

BPV = CK x Pck + OD Pod

TC = SR x Ps + PC

Where:

PC = Per M.T. edible oil processing costs

RR = Edible oil recovery ratio

SR = Per M.T. seed requirement

Ps = Price of oilseed

SC = oilseed cost

TC = Total cost (PC + SC)

Pmo = Per M.T. market price of edible oil

Pml = Price of meal

LNT = cotton lint

Pl = Price of lint

OD = Oil Dirt

Pod = Price of oil dirt

HUL = Hull

Ph = Price of hull

BPV = value of by-product

PROFT = Per M.T. profit

Source: PC is from table 6, chapter 5.

RR, ML, LNT, HUL, OD, CK are from Appendix 7.

Ps, Pmo, Pml, Pod, Ph, Pck and Pl are from appendix 10.

Appendix 10

Market Prices of Oilseeds/Edible Oils and the By-products

Items	Cotton-seed	Sunlflower	Soybean	Rapeseed/ Mustard
Oil	8000	11150	11150	12000
Cake	2000	1200	---	1800
Meal	2200	2200	2200	2200
HUllS	800	800	800	800
Oil Dirt	1600	1600	1600	1600
Lint	3350	---	---	---
Seed	2125	4250	4000	6697.5

Source: Saeed and Manzoor:1988

BIBLIOGRAPHY

Ahmad E., Coady D., and Stern M. " A Complete Set of Shadow Prices for Pakistan: Illustration for 1975-76", The Pakistan Development Review, Vol. XXVI No.1 (Spring 1988)

Agricultural Prices Commission (APC) Support Price Policy for Non-Traditional Oilseeds 1987-88 Crops Islamabad: APCOM, 1987

Ali, Mubarik Domestic Resource Cost of Alternative Rice Varieties in Pakistan, Islamabad:mimeo, 1985.

Amachree, O.S.M Investment Appraisal in Developing Countries, Brookfield:Avebury, U.S.A., 1988.

Appleyard, R. Dennis. Report on Comparative Advantage, Islamabad: Agricultural Prices Commission, 1987.

Asian Development Bank. Asian Development Outlook 1990, Manila:1990.

Azhar, A.R. and Mahmud Fakhre Domestic Resource Cost of Alternative Rice Varieties in Pakistan, Karachi:Applied Economic Research Centre, 1981.

Akrasanee, Narongchai and Wattananukit, Atehana. "Comparative Advantage in Rice Production in Thailand ", Food Research Institute Studies XV, 2, 1976.

Bacha, E. and Taylor, L. " Foreign Exchange Shadow Prices: A Critical Review of Current Theories ", Quarterly Journal of Economic, Vol. LXXXV, NO.2, 1971.

---------------------. "Growth and Trade Distortions in Chile and Their Implication in Calculating the Shadow Price of Foreign Exchange", in R.S. Eckaus, P. N. Rosenstein Roden (eds.), Analysis of Development Problem, Amsterdam: North-Holland Publishing Company, 1973.

Balassa, Bela. Methodology of the Western Africa Research Project Mimeo, 1977.

-------------. "Estimating the Shadow Price of Foreign Exchange in Project Appraisal", Oxford Economic Papers, Vol. 26, No. 2, July 1974.

Balassa, Bela et,al. Development Strategies in Semi-Industrial Economies, Washington: The World Bank, 1982.

Balassa, Bela and Schydlowsky, D. " Effective Tariffs, Domestic Cost of Foreign Exchange, and the Equilibrium Exchange Rate ", Journal of Political Economy, 76, May/June 1968.

------------------------------. "Domestic Resource Costs and Effective Protection Once Again", Journal of Political Economy, 80, February 1972.

Baldwin, Robert. Nontariff Distortions of International Trade, Washington, D.C: Brookings Institute, 1970.

Banerji, R and Juergen B. Donges. " The Domestic Resource Cost Concept Theory and an Empirical application to the case of Spain ", Kieler Arbeitspapierre, 24 (Kiel Working Papers), Kiel: Institut Fuv Weltwivtschaft, 1974.

Bhagwati, J. N and Srinivasan T. N. " Shadow Prices for Project Section in presence of Distortions: Effective Rates of Protection and Domestic Resource Cost ", Journal of Political Economy, February 86, NO. 1, 1978.

---------------------------------- " Domestic Resource Cost, Effective Rates of Protection, and Project Analysis in Tariff Distorted Economies ", The Quarterly Journal of Economics, VOL. XCIV NO. 1, February 1980.

Bruno, M. " Optimal Pattern of Trade and development ", The Review of Economics and Statistics, VOL. 49 1967.

--------- " The Optimal Selection of Export-Promoting and import-Substituting Projects", in Planning the External Sector: Techniques, Problems, and Polices, New York: United Nations, 1967.

--------- " Development Policy and Dynamic Comparative Advantage ", in Raymond Vernon (ed.), The Technology Factor in International Trade, New York: 1970.

---------- " Domestic Resource Cost and Effective Protection: Clarification and Synthesis ", Journal of Political Economy, VOL. 80, 1972.

Clark, P. B. Planning Import Substitution, Amsterdam: North-Holland Publishing Company, 1970.

Chaudhry, M. Ghaffar " Mechanization and Agriculture Development in Pakistan" The Pakistan Development Review Vol. XXV, No. 4., (Winter 1986).

Chaudhry, M. A., and M. M. Ashraf An Economic Analysis of Level and Structure of Irrigation Water Charges, Islamabad: Pakistan Institute of Development Economics, 1981.

Chenery, H. B. " Comparative Advantage and Development Policy ", American Economic Review, March, 1961.

Corden, W. M. "The Structure of a Tariff System and the Effective Protection Rate" Journal of Political Economy, June 1966.

Dobb, M. H. An Essay on Economic Growth and Planning, London: Routledge and Paul 1960.

Findlay, R. " Comparative Advantage, Effective Protection and the Domestic Resource Cost of Foreign Exchange ", _Journal of International Economics_, 1, 1971.

Food and Agriculture Organization (FAO). _Pakistan National Oilseed Development Project_, Rome:1986

------------------------------------. _FAO Year Book Trade_, Rome: Vol 42, 1990.

------------------------------------. _FAO Quarterly Bulletin of Statistics_, Rome: 1988.

------------------------------------. _Food Outlook, Statistical Supplement_, Rome: June 1989.

Galenson, W. and Leibenstein, H. "Investment Criteria, Productivity and Economic Development" _Quarterly Journal of Economics_, LXIX, 1955.

Gittinger, J. Price. _Economic Analysis of Agricultural Projects_, Baltimore:The John Hopkins University Press, 1982.

Gotsch, C. and Brown, G. _Prices, Taxes, and Subsidies in Pakistan, 1960-70_ Washington, D.C.: The World Bank, 1980.

Government of Pakistan (GOP). _Agricultural Statistics of Pakistan 1987-88_ Islamabad: Ministry of Food and Agriculture and Co-Operatives, 1988.

--------------------. Economic Survey 1988-89 Islamabad: Finance Division, Economic Advisor's Wing, 1989.

--------------------. Pakistan Basic Facts, Islamabad: Finance Division, Economic Advisor's Wing, 1984.

--------------------. Sixth Five Year Plan, Islamabad: Planning Commission, 1987

--------------------. Seventh Five Year Plan (1988-93) and Perspective Plan (1988-2003), Islamabad: Planning Commission, 1987.

--------------------. Report on the National Commission on Agriculture, Islamabad: Ministry of Food and Agriculture, 1988a.

--------------------. Economic Survey, Islamabad: Finance Division, Economic Advisor's Wing, 1990.

Guisinger, S. "Calculating Shadow Prices in Pakistan: Reflections on the Paper by Squire, Little, and Durdag", Pakistan Development Review, Vol XVIII No. 2, Summer 1979.

Hannah, G. J. Canola and Groundnut Cost of Production and Oil Extraction Break-Even Analysis, Islamabad: Pakistan Agricultural Research Council, 1988.

----------- Canola Cost of Production Budgets, Recommended Practices, Fully Mechanized, Islamabad:Pakistan Agricultural Research Council, 1987.

Harberger, C. A. "The Social Opportunity Cost of Labour", International Labour Review, 103, 1971.

---------------. "Survey of Literature on Cost-Benefit: Analysis for Industrial Project Evaluation", Evaluation of Industrial Projects, New York: United Nations (UNIDO), 1968.

Herdt, R. W and Lacsina, T. A. " The Domestic Resource Cost of Increasing Philippine Rice Production", Food Research Institute Studies, XV, 2, 1976.

Jonson, B.L.C. Pakistan, London: Heinemann Educational Books Ltd. 1979.

Khan, A. E. "Investment Criteria in Development Programs" Quarterly Journal of Economics, LXV, 1951

Khan, M. Z. "Estimation of Shadow Prices for Project Evaluation in Pakistan", The Pakistan Development Review, Vol. XVIII, No. 2, Summer 1979.

Khan, S. R. "An Estimation of Shadow Rate in Pakistan" Pakistan Development Review, Vol. XIII, No. 4. Winter 1974.

Kirkpatrick, C. H., Lee, N., and Nixson, F. N. Industrial Structure and Policy in Less Developed Countries, London: George Allan and Unwin, 1984.

Krueger, A. O. C. " Some Economic Costs of Exchange Control: The Turkish Case ", Journal of Political Economy, 74, October, 1966.

---------------- " Evaluating Restrictionest Trade Regimes: Theory and Measurement ", Journal of Political Economy, January/February, 1972.

----------------- The Benefits and Costs of Import Substitution in India: A Microeconomic Study, Minneapolis: University of Minnesota Press, 1975.

Lawreence, R. Some Economic Aspects of Farm Mechanization in Pakistan, mimeo, 1970.

Lewis, W. A. Economic Development with Unlimited Supplies of Labour, Manchester: School of Economics and Social Sciences, 1954.

Little, I. M. D. and Mirless, J. A. Project Appraisal and Planning for Developing Countries, London: Heinemann, 1974.

----------------------------------. Manual of Industrial Project Analysis in Developing Countries Volume II: Social Cost-Benefit Analysis, Paris: OECD, 1968.

Little, I. M. D., Squire, L. and Durdag, M. "Shadow Pricing and Macroeconomic Analysis: Some Illustration from Pakistan" Pakistan development Review, Vol. XVIII, NO. 2., Summer 1979.

Mahmood, Amir. Economics of Rapeseed/Mustard Production Under Barani (Rainfed) Conditions and Issues in Edible Oil Prices and Canola Processing in Pakistan, Ottawa: Agriculture Canada, 1990.

Mahmood and Sahibzada. "Social Rates of Return in Pakistan's Large Scale Manufacturing Sector", Pakistan Development Review, Vol XXV, Winter 1986.

Malick, S.J. "Choice of Techniques: A Case Study of the Cottonseed Oilextraction Industry in Pakistan" Pakistan Development Review, Vol. XXV, Winter 1986.

Manzoor, K. and Saeed, T. A Report on the Oil Extraction Industry in Pakistan, Karachi: NDFC, 1988.

Mashayeki, Afsaneh. Shadow Prices for Project Appraisal in Turkey, World Bank Staff Working Paper No. 392. Washington, D.C.: World Bank, 1980.

Mears A, Leon. " The Domestic Resource Cost of Rice Production in the United States " Food Research Institute Studies XV, 2 1976.

Michaely, M. Foreign Trade Regimes and Economic Development: Israel, New York: National Bureau of Economic Research, 1975.

Mishra, S. N. " Protection Versus Underpricing of Agriculture in the Developing Countries: A case Study of India ", The Developing Economics. XXIV June, 1986.

Monke, Eric., Pearson R. Scott., and Akrasanee, Narongchai. " Comparative Advantage, Government Policies, and International Trade in Rice ", Food Research Institute Studies, XV, 2, 1976.

Mustafa, S.M. Focus on the Pakistan Economy, Karachi: Royal Book Company, 1989.

Naqvi, S. N. H., and Kemal, A. R. The Structure of Protection in Pakistan, Islamabad: Pakistan Institute of Development Economics, VOL. 1 and 2, 1983.

National Development Finance Corporation. The Feasibility of Indigenisation: A Study of Vehicle Manufacture in Pakistan, Karachi: NDFC, 1986.

National Fertilizer Development Centre (NDFC). Pakistan Fertilizer Statistics, Islamabad: NFDC, 1986.

Nishimizu, M and Page, J. M. " Productivity Change and Dynamic Comparative Advantage ", The Review of Economics and Statistics, VOL. LXVIII. No.1, February, 1986.

Nziramasanga, Mudzivivi. T. " Domestic Resource Costs of Investment Projects in Zambia's Second National Development Plan ", Eastern Africa Economic Review, VOL. 6, No. 2. December, 1974.

Oil World, Hamburg: ISTA Mielke Gmbh, 1988.

Pack, H. Structural Change and Economic Policy in Israel, New Haven: Yale University Press, 1971.

Pakistan Institute of Development Economics. Final PIDE Input-Output Table of Pakistan: 1975-76, Islamabad: PIDE, 1985.

Pearson, S. R. " Net Social Profitability, Domestic Resource Costs, and Effective Rate of Protection ", The Journal of Development Studies, VOL. 12. July, 1976.

Pearson, R. S., Akrasan, Narongchai., and Nelson, C. Gerald. " Comparative Advantage in Rice Production: A Methodological Introduction ", Food Research Institute Studies, XV. 2, 1976.

Pomfret, R. W. T. Trade Policies and Industrialization in a Small Country: The Case of Israel Kiel: Institut Fuv Weltwivtschaft an der Universit at Kiel, 1976.

Rempel, Henry. An Agricultural Sector Strategy: Pakistan, Ottawa: CIDA, 1990.

Roemer and Stern. The Appraisal of Developing Projects, Praeger Publisher, 1975.

Sahibzada, A. S. and Mahmood, A. M. "Social rates of Return in Pakistan's Large-Scale Manufacturing Sector", The Pakistan Development Review, Vol. XXV, NO. 4 Winter 1986.

Sattar, A. Competitiveness of Agricultural Projects Under Different Farming Systems and Levels of Technology Adoption, Peshawar: Institute of Development Studies, 1985.

Scott, M. F.G. "How to Use and Estimate Shadow Exchange Rate", Oxford Economic Papers, Vol. 26, No. 2., July 1974.

Schydlowsky, M. Daniel. " A Policymaker's Guide to Comparative Advantage ", World Development, VOL. 12, No 4, 1984.

---------------------. "On the choice of a Shadow Price of Foreign Exchange" Economic Report No. 108, Cambridge: Development Advisory Service, Centre for International Affairs, Harvard University, 1968.

--------------------, and Balassa, Bela. " Domestic Resource Costs and Effective Protection Once Again ", Journal of Political Economy, VOL. 80, January/February - November/December, 1972.

Sharif, M. Edible Oil Supply and Demand Situation in Pakistan, mimeo, Islamabad: Ministry of Food and Agriculture, 1989.

Squire, L., and Van der Tak, H. G. Economic Analysis of Projects, Baltimore: John Hopkins University Press, 1975.

Steel, W. F. " Import Substitution and Excess Capacity in Ghana ", Journal of Development Economics, 3. 11, 1976.

Sukharomana, S. "Domestic Resource Cost of Agricultural mechanization in Thailand :A Case Study of Small Rice Farmes in Supanburi", in IRRI Publication, Consequences of Small-Farm Mechanization, Los Banos: International Rice Research Institute (IRRI), Philippines, 1983.

Teitel, S. and Thoumi " From Import Substitution to Exports. The Manufacturing Exports Experience of Argentina and Brazil ", Economic Development and Cultural Change ", 34(13), April, 1986.

Thomas, V. Bulmer. Input-Output Analysis in Developing Countries, New York: John Wiley and Sons Ltd., 1982.

United Nations Industrial Development Organization (UNIDO) Guidelines for Project Evaluation, New York: United Nations, 1972.

United States Agency for International Development (USAID). How to Improve Market Stability, Lower Import Costs and Foreign Exchange in the Edible Oil Trade, Islamabad: 1985.

United States Department of Agriculture (USDA). LOTUS File Spreadsheet of Data on Pakistan, Washington, D.C: Economic Research Services, USDA, 1989.

---. *World Oilseed Situation and Outlook*, Washington, D.C: Foreign Agricultural Service, December, 1990.

---. *South Asia Outlook and Situation Report*, Washington, D.C: Foreign Agricultural Service, 1987.

---. *Foreign Agricultural Trade of USA*, Washington, D.C: 1989

Office of International Cooperation and Development. *Pakistan's Edible Oil Industry*, Washington, D .C.: United States department of Agriculture, 1984.

Warr, P. G. " Domestic Resource Cost as an Investment Criterion ", *Oxford Economic Papers*, 35, 1983.

Waterston, Albert. *Planning in Pakistan*, Baltimore: The John Hopkins Press, 1963.

Weiss, J. "Project Selection and Equity Objections: The Use of Social Analysis" *The Pakistan Development Review*, Vol. XVIII, No. 2,1979.

--------. *Practical Appraisal of Industrial Projects: Applications of Social Cost-Benefit Analysis in Pakistan*, New York: UNIDO, 1980.

World Bank. *World Debt Tables*, Washington, D.C: The World Bank, 1989.

----------. World Development Report, New York: Oxford University Press, 1990

Wu, Kung-Hsien Carson and Mao Yu-Kang. " International Comparative Advantage of Rice Production in Taiwan ", Food Research Institute Studies, XV, 2., 1976.

Zaidi, I.A. The Changing Oil Seeds Sector In Pakistan, Research Paper Submitted to Institute of Social Studies, Hague: 1984