AGRICULTURAL EXPORT POLICIES: A CASE STUDY OF THE JAMAICAN WINTER VEGETABLE SECTOR

by

Carlyle A.J. Farrell

A thesis
presented to the University of Manitoba
in fulfilment of the
thesis requirement for the degree of
Doctor of Philosophy
in
Agricultural Economics and Farm Management

Winnipeg, Manitoba

ISBN 0-315-77850-4

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TO

BUELAH AND DOMINICK

ABSTRACT

AGRICULTURAL EXPORT POLICIES: A CASE STUDY OF THE JAMAICAN WINTER VEGETABLE SECTOR

This dissertation is concerned with the constraints to the expansion of non-traditional agricultural exports in Jamaica. Using the winter vegetable component of the failed Agro 21 program as an example, the research seeks to evaluate the impact of technology choices and macro-economic policies on the export performance of the sector. The research is also concerned with the identification and analysis of the economic forces operative in the competitive environment which could provide an opportunity for the re-entry of Jamaican producers into the export market for winter vegetables.

Using the recently developed Monke-Pearson policy analysis matrix (PAM) as an analytical framework, it was discovered that Jamaica did not have a comparative advantage in winter vegetable production and exports over the 1982-1987 period. In fact, this sector of the Agro 21 program resulted in a loss to the Jamaican economy of $J 77 million valued at 1982 social prices. Government policies were also found to be inimical to the development of this non-traditional export sector. Overvaluation of the Jamaican exchange rate unwittingly levied a punitive 38% tax on vegetable exports over the period of the program's operation.

Prospects for the re-entry of Jamaican exporters into this market were assessed by an examination of the organisation and performance of the Mexican winter vegetable industry. The reasons for the success of this latter country in the United States

ABSTRACT

winter vegetable market were identified, and an attempt was made to assess the extent to which the Mexican export strategy differed from that employed by Agro 21 exporters. It was discovered that the determinants of Mexico's success in the U.S. market are a complex mix of economic, geographic and political factors which does not lend itself to rote duplication. The analysis also revealed that changes in the cost structure of Mexican producers could not be relied upon to provide a catalyst for the re-entry of Jamaican exporters, over the short to medium term.

ACKNOWLEDGEMENTS

Several individuals have contributed to the successful completion of this dissertation. I wish to thank Drs. Edward Tyrchniewicz and Richard Lobdell for the instrumental role they played as members of my internal examining committee. I benefited immensely from their keen academic insights and well timed words of encouragement and support. I also wish to thank Dr. Eric Monke for his constructive criticism of my work. As external examiner, he gave up an inordinate amount of his time in order to read and critique the several incarnations of this document. I believe that the overall quality of the final result is better as a result of his contribution.

Several other individuals, though not members of the formal examining committee, provided constructive insights and financial support for which I am grateful. I owe an intellectual debt to Dr. Merle Faminow for alerting me to the existence of the Monke-Pearson Policy Analysis Matrix. Merle also provided a useful sounding board for discussion of various aspects of the research, and gave freely of his extensive knowledge of the professional literature and his experience in applied economic research. Dr. Bishnodat Persaud, formerly Head of the Economic Affairs Division at the Commonwealth Secretariat, provided me with a research grant to undertake the field work in Jamaica. Without this financial support completion of the present research project would have been seriously delayed.

A great number of people in Jamaica also contributed, in no minor way, to the realisation of this goal. A complete listing of these individuals and the roles they played would require more space than is available here, but the following individuals are especially deserving of mention. Mr. Asgar Ally, formerly President of the National Investment Bank of Jamaica, seeded the initial idea for an investigation of the Agro 21 program. Once I was convinced of the merits of this line of inquiry, Asgar provided me with unrestricted access to documents on the program, and set up interviews with several key individuals in the Jamaican private and public sectors. Members of his staff, most notably Ms. Eltha Brown, took on the task of assisting me with the challenge of untangling the maze of reports, memos, and letters generated on the Agro 21 program, with zeal and enthusiasm. Ms. Brown also gave up several hours of her leisure time to answer my many questions regarding Jamaican politics and culture. For this I owe both an intellectual and personal debt.

At this point it is also appropriate that I recognise the contributions made by the several individuals interviewed during the course of this study, as well as the many professionals at agencies such as the Planning Institute of Jamaica, Institute for Social and Economic Research, Ministry of Agriculture, Agro 21 Secretariat, Jampro, and the Statistical Institute of Jamaica who responded willingly to my numerous requests for data. Without the cooperation of dedicated colleagues such as Errol Graham, Errol Lewin, Barry Hibbert, Valerie Tate, Patricia Anderson and many others, it would have been impossible to complete this analysis. The project also benefitted from discussions

ACKNOWLEDGEMENTS

with Drs. Omar Davies of the Planning Institute of Jamaica and Norman Girvan of the Consortium Graduate School.

Ms. Claudine Lemare was largely responsible for word processing of the early drafts of the document. She tolerated well my poor penmanship skills and my obsession with minor editorial detail. For her skill and patience I am indeed grateful. In the final stages of document preparation Ms. Lona Touckly came to my assistance, lending her talents in graphics and word processing. Again, a debt of gratitude is owed.

On a more personal note I also wish to express my gratitude to Dr. Owen Jefferson and family for welcoming me into their home and putting up with me during my first visit to Jamaica.

Finally, I wish to express my sincere appreciation to my family. My brothers Trevor and Terrance, by their example, provided the inspiration required to undertake a project of this magnitude. Once underway, my wife Buelah, kept me focused on the goal, and provided the much needed shoulder of support during those times when the ultimate objective seemed unattainable and not worth the cost. Last, but by no means least my mother, Mrs. Una Farrell, provided requisite and timely spiritual intercessions without which my objective would have remained unrealised. God bless them all.

Carlyle A. J. Farrell
September, 1992

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LIST OF ABBREVIATIONS

1.	ACB	Agricultural Credit Bank
2.	ACF	Average Conversion Factor
3.	ACP	African Caribbean and Pacific
4.	AIDS	Almost Ideal Demand System
5.	AMC	Agricultural Marketing Corporation
6.	CADDES	Confederacion de Asociaciones Agricolas del Estado de Sinaloa
7.	CBERA	Caribbean Basin Economic Recovery Act
8.	CD/I	Crop Diversification and Irrigation
9.	CF	Conversion Factor
10.	CGE	Computable General Equilibrium
11.	CNPH	Confederacion Nacional de Productores de Hortalizas
12.	CPI	Consumer Price Index
13.	CSA	Commonwealth Sugar Agreement
14.	DCU	Domestic Currency Units
15.	DP	Domestic Price
16.	DRC	Domestic Resource Cost
17.	DW	Durbin Watson
18.	EPC	Effective Protection Coefficient
19.	FAO	Food and Agriculture Organization
20.	FAS	Foreign Agricultural Service

LIST OF ABBREVIATIONS

21.	FTC	Florida Tomato Committee
22.	GDP	Gross Domestic Product
23.	GOJ	Government of Jamaica
24.	GSP	Generalized System of Preferences
25.	HFCS	High Fructose Corn Syrup
26.	IMF	International Monetary Fund
27.	IO	Input - Output
28.	JNIC	Jamaica National Investment Corporation
29.	JNIP	Jamaica National Investment Promotion
30.	LDC	Less Developed Country
31.	MFN	Most Favoured Nation
32.	MinAg	Ministry of Agriculture
33.	MS	Mother farm - Satellite farm
34.	MWR	Market Wage Rate
35.	NIBJ	National Investment Bank of Jamaica
36.	NPA	National Planning Agency
37.	NPCI	Nominal Protection Coefficient on Tradable Inputs
38.	NPCO	Nominal Protection Coefficient on Tradable Output
39.	OER	Official Exchange Rate
40.	OPM	Office of the Prime Minister

LIST OF ABBREVIATIONS

41.	PAM	Policy Analysis Matrix
42.	PC	Profitability Coefficient
43.	PCR	Private Cost Ratio
44.	PIOJ	Planning Institute of Jamaica
45.	PPR	Purchasing Power Parity Exchange Rate
46.	SAM	Social Accounting Matrix
47.	3SLS	Three Stage Least Squares
48.	SRP	Subsidy Ratio to Producers
49.	Statin	Statistical Institute of Jamaica
50.	SWFWVGA	South West Florida Winter Vegetable Growers Association
51.	SWR	Shadow Wage Rate
52.	TNC	Transnational Corporation
53.	UNPH	Union Nacional de Productores de Hortalizas
54.	USAID	U.S. Agency for International Development
55.	USDA	United States Department of Agriculture
56.	WMVDA	West Mexico Vegetable Distributors Association
57.	WP	World Price
58.	WPI	Wholesale Price Index

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

This dissertation is concerned with the potential for the expansion of nontraditional agricultural exports from Jamaica. Interest in the development of a program of nontraditional exports stems from at least two factors. The first is the need to increase foreign exchange earnings from the agricultural sector in light of the poor performance of the country's traditional export crops. Data provided in Appendix A suggest that the contribution to gross domestic product (in constant prices) made by the export agricultural sector declined by almost 9% over the period 1972-1982. Given the country's burgeoning international debt and the difficulty of securing adequate foreign exchange to finance imports, this performance was viewed seriously by Jamaican government policy makers.

A major contributing factor to the poor performance of the export sector is undoubtedly the difficulties currently faced by the country's sugar industry. Sugar, it should be recognized, accounts for upwards of 60% of the export earnings generated by the agricultural sector[1]. While Jamaica's access to the North American and European

[1]Jamaica's second major export crop is banana which has also not fared well on international markets (see for example, Salmon and Srivastava 1986).

sugar markets is guaranteed under preferential trade agreements such as the African Caribbean and Pacific (ACP) Sugar Protocol, such protection has not been sufficient to offset the factors militating against profitability of the industry.

The ACP Sugar Protocol, as is well known, provides ACP countries and India with a global quota of 1.3 million tons of sugar per year, and a guaranteed price equivalent to that offered to European sugar beet producers (World Bank 1988). This guaranteed price is well above the price of sugar on international markets. Insulation from international market conditions provided Jamaican sugar producers with little incentive to pursue cost effective methods of production, and with the onset of rapid inflation in the mid 1970s, the industry found itself in the grip of a cost price squeeze. Guaranteed prices offered to Caribbean sugar exporters, it should be noted, were not linked to inflation (Thomas 1988).[2]

As Jamaica's terms of trade in international markets deteriorated, the sugar industry found itself faced with additional new challenges. Recent advances in sucrochemistry, for example, made possible the introduction of high fructose corn syrup (HFCS) in 1967, a caloric sweetener made from maize. This technological breakthrough heralded the development of several other sugar substitutes, e.g aspartame, and the dominant position of sugar cane in the international sweetener market was called into

[2]The historical antecedent to the ACP Sugar Protocol was the Commonwealth Sugar Agreement (CSA) of 1950 which expired in the mid 1970s. The CSA, unlike the Sugar Protocol, was based on a cost of production plus profit formula which provided Caribbean producers with protection from any escalations in input costs (Thomas 1985).

question (see Carman 1982, and Thomas 1985 for discussion of the demand for HFCS and its impact on the sugar industry).

In addition, protectionist sentiments were surfacing in the U.S sugar industry. After the expiration of the U.S Sugar Act, quotas on the import of sugar from the Caribbean and other sugar producing countries were once again introduced. In October 1982 these quotas were fixed at 151,000 tons for the Caribbean region as a whole, roughly 5% of the global allocation. Data for the period 1980 to 1987 indicate that for the Caribbean region imposition of the quota reduced sugar shipments by some 73%. In the case of Jamaica, however, the decline in shipments amounted to 83% (World Bank 1988).[3]

The above events unfolding in the international sugar market and the resultant inability of the industry to provide a stable source of export earnings was part of the rationale forcing an examination of nontraditional exports. A second factor which was perhaps equally important was the issue of employment creation. As with other Caribbean countries, Jamaica's rate of unemployment over the decade of the eighties averaged roughly 25% of the available labour force. The country was, therefore, in

[3] It should be noted at this point that over the mid 1980s a number of one way trade preference agreements were executed between the Caribbean and North America. The U.S government's Caribbean Basin Economic Recovery Act (CBERA), established in 1984, provides for one way duty free access to the U.S market for a wide range of Caribbean products in an effort to stimulate exports from the region. In 1986 the Canadian government announced a similar program, Caribcan, with essentially the same objectives. Numerous authors (e.g, Sawyer and Sprinkle 1984; Farrell and Tyrchniewicz 1989; and Peters and Taylor 1990) have, however, questioned the usefulness of such initiatives given the low tariff rates imposed on Caribbean exports under the Generalized System of Preferences (GSP), and the fact that several major export commodities, e.g sugar, are not comprehensively covered by these agreements.

urgent need of employment creating productive activities. The sugar industry in Jamaica has historically been the island's major employer of agricultural labour. In fact a recent commission of enquiry into the industry's cost of production suggested that over 40,000 farmers and workers were employed in sugar production and processing (Sugar Industry Commission 1988). Apart from individuals directly employed in the industry, however, an undocumented number of individuals are also indirectly dependent on sugar production and export. The decline in the fortunes of the sugar industry, therefore, threatened to exacerbate the country's unemployment problem, with the attendant social and political ramifications.

Several approaches to circumventing the negative consequences of the decline in the sugar industry have been debated by Jamaican and other Caribbean policy makers. Three alternatives are usually identified:

1. Diversification away from sugar, i.e the production and export of nontraditional crops.
2. Diversification around sugar, i.e the production and export of commodities produced from sugar, and
3. Complete abandonment of all export activities, i.e a return to the inward looking import substitution strategies popularized by Nurske and Prebish in the late 1950s (see Nurske 1961; Prebish 1950; as well as Myrdal 1957).

The Jamaican government in assessing these alternatives opted to pursue a strategy of diversification away from sugar. Over the period 1982-1989 the Jamaican government planned and implemented an export expansion program dubbed Agro 21. This program focused on the production of nontraditional exports, such as winter vegetables, for the North American and European markets.

The initiative was predicated on the use of advanced capital intensive farm technologies and a new commercial philosophy toward management of the country's agricultural resources. The program's emphasis on a commercial orientation is important. Unlike earlier agricultural programs, Agro 21 was designed to be led by the private sector. The driving force behind the program was envisioned as local and/or foreign private sector investment, with the central government in a supportive and facilitative role. The program was also characterized by the reallocation of unused and under-utilized sugar lands to private sector investors involved in nontraditional crop production. Appendix B provides a detailed description of the Agro 21 program, while Appendix C documents its achievements and failings. The program was eventually disbanded by the incoming Manley government after the 1989 election.

The Agro 21 program involved a total of nineteen crop subsectors. However, for purposes of this dissertation the discussion will be confined to the winter vegetable subsector. The following reasons guided the choice of this industry for case analysis:

1. The winter vegetable subsector provides a rigorous test of a country's ability to develop a viable export program. The products are highly perishable and

considerable organizational skill is required in field to market operations. Also, the winter vegetable market is highly competitive making cost effective operation a sine qua non for survival and growth.

2. The establishment of the winter vegetable sector became highly politicized over the life of the program owing to the unprecedented capital intensity of the projects, the focus on foreign "high technology", and bitter reaction from the sugar lobby in response to the loss of their strategic land resource. This subsector is, therefore, of considerable interest to Jamaican policy makers, academics and the general public.

As is pointed out in the evaluation of the Agro 21 program in Appendix C, the winter vegetable sector earned an average of U.S $5 million/year for the Jamaican economy over a four year period, roughly 36% of the government established foreign exchange target. The sector also created, on average, an additional 5,000 new jobs. More importantly, however, the winter vegetable export operations posted significant financial losses and all the firms had exited the industry by 1988.

There is little doubt that it is technically possible for Jamaica to produce export quality vegetables on a commercial scale. The extent to which it is economically feasible to do so is, however, dependent on the costs incurred in production and marketing, as well as on the prices received in the overseas market. A recent study by Buckley (1986) indicated that Jamaica's total production and marketing costs for cucumbers, peppers and zucchini squash, during the 1985/6 crop year, were higher than those of Mexico and Florida, the major players in the U.S vegetable market.

One possible explanation for the negative variance in production costs was the capital intensive nature of the Jamaican operations. As will be argued in Chapter 2, Jamaican exporters utilized advanced technologies not employed by their Floridian and Mexican rivals. The perverse nature of such technological choices is evident. In a labour surplus country, such as Jamaica, the theory of comparative advantage would dictate the production and export of commodities utilizing labour intensive methods. A comparative analysis of the technological choices open to Jamaica should allow for a determination of what impact (if any) these choices had on Jamaica's cost competitiveness.

Apart from technological choices and their impact on cost of production, several other factors impinge on the ability of new exporters to successfully penetrate international markets. One of these factors is the impact of government macroeconomic policies, e.g. exchange rate policy, on the export sector. It is well known that macroeconomic policies in Less Developed Countries (LDCs) are often inimical to the development of a viable export agricultural sector. For example, Krueger, Schiff and Valdés (1988) have argued in a recent paper that:

> The negative protection [from domestic government policies] accorded producers of agricultural export commodities was a significant factor in depressing export earnings in many countries. ...The dominant pattern has been one of systematic and sizeable discrimination (Krueger, Schiff and Valdés 1988, p.263).

The conclusion of the above authors relate to work done on a sample of eighteen developing countries. In the case of the winter vegetable industry in Jamaica it may be argued that government macroeconomic policy did in fact retard its performance in international market penetration. Acceptance of this premise would, of course, suggest the need for policy reforms at the domestic level prior to further attempts at international market entry. It should be emphasised at this point, that while the potentially deleterious impact of government policies on export performance is well recognized, the author is unaware of any studies which have attempted to quantify the impact of these policies on Jamaican nontraditional exports. This research will attempt to fill this void.

Organization and institutional support are also factors which are likely to impact on Jamaica's success at penetrating the international vegetable market. The salience of effective organization and institutional support is immediately recognized when the nature of the winter vegetable trade is understood. The market is oligopolistic, and highly concentrated in terms of its production and distribution activities (Simmons, Pearson and Smith 1976; Emerson 1980; and Bredhal et al 1983). In addition, the perishable nature of the output ensures that failure to move product quickly will result in substantial losses to the exporter. Importers in this market exhibit little loyalty to suppliers who are unable to fulfil their contractual agreements either in terms of volume, quality or delivery times.

The major players in the market are Mexico and Florida. Mexico, over the last several decades, has entrenched herself as a reliable supplier of quality fresh produce to the U.S residual market.[4] Given climatic conditions, Florida represents the major source of U.S production during the winter months. Output from this state is generally insufficient to meet domestic demand, however, and so the need for imports is well established. This demand for imports has expanded substantially in some years due to the occurrence of freeze conditions in Florida. The result has been significant upward pressure on prices and windfall profits for exporters.

The Mexican exporters' challenge for the U.S market has not gone unnoticed by Floridian producers and their proponents. Numerous trade disputes have erupted between these groups over the years, as Mexico has continued to make incursions into this market (Bredhal et al 1983). Mexico has, however, survived these attempts to dislodge her from the market, and currently controls as much as 98% of the residual market for some product groups. It is believed that an analysis of the organization and institutional support which has allowed the Mexican industry to flourish may offer some clues to the failure of the Jamaican program. This study will, therefore, attempt to identify those organizational and institutional factors which have contributed to the success of the Mexican industry and may have been absent in the Jamaican program. It may be found that the adoption of certain elements of the Mexican program may have improved Jamaica's chances of success in this market. On the other hand, it may well be the case that the factors which led to Mexico's success are sufficiently unique to that

[4]The term residual market, as used here, refers to that portion of the U.S vegetable market which is not controlled by Floridian (and other U.S) producers.

country that new exporters such as Jamaica would need to develop an entirely different model.

Changes in the competitive environment may also impact on the ability of a new exporter to successfully penetrate an established market. For example, despite Mexico's record of success in the fresh produce trade a number of observers have suggested that this country may soon begin to lose her dominant position in the industry (see for example, Sanderson 1986; Simmons and Pomareda 1975; and Bredhal et al 1983). Several factors have been advanced in support of this claim, chief among them being the observation that the Mexican government seems to be incapable of continuing its current level of support for the industry. Mexico's vegetable producers, as will be noted in a later chapter, are the recipients of a wide range of government subsidies. The removal of these supports is projected to lead to a rapid escalation in input costs, reduced profitability of the export operations and a contraction in export supply[5].

Also, inflation continues to rise unabated in Mexico and demands for increases in the country's minimum wage have been strong. Escalation in the wage bill of the country's vegetable exporters is likely to lead to further curtailment of export production and a declining share of the residual market [6].

[5]The fact that the Mexican vegetable industry is heavily subsidised does not, of course, negate the benefits that Jamaican exporters would derive from a study of its organization and policy framework.

[6]A cursory examination of the data on the industry tends to support this view. Data provided by Buckley et al (1986) indicate that over the period 1970-1981 Mexico's minimum daily agricultural wage rose from 26.75 pesos/day to 200.84 pesos/day, a 650% increase in nominal terms. Over the same time period, data provided by Bredhal et al (1983) indicate that Sinaloa Mexico's share of the U.S tomato market fell by 39%. It should be noted that this erosion of Mexico's share redounded to the benefit of Florida and other U.S producing regions, which experienced increases in their shares of the U.S market.

Of course, this scenario may be negated by simultaneous improvements in overall agricultural productivity which may compensate for the higher costs of labour and other inputs. Some analysts, e.g Sanderson (1986), have argued that such improvements in productivity of the Mexican vegetable export operations are not, however, likely to be forthcoming. Mexican producers have not, for example, adopted the plastic mulch technology which has significantly improved the productivity of Floridian producers. Also, a number of local viral and fungal diseases have consistently created problems for Mexican producers and to date the technological response to these agronomic problems has not been rapid.

The reduction in cost competitiveness of the Mexican industry may also be addressed by devaluation of the peso versus the U.S dollar. Data provided by Bredhal et al (1983) indicate that the Mexican exchange rate was severely overvalued over the 1970-1981 period. The authors have argued, however, that given the country's high exchange rate elasticity (with respect to Mexican vegetable prices), a government policy of periodic devaluations may serve as a subsidy on the prices received by vegetable growers. The extent to which the Mexican government can pursue a strategy of periodic devaluations in order to salvage competitiveness of the export sector is obviously a moot issue. Other macroeconomic objectives, such as the need to control import inflation and interest rate increases, will certainly figure significantly in the decision makers' calculus.

Of interest to Jamaican exporters is the issue of how any further reduction in Mexico's cost competitiveness would impact on the market share available to non-Mexican residual suppliers. One would expect, ceteris paribus, that the demand for non-

Mexican supplies would increase and provide additional incentives for smaller exporters such as Jamaica to re-enter the U.S market. The realization of this potential for growth in Jamaican exports is, of course, heavily contingent on a number of assumptions such as the amelioration of any institutional and policy constraints on export expansion, as well as the absence of any response by Floridian (and other U.S) producers. Before these concerns become germane, however, it is first necessary to establish that there is in fact potential for expansion of the residual market as Mexico's input costs (and other external factors) change.

1.2 RESEARCH OBJECTIVES

The major objectives of this study may now be summarized as:

1. To review the structure and performance of the Jamaican winter vegetable industry over the period 1983 to 1988.
2. To evaluate the impact of Jamaica's technological choices and macro-economic policies on the performance of the winter vegetable industry.
3. To compare the organization of the Mexican and Jamaican winter vegetable programs and the policy environments within which they were developed.
4. To identify the economic factors which could force a withdrawal of Mexico from the U.S. winter vegetable market, and to quantify their impacts.

1.3 RESEARCH METHODOLOGY AND DATA SOURCES

The analyses reported in the chapters which follow are based primarily on secondary data collected during a series of visits to Jamaica over the period January to November, 1989. A total of three visits were made to the island, the first conducted in January was roughly one week in duration, and largely exploratory in nature. The bulk of the data collection activities were performed during the second visit in September-October, 1989. This second visit was approximately six weeks in duration. The third and final visit to the island was brief (3 days), and was conducted in November, 1989.

Apart from the collection of published and unpublished secondary data, a series of in-depth personal interviews was also conducted with key individuals associated with the program[7]. There were two principal reasons for conducting these interviews. The first was to assist the author in understanding the sequence of events leading up to the eventual collapse of the Agro 21 program, in general, and the winter vegetable operations in particular. The second was to identify the major problems encountered during the implementation and operation of the winter vegetable program, and to establish some order of priority of the problems which militated against successful implementation.

The secondary data collected and the series of personal interviews were also used in the development of a system of national economic parameters (i.e conversion factors for the shadow pricing of traded and non-traded inputs and outputs) for Jamaica,

[7]The complete list of interview participants is presented in Appendix F.

and the construction of Monke-Pearson Policy Analysis Matrices. These policy matrices are the primary investigative tools used to probe the impact of government policies on the performance of the program.

Secondary data were also collected on the operation of the Mexican vegetable export program and on the specific government policies applied to the sector. These data allow for a comprehensive comparative analysis of the Mexican and Jamaican initiatives and some indication of the extent to which the Mexican model would be useful in reformulating an export program for Jamaica.

Assessment of the likely impact of changes in Mexican input costs on export supply (and by implication on the size of the residual market) is conducted using an econometric model of the U.S vegetable industry. The demand and supply conditions in the market are explicitly modelled as is the supply relationship for Mexican exports. Treating U.S vegetable exports as a residual, the response of the model to changes in exogenous variables such as the wage rate may be assessed using dynamic interim and total multipliers. The potential for reductions in Mexican export supply is easily assessed using these multipliers, and the potential for growth in non-Mexican exports inferred.

1.4 ORGANIZATION OF THE DISSERTATION

This dissertation is divided into seven chapters. Following the introduction is an overview of the structure and performance of the Jamaican vegetable industry. This chapter examines issues such as the policy incentives that were granted to the new export operation, and the sector's performance in terms of export volume and market shares. This chapter also contains some discussion of the organization of the initiative's marketing and distribution systems.

Chapter 3 attempts to lay the foundation of a theoretically consistent framework for the analysis of the impact of government policy on the performance of the industry. Two related matters are discussed in this chapter, the development of a system of conversion factors for the shadow pricing of inputs and outputs, and a description of the Monke-Pearson Policy Analysis Matrix (PAM). In the fourth chapter the PAM is applied to the Jamaican vegetable sector in an attempt to evaluate the impact of government macroeconomic policies on the industry. The PAM is also used in this chapter to examine the impact of technological choices on Jamaica's cost competitiveness.

Chapter 5 contains a comparative analysis of the organizational and institutional support framework provided to Mexican and Jamaican exporters. As noted earlier, the objective of this analysis is to identify those factors responsible for the success of the Mexican initiative, and which were absent in the Jamaican program. Some comments regarding the transferability of the Mexican organizational and institutional support framework to the Jamaican environment are also contained in this chapter.

The penultimate chapter is concerned with the development of an econometric model of the U.S industry. The theoretical foundation underlying the model's structure is examined in this chapter and the data sources are identified. The results of the model estimation and impact assessment are also presented in the sixth chapter as is a discussion of the implications for the expansion of Jamaican exports. The final chapter of the dissertation reiterates the study objectives and principal findings, as well as provides a set of policy recommendations that derive from the analysis. The seventh chapter also discusses the limitations of the research completed and provides suggestions for further study.

CHAPTER 2

AN OVERVIEW OF THE STRUCTURE AND PERFORMANCE OF THE JAMAICAN WINTER VEGETABLE INDUSTRY

2.1 INTRODUCTION

Prior to the advent of the Agro 21 program all vegetable production on the island of Jamaica was destined for domestic and regional markets. Export operations to North America and Europe began, under the aegis of the Agro 21 initiative, in 1984 and continued for approximately five years. Over that time period several major vegetable enterprises were established on the island. However, as noted in Chapter 1, all of these firms had exited the industry by 1988 having incurred significant financial losses.

Prior to a formal assessment of the impact of government policies on the viability of the industry, it would be useful to first review its structure and performance. This is the purpose of the present chapter. Chapter 2 is organized into six major sections. After the introduction the structure of the industry is briefly described. This is followed in section three by an analysis of the industry's performance in terms of output and yields. The production systems that were operative in Jamaica during the Agro 21 era are also described in this section and contrasted with the systems currently operative in Mexico and Florida.

The fourth section describes the export promotion incentives that were available to firms in the industry, while the fifth attempts to analyze the export performance of the sector over its ephemeral existence. Trends in export volumes and market shares are described in the fifth section and parallels are drawn with Mexico. The final section of the chapter summarizes the discussion.

2.2 THE STRUCTURE OF THE JAMAICAN VEGETABLE INDUSTRY

Five major winter vegetable operations were established in Jamaica over the 1984-1988 period. The enterprises were located primarily in the parishes of St. Catherine and Clarendon, although a relatively small operation was sited at Trelawny on the north coast. It is interesting to note that some of Jamaica's best lands are found in the parishes of St. Catherine and Clarendon (Barker 1985). The location of the vegetable operations in these areas is, therefore, not surprising.

Of the five firms comprising the industry, two were wholly owned Jamaican private sector operations, two were joint ventures between the Jamaican and U.S private sectors, while the fifth featured participation between the Jamaican government and Israeli private sector. This latter firm was the largest enterprise in the industry with a productive capacity of over 800 hectares and an estimated initial capital cost of U.S $ 24.4 million. It is important to note that the commercial production of export quality vegetables on such a large scale was an unprecedented event in the history of Jamaican agriculture. Prior to the advent of the Agro 21 initiative vegetable production in Jamaica was exclusively the preserve of the small farmer and gardening enthusiast.

2.3 PRODUCTION SYSTEMS AND OUTPUT TRENDS

In this section the performance of the Jamaican vegetable industry in terms of output and yields per hectare is analyzed. Before this is attempted, however, it would be instructive to briefly review the technological packages adopted by Jamaican exporters in their attempt to capture a meaningful share of the U.S (and European) residual market. It would be reasonable to expect that Jamaica's technological choices would impact on the overall cost competitiveness of the industry. This represents the chief rationale for the following review of production systems. To simplify the discussion, only cucumber and sweet pepper production practices for the largest firm in the industry will be described. It should be borne in mind, however, that there were differences in the cultural practices employed by the various firms in the Jamaican industry.

In the case of cucumber production in Jamaica, a combination of seed and seedlings were used to establish the crop after land preparation. Approximately 44,000 seedlings and 300 grams of seed were planted per hectare. As with Florida producers, planting in Jamaica was done by hand, while in Mexico cucumbers are planted mechanically in close furrows. Dasher and Dasher 11 were the principal varieties used by Jamaican producers, while Floracuke, a gynoecious cultivar is the predominant variety used by Floridian producers. It should be noted that because Floracuke produces only female flowers the number of fruits per plant (and consequently yield per hectare) is higher using this variety (Buckley 1986).

As with their Floridian counterparts, Jamaican vegetable producers had adopted plastic mulch technology to conserve soil moisture, and to control weeds and diseases. It was noted in Chapter 1 that Mexican producers have to date not made use of this technology. With plastic mulching the beds must be fumigated and fertilized prior to laying the plastic, and this was the practice in both Jamaica and Florida. When plastic mulches are employed, additional fertilizers and chemicals may be applied via the irrigation system.

A major point of difference in the technologies employed by Jamaican producers and those in Mexico and Florida may be found in the irrigation system. At least three of the five firms in the Jamaican industry (including the largest) used advanced drip systems for at least part of their irrigation needs. In contrast, Mexican producers utilize furrow irrigation, while Floridian exporters rely on a variant of furrow irrigation known as seepage irrigation (Buckley 1986). The technical advantage of the drip system is that it significantly reduces water usage and the cost of fertilizer and chemical applications. These were considered to be important advantages given the location of the vegetable enterprises. The parishes of St. Catherine and Clarendon, as noted in Appendix A, exhibit high daytime temperatures and low levels of precipitation making rainfed vegetable production a risky proposition.

The major disadvantage of the drip irrigation system is, however, its cost. The technology is expensive and was a significant component of the high capital cost of the majority of Jamaican vegetable enterprises. In fact, in the case of the enterprise being discussed, the irrigation system represented 60% of the firm's projected fixed capital requirement (Pragma Consultants and TMS Associates, 1989). The use of drip irrigation by Jamaican producers, whether or not justified on technical grounds, represented a major point of departure from the agronomic practices employed in Mexico and Florida. It is certainly a difference which is likely to have impacted on Jamaica's cost competitiveness over the 1984-1988 period.

In the production of cucumbers in Jamaica, fertilizers and chemicals were applied directly to the root zone of the plant in the irrigation water. The chemicals and fertilizers used included ammonium nitrate, potassium nitrate, phosphoric acid, sequestrene 138 Fe and 7-14-14. A similar regime of nitrogen, phosphorus and potassium fertilizers is employed in Florida and combined with a regular spraying program to control weeds and diseases (see Jamaica Agro Products Ltd. n.d).

Harvesting of the cucumber crop is done manually in Jamaica, Mexico and Florida. In Jamaica harvesting was begun 40-42 days after planting, and the crop was picked every 5 to 6 days. In Florida cucumbers are harvested later, about 50-60 days after planting, and a 4-5 day picking cycle is used (Buckley 1986).

In the case of sweet pepper production in Jamaica the crop was established by seedlings planted on beds 122 cms wide, and with an equal interrow spacing. The plants were normally staked and as with cucumbers, plastic mulch was used to control weed and disease problems. By contrast, Floridian and Mexican producers establish their crops by seed with the most common cultivar being Wonder 300. As with Jamaican producers, plants are staked in Mexico and Florida, but only in the case of Jamaica and Florida was plastic mulch used.

Irrigation methods for pepper production in the three regions are the same as described above for cucumbers. In the case of Jamaica the major nutrients applied via the irrigation system were 7-14-14, ammonium nitrate, potassium nitrate, and phosphoric acid. In all production areas harvesting of the peppers is done manually. In Jamaica the crop matured after 70 days in the field and was harvested 4-5 times over a one month period. In Florida, peppers are picked 4-5 times over the season, while in Mexico harvesting is done twice per week (Buckley 1986).

In summary, the most glaring difference in the production practices of Jamaica and the other two exporting regions would appear to be the use of drip irrigation. Given the cost and sophistication of this irrigation method, its adoption is likely to have had at least some impact on Jamaica's cost competitiveness. As noted earlier, the extent of this impact and its direction are empirical matters which will be examined in a later chapter.

2.3.1 OUTPUT TRENDS IN THE JAMAICAN VEGETABLE INDUSTRY

In this subsection production trends in the Jamaican vegetable industry are reviewed and contrasted with those in other vegetable exporting regions. Although Jamaica has the capacity to produce a wide range of vegetables, the discussion will be confined mainly to cucumbers, pumpkin and tomatoes. These three vegetables represented just over 60% of Jamaica's export volume over the 1984-1988 period.

It has already been argued that Jamaica was a relatively minor player in U.S (and by implication world) vegetable trade. In order to put Jamaica's production in its proper global context Table 2.1 provides data on the output of vegetables from Jamaica, Mexico, North Central America and the world. The evidence is quite clear that Jamaica was not a major player in the international market, failing to produce even 1% of world output. The production estimates also reveal that even Mexico which has dominated the U.S residual market is in fact a relatively minor player when its output is viewed from a global perspective.

Looking more closely at Jamaica's output of the three target vegetables over the period 1977 to 1987, it is observed that output of cucumbers increased by 86% over the eleven year period under study, from 7,154 mt to 13,340 mt (Table 2.2). A decline of 34% in the output of tomatoes is, however, observed with annual production falling to just under 16,000 mt from an output of roughly 24,000 mt at the beginning of the sample period. Tomato production in Jamaica, as may be observed from Table 2.2 peaked at 29,000 mt in 1984. In the case of pumpkins, Jamaica's output remained reasonably constant over the period under review, beginning and ending the period at just over 26,000 mt. Production of pumpkins also surged in 1984 reaching a level of 38,000 mt. The surge in output of these two crops in 1984 is presumably linked to export activities under the Agro 21 program. In the case of cucumbers, output increased dramatically a year later, in 1985.

Table 2.1

Vegetable Production in Jamaica, Mexico, North Central America and the World, 1983-1988

Production (000's mt)

Year	Jamaica	Mexico	N.C. America	World
1983	117	4,031	33,718	373,881
1984	147	3,821	36,038	394,722
1985	136	4,114	36,376	402,445
1986	115	4,447	35,607	418,147
1987	120	4,766	36,901	243,081
1988	120	4,675	36,812	426,187

Source: Food and Agriculture Organization, Production Yearbook Vols. 39 and 42.

Note: Vegetable production includes the production of melons.

Table 2.2

Production of Export Vegetables in Jamaica,
1977-1987

Production (mt)

Year	Cucumber	Tomatoes	Pumpkin
1977	7,154	23,796	26,614
1978	6,933	23,899	33,386
1979	5,351	20,450	22,492
1980	6,033	22,642	24,752
1981	5,890	22,158	27,157
1982	5,038	16,746	22,926
1983	6,378	18,841	31,929
1984	7,016	29,044	38,353
1985	11,683	19,174	29,854
1986	12,962	16,182	25,229
1987	13,340	15,698	26,496

Source: Statistical Institute of Jamaica, Production Statistics, Various issues.

Table 2.3 shows Jamaica's performance in terms of yield per hectare for tomatoes, cucumbers and pumpkin as well as comparative yield data for Mexico.

In the case of tomatoes it is observed that Jamaica's yield performance declined by roughly 14% over the 1983-1988 period. Yields per hectare peaked at 15,556 kg/ha in 1985, but yields as low as 11,251 kg/ha are observed. It is also significant that Jamaica's best yield performance (in 1985) represented only 65% of that achieved by Mexico in the same year. In the case of cucumbers, Jamaica's yield performance was again below that of Mexico, but yields did increase by roughly 18% over the 1983-1988 period. In 1986 Jamaica achieved its best yield of 27,000 kg/ha. The situation with respect to pumpkin was slightly more encouraging. Although overall yield fell by just over 2% this performance was consistently higher than that achieved by Mexican producers.

It needs to be emphasised at this point that the yield data presented in Table 2.3 for Jamaica represent the average performance for vegetable growers in that country. It includes, therefore, vegetable yields achieved by exporters under drip irrigation as well as yields attained by growers for the domestic market who did not employ sophisticated production technologies. It is known that export vegetable producers were able to achieve yields as much as 50% above the Jamaican average (Mr. Joseph Green, Interview by author, Tape recording, Kingston Jamaica, October 17th, 1989).

Apart from production and yield levels, in describing the Jamaican industry one need also address the matter of production costs. It has already been stated that

Table 2.3

Jamaican and Mexican Yield Performance for Cucumbers, Pumpkin and Tomatoes, 1983 to 1988

Yields (kg/ha)

	Tomatoes		Cucumber		Pumpkin	
Year	Jamaica	Mexico	Jamaica	Mexico	Jamaica	Mexico
1983	13,035	23,366	9,978	17,318	12,989	12,980
1984	14,994	19,257	10,811	21,739	14,031	11,667
1985	15,556	23,957	10,968	21,505	12,963	11,667
1986	12,110	26,206	27,200	15,615	n.a.	n.a.
1987	11,251	24,232	13,107	15,854	12,887	5,161
1988	11,268	25,107	11,781	16,265	12,689	5,000
Mean	13,036	23,688	13,974	18,049	13,112	9,295
% Change	-13.5	+7.5	+18	-6.1	-2.3	-61.5

Source: Food and Agriculture Organization, Production Yearbook, Various issues.

n.a. not available.

Jamaica was not competitive in the area of cost of production, when comparisons were made with Mexico and Florida (see Chapter 1). Data for the 1985/6 crop year, presented in Table 2.4, attest to this fact. Jamaica's total preharvest and packing costs are seen to exceed those of Mexico and Florida for cucumbers and peppers

While it may be dangerous to draw firm conclusions from data for one growing season, it is interesting that Jamaica does appear to be competitive in the areas of harvesting and packing, two relatively labour intensive activities. Preharvest costs, which include the costs of fertilizers, chemicals and interest charges, represent the area where Jamaica is unable to successfully compete.

Possible reasons for this result are explored in a later chapter, but it may be noted here that Jamaica (as with most other Caribbean Basin countries) is heavily dependent on imported inputs (see Mandle 1985). Projects which are implemented in such an environment are, of course, vulnerable to fluctuations in the international prices of these inputs. Also, domestic macroeconomic forces such as exchange rate movements can cause these costs to escalate.

2.4 EXPORT PROMOTION INCENTIVES

In an attempt to encourage vegetable exports, the Jamaican government put in place a range of incentives. These incentives are identified and briefly discussed in this section. Under Jamaica's Export Industry Encouragement Act vegetable exporters were granted waivers on import duties on all machinery and equipment used in their

Table 2.4

Preharvest, Harvest and Packing Costs for Jamaica, Mexico and Florida, 1984/5 and 1985/6

	S.W. Florida 1984-5 Crop Year		Mexico 1984-5 Crop Year		Jamaica 1985-6 Crop Year	
Cost	Cucumber	Peppers	Cucumber	Peppers	Cucumber	Peppers
	. . . . U.S. $ / Box					
Preharvest	4.69	3.13	1.66	1.95	7.44	6.42
Harvest and Packing	3.87	3.16	2.26	2.11	2.33	2.44
Total	8.56	6.29	3.92	4.06	9.77	8.86

Source: Buckley 1986.

operations. Machinery and equipment imports into Jamaica, it should be noted, attract import duties, consumption duties and additional stamp duties unless exemptions have been obtained. Import duties are applicable to all goods entering Jamaica, while consumption duties are applied on specified goods whether imported or locally produced. Consumption duties are generally 27.5% of the value of the goods produced or imported. Additional stamp duties are typically 16% of the value of raw materials, and 30% of the value of capital goods (Jamaica National Investment Promotion, 1987)[1]

It must be pointed out at this juncture that the Agro 21 program was being implemented during a period of fiscal restraint in Jamaica. As a result, the import duty concessions noted above were gradually reduced over time, finally becoming no more than moratoriums on the payment of these duties (Mr. Aaron Parke, interview by author, Tape Recording, Kingston Jamaica, October 17th, 1989). The roll back of these incentives was a factor in limiting the attractiveness of vegetable exports as an investment opportunity.

The second major incentive provided by the Jamaican government was relief from the payment of income tax on all profits from the export operation. Income tax relief was granted for a ten year period. In terms of credit facilities, however, it is to be noted that no soft loan provisions were in place to assist new export operations. The Agricultural Credit Bank (ACB) did provide loans for agricultural projects, but these

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[1]The Export Industry Encouragement Act also provides for an export tax rebate of 7.5% of the value of the goods exported, should exporters choose to pay the above import duties.

were at interest rates of 15-18% per annum, only a few percentage points below that charged by commercial banks.

The picture which emerges from the above is of an industry which was not the beneficiary of significant government support. Having made this point, however, it needs to be quickly pointed out that the largest firm in the industry, a government of Jamaica joint venture, was the recipient of other incentives. These included the free use of land for vegetable production, and Bank of Jamaica permission for the National Investment Bank of Jamaica (NIBJ)[2] to operate an external account on behalf of this enterprise to facilitate foreign exchange transactions. Substantial debt financing was also provided to this firm by the NIBJ, in amounts disproportionate to its equity in the project (Pragma Consultants Ltd. and TMS Associates June, 1989). The other firms in the industry were not as privileged.

2.5 EXPORT MARKET PERFORMANCE

In this section Jamaica's export market performance will be examined. Trends in export volumes and market shares are presented in this section and parallels are drawn with Mexico. Before this is done, however, the organization of the export marketing operation will be described. It should be clearly understood that marketing

[2]The National Investment Bank of Jamaica (NIBJ) is the investment arm of the Jamaican government, and holds government equity in a number of projects. Appendix B provides additional detail on the NIBJ and the other supporting Agro 21 institutions.

and transportation were identified by Jamaican exporters as being their major constraint to market penetration (Mrs. Mable Tenn, Mr. John Williams, and Mr. Shariq Gasnavi, interviews by author, Tape Recording, Kingston Jamaica, October 11th and 12th and September 29th, 1989). Failure to properly orchestrate these functions is reported to have resulted in substantial losses to Jamaican exporters.

After harvest, produce was transported in refrigerated containers to on-farm packing houses. There the produce was washed, sized and graded according to U.S.D.A standards. The produce was next packaged and loaded for transshipment to the overseas market. Typically 1-2 days would elapse from harvest to transshipment.

Both sea and air transportation was utilised by Jamaican exporters with each mode possessing its unique advantages and disadvantages. Shipment of fresh produce by sea involved a voyage of between 3 and 7 days dependent on the destination. Jamaican produce was shipped to two major U.S cities, Miami and New York, with the New York destination requiring 2-4 days of additional sailing time. Produce was also flown to Miami and subsequently trucked to New York. This route required far less time, a matter of hours flying time to Miami and thirty six hours by refrigerated truck to New York.

Table 2.5 shows marketing costs for Jamaica with comparisons with Mexico and Florida. These data would suggest that Jamaica's marketing costs were not seriously out of line with those of Mexico during the 1984-5 growing season. However, marketing costs for both countries were understandably higher than those of Floridian producers.

Table 2.5

Jamaican Marketing Costs for Cucumbers and Peppers with Comparisons with Mexico and Florida

Marketing Costs (U.S. $ / Box)

Commodity	Jamaica 1985/6 Crop	Sinaloa Mexico 1984/5 Crop Year	S.W. Florida 1984/5 Crop Year
Cucumber	4.58	4.62	0.25
Bell Pepper	4.22	3.74	0.32

Source: Buckley 1986.

Note: Data for Jamaica are the simple averages of the costs for the two firms analyzed by Buckley.

While total marketing costs are similar for Mexico and Jamaica there were significant differences in the composition of these costs. In the case of Jamaica, upwards of 60% of total marketing costs was accounted for by transportation charges. In the case of Mexico, however, transportation accounted for only 35% of total marketing costs (see Table 2.6).

Table 2.6, which disaggregates marketing costs for Mexico and Jamaica into their components, also demonstrates that U.S import duties and fees on Mexican produce are roughly double that charged on Jamaican produce. This no doubt reflects the impact of the U.S Caribbean Basin Economic Recovery Act (CBERA) mentioned in the first chapter. Mexico is not a signatory to the CBERA and as such does not qualify for duty free access to the U.S market[3]. Selling charges for Jamaican produce are also slightly lower than those incurred by Mexican exporters.

Returning to the issue of the marketing channels through which Jamaican produce moved, it is important to note that sea transportation of fresh vegetables was less expensive than air shipment, although the latter was considerably faster. There were, however, problems with both modes of transport for Jamaican exporters, most notably the matter of limited availability of cargo space in the case of air transportation, and infrequent sailings in the case of sea transportation.

On reaching the U.S port of entry Jamaican produce was handled by

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[3]Under the recently executed North American Free Trade Agreement (NAFTA) between Mexico, the United States and Mexico, all tariff barriers are to be eliminated within ten years (Government of Canada, August 1992).

Table 2.6

Percentage Distribution of Jamaican and Mexican Marketing Costs for Cucumber and Peppers, 1984-5 and 1985-6

	Percentage of Marketing Costs (%)					
	Jamaica			Mexico		
	Transportation	Duties	Selling	Transportation	Duties	Selling
Cucumbers	62	14	24	35	32	32
Peppers	61	15	23	26	26	39

Source: Calculated from Buckley 1986.

Note: Percentages may not add to 100 due to rounding.

brokers. As is typical for this industry these brokers do not take title to the goods they handle, and therefore incur no risks or liabilities for produce which does not meet the standards of the U.S market. It should also be noted that there was no Jamaican marketing representative at the U.S port of entry to facilitate the movement of produce through the U.S system. The significance of this observation is pointed out by Buckley (1986):

> The lack of adequate representation of Jamaican interest in the marketplace has left Jamaican growers vulnerable to U.S markets during the previous seasons. In 1985/86, the Jamaican farms received lower prices on the average than Florida producers marketing in Pompano, Florida. This emphasises the importance of developing an efficient marketing and promotion system that ensures Jamaican produce is shipped and received in a timely manner, is in a good marketable condition, and that a fair price is obtained (Buckley 1986 p.ii).

The marketing channels for fresh produce within the U.S has already been adequately described by others and, therefore, bears no repeating here (see Buckley et al 1986 and Bredhal et al 1983).

2.5.1 TRENDS IN EXPORT VOLUMES AND MARKET SHARES

Table 2.7 shows the volume and composition of Jamaican exports over the 1984 to 1988 period. The data presented in that table indicate firstly that Jamaica exported 28,000 mt of fresh vegetables over the five year period under study. Export volume peaked at 9000 mt in 1986, falling to less than one-third that level by 1988. The table also indicates that three crops, cucumbers, pumpkin and sweet pepper dominated

Table 2.7

Volume and Composition of Jamaican Vegetable Exports, 1984-1988

Quantity (mt)

	1984	1985	1986	1987	1988	Average %
Ackee	2	3	7	0	0	0.04
Breadfruit	119	119	120	244	193	2.80
Spinach	29	114	147	113	110	1.80
Carrots	0	0	1	0	1	0.01
Cabbage	7	-	1	0	-	0.03
Cherry Tomato	38	209	0	-	-	0.88
Cho Cho	12	21	18	5	2	0.21
Cucumber	252	2,624	3,799	2,286	398	33.41
Eggplant	-	0	0	0	21	0.07
Hot Pepper	185	271	199	212	98	3.44
Irish Potato	-	-	8	1	1	0.04
Lettuce	-	-	0	0	-	-
Okra	58	11	35	3	7	0.41
Onions	-	-	0	0	-	-
Pumpkin	2,062	1,756	1,215	1,165	763	24.85
Squash	114	253	559	301	394	5.79
Sweet Pepper	431	1,114	3,187	716	639	21.73
Thyme	27	42	48	37	52	0.74
Tomatoes	885	5	33	3	1	3.31
Zucchini	49	5	38	7	8	0.38
Total	4,270	6,547	9,415	5,093	2,688	

Source: Ministry of Agriculture. Monthly Report of Jamaica's Export Crops. (Unpublished) n.d.

the export thrust. These crops represented 33%, 25% and 22% of total export volume respectively. In a market which is marked by wide price swings it is interesting that 80% of Jamaica's export volume should be accounted for by only three commodities.

It is instructive to place Jamaica's vegetable export performance in the context of her domestic production. This analysis is presented in Table 2.8 and suggests that despite the existence of the Agro 21 program, by far the larger share of total production was consumed locally. In 1986, the program was most successful in the case of cucumbers where 29% of domestic supply found its way to the export market. Relative to domestic production, insignificant volumes of tomatoes and pumpkin were directed to the foreign market.

Table 2.9 puts Jamaica's export volume performance in a more international context. This table shows Jamaica's share of the U.S market for cucumbers, peppers and tomatoes. The market shares achieved by Mexico are shown for purposes of comparison. Again, it is evident from the data presented in this table that the U.S residual market is dominated by Mexico, and that Jamaica was unable to establish a significant presence. Market shares of 1 to 2 percent were the best achieved by Jamaica in an industry where imports of some product groupings were increasing by as much as 50%.

Table 2.8

Jamaica's Vegetable Exports as a Percentage of Domestic Production, 1984-1987

	Exports as a Percentage of Domestic Production		
Year	Cucumbers %	Tomatoes %	Pumpkin %
1984	3.6	3.00	5.4
1985	22.5	0.03	5.9
1986	29.3	0.20	4.8
1987	17.1	0.02	4.4

Source: Calculated from data in Tables 2.2 and 2.7.

Table 2.9

U.S. Imports of Fresh Vegetables, and Mexican and Jamaican Market Shares, 1984-1989

	Volume (mt) and Market Shares				
Commodity	1984/5	1985/6	1986/7	1987/8	1988/9
Cucumber:	176,967	182,331	190,983	213,905	192,548
Mexico Share	92%	94%	96%	98%	94%
Jamaica Share	1%	2%	1%	-	-
Peppers:	107,144	106,930	112,774	128,831	133,077
Mexico Share	91%	89%	90%	92%	93%
Jamaica Share	1%	3%	3%	-	-
Tomatoes:	374,337	422,200	441,321	376,081	365,849
Mexico Share	98%	97%	98%	98%	98%
Jamaica Share	-	-	-	-	-
Other Vegetables:	271,433	273,551	350,675	371,742	412,662
Mexico Share	67%	41%	51%	55%	56%
Jamaica Share	2%	2%	2%	2%	1%

Source: USDA Foreign Agricultural Trade of the United States, Various issues.

\- Less than 1%

2.6 SUMMARY

This chapter has attempted to provide an overview of the structure and performance of the Jamaican vegetable industry. The oligopolistic and ephemeral nature of the industry was noted along with its high fixed cost structure. Production practices in the industry were also reviewed and contrasted with those in Florida and Mexico. The Jamaican focus on advanced drip irrigation systems was highlighted as a major difference between the production practices in the three regions.The chapter also reviewed trends in production and yields of selected vegetables and attempted to draw meaningful parallels with Mexico. The marketing channel through which Jamaican produce was moved to the export market was also discussed in this chapter. Finally, trends in volumes and market shares were analyzed for the major vegetables exported from Jamaica.

CHAPTER 3

THE MONKE-PEARSON POLICY ANALYSIS MATRIX AND SHADOW PRICING METHODOLOGY

3.1 INTRODUCTION

Chapter 2 sought to provide some background information on the structure and performance of the Jamaican winter vegetable sector. Before the impact of government policies and technological choices are assessed, however, it is necessary to first lay the foundation of a consistent framework for the analysis. This is the subject of the present chapter.

The analytical framework employed in the evaluation is the recently developed Monke-Pearson Policy Analysis Matrix (PAM). A description of the matrix is presented in the following section. Section 3.3 provides an overview of alternative approaches to policy evaluation and discusses the strengths and weaknesses of the framework adopted for this study. Section 3.4 explores an issue closely associated with the application of the Monke-Pearson PAM, the shadow pricing of traded and non-traded inputs and outputs. The fifth and final section contains a brief summary of the discussion.

3.2 THE MONKE-PEARSON POLICY ANALYSIS MATRIX

The Monke-Pearson PAM has its origins in the literature on social cost benefit analysis and international trade policy. The matrix is an integrated organizational framework which is useful in the analysis of a range of policy issues in both developed and developing countries. The PAM incorporates two accounting identities. The first defines private and social profitability as the surplus of revenues over costs valued at market and social prices, respectively. The second identity is concerned with divergences between the market and social price valuations of revenues, costs and profits. These divergences, of course, capture the impact of market failures, and efficient and distorting government policies (Monke and Pearson 1989). The second impact, that of efficient policies, represent countervailing government measures designed to ameliorate the negative consequences of market failures and distortions.

A simplified version of the matrix is shown below in Exhibit 3.1. The discounted input costs (valued at market prices) associated with any project or program under study are first disaggregated into their tradable and non-tradable components, and subsequently revalued using appropriate shadow prices.

Discounted revenues generated by the project or program (valued at market prices) are also appropriately shadow priced. The above data allow for the construction of the matrix.

Exhibit 3.1

The Monke-Pearson Policy Analysis Matrix

	COSTS			
	Revenue	Tradable Inputs	Domestic Inputs	Profit
Private Prices	A	B	C	D
Social Prices	E	F	G	H
Effects of Divergences and Efficient Policies	I	J	K	L

Source: Monke and Pearson (1989).

Profits in private and social prices (D and H respectively) are calculated as the surplus of revenues (at market and social prices) over costs (again at market and social prices), i.e.

$$D = A - (B + C)$$

$$H = E - (F + G)$$

Divergences between the private and social price valuations of revenues (A - E), tradable input costs (B - F), domestic input costs (C - G), and profits (D - H), measure the extent of market failures, efficient and distorting government policies, i.e.

$$I = A - E$$

$$J = B - F$$

$$K = C - G$$

$$L = D - H$$

It should be recognized that barring computational errors, the Monke Pearson PAM is balanced, i.e.

$$I - (J + K) = L$$

$$D - H = L$$

Earlier, the Monke-Pearson PAM was described as an "integrated" framework. A number of indices of program/project performance which have been routinely used in the development planning literature may in fact be derived quite easily once the matrix has been properly constructed. These indices may be listed as:

1. The Domestic Resource Cost (DRC) ratio
2. Nominal Protection Coefficient on Tradable Inputs (NPCI) and Outputs (NPCO)
3. Effective Protection Coefficient (EPC)
4. The Private Cost Ratio (PCR)
5. The Profitability Coefficient (PC), and
6. The Subsidy Ratio to Producers (SRP).

Calculation of these performance indices provides a comprehensive overview of the performance of any program or project and the impact of government trade and macroeconomic policies on its economic viability. The computation and interpretation of these ratios are discussed below.

3.2.1 RATIO ANALYSIS

The Private Cost Ratio (PCR)

The PCR measures the competitiveness of a commodity system under existing policies. The index is calculated as the ratio of domestic factor costs at market prices to value added at market prices. Using the symbols contained in Exhibit 3.1 we may write:

$$PCR = \frac{C}{(A-B)}$$

The ratio measures how much the commodity system can afford to pay domestic factors while remaining competitive. By minimizing the PCR (i.e. by holding down domestic and tradable input costs) private profits would be maximized.

Domestic Resource Cost Ratio (DRC)

The DRC is similar to the PCR but is measured in social prices. The measure is calculated as the ratio of domestic factor costs in social prices to value added also in social prices. Using the notation in Exhibit 3.1:

$$DRC = \frac{G}{(E-F)}$$

Minimizing the DRC is equivalent to maximizing social profits.

Nominal Protection Coefficient on Output (NPCO)

This is the ratio of revenue at social prices to revenue valued at market prices, i.e. A/E in Exhibit 3.1. The NPCO measures the extent to which government macroeconomic and trade policies have caused output prices to deviate from their world price equivalents.

Nominal Protection Coefficient on Inputs (NPCI)

This is the ratio of tradable input costs at market prices to tradable input costs at social prices i.e. B/F in Exhibit 3.1. This ratio is similar to the NPCO but measures deviations in input costs from world price equivalents.

The Effective Protection Coefficient (EPC)

The EPC measures the extent of product market transfers and is, therefore, an indicator of the degree of incentive support received by a commodity system. The measure is computed as the ratio of value added at market prices to value added at social prices i.e.

$$EPC = \frac{A - B}{E - F}$$

It should be readily recognized that the EPC is not a complete indicator of incentive support as it ignores policies which impact on the cost of domestic inputs. A more comprehensive indicator of the extent of product market transfers is provided by the profitability coefficient below.

The Profitability Coefficient (PC)

The PC is the ratio of profits at market prices to profits at social prices i.e. D/H in Exhibit 3.1. The PC is a more complete measure of incentive effects as it considers both product and factor market transfers.

The Subsidy Ratio to Producers (SRP)

The SRP is the ratio of the difference between profits at market and social prices to social revenue i.e.

$$SRP = \frac{D - H}{E}$$

The SRP indicates the proportion of social revenue that would be required if a single tax or subsidy were to be substituted for a country's entire slate of macroeconomic and commodity support policies.

The above has been an attempt to elucidate the major features of the Monke-Pearson PAM. The matrix will be applied in the evaluation of the Agro 21 winter vegetable program in Chapter 4. Before this is done, however, it may be useful to briefly review the strengths and weaknesses of the Monke-Pearson PAM, and discuss the alternative policy analysis frameworks that could also be used.

3.3 AN ASSESSMENT OF THE PAM AND ALTERNATIVE POLICY EVALUATION FRAMEWORKS

In a recent book review Thorbecke (1990) identified three major weaknesses of the Monke-Pearson PAM. Two of these limitations are of particular relevance to this study, and are likely to affect the empirical results and policy recommendations which are presented later.

The first major limitation of the PAM lies in its inability to trace the intersectoral impacts of government policy interventions. It is well known that policy initiatives in the non-agricultural sector, for example, may impact on the prices of agricultural inputs and outputs, as well as on production and trade flows. Thorbecke (1990) has argued that these indirect impacts may often be more important than the limited direct effects quantified by the PAM.

There are, of course, several more appropriate methods for analyzing indirect effects within the economy. Khan and Thorbecke (1988) advocate the use of the Social Accounting Matrix (SAM) which describes the inter-relationships between the structure of production, the distribution of value added from productive activities, and income distribution among households. The SAM is, therefore, a more general analytical framework than the PAM, allowing for the analysis of a wider range of important policy issues. However, given the detailed disaggregation of all production and consumption activities required to construct a SAM, the data needs of this approach far exceed those of the PAM.

To a more limited extent the Leontief input-output (I-O) model may also be employed to capture the indirect impacts of government policies. However, the I-O model captures only intersectoral linkages within the production system, ignoring further impacts in terms of employment and household consumption (Khan and Thorbecke 1988).

Finally, intersectoral effects may be measured using Computable General Equilibrium (CGE) models in which the linkages between the various sectors of the economy are explicitly modelled. CGE models, while perhaps superior to any of the above approaches in capturing indirect effects, are extremely demanding in terms of their data requirements. For this reason alone CGE models are not well suited to the analysis of Jamaican policy issues. In fact, given that the PAM is based on farm budget data, which were easily obtainable in the case of the Agro 21 winter vegetable projects, this method placed the least demands on the limited data available.

The second major limitation of the PAM stems from the use of border prices (i.e world prices inclusive of transportation costs). As Thorbecke (1990) has correctly argued, this reliance on world prices makes the PAM sensitive to price distortions in international agricultural markets. Agricultural protectionism in the developed world, the author has argued, distort international commodity prices, and decisions based on the application of the PAM are, therefore, likely to fuel further distortions in world wide resource allocation.

Thorbecke's (1990) third criticism of the PAM relates to the inability of the matrix to incorporate tradeoffs in government policies over time. The author argues that the PAM is essentially static[1] and that issues such as the tradeoff between efficiency and income distribution now and in the future cannot be adequately dealt with using the matrix. This latter criticism is not, however, likely to be seriously damaging to this analysis which is not directly concerned with such policy tradeoffs.

3.4 SHADOW PRICING METHODOLOGY

It is widely recognized that market prices do not reflect social benefits and costs in a decentralized market economy. The divergence between revenues and costs valued at market prices (i.e. net economic profit) will, therefore, not provide an appropriate signalling mechanism to guide investment decisions in such an economy (Little and Mirrlees 1974; Dasgupta and Pearce 1978). It is only under the economist's theoretical construct of perfect competition would there be no difference between market and social prices.

Several distortions in a market economy may cause the price mechanism to not adequately reflect social value. The use of price controls is an obvious example, as

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[1]Monke and Pearson (1989) do, however, discuss how the PAM may be used to trace the time path of comparative advantage of a commodity system.

are overvaluation of a country's exchange rate and imperfections in the operation of its capital markets. These distortions are present to some extent in all countries but are particularly relevant in the context of developing countries such as Jamaica. The existence of these distortions provide the raison d'être for the use of social price valuations in the Monke-Pearson PAM.

The approach to the shadow pricing of traded and non-traded inputs and outputs used in this research is based on the modification and revision of an earlier study by Weiss (1985). This study was commissioned by the Administrative Staff College, Ministry of the Public Service and is based on data for the period 1980-1982. Weiss established conversion factors (i.e. ratios of shadow prices to market prices) for several sectors: distribution, transportation, construction, electricity, investment, skilled labour and unskilled labour, as well as an Average Conversion Factor (ACF) for the entire economy.

In 1983, however, Jamaica abandoned its dual exchange rate system and adopted a unified exchange rate (relative to the US dollar) which was significantly below both the official and parallel market rates. This de facto devaluation of the domestic currency resulted in a significant rise in the general price level (as evidenced by the data on the Consumer Price Index, or CPI, contained in Table 3.1), and the consequent invalidation of Weiss's earlier estimates.

Conversion factors, it should be noted, compare a shadow price at world levels (but denoted in domestic currency) to a domestic price. Therefore in the case of

Table 3.1

The Jamaican Consumer Price Index,
1980-1987

Year	CPI (All Groups)
1980	291.3
1981	326.1
1982	347.4
1983	386.7
1984	497.3
1985	622.9
1986	714.8
1987	762.9

Source: The Statistical Institute of Jamaica, Consumer Price Indices, Annual Review 1984-1987.

a non-traded commodity say, x we have:

$$CF_x = \frac{WP_x * OER}{DP_x}$$

Where:

WP_x = The world price of x

DP_x = The domestic price of x

OER = The official exchange rate

A devaluation of ϵ % will change the OER to $OER(1 + \epsilon) = OER'$. The CF_x then becomes:

$$CF_x = \frac{WP_x * OER'}{DP_x}$$

Given that the $OER' > OER$ the CF_x will immediately rise with a devaluation. This is likely to be a short run impact, however, as DP_x will probably also rise with the devaluation of the official exchange rate. The rise in DP_x, however, will not necessarily be by the full extent of ϵ. It should be clear that the precise extent of the impact is an empirical matter which will vary from product to product and sector to sector.

It should also be noted that the change in the conversion factor for the non-traded commodity, whatever its magnitude, will also impact on the conversion factor for tradables. These changes necessitate a complete re-calculation of all conversion factors for the economy.

The following subsections will examine in turn the derivation of conversion factors for skilled and unskilled labour, manufacturing, the major non-traded sectors as well as an ACF for the entire Jamaican economy. A comparison of the revised estimates with those obtained by Weiss will also be presented.

3.4.1 THE SHADOW PRICE OF LABOUR

In this subsection estimates of the shadow price of skilled and unskilled labour (i.e. the shadow wage rate) are computed. In the case of unskilled labour two shadow wage rates are calculated. One is specific to seasonal unskilled labour employed in Agro 21 winter vegetable projects, while the second is a general wage rate applicable to unskilled non-agricultural labour in any area of the Jamaican economy. The procedure for calculating the shadow price of skilled labour is straightforward, and the estimates are of general applicability.

The Shadow Price of Unskilled Labour

The shadow price of unskilled labour is computed as the foreign exchange value of the opportunity cost of unskilled labour in the sector from which workers are drawn. In the present case labour was assumed to be drawn primarily from the export agricultural sector. We have:

$$SWR = \Sigma \phi_i \alpha_i m_i$$

Where:

SWR	=	Shadow wage rate
ϕ_i	=	Proportion of workers coming from the ith sector
α_i	=	Output foregone per worker employed in the ith sector if transferred to the next best alternative use (and valued at domestic prices), and
m_i	=	Conversion factor used to revalue the output level in sector i from domestic to world prices

A corresponding conversion factor for unskilled labour is then calculated simply as:

$$CF_{ul} = SWR / MWR$$

Where:

CF_{ul}	=	Conversion factor for unskilled labour
MWR	=	Market wage rate
SWR	=	As defined earlier

The above estimation procedure is first applied to the derivation of a conversion factor for seasonal agricultural workers engaged in Agro 21 winter vegetable production. Based on information provided to the author during field interviews, it was assumed that women are employed in winter vegetable production for a nine month period (August - April). For the remaining 3 months of the year women are assumed to be involved in various "higglering"[2] activities in the informal sector.

Wages applicable to winter vegetable production are U.S $ 3.64 per day, while Anderson (1987) estimates that earnings from the informal sector approximate U.S $3.27 per day. These wage rates provide an estimate of the total annual earnings for unskilled female labour of U.S $ 851 (i.e. U.S $3.64 x 180 days + U.S $3.27 x 60 days).

Men are assumed to be employed in winter vegetable production for 9 months at a rate of U.S $4.36 /day and for the remaining months are assumed to find work in

[2]Higglers are informal traders who typically purchase and sell small quantities of agricultural commodities collected from geographically dispersed farm locations (see Appendix A).

banana cultivation at a rate of U.S $4.95/day.[3] An annual earnings estimate for male unskilled workers is, based on the above, U.S $1082 (i.e. 180 x U.S $4.36 + 60 x U.S $4.95).

It should be noted at this point that banana cultivation was assumed to be the most likely source of alternative employment for male workers because of the relative dominance of this type of production in the three parishes in which Agro 21 winter vegetable projects were established. Table 3.2 shows the numbers of farmers engaged in the cultivation of various export crops in the parishes of Clarendon, St. Catherine and Trelawny in 1982.

In order to arrive at an overall estimate of the gross annual earnings of workers engaged in winter vegetable production it is necessary to combine the estimates for male and female unskilled labour. An appropriate weight to use for this purpose is the percentage of female vs. male workers drawn into Agro 21 winter vegetable production. Based on information collected during discussions with the management of these projects an 80:20 split was assumed. Application of this weighting system resulted in a combined estimate of the opportunity cost of unskilled labour of U.S $897/year. (i.e. 0.8 x $851 + 0.2 x $1,082) or U.S $3.74/day.

The above wage rate at market prices must now be revalued to world prices using an appropriate conversion factor for export agriculture (CF_{ea}). Following Weiss

[3]Estimate provided by the Jamaica Banana Producers Association.

Table 3.2

Number of Farmers in Export Crop Production by Parish

	NUMBER OF FARMERS		
Crop	Clarendon	St. Catherines	Trelawny
Sugar	3,814	2,446	1,511
Banana	9,765	9,897	3,691
Coffee	8,084	6,551	1,416
Cocoa	5,101	5,437	111
Pimento	1,183	1,821	413
Coconut	2,491	1,764	446
Oranges	4,112	2,797	226
Grapefruit	1,467	1,068	30
Other Citrus	710	539	36
Horticulture	127	100	1
Root Crops	1,391	2,080	301

Source: Ministry of Agriculture, Farmer's Register, 1982.

(1985) the CF_{ea} is calculated as the weighted sum of the conversion factors for sugar and bananas, each of which is calculated based on the price structures of the respective crops. The procedure is illustrated in Exhibits 3.2 and 3.3.

The computed value of 1.3 for CF_{ea} is used in conjunction with an annual estimate of the market wage rate for unskilled agricultural labour of U.S $4/day (or $960/year) to derive the conversion factor for seasonal unskilled Agro 21 labour.

$$\text{CFul Agro 21} = \frac{[\text{SWR} \times CF_{ea}]}{\text{MWR}}$$

$$= ((3.74 \times 1.3) / 4)) = 1.2$$

These calculations suggest that at wages prevailing in the Agro 21 winter vegetable production system workers would have been better off to confine their efforts to non-Agro 21 activities. This result is, of course, due to the assumption that the predominant form of alternative employment would be in the relatively higher paying formal export agriculture sector. Had the assumption of open unemployment (and perhaps complete reliance on grants from relatives abroad), or exclusive employment in the informal sector been adopted, the CF for unskilled agricultural labour would have been less than one. In the case of Jamaica, however, these latter assumptions were inconsistent with information provided to the author during the course of personal interviews. Further, while data are available on incomes in the informal sector, the

Exhibit 3.2

Derivation of the Sugar Conversion Factor for Jamaica

CF(Sugar) = {f.o.b price/ton - processing costs at world prices - transportation and distribution costs/ton at world prices} / Domestic price to farmers for sugar cane needed per ton of sugar.

The relevant prices for the period 1984-1988 are* :

c.i.f price EEC	=	U.S $275
Domestic ex-factory price	=	U.S $382
Price to Growers	=	U.S $236
Factory price	=	U.S $146 (i.e. $382 - $236)

A transportation cost of U.S$9.31/ton is assumed - this being the average cost of transporting sugar from refineries at different locations on the island to the sea port at Orcho Rios. Processing costs are assumed to approximate U.S$112/ton. All costs are converted to world price equivalent using the ACF of 0.88 which is derived in a later section. We therefore have:

$$\text{CF(sugar)} = \frac{\$382 - (\$112 \times 0.88) - (\$9.31 \times 0.88)}{\$236} = 1.16$$

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*<u>Source</u>: Unpublished data, Sugar Industry Authority.

Exhibit 3.3

Derivation of the Banana and Export Agriculture Conversation Factors for Jamaica

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The conversion factor for banana is calculated as:

CF(Banana) = {f.o.b price/ton - administration and boxing costs at world prices - transportation cost to the port} / Domestic price to the growers per ton.

The relevant price/cost data for the 1986-1988 period are*:

U.K Green Boat Price	=	U.S $547
Total U.K Shipping and handling costs	=	U.S $310
F.O.B Price	=	U.S $238
Total Jamaica shipping and handling costs	=	U.S $37
Income available to growers	=	U.S $200
Income paid to growers	=	U.S $487
Loss to the Jamaican Banana Export Company	=	(U.S $287)

In the absence of a revised estimate of administration costs, Weiss's figure of U.S $74/ton is retained. We have:

$$\text{CF(banana)} = \frac{\$238 - (\$74 \times 0.88)}{96.17} = 1.79$$

The conversion factor for export agriculture:

The conversion factor for export agriculture is the weighted sum of CF(sugar) and CF(banana) with a 75:25 split assumed.
$CF_{ea} = 0.75(1.16) + 0.25(1.8) = 1.3$

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*Source: Unpublished Data, Jamaica Banana Export Company.

author is not aware of reliable estimates of monetary grants provided to families by expatriate Jamaicans. It is conceded, however, that the assumption adopted above could lead to some bias in the social valuation of the unskilled labour input.

As noted earlier two conversion factors for unskilled labour are computed. The first presented above is specific to the Agro 21 winter vegetable project and will be used in shadow pricing unskilled labour in Chapter 4. This specialized conversion factor is necessary as it captures important features of the labour supply to the Agro 21 winter vegetable projects such as:

1. The differential wage rates paid to men and women associated with the Agro 21 winter vegetable program.
2. The preponderance of women who were attracted to the Agro 21 winter vegetable projects, and
3. The seasonal nature of the employment opportunities open to these workers.

The second conversion factor for unskilled labour is specific to non-agricultural sectors of the economy. This latter conversion factor is not used in the ensuing analysis but is provided in the interest of completeness. The conversion factors developed here, it must be remembered, are designed to be applicable to a wide range of project evaluation situations in the industrial or agricultural sectors of the Jamaican economy.

The derivation of the non-agricultural unskilled labour conversion factor follows the procedure adopted by Weiss (1985), and is based on a consideration of the output foregone in export agriculture. Sugar and banana cultivation are again considered to be representative of this branch of agricultural production.

Data obtained from the Sugar Industry Authority indicate that cane cutters can earn U.S $1.37/ton of burnt cane for a period of 28 weeks per year. One man is normally expected to cut 5 tons of cane per day which, if one assumes a 5 day work week, represents U.S$956 for the cropping season.

Sugar workers are guaranteed out of crop work for 3 days per week at the rate of pay for the job performed (and not necessarily the worker's grade). A rate of pay for a general labourer of U.S$4/day is used, this being the average wage paid to unskilled labour that was communicated to the author in discussions with Statin[4] officials. Based on the above, total out of crop earnings are estimated as U.S $288 (i.e. $4 x 3 x 24). The combined earnings of sugar workers are therefore equivalent to U.S $1244/year.

Workers in banana cultivation earn slightly more than their counterparts in the sugar industry, U.S $4.95/day. Workers in this industry have recently benefitted from a wage increase from U.S $3.45-$4.00/day for day labour to the current U.S $4.95. Assuming a 160 day per year work period, annual earnings from banana cultivation are U.S $792.

[4]Statin is an acronym for the Statistical Institute of Jamaica.

The average annual earnings from the above two branches of export agriculture are calculated as U.S $ 1094.67 (i.e. 0.67 x $1243.8 + 0.33 x $792). In the above computation annual earnings from sugar and banana production are weighted by their shares of the wage bill for these activities.

In the calculation of the shadow wage rate for unskilled non-agricultural workers, labour is assumed to be drawn primarily from the agricultural sector. Data in Table 3.3 indicate that approximately 60% of male unskilled workers on the island was engaged in primary agricultural production, with the remaining 40% being distributed among the various other sectors of the economy. Based on these data it was assumed that a non-agricultural project established in any sector of the economy would attract 60% of its unskilled labour from the agricultural sector and 40% from all other sectors.

Anderson (1987) provides an estimate of earnings in the secondary formal and informal (non-agricultural) sectors of U.S $853/year.[5] This figure is used as a proxy for output foregone in the non-agricultural sector in the calculation of a conversion factor for unskilled labour. The estimate of non-agricultural output foregone is revalued to world price equivalents using the ACF of 0.88 which is calculated in a later section. We therefore have:

$$SWR_{ul} = 0.6\ [\$1095 \times 1.3] + 0.4\ [\$853 \times 0.88]$$

[5]It should be noted that in Anderson's work the bulk of the skilled labour force are represented by the primary formal and central government sectors.

Table 3.3

Percentage Distribution of Male Unskilled and Semiskilled Workers

Sector	YEAR			
	1988 %	1987 %	1986 %	1985 %
Agriculture	58.1	60.0	62.0	64.0
Mining/Quarrying	0.4	0.4	0.3	0.4
Manufacturing	8.1	8.1	7.5	7.3
Construction	3.8	3.6	3.0	3.4
Electricity	0.5	0.5	0.3	0.3
Commerce	8.1	7.8	7.5	6.5
Transportation	4.0	4.0	3.4	3.4
Public Administration	5.0	4.8	5.8	6.3
Services	11.7	10.6	10.2	9.1
Occupation Unspecified	0.3	0.2	0.3	0.3

Percentage may not sum to 100 due to rounding.

Source: Unpublished Statin Data.

Assuming an average market wage for unskilled workers in agriculture, manufacturing, wholesaling, retail trade, restaurants and hotels of U.S $6/day[6] a conversion factor for unskilled labour is given as:

$$CF_{ul} = 0.6\ [\$1095 \text{ x } 1.3] + 0.4\ [\$853 \text{ x } 0.88]/(\$6 \text{ x } 5 \text{ x } 52)$$

$$(\$854 + \$300)/\$1560 = 0.74$$

The Shadow Price of Skilled Labour

In practical applications of the tools of cost-benefit analysis in developing countries it is usual to assume that the market for skilled labour functions more or less competitively, and that the opportunity cost of such workers can be approximated by the prevailing market wage rate (Weiss 1985). Assuming this to be the case the following relationship holds:

$$SWR_{sl} = MWR_{sl} \text{ x } ACF$$

Where:

SWR_{sl} = Shadow wage rate of skilled labour

[6]Data for the average market wage of workers in all the above sectors excluding agriculture were obtained from Statin's Employment, Earnings and Hours Worked in Large Establishments.

MWR_{sl} = Market wage rate of skilled labour

and:

$$CF_{sl} = SWR_{sl} / MWR_{sl} = ACF$$

The conversion factor for skilled labour, therefore, equals the ACF for the overall economy and does not have to be estimated independently.

3.4.2 THE CONVERSION FACTOR FOR MANUFACTURING

In this subsection a conversion factor for manufacturing, CF_{mf} will be established. This conversion factor will be useful primarily as an input into the calculation of an ACF for the overall economy (See Section 3.4.4).

These are essentially two approaches to arriving at a conversion factor for manufactured goods, the first is based on an examination of tax and tariff data to determine the divergences between ex-factory and world prices. Weiss (1985) has correctly pointed out that this approach will likely lead to misleading results when applied to countries such as Jamaica with control on foreign exchange. The imposition of controls on foreign exchange creates a situation in which import prices contain a scarcity mark up due to the existence of the controls. The result would be that taxes and tariffs would not represent the true divergence between ex-factory and world prices.

The second approach to arriving at an accurate estimate of CF_{mf} is direct price comparisons between similar items manufactured domestically and those which are also imported. Such a study was conducted by Chen-Young and Associates in 1982 as part of an assessment of Jamaica's international price competitiveness under IMF structural adjustment. The Chen-Young and Associates study is, however, based on 1982 data and there have been no attempts to revise the estimates provided in that study since the unification of the country's dual exchange rates (Chen-Young and Associates 1982).

To reflect the post devaluation situation, the price data contained in the 1982 study are adjusted. Ex-factory prices are adjusted using the change in CPI between 1982 and 1987, while CIF prices are modified using the movement in the Jamaican exchange rate (relative to the U.S. dollar) over the same time period. The above procedure is crude as it implies no change in relative prices. However, short of repeating the detailed price comparisons performed by the consultants, an expensive and time consuming proposition, the above adjustments represent a practical compromise.

In the calculation of CF_{mf} based on direct price comparisons each individual commodity price is weighted by the share of that commodity in 1987 GDP (constant prices). The results are presented in Table 3.4. The calculated CF_{mf} of 1.03 is significantly higher than Weiss's value of 0.77. This increase is however consistent with an economy which is becoming increasingly more liberalized in response to IMF structural adjustment.

Table 3.4

Derivation of the Conversion Factor for Jamaican Manufacturing

Product	Average Ratio of Adjusted Ex-Factory to CIF Price	Weight	Weighted Average Price
Food	1.04	0.55	0.572
Garments	0.73	0.09	0.066
Footwear	1.05	0.03	0.032
Electrical	1.57	0.01	0.010
Furniture	0.61	0.05	0.030
Metal Production	1.26	0.04	0.050
Chemicals	0.90	0.02	0.020
Plastics	0.87	0.05	0.040
Cosmetics	0.89	0.01	0.010
Pharmaceutical	0.54	0.01	0.003
Printing	0.79	0.08	0.060
Automotive	1.13	0.07	0.080
Jewellery	0.75	0.0006	0.000045

All manufacturing average price ratio = 0.975

$CF_{mf} = 1/0.975 = 1.03$

Source: Author's calculations, based on data in Chen-Young and Associates 1982.

3.4.3 THE SHADOW PRICE OF NON-TRADED GOODS

This section examines the procedure for generating conversion factors for the major non-traded sectors: distribution, transportation, construction, electricity investment and domestic agriculture. Perhaps the most accurate approach to conducting such an exercise is with the use of an Input-Output (I-O) model of the entire economy. By using such a model the individual I-O coefficients for traded components (at market prices) may be revalued to world price equivalents using specific conversion factors computed using tax and tariff data. In the case of domestically produced components of non-traded sectors these I-O coefficients may be revalued using the ACF (Ahmed 1985; Dervis, DeMelo and Robinson 1982).

Use of an I-O model to develop conversion factors for non-traded sectors is usually dependent on the availability of an ACF for the overall economy. Such a conversion factor may be calculated using the familiar trade data approach (Squire and Van der Tak 1975):

$$ACF = \frac{M + X}{M(1 + t_m) + X(1 + t_x)}$$

Where:

M = c.i.f value of imports

X = f.o.b value of exports

t_m = Average tax on imports

t_x = net average tax on exports

A fairly large (34 x 34) I-O model has been constructed for Jamaica and is currently maintained by the PIOJ[7]. The model was developed using 1982 data and has been revised annually using the RAS technique, a computerized procedure for rebalancing the rows and columns of the table.

In this research the PIOJ I-O model is not used in the analysis. As pointed out earlier for countries in which there exists controls on foreign exchange the use of tax and tariff data would under-represent the extent of divergences between domestic and world prices. This would certainly impair the accuracy of the specific conversion factors and ACF used to revalue the individual I-O coefficients.

An alternative approach is to use national accounts data to disaggregate the value of sectoral output for each non-traded sector into various components and to revalue each component to its world price equivalent. The major problem here is that the level of disaggregation that can be achieved is considerably less than if an I-O table is used. A large "intermediates" category usually results which cannot be further decomposed. Table 3.5 shows the breakdown of GDP averaged over the period 1983-87 for: construction, distribution, transportation, electricity/water and domestic agriculture. The intermediates category is seen to account for between 26% and 67% of total output. Construction and electricity are seen to be the sectors with the largest intermediates

[7]PIOJ is an acronym for the Planning Institute of Jamaica.

Table 3.5

Five-Year Average Sectoral Output Breakdown, 1983-7
US $'000

	SECTOR				
Category	Construction	Distribution	Transportation	Electrical	Agricultural
Wages	110,812 (18.9%)	96,969 (14.7%)	80,588 (17.2%)	19,534 (10.9%)	29,675 (19.6%)
Intermediates	395,616 (67.3%)	172,067 (26.08%)	270,855 (58.0%)	110,776 (61.5%)	79,031 (52.1%)
Depreciation	5,583 (0.95%)	14,310 (2.2%)	39,204 (8.4%)	23,500 (13.1%)	2,731 (1.8%)
Operating Surplus	73,916 (12.6%)	260,504 (39.5%)	56,888 (12.2%)	24,216 (13.5%)	38,394 (25%)
Net Indirect Taxes	1,329 (0.22%)	115,717 (17.5%)	19,182 (4.1%)	1,911 (0.1%)	1,891 (0.01%)
Gross Output	587,256 (100%)	659,567 (100%)	466,717 (100%)	179,937 (100%)	151,722 (100%)

Source: Statin, unpublished data.

category, while a much finer degree of disaggregation is achieved for the distribution sector.

In deriving shadow prices and conversion factors for non-traded sectors it is important to allow for the interdependence which exists between estimates of the various parameters (Weiss 1985). As an example, conversion factors for construction and distribution cannot be determined without explicitly recognizing the influence of the conversion factor for unskilled labour. Unskilled labour is obviously an input into these two nontraded sectors. Similar interdependencies will exist for all the other nontraded sectors.

To deal with the issue of interdependence, the relationships between the conversion factors are expressed as a system of simultaneous equations which are solved to find the unique values of all the variables which satisfy the system. Assuming that these are n conversion factors we have:

$$
\begin{array}{l}
CF_1 = \alpha_1 + \beta_{11} CF_1 + \ldots + \beta_{n1} CF_n \\
\quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
\quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
CF_n = \alpha_n + \beta_{1n} CF_1 + \ldots + \beta_{nn} CF_n
\end{array}
$$

Where:

CF_n = conversion factors

α_n = constants

β_{nn} = weights

The value of each conversion factor is, therefore, represented by a constant and the weighted value of all other conversion factors in the system. In the above, the constants (α_n) reflect direct and indirect foreign exchange costs in the form of traded goods. The weights (β_{nn}) which are assigned to the various conversion factors represent the share of the various non-traded inputs in sectoral output. Some of these weights will invariably be zero if inputs from the particular sectors are not identifiable.

The system of equations that was solved is presented below in Exhibit 3.4 This is followed by a discussion of the derivation of α_n and β_{nn} for the various equations. Readers familiar with the Weiss study will note the inclusion of a separate equation for domestic agriculture in the system presented below.

Adjustments to develop the system of simultaneous equations:

(a) Distribution

Direct foreign exchange content is computed as CF_{mf} x percentage of intermediates in total output (i.e. 1.03 x 0.2608 = 0.268). The conversion factor for distribution is calculated as 1/3 of operating surplus plus depreciation (.33 x 0.395 + 0.027 = 0.15735). Using Weiss's assumption that 60% of the labour used in this sector

Exhibit 3.4

Simultaneous Equation System

$$CF_d = 0.27 + 0.157CF_{inv} + 0.25CF_{ul} + 0.16CF_{sl}$$
$$CF_t = 0.48 + 0.21CF_{inv} + 0.10CF_{ul} + 0.07CF_{sl}$$
$$CF_c = 0.72 + 0.14CF_{inv} + 0.14CF_{ul} + 0.05CF_{sl}$$
$$CF_e = 0.5 + 0.27CF_{inv} + 0.055CF_{ul} + 0.55CF_{sl}$$
$$CF_{inv} = 0.52 + 0.5CF_c$$
$$CF_{ul} = 0.20 + 0.08CF_d + 0.88CF_c$$
$$CF_{sl} = 1.0ACF$$
$$CF_{da} = 0.52 + 0.28CF_{inv} + 0.28CF_{ul} + 0.069CF_{sl}$$
$$ACF = 0.50 + 0.25CF_d + 0.13CF_t + 0.095CF_c + 0.025CF_e$$

Where:

CF_d = Conversion factor for distribution
CF_t = Conversion factor for transportation
CF_c = Conversion factor for construction
CF_e = Conversion factor for electricity
CF_{inv} = Conversion factor for investment
CF_{ul} = Conversion factor for unskilled labour
CF_{sl} = Conversion factor for skilled labour
CF_{da} = Conversion factor for domestic agriculture
ACF = Average Conversion Factor

Note: Zero weights have been omitted.

Source: Author's calculations.

is unskilled and 40% skilled, and also that payments to family labour are 67% of operating surplus or 0.265, we have:

Total labour cost = 0.147 + 0.265 = 0.412

Unskilled labour = 0.6 x 0.412 = 0.247

Skilled labour = 0.4 x 0.412 = 0.1648

(b) Transportation

From Table 3.4 the ratio of ex-factory to c.i.f prices for automotive products is 1.13 which implies a conversion factor of 0.88 (1/1.13) for this item. The direct foreign exchange cost for this sector arises from intermediates which represent 58% of sectoral output. Assuming an equal division of intermediates between fuel and automotive products and Weiss's conversion factor for fuel (0.75), direct foreign exchange cost is 0.48 (i.e. 0.29 x 0.88 + 0.29 x 0.75).

The CF_{inv} is computed as the sum of depreciation and operating surplus which equals 20.6% or 0.21. Weiss's assumption with respect to the distribution of skilled and unskilled labour in this sector is adopted:

Unskilled labour = 0.6 x 0.172 = 0.10

Skilled labour = 0.4 x 0.172 = 0.069

(c) Electricity

Direct foreign exchange cost for this sector are assumed to be 80% fuel and 20% other manufactures. The former is revalued using Weiss's conversion factor for fuel while the latter is revalued using the CF_{mf} from an earlier subsection. Given that intermediates represent 62.2% of sectoral GDP we have:

$$\{[0.8 \times 0.622] \times 0.75 + [0.2 \times 0.622] \times 1.03\} = 0.5$$

The capital cost for this sector is calculated as the sum of depreciation and operating surplus = 0.263. Wages represent 10.9% of sectoral output for this sector and is assumed to be divided equally between skilled and unskilled labour.

(d) Investment

For this sector direct foreign exchange cost is assumed to be 50% of CF_{mf} or 0.52. The other 50% of investment expenditure is assumed to be on buildings and is revalued using CF_c.

(e) Unskilled Labour

The weight required for traded and non-traded goods are 0.2 and 0.16 respectively. The latter is assumed to be divided equally between distribution and construction.

(f) Skilled Labour

As noted in an earlier sub-section CF_{sl} is the same as the ACF.

(g) Domestic Agriculture

It is assumed that all inputs in domestic agriculture are imported duty free and that direct foreign exchange costs are 100% of intermediates. Some 60% of the operating surplus in this sector is assumed to be a return to family labour so that capital costs are (0.4 x 0.253 + .18 = 0.28). With respect to labour it is assumed that 80% of the labour used is unskilled and 20% skilled. We therefore have:

Skilled labour:	0.2 x 0.196 + 0.2 (.6 x .253)
Unskilled labour:	0.8 x 0.196 + 0.8 (0.6 x 0.253)

3.4.4 DERIVATION OF THE ACF

The ACF of 0.88 represents the weighted average of the conversion factors for: construction, distribution, electricity, transportation, manufacturing and agriculture and mining. The weight used were the shares of GDP at constant prices for the 1983-7 period (See Table 3.6).

Table 3.6

Derivation of the ACF

Sector	Weight	Conversion Factor
Construction	0.09	0.948
Distribution	0.25	0.648
Electricity	0.02	0.834
Transportation	0.12	0.782
Manufacturing	0.26	1.030
Agriculture	0.14	0.950
Mining	0.09	1.000

ACF = 0.88

Source: Author's calculations.

3.4.5 RESULTS

The results of the above procedure are shown in Table 3.7 below along with Weiss's earlier estimates. Solution of the linear simultaneous equation system was accomplished using Maple, a mathematical software package.

From Table 3.7 it is noted that all revised estimates are higher than those calculated by Weiss although differences are quite small in the case of some sectors such as: distribution, transportation and the ACF. The largest variances are seen in the areas of manufacturing, investment and unskilled labour.

3.5 SUMMARY

This chapter has examined two related issues. The first was the development of a framework for the economic evaluation of the Agro 21 program. The framework, the Monke-Pearson PAM was described along with several indices of program performance that derive from its construction.

The second issue addressed was the development of a system of shadow prices (conversion factors) for the Jamaican economy. Conversion factors were developed for several nontraded sectors as well as an Average Conversion Factor for the overall economy.

Table 3.7

National Conversion Factors for Jamaica

Sector	Conversion Factor	Weiss (1985)
Distribution	0.65	0.63
Transportation	0.78	0.73
Construction	0.95	0.73
Electricity	0.84	0.74
Investment	0.99	0.74
Unskilled Labour	0.80	0.57
Seasonal Unskilled Agricultural Labour	1.20	n.c.
Skilled Labour	0.88	0.79
Domestic Agriculture	0.95	n.c.
Export Agriculture	1.30	1.15
Manufacturing	1.03	0.77
ACF	0.88	0.79

Source: Weiss (1985) and author's calculations.

n.c. not calculated.

CHAPTER 4

POLICY EVALUATION OF THE JAMAICAN WINTER VEGETABLE INDUSTRY

4.1 INTRODUCTION

The purpose of this chapter is to analyse the impact of government policies and technology choices on the performance of the Jamaican winter vegetable industry. The evaluation is conducted within the framework of the Monke-Pearson PAM, the construction of which was described in the previous chapter.

This chapter is divided into five major sections. Following the introduction the impact of government policies on the overall performance of the industry is quantified. The specific government policies investigated in this section are exchange rate overvaluation and import duty concessions. The former was identified in Chapter 1 as a potential source of export bias. Import duty waivers were identified in Chapter 2 (along with income tax exemptions) as being the major economic incentives provided by the Jamaican government to Agro 21 exporters.

Section 4.3 examines the impact of technology choice on the performance of the sector. The specific technologies of interest are the highly capital intensive drip irrigation system and the less capital demanding flood irrigation method. Drip irrigation was discussed in Chapter 2 where it was pointed out that this technology distinguished production practices in Jamaica from those employed in Mexico and Florida. The impact of the adoption of this technology on the viability of the Jamaican industry is therefore of some importance.

Section 4.4 is brief and concentrates on activities beyond the farm gate. The main objective of this section is to examine efficiency within the marketing and transportation networks. In analysing export potential in an island economy such as Jamaica, this type of analysis is useful in determining areas within the system where efficiency (and hence overall competitiveness) might be improved.

The final section of the chapter summarizes the main points of the discussion, while discussion of the limitations of the analysis and its policy implications are relegated to Chapter 7.

4.2 THE IMPACT OF GOVERNMENT POLICIES ON THE INDUSTRY

The analysis presented in this section is based on data obtained from the audited financial statements and company records of three of the five firms that entered and exited the industry over the 1982/3-1986/7 period. Data for the two largest firms in the industry are included in the data set and so the results obtained can reasonably be expected to reflect the performance of the sector.

Revenue and cost streams for the industry are shown in Table 4.1, while the PAM constructed for the industry is shown in Table 4.2. From Table 4.1 it is observed that the industry incurred serious financial losses in each year of its operation, with the

Table 4.1

Revenue and Cost Streams for the Jamaican Winter Vegetable Industry ($ J m), 1982/3-1986/7

Revenue/Cost	1982/3	1983/4	1984/5	1985/6	1986/7
Gross Revenue	2.09	13.01	21.18	34.48	10.47
Tradable Inputs:					
Capital Equipment (net depreciation)	20.99	21.86	21.76	21.50	6.33
Raw Material	0.09	3.10	8.47	10.42	4.93
Total Tradable	21.08	24.96	30.23	31.92	11.26
Domestic Inputs:					
Unskilled Labour	0.91	1.71	4.19	2.53	2.53
Skilled Labour	0.22	2.10	2.36	0.73	0.46
Transportation	0.68	3.78	12.79	10.76	3.45
Electricity	0.03	0.03	0.87	0.56	0.39
Debt Service	0.36	0.46	1.07	3.89	1.18
Administration	2.95	2.49	2.23	2.03	0.00
Other Expenses	1.56	0.88	3.28	19.40	7.93
Total Domestic Costs	6.71	11.45	26.79	39.90	15.94
Total Costs	27.80	36.41	57.02	71.82	27.20
Profit/Loss	**-25.7**	**-23.4**	**-35.8**	**-37.3**	**-16.7**

Source: Unpublished Audited Financial Statements and Company Records.

largest single period loss occurring in 1985/6 ($J 37 million).[1] The PAM for the industry is based on the discounting of all revenues, tradable and domestic input costs to 1982/3 values. A 10% discount rate is used in the calculations.[2]

The discounted revenues and cost streams are converted to world price equivalents using the conversion factors (CFs) developed in the previous chapter. The general nature of these CFs needs to be recognized at this point. These CFs are designed to be applicable to a wide range of project evaluation situations in the Jamaican economy. Given their general nature, however, these CFs may not fully capture the impact of specific policies on the winter vegetable sector.

The CFs used to revalue individual items of revenue and costs are shown in Table 4.2. The discounted revenue stream is converted to world price equivalents using the CF for export agriculture (CF_{ea}). Capital equipment is revalued using the investment CF (CF_{inv}), while raw material purchases of imported planting material, fertilizers and chemicals are converted to social values using the ACF. Unskilled labour, skilled labour, transportation and electricity are shadow priced using the specialized CFs developed for these cost categories. Debt service, administration expenses and the cost of other nontradables are revalued using the ACF.

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[1]It should be noted that in the Monke-Pearson PAM, returns to land and other fixed factors(e.g. management and riskbearing) are interpreted as components of private and social profitability. For this reason the opportunity cost of land is not explicitly included in the calculations. (See Monke and Pearson, 1989, p.22.)

[2]PAMs are usually reported in domestic currency units (DCUs), although foreign currencies may also be used. The convention of using DCUs in the construction of PAMs is adhered to in this chapter.

Table 4.2

Base PAM for the Jamaican Winter Vegetable Industry
($ J m)

Revenue/Cost	Valuation at Market Prices (1982 $)	CF	Valuation at Social Prices (1982 $)	Divergence
Revenue	58.65	1.30	76.25	-17.60
Tradable Inputs:				
Capital Equipment (net depreciation)	72.13	0.99	71.40	0.73
Raw Materials	19.19	0.88	16.89	2.30
Total Tradable	91.32		88.29	
Domestic Inputs:				
Unskilled Labour	8.69	1.20	10.44	-1.75
Skilled Labour	4.49	0.88	3.95	0.54
Transportation	22.85	0.78	17.82	5.03
Electricity	1.32	0.84	1.11	0.21
Debt Service	4.91	0.88	4.32	0.59
Administration	7.81	0.88	6.87	0.94
Other Expenses	22.75	0.88	20.02	2.73
Total Domestic Costs	72.82		64.53	
Total Costs	164.14		152.82	
Profit/Loss	**-105.5**		**-76.57**	**-28.93**

Source: Calculated from Data in Table 4.1 and CFs in Chapter 3.

Also shown in Table 4.2 is the divergence between market and social price valuations for each category of revenue, tradable and domestic input cost. As noted in Chapter 3 this column measures the impact of market failures and distorting government policies as well as the effect of any offsetting efficient government initiatives.

4.2.1 RESULTS OF THE BASE PAM

The results of the base PAM presented in Table 4.2 suggest that, in social terms, the loss to the Jamaican economy from the experiment in winter vegetable exports was approximately $ J 77 million. The fact that social profits are negative for the industry indicates that Jamaica did not have a comparative advantage in this activity, given technology choices, the international price environment, and the slate of government policies in effect at the time.

Also, as was noted earlier, one of the major objectives of the Agro 21 winter vegetable initiative was to generate much needed foreign exchange. The base PAM shows, however, that the industry was a net drain on the country's foreign exchange reserves. The net foreign exchange balance, in the short run, is given by the difference between social revenue and social tradable input (all of which was imported) costs, and amounts to -$J12.0 million. In the long run, of course, when all domestic factors have had time to adjust the net foreign exchange balance would equal the full social loss of -$J77 million.

It is also readily apparent from Table 4.2 that any attempt to correct existing market failures and deleterious government policies would have resulted in a gain of only J$ 29 million - an amount too low to offset the financial losses actually incurred. As is well known Jamaica has for the last several years been the recipient of International Monetary Fund (IMF) support. The structural adjustments associated with the use of these funds, while moving the economy close to the economist's theoretical concept of perfect competition (as reflected by the small divergence between market and social prices), were not concomitant with increased competitiveness in the area of vegetable exports.

In order to probe more deeply into the impact of government policies on the sector's performance the ratios discussed in the preceding chapter were calculated. Table 4.3 presents the NPCO, NPCI, DRC, PCR, EPC, PC and SRP for the base PAM.

As was noted in Chapter 3 the NPCO and NPCI measure the extent to which government policies caused output and input prices to differ from their undistorted values. The NPCO of 0.77 indicates that government policies acted to depress the prices received by Jamaican vegetable exporters while the NPCI of 1.03 suggests that input prices were pushed 3% higher than their (undistorted) world levels.

The sector's DRC and PCR, which reflect social and private profitability respectively, are also observed to be low (and in fact negative). In the Monke-Pearson PAM social profits are a measure of the efficiency or comparative advantage of a commodity system. An industry which generates negative social profits is not self-sustaining and cannot continue to operate without assistance. The DRC estimate of -5.36

Table 4.3

Base PAM Performance Ratios for the Jamaican Winter Vegetable Industry

Ratio	Base Value
NPCO	0.77
NPCI	1.03
DRC	-5.36
SRP	-0.38
EPC	2.71
PC	1.38
PCR	-2.23

Source: Author's Calculations.

in Table 4.3 indicates that Jamaica did not have a comparative advantage in the export of winter vegetables.

The SRP estimate provided in Table 4.3 is also revealing. As noted in the previous chapter this ratio represents transfers from divergences as a proportion of social revenues. The ratio shows the proportion of social revenue that would be required to correct for all distortions if the entire slate of government macroeconomic and support policies were substituted by a single tax or subsidy. The estimate calculated for the Jamaican winter vegetable sector is -0.38 and indicates that government macroeconomic policies levied a 38% tax on this fledgling export industry while purporting to encourage its development.

As noted earlier government exchange rate policy is often inimical to the development of export industries. The 38% tax shown in Table 4.3 suggests that this may in fact be the case for the Jamaican vegetable industry. More will be said about this, later in this section.

Continuing the examination of the performance ratios it is observed that the EPC and PC were estimated as 2.71 and 1.38 respectively. As would be remembered from Chapter 3 the EPC measures the extent to which government policies in the product market caused observed value added to differ from what it would be in the absence of government intervention. The PC is, of course, merely an extension of the EPC concept which recognizes the importance of factor transfers.

The ratios indicate that value added at distorted market prices was higher than it would have been at international prices. In fact, the PC of 1.38 suggests that removal of the policy distortions which levied the 38% tax on the industry would have brought private value added in line with its social equivalent.

4.2.2 SENSITIVITY ANALYSIS

Prior to the conduct of policy experiments on the base PAM it would be useful to test its sensitivity to changes in the CFs used. The PAM results presented in Table 4.2 are based on CFs calculated in the preceding chapter. While every effort was made to ensure the accuracy of these CFs, their reliability reflect the veracity of the assumptions built into their calculation. While it is difficult to objectively assess the validity of the CFs, the response of the base PAM to underestimation or overestimation of these CFs may be determined.

The results of the sensitivity analysis are presented in Table 4.4 which shows changes in the magnitude of the performance ratios given positive and negative stepped changes in <u>all</u> the CFs. The base case PAM results are also shown in that table for comparative purposes. The analysis indicates that overestimation or underestimation of all conversion factors by as much as 30% would have had no impact on the social and private profitability of the industry, given that revenues and costs are proportionally adjusted. Also, a 30% error in the magnitude of the CFs would not have changed the basic result that a heavy tax was levied on the industry. In fact, a 30% underestimation of all CFs would have produced a tax of as much as 97%.

Table 4.4

Sensitivity of the Base PAM to Stepped Changes in All Conversion Factors

Change in CFs	NPCO	NPCI	DRC	SRP	EPC	PC	PCR
+10%	0.70	0.94	-5.36	-0.25	2.47	1.25	-2.23
+20%	0.64	0.86	-5.36	-0.15	2.26	1.15	-2.23
+30%	0.59	0.80	-5.36	-0.06	2.09	1.06	-2.23
Base	**0.77**	**1.03**	**-5.36**	**-0.38**	**2.71**	**1.38**	**-2.23**
-10%	0.85	1.15	-5.36	-0.53	3.01	1.53	-2.23
-20%	0.96	1.29	-5.36	-0.73	3.39	1.72	-2.23
-30%	1.10	1.48	-5.36	-0.97	3.87	1.96	-2.23

Source: Author's Calculations.

Changes in the CFs have a significant impact on the NPCO and NPCI. A 30% underestimation of all CFs would have increased these ratios by over 40%. Similar conclusions apply to the EPC and PC estimates.

In summary, overestimation or underestimation of the CFs used in the base PAM are not likely to change the fundamental conclusions arrived at in this section. Negative social and private profitability are still observed, as well as a heavy tax on the export sector.

4.2.3 EXCHANGE RATE VALUATION

The estimate of the SRP presented in Table 4.3 suggests that overvaluation of the Jamaican dollar may have constituted a tax on the export sector. This issue clearly deserves further attention.

In order to assess the extent (if any) of the overvaluation of the Jamaican exchange rate the concept of the purchasing parity exchange rate (PPR) may be employed. The PPR is calculated as:

$$PPR_t = R_0 \times \frac{CPI_t^J}{CPI^J_{base}} \times \frac{CPI_t^{US}}{CPI^{US}_{base}}$$

Where:

PPR_t = Purchasing Power Exchange Rate in year t

R_0 = Exchange Rate in the Base Year

CPI^J = Jamaican CPI

CPI^{US} = U.S CPI

The ratio of PPR_t to the observed (official) exchange rate in any period results in an index which tracks the extent of overvaluation (or undervaluation) of the Jamaican dollar relative to the U.S dollar. A value of $PPR_t/R_t < 1.0$ indicates that the Jamaican dollar is undervalued, while a value > 1.0 indicates overvaluation of the domestic currency.

The results of the calculations and the raw data are presented in Table 4.5 and 4.6 respectively. The analysis indicates that the Jamaican dollar was severely overvalued over the 1982-1988 period during which the Agro 21 program was implemented. In fact, the purchasing power exchange rate calculations suggest that the extent of overvaluation of the Jamaican dollar was of the order of 600% to 1100% over the sample period, and relative to the 1962 base year.[3]

It is to be remembered that in the base PAM presented above all revenue and cost streams were discounted to 1982/3 dollars. In 1982 the Jamaican dollar was

[3]The year 1962 was chosen as base given that it represented a period of stability in the country's balance of payments (see Bank of Jamaica, 1985). Trade data published by the IMF also indicate that the country's net trade balance (in absolute terms) was the lowest in 1962, suggesting a close balance in aggregate supply and demand for foreign exchange (International Monetary Fund, various issues).

Table 4.5

Purchasing Power Parity Exchange Rates, 1960-1988

Year	CPI_t^J/CPI_{1962}^J	$CPI_t^{US}/CPI^{US}_{1962}$	PPR_t	PPR_t/R_t
1960	0.92	0.98	0.64	0.89
1961	0.98	0.90	0.62	0.87
1962	1.00	1.00	0.71	0.99
1963	1.02	1.01	0.74	1.03
1964	1.03	1.02	0.75	1.05
1965	1.07	1.04	0.79	1.11
1966	1.08	1.07	0.82	1.14
1967	1.14	1.10	0.89	1.07
1968	1.18	1.15	0.97	1.16
1969	1.26	1.21	1.09	1.31
1970	1.44	1.28	1.32	1.58
1971	1.52	1.33	1.44	1.84
1972	1.61	1.38	1.59	1.87
1973	1.89	1.46	1.97	2.17
1974	2.39	1.63	2.78	3.06
1975	2.82	1.78	3.58	3.94
1976	3.08	1.88	4.13	4.54
1977	3.44	2.00	4.91	5.40
1978	4.64	2.16	7.15	4.22
1979	5.98	2.40	10.24	5.75
1980	7.61	2.73	14.83	8.32
1981	8.60	3.01	18.47	10.37
1982	9.14	3.19	20.81	11.68
1983	10.21	3.30	24.04	7.34
1984	13.05	3.44	32.03	6.49
1985	16.39	3.56	41.64	7.59
1986	18.87	3.63	48.89	8.92
1987	20.13	3.76	54.01	9.82
1988	21.71	3.91	60.80	11.09

Source: Author's calculations based on data in Table 4.6.

Table 4.6

CPI and Exchange Rates for Jamaica and the United States,
1960-1988

Year	CPI_t^J	Exchange Rate	CPI_t^{US}
1960	5.6	0.7133	27.5
1961	6.0	0.7122	27.8
1962	6.1	0.7136	28.1
1963	6.2	0.7152	28.5
1964	6.3	0.7168	28.8
1965	6.5	0.7136	29.3
1966	6.6	0.7168	30.2
1967	6.8	0.8312	31.0
1968	7.2	0.8388	32.3
1969	7.7	0.8331	34.1
1970	8.8	0.8355	36.1
1971	9.3	0.7835	37.6
1972	9.8	0.8518	38.9
1973	11.5	0.9091	41.3
1974	14.6	0.9091	45.8
1975	17.2	0.9091	50.0
1976	18.8	0.9091	52.9
1977	21.0	0.9091	56.3
1978	28.3	1.6950	60.6
1979	36.5	1.7814	76.6
1980	46.4	1.7814	84.5
1981	52.4	1.7814	84.7
1982	55.8	1.7814	89.7
1983	62.3	3.2778	92.6
1984	79.6	4.9300	96.6
1985	100.0	5.4800	100.0
1986	115.1	5.4800	101.9
1987	122.8	5.5000	105.7
1988	132.9	5.4800	109.9

Sources:

1. CPI for Jamaica: PIOJ, Economic and Social Survey, various issues.

2. CPI for the US: US Department of Commerce, Bureau of the Census, Statistical Abstract of the United States, various issues.

3. Exchange rates calculated from data in: IMF, International Financial Statistics, various issues.

overvalued by as much as 1100% giving credence to the tax on export activities revealed by the SRP calculations. Interestingly, the exchange rate tax would have been levied against firms in the export industry during their first critical year of operation when a significant portion of their capital equipment purchases would have been made.[4]

4.2.4 IMPACT OF IMPORT DUTY CONCESSIONS

This subsection examines the impact of exchange rate overvaluation and import duty concessions on the performance of the Jamaican winter vegetable industry. The analysis presented in this subsection is essentially a counterfactual experiment. Although the Jamaican dollar was found to be overvalued in 1982, it was pointed out in Chapter 2 that exemptions on import duties were hastily withdrawn once the Agro 21 program was initiated. In effect, Jamaican exporters experienced little relief from duties on imported raw materials and capital equipment.

The analysis presented here seeks to elucidate the impact a policy of continued import duty concessions would have had on the profitability of the Jamaican industry. It was noted in Chapter 2 that imports of capital equipment and raw materials attract consumption duties, stamp duties and import duties. Considered in combination these taxes could raise the domestic price of capital equipment and raw materials by as

[4]Of the three firms under investigation one began operations in 1982 while a second started in 1986. In these years the Jamaican dollar was overvalued by 1100% and 900% respectively. The third firm began its export operations in 1983, and would have faced a Jamaican dollar which was overvalued by over 700%

much as 60% and 50% respectively, over their world levels. Exemptions would, of course, have the opposite effect on domestic prices.

It has been argued earlier that exchange rate overvaluation is an implicit tax on export activities. If a country's exchange rate is overvalued, the cost of imported inputs (in DCUs) would be lower than world levels. The impact of an overvalued exchange rate therefore acts in opposition to government subsidy programs, and the net effect on tradables would depend on the magnitude of the subsidy applied and the extent of overvaluation.

To capture the impact of these two government policies, a number of adjustments were made to the base PAM. The effect of import duty relief will, of course, manifest itself in a reduction in the domestic input prices paid by local exporters, and so the domestic prices of tradables were adjusted downwards by the appropriate percentage. Capital equipment costs were reduced by 60%, and raw material costs by 50%. These new (subsidized) costs must next be converted to world price equivalents, and this must reflect a different relationship between domestic and world price levels.[5]

The exchange rate tax on the sector was previously calculated at 39%, and this would serve to raise the cost of tradables by an equivalent percentage. The escalation in input costs can be expected to be moderated by the imposition of the subsidies on inputs which should depress prices by 50-60% relative to social equivalents. The net effect of the two opposing policies should be a small subsidy of 11% on raw

[5]Jamaican government policies, of course, have no impact on world prices. Jamaica is a price taker in international input markets.

material inputs and 21% on capital equipment. The base CFs were therefore adjusted to 1.11 for tradable raw materials and 1.21 for capital equipment purchases. The above two changes should reflect the short run impact of a policy of input subsidization. Of course, in the long run even domestic factor prices would be affected, as economic agents respond to the changing level of profitability in the industry.

A final change was made to the base PAM prior to the experiment. Given that all tradables should be affected by the exchange rate tax, the CF_{ea} was adjusted to 1.39 from 1.30 in order to more closely measure the full extent of taxation on tradable outputs.

The resulting performance ratios are reported in Table 4.7. Even with the application of these incentives, the industry posts a social loss of J$ 29 million (in 1982/3 dollars). This is a significant sum, although considerably less than the J$ 77 million lost in the base PAM. At market prices the loss incurred by the industry is also considerably reduced.

The extent of the tax relief experienced by the industry is reflected in the SRP which increases from -0.38 to -0.30. While still negative, the revised estimate does indicate a reduced level of taxation of the export operations. The NPCI of 0.84 similarly indicates significant input subsidization. As can be noted from Table 4.7, in the absence of government policies input prices were 3% higher than world levels.

The important point to be noted here is that is that even in an environment of input subsidization, private and social profitability would have remained negative, and the industry would not have been viable. In fact, a far more generous regime of input

Table 4.7

Impact of Import Duty Concessions on the Base PAM

Ratio/Profits	Value	Base Value
NPCO	0.72	0.77
NPCI	0.84	1.03
DRC	1.79	-5.36
SRP	-0.30	-0.38
EPC	0.56	2.71
PC	1.84	1.38
PCR	3.60	-2.23
Social Loss (J$m)	-28.60	-76.50
Private Loss (J$m)	-52.60	-105.40

Source: Author's Calculations.

subsidies would have had to be in place if private profitability was to be achieved. Apart from the obvious budgetary implications, a range of non-efficiency objectives would also need to be factored into any policy makers' decision to provide a broader range of industry support.

4.3 THE IMPACT OF TECHNOLOGY CHOICES

In this section the impact of technology choices on the performance of the Jamaican winter vegetable industry is addressed. The specific technology investigated is the drip irrigation system which was widely utilized by Jamaican exporters. As was noted in an earlier chapter this technology choice, while perhaps justifiable given the location of the enterprises, was expensive. Also, this capital intensive technology was not used by Mexican and Floridan producers, the major rivals in the North American vegetable trade. It is logical to inquire about the impact of this technology on the profitability of the industry.

Of the five enterprises which entered and exited the industry over the 1982/3-1986/7 period all but one adopted advanced drip systems. The smallest firm in the industry (located in Trelawny) was the only enterprise to rely exclusively on flood and overhead sprinkler systems for its irrigation needs. This firm would have provided an appropriate benchmark for a objective comparison of the technologies, but unfortunately, revenue and costs data for this enterprise were not available.

In 1985/6, however, the largest firm in the industry produced cucumbers using a combination of drip and flood methods. Approximately 49 ha (two blocks) were planted to cucumbers on marly and clay soils and irrigated using the drip system. Two other blocks (a combined area of 69 ha) were planted to cucumbers and irrigated using the flood method. Marly and clay soils were again used. Detailed revenue and cost data were available for these blocks, allowing for the construction of PAMs for each irrigation method.

The first difficulty in constructing PAMs for the two irrigation methods stemmed from the need to allocate the fixed cost of the irrigation system. The drip system was used to produce a number of different crops in 1985/6 and so only a portion of the capital cost can properly be attributed to the production of cucumbers in that year. Further, the firm's total capital expenditure for the year was known but no firm estimates of the proportion of that cost attributable to the drip system were available.

To deal with the latter problem an estimate of 60% of the total capital cost was attributed to the drip system. This estimate coincides with that contained in an investment proposal for the establishment of this enterprise cited by Pragma and TMS Associates (1989). To deal with the allocation of the estimated irrigation cost, the capital recovery method was used (see Exhibit 4.1). This technique allows for the computation of the annual payments required to recover the cost of the fixed asset over its useful life (in addition to a modest economic return). In these calculations the share of irrigation costs attributable to cucumbers was based on the proportion of the total irrigated acreage planted to this crop.

Exhibit 4.1
Calculation of Annual Equivalent Value of Capital Equipment

Total Capital Expenditure (net Depreciation)	J$ 18.9m
Expenditure on Irrigation (assumed 60%)	J$ 11.3m
No. of ha of Irrigated Crops	365
No. of ha of Irrigated Cucumbers	49
Irrigation Expenditure Attributed to Cucumbers	(49/365) x 11.3 = J$ 1.52m
Capital Recover Factor (10 years, 2%)	0.111327
Annual Capital Cost Attributed to Cucumbers	1.52 x 0.111327 = $ 0.17m
Annual Capital Cost/ha	($0.17/49) = $3,458.7
Expenditure on Non-irrigation Capital	$18.9m - $11.3m = $7.56m
No. ha of Cucumbers (Flood and Drip)	118
Total No. of ha Sown (all crops)	472
Share of Cucumbers in Total ha	(118/472) = 0.25
Share of Non-irrigation Capital Attributable to Cucumbers	0.25 x 7.6 = 1.9
Annual Non-irrigation Cost Attributable to Cucumbers	1.9 x 0.111327 = 210,408
Annual Non-irrigation Costs/ha	210,408/118 = $1,783

Sources:
1. Jamaica Agro Products, n.d.
2. Pragma and TMS Associates, 1989.

The capital cost of the irrigation system attributable to cucumber was estimated as $J3,458/ha, while non-irrigation capital costs were estimated as $J1,783/ha. In the PAMs constructed for each technology (Table 4.8 and 4.9) irrigation costs were included only for the blocks using this technology, while non-irrigation capital costs were included in both PAMs.

The comparative analysis of the technologies reveal that use of both technologies resulted in net losses to the firm. In social terms drip irrigated blocks yielded a loss of $J4,345/ha while the loss from the flood irrigated acreage stood at $J3,796/ha. This is an interesting result given that the drip irrigated blocks were higher yielding and produced a higher proportion of top quality produce (Table 4.10). As noted from Table 4.10 the drip irrigated blocks produced a higher proportion of the Super Select grade which commands a price premium on international markets. Also, yield per ha for the drip irrigated and flood irrigated blocks were 4,825 kg/ha and 2,730 kg/ha, respectively.

Despite the above yield and price advantage the cost associated with the drip technology sharply depressed overall profitability. Also important to note, however, is that adoption of the less capital intensive technology would not by itself have ensured social profitability.

Table 4.11 summarizes the performance ratios for the two technologies. The estimates presented are not widely different for the two irrigation methods. There are differences in the PCR, EPC and PC ratios but very little divergence in the more important indicator of social profitability and comparative advantage.

Table 4.8

PAM for Drip Irrigated Cucumber Production, 1985/6
(J$/ha)

Cost/Revenue	Valuation (Market)	CF	Valuation (Social)	Divergence
Gross Revenue	9,814.68	1.3	12,759.08	-2,944.4
Tradable Inputs:				
Equipment (net depreciation)	1,783.12	0.99	1,765.28	17.8
Drip System (net depreciation)	3,458.76	0.99	3,424.17	34.5
Packing Material	161.11	0.88	141.77	19.3
Boxes	942.56	0.88	829.45	113.1
Fertilizer	567.18	0.88	499.12	68.0
Chemicals	589.10	0.88	518.41	70.6
Supplies	888.31	0.88	781.71	106.6
Total Tradable	8,390.14		7,959.91	403.2
Non-Tradables:				
Transportation	3,296.22	0.78	2,571.05	725.1
Electricity	262.49	0.84	220.49	41.9
Unskilled Labour	965.03	1.20	1,158.03	-193.0
Crop Mgm't	559.51	0.88	492.37	67.1
Marketing	1,248.89	0.65	811.78	437.1
Administration	1,692.77	0.88	1,489.64	203.1
Other Packing	8.00	0.88	7.04	0.9
Other Growing	1,142.03	0.88	1,004.99	131.0
Other Overhead	1,577.69	0.88	1,388.37	189.3
Total Non-Tradable	10,752.63		9,143.76	1,608.9
Profit/Loss	-9,328.09		-4,344.59	-4,983.5

Source: Jamaica Agro Products, n.d.

Table 4.9

PAM for Flood Irrigated Cucumber Production, 1985/6
(J$/ha)

Cost/Revenue	Valuation (Market)	CF	Valuation (Social)	Divergence
Revenue	5,562.2	1.3	7,230.86	-1,668.7
Tradable Inputs:				
Equipment (net depreciation)	1,783.12	0.99	1,765.29	17.8
Drip Irrigation	0	0.99	0	0
Packing Materials	92.61	0.88	81.50	11.1
Boxes	538.68	0.88	474.04	64.6
Fertilizer	432.37	0.88	380.49	51.9
Chemicals	611.57	0.88	538.18	73.4
Supplies	758.98	0.88	667.90	91.1
Total Tradable	4,217.33		3,907.90	309.9
Non-Tradable Inputs:				
Transportation	1,944.85	0.78	1,516.98	427.9
Electricity	204.95	0.84	172.16	32.8
Unskilled Labour	942.01	1.20	1,130.41	-188.4
Crop Mgm't	392.37	0.88	345.29	47.1
Marketing Cost	716.24	0.65	465.56	250.7
Administration	1,692.77	0.88	1,189.64	203.1
Other Packing	24.66	0.88	21.70	3.0
Other Growing	670.20	0.88	589.78	80.4
Other Overhead	1,577.64	0.88	1,388.37	189.3
Total Non-Tradable	8,165.74		7,119.89	1,045.9
Total Cost	12,383.07		11,027.29	1,355.8
Profit/Loss	-6,820.84		-3,796.43	-3,024.44

Source: Jamaica Agro Products, n.d.

If the results for this particular crop during the 1985/6 season can be considered representative, widespread adoption of the flood technology would not have spelt the difference between the success and failure of the Jamaican industry. If such adoption were feasible, however, given the location of the enterprises, it would have resulted in a reduction in production costs. This could have been an important first step in the industry's transition to profitability in such a highly competitive market.

4.4 MARKETING AND TRANSPORTATION

This section examines in more detail the costs associated with the marketing and transportation of fresh produce. In an island economy, such as Jamaica, transportation costs are expected to be high and provide a source of natural protection for producers in the overseas market. In fact data provided in Table 4.2 indicate that transportation costs represented roughly 12% of the industry's total costs, and 28% of its total domestic costs. It is, therefore, important to examine in more detail efficiency within the marketing and transportation network.

Due to the unavailability of disaggregated data for all firms in the industry reliance must again be placed on the largest firm's production for 1985/6. The extent to which this firm and growing season are representative of the industry is a moot point, but this was the only enterprise able to provide comprehensive marketing and transportation costs. The disaggregated data for the various crops produced in 1985/6

Table 4.10

Cucumber Production: Price and Quality Distribution

Grade	Drip Irrigated Production (Boxes)	Flood Irrigated Production (Boxes)	Average Price/ Box ($J)
Super Select	551	304	58.19
Select	208	114	36.98
Small	88	78	47.05
Large	37	27	36.24
Count 24	142	62	22.54

Yields/ha: Drip Irrigated Blocks: 4,825 kg/ha
Flood Irrigated Blocks: 2,730 kg/ha

Source: Jamaica Agro Products, n.d.

Table 4.11

Ratio Analysis: Alternative Technologies

	RATIO						
Technology	NPCO	NPCI	DRC	SRP	EPC	PC	PCR
Drip Irrigation	0.77	1.05	1.9	-0.39	0.29	2.15	7.55
Flood Irrigation	0.77	1.07	2.1	-0.42	0.40	1.79	6.07

Social Loss: Drip Irrigation: J$ 4,345/ha
Flood Irrigation: J$ 3,796/ha

Source: Author's Calculations.

are shown in Tables 4.12 and 4.13, while the PAM constructed for the marketing and transportation functions is shown in Table 4.14.

Marketing costs were revalued to social prices using the CF for distribution, while road haulage and freight were shadow priced using the CF_T. Brokerage fees and export/shipping management were revalued using the ACF and CF_{SL}, respectively which as was shown in Chapter 3 take on the same numerical value.

Examining the various cost categories, it is immediately apparent that freight cost (both sea and air) was the most heavily distorted link in the marketing chain. In fact, the price of transportation services faced by Jamaican exporters was considerably above world levels. Jamaica is a price taker in the international market for transportation and does not have any specific policies in place which would adversely affect the price of this service. The divergence observed may therefore reflect the exercise of monopoly power on the part of international shipping lines serving the island.[6]

Handling costs are also seen to be an area where efficiency could be improved. Handling charges (in DCUs) were $4,363/ha above world equivalents. It needs to be re-emphasised at this point that the above analysis considers only one firm's performance during one growing season, and may therefore not reflect the situation faced by all firms in the industry.

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[6]This is of course, an empirical matter which falls outside the scope of this study but is deserving of further investigation.

Table 4.12

Transportation Costs for the Largest Firm in the Industry During the 1985/6 Growing Season (J$/ha)

Crop	Road Haulage	Freight	Brokerage Fees	Export/ Shipping Management
Sweet Pepper	225.0	4,704.7	161.4	119.6
Cucumbers	157.7	2,170.3	172.8	119.6
Melons	179.6	2,555.4	177.1	119.6
Eggplant	357.1	7,734.1	235.8	119.6
String Beans	88.3	2,457.6	37.4	119.6
Squash	68.0	1,643.9	51.3	119.6
Total	1,075.7	21,266	835.8	717.6

Source: Jamaica Agro Products, n.d.

Table 4.13

Revenues and Marketing Costs for the Largest Firm in the Industry During the 1985/6 Crop Year
(J$/ha)

Crop	Revenue	Commission	Handling
Peppers	15,568.7	1,245.5	1,214.4
Cucumbers	7,029.7	636.5	346.0
Melons	20,291.5	1,623.3	7,492.7
Eggplant	19,202.8	1,536.2	1,527.0
String Beans	8,781.7	658.1	1,418.8
Squash	3,601.7	288.1	467.5
Total	74,476.1	5,987.7	12,466.4

Source: Jamaica Agro Products, n.d.

Table 4.14

Post-Farm PAM for the Largest Firm in the Industry During the 1985/6 Growing Season
(J$/ha)

Cost/Revenue	Valuation (Market)	CF	Valuation (Social)	Divergence
Revenue	74,476.1	1.3	96,818.93	-22,342.83
Costs:				
Commissions	5,987.7	0.65	3,892.01	2,095.69
Handling	12,466.4	0.65	8,103.16	4,363.24
Total Marketing	18,454.1		11,995.17	6,458.93
Road Haulage	1,075.7	0.78	839.05	236.65
Freight	21,266.0	0.78	16,587.48	4,678.52
Brokerage	835.8	0.88	735.50	100.30
Export/Shipping Management	717.6	0.88	631.49	86.11
Total Transportation	23,895.1		18,793.52	5,101.58
Total Marketing and Transportation	42,349.2		30,788.69	11,560.51
Profit/Loss on Marketing and Transportation Activities	32,126.9		66,030.25	-33,903.35

Source: Author's calculations based on data in Tables 4.12 and 4.13; and CFs in Chapter 3.

4.5 SUMMARY

This chapter has examined the impact of government policies and technology choices on the performance of the Jamaican winter vegetable sector. It was discovered that the industry lost roughly J$77 million (valued at social prices) and was subjected to a severe 38% tax by government macroeconomic policies. It was also found that this result was invariant to changes of 10-30% in the value of the CFs used in the base PAM.

Government incentive policies were also discussed and a counterfactual experiment was conducted in which generous input subsidies on capital equipment and raw materials were provided to firms in the industry. Losses incurred by the enterprises were observed to fall significantly in response to the incentives, but were not eliminated.

The choices made by Jamaican exporters in their selection of irrigation technology was also investigated. It was found that the use of drip irrigation, while producing higher yields and a higher proportion of better quality produce, also resulted in a higher social loss to producers when compared to the flood method. Use of both irrigation methods were, however, associated with substantial losses to Jamaican exporters.

Post-farm activities were also examined in this chapter, and the point was made that freight and handling activities contributed significantly to the losses experienced by the Jamaican industry. The market for these activities was found to be seriously distorted, and constituted a tax on Jamaican fresh vegetable exports.

CHAPTER 5

AN ANALYSIS OF THE MEXICAN WINTER VEGETABLE INDUSTRY: INSTITUTIONAL STRUCTURE AND POLICY ENVIRONMENT

5.1 INTRODUCTION

The preceding chapters have examined a number of issues related to the structure and performance of the Jamaican winter vegetable program. This chapter takes the analysis outside the strict geographic confines of the Jamaican borders and considers in more detail the nature of the competitive environment within which new exporters must operate.

In the present chapter the organization and operation of the Mexican vegetable industry is described, and parallels are drawn with the Jamaican program. As noted at several points throughout the preceding discussion, Mexico has dominated the U.S residual market for several years, controlling as much as 98% of the market for some products. Any assessment of the competitive environment facing new entrants to the U.S market is therefore essentially an analysis of the Mexican industry. The underlying logic of the analysis presented in this chapter rests on the assumption that Jamaica, and other LDC exporters, can improve their chances of successful market entry by an understanding of Mexican export strategy. The emphasis in this chapter is therefore on the institutional characteristics of the industry, and the elements of the policy environment which have led to Mexico's success.

Following the introduction the structure of the Mexican industry is described. The focus of this section is on the close network of relationships which exists between Mexican exporters and U.S importing agencies, as well as on the mechanism for co-ordinating export volumes and quality. The third section of the chapter examines the government incentives available to producers, and contrasts these with the level of support afforded the Jamaican initiative. Section 5.4 deals with the legal and technological challenges that have had to be overcome by Mexican exporters. In this section the various trade disputes which have erupted between Mexican vegetable producers and their U.S counterparts are reviewed. The analysis in this section should provide some clues to the entry barriers that are likely to be erected should other LDC exporters make a serious attempt to become established in this market. The fifth and final section of the chapter summarises the main points of the discussion.

5.2 THE STRUCTURE OF THE MEXICAN VEGETABLE INDUSTRY

For reasons to be identified later the production of vegetables in Mexico is concentrated in the state of Sinaloa[1]. Data provided in Table 5.1 indicate that this state

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[1]Sonora was once a leading area of vegetable production for exports but because of occasional mild freezes production operations moved south to Sinaloa.

TABLE 5.1

Acreage Planted and Total Production of Tomatoes by State, 1989

State	Acreage Planted (ha)	%	Production (t)	%
Sinaloa	29,450	42.9	1,096,200	67.5
Tamaulipas	7,008	10.2	62,098	3.8
Veracruz	3,217	4.6	30,038	1.8
Michoacan	2,925	4.3	29,340	1.8
Baja California	2,885	4.2	125,209	7.7
Morelos	2,371	3.5	41,080	2.5
Guanajuato	1,897	2.8	30,994	1.9
Hidalgo	1,992	2.9	24,811	1.5
Sonora	1,379	2.0	26,674	1.6
Other	15,433	22.5	158,358	9.7
Total	68,557		1,624,802	

Source: Confederacion Nacional de Productores de Hortalizas (CNPH), Programacion de Siembras y Perspectivas de Expectacion de Tomates, Temporada 1990-1.

accounted for 68% of Mexico's tomato production in 1989, and 43% of the total number of hectares planted in the same year. Sinaloa was followed by Baja California in terms of total output, and Tamaulipas in terms of total hectares planted. A similar picture emerges when one examines the total volume of tomato exports by the various states (Table 5.2). Sinaloa is seen to have accounted for roughly 74% of exports, over the 1985/6 to 1989/90 period, with Baja California representing some 21%. Three key areas within Sinaloa - Los Mochis, Guasave and Culiacan are particularly important in supplying the U.S. vegetable market (Exhibit 5.1). The three major production areas along the Baja peninsula are Mexicali, San Quintin and Santo Domingo (Buckely et al 1986).

The production of winter vegetables in Sinaloa is a highly concentrated and close knit industry. There are about one thousand small owners, ejiditarios[2] and tenant farmers who produce vegetables in Sinaloa. Approximately half of the state's exports are, however, accounted for by ten large farms of between 300 - 1,500 ha in size. The operations are based primarily in the Culiacan valley but these producers also operate additional holdings in Los Mochis and Guasave (Emerson 1980). These large farms it should be noted are run by families which oversee all growing, packing and marketing operations, and have been in the business of vegetable production since the 1950's.

Emerson (1980) notes that there are approximately 100 vegetable packing plants in Sinaloa. The 10 largest farms operate roughly 25 of these packing facilities and handle at least half of the total vegetable exports. The export marketing channels for

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[2]Ejidatarios are farmers who cooperatively cultivate government owned land.

TABLE 5.2

Exports of Tomatoes Controlled by CNPH by State,
1985/6 - 1989/90

State	YEAR					Average %
	1985/6	1986/7	1987/8	1988/9	1988/90	
	.... tons					
Sinaloa	322,786	338,330	273,383	253,317	269,335	74.2
Baja California	83,263	106,699	94,672	48,456	73,190	20.7
Jalisco	9,284	3,873	8,289	1,018	4,759	1.4
Sonora	5,071	6,324	5,709	7,095	6,547	1.6
Tamaulipas	3,941	3,415	4,359	1,274	2,880	0.8
Michoacan	438	110	237	472	362	0.1
Other	6,084	5,376	5,383	3,055	4,317	1.2
Total	430,867	464,127	392,032	314,687	361,390	100.0

Source: Confederacion Nacional de Productores de Hortalizas (CNPH), Programacion de Siembras y Perspectivas de Expectacion de Tomates, Temporada 1990-1.

Exhibit 5.1

Mexico: Major Production Areas

Source: Buckley et al 1986.

Mexican fresh produce is shown below in Exhibit 5.2. The bulk of Sinaloa's exports flow through Nogales, Arizona. Produce is held temporarily on the Mexican side of Nogales for custom inspection and the collection of export fees. Simmons, Pearson, and Smith (1976) have noted that Mexican trucks are not permitted to enter the United States except to unload their produce at the port of entry. Vegetables must therefore be unloaded and then re-loaded onto U.S trucks prior to movement to the retail outlets. This system is, of course, expensive and inefficient. The above authors have also pointed out that problems of communication between producers and border distributors have contributed to inefficiencies in the marketing system.

Strong grower-distributor relationships have been formed between agents located between the Culiacan shipping points and Nogales distribution centre.[3] There are approximately 50 distributors in Nogales, Arizona, and together with a few brokerage companies they constitute a powerful association known as the West Mexico Vegetable Distributors Association (WMVDA).

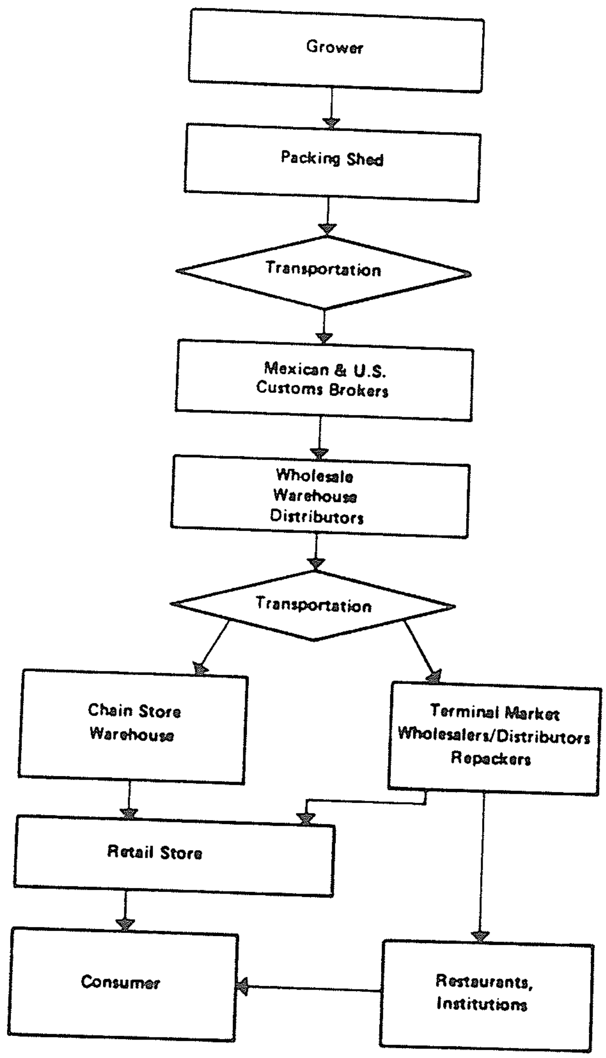
The WMVDA was established in 1964 as an American trade association and operates in conjunction with the Food Marketing Institute and other retail organizations to market produce within the United States. The distributors of the WMVDA control the bulk of the fresh vegetable exports coming in from Mexico.

It is interesting to note that many distributors are financially integrated with Mexican growers. Buckley et al (1986) note that roughly 60% of the distributors in

[3]The bulk of Baja's vegetable exports flow through San Ysidro, California to the Chula Vista market. Similar close relationships exists between growers and distributors at these points.

Exhibit 5.2

Mexico: Marketing Channels



Source: Buckley et al 1986.

Nogales are partners with one or more Mexican producers. These partnerships account for roughly 60% of the Mexican produce entering the United States. Approximately 20% of the distribution firms are wholly owned subsidiaries of Mexican producers and account for 10% of imports. The remaining 20% of distributorships are independent firms which contract with Mexican growers for produce. These independents handle an estimated 30% of produce imports form Mexico.

Contracts between producers and distributors are straightforward agreements to purchase a certain volume of produce provided delivery date, quality, size and other criteria are satisfied. Mexican shipments are sent to Nogales Arizona on consignment, a practice which was not the norm in the 1960s and 1970s. In those early periods producers merely shipped their produce to the U.S border in the hope that the market would absorb supplies at a price high enough to cover production and marketing costs (with a fair return to the producer). As is well known, in the case of consignment sales, brokers do not take title to the goods they handle, and therefore all market and production risks are for the grower's account. It has been argued that consignment transactions are the reason for the high volumes and rapid sales turnover which have become characteristic of the vegetable trade. In their attempt to minimise risks, brokers usually dispose of perishable products quickly irrespective of prevailing prices (Sanderson 1986).

Consignment sales obviously favour the U.S distributor. Mexican producers would clearly benefit from a firm contract price rather than the auction price they currently receive after retailers have bid on their produce. Also, it would be in the best interest of the exporter to transfer ownership of the shipment at the border when the produce is at its peak quality. This however is not the norm in the industry, and new exporters need to recognize the potential downside risks of such consignment transactions.

Apart from the handling of produce U.S distributors also perform other services for Mexican growers such as the provision of market intelligence, supervision of growing and packing operations as well as the provision of U.S. farm inputs. In fact, Andrew, DeBoon, and McPherson (1975) have estimated that 75% of the Mexican vegetable exporters' capital needs were supplied from U.S sources in the mid 1970s. The absence of any formal relationship between Jamaican producers and the middlemen who control distribution should be noted at this point. Channel members had no pecuniary interests in Jamaican exports and hence no incentive to ensure timely and efficient passage through the system. Jamaica did not provide the only (or even an important) source of supply (see market share data in Chapter 2).

Once cleared by Mexican customs officials produce moves to the U.S wholesale warehouses where customs brokers collect import tariffs, process export documents and provide the necessary inspection certificates. Many customs brokers operate on both sides of the U.S border, but the brokerage function is also highly concentrated with three firms handling the bulk of the produce on both sides. Competition among U.S customs brokers is keen with non-price factors being the major determinant of the distribution of imports among firms (Buckley et al 1986).

From the wholesale warehouse, produce is transported to chainstore warehouse and terminal markets and finally on to the final consumer via retail outlets, and restaurants and institutions.

5.2.1 SEGMENTATION OF THE U.S. MARKET

It has already been noted that producers in Mexico and Florida are the key players in the U.S vegetable market. In both Mexico and Florida the winter vegetable season extends from October to May/June of the following year. Shipments are usually greatest in the December to April period when production in both regions is highest. In the case of tomatoes, cucumbers, peppers and eggplant, Florida's shipments are greatest in late fall and early spring. Mexico's shipments, on the other hand, are highest in mid-winter (Simmons, Pearson and Smith 1976).

Geographically, Mexico has traditionally concentrated on markets in the western United States, while Florida has dominated the eastern markets. In the mid-west, competition between these two rivals has tended to be slightly more balanced. The above pattern is clearly seen in data provided in Simmons, Pearson, and Smith (1976), which are summarised in Table 5.3.

Table 5.3 shows the average market shares achieved by Mexican and Floridian exporters disaggregated by region. The data are simple averages for the 1962-1974 period, and closely reflect Mexico's dominance of the Western United States. This country's share of the U.S market ranged from 70% in the case of peppers to as much

TABLE 5.3

Mexico and Florida Average Market Shares for Tomatoes, Peppers, Cucumber and Eggplant, by Region

	MARKET SHARES (%)			
	Tomatoes	Peppers	Cucumber	Eggplant
Northeast:				
Florida	83.4	92.3	81.4	80.3
Mexico	16.4	7.7	18.6	19.7
Southeast:				
Florida	82.6	92.2	85.0	86.9
Mexico	17.4	7.8	15.0	13.1
Midwest:				
Florida	58.3	81.4	73.7	71.8
Mexico	41.7	18.6	26.3	28.2
West:				
Florida	12.3	30.5	21.1	14.2
Mexico	87.7	69.5	78.9	85.8

Source: Calculated from Simmons, Pearson and Smith, 1976.

West: Dallas, Ft. Worth, Denver, Houston, L.A., Oklahoma City, Portland, Salt Lake City, San Antonio, San Francisco and Seattle.

Midwest: Chicago, Cincinnati, Cleveland, Detroit, Indianapolis, Kansas City, St-Louis, Milwaukee, Minneapolis and Louisville.

Southeast: Atlanta, Birmingham, Columbia, Memphis, Miami, Nashville and New Orleans.

Northeast: Albany, Baltimore, Boston, Buffalo, NYC, Philadelphia, Pittsburg, Providence and Washington, D.C.

as 88% in the case of tomatoes. Market shares achieved by Florida exporters are correspondingly weak in this geographic segment.

Mexico appears to have been less successful in the mid-western U.S markets. Although an average market share of 42% was achieved for tomatoes, Mexico's performance in the other three product groups is far less strong. Florida exporter's share of the mid-western market is seen to range from 58% to 81%.

The north-eastern and south-eastern segments of the U.S vegetable market are seen to be dominated by Florida exporters, with market shares ranging from 81% to 92%. The best market share performance achieved by Mexico in these segments is 20% in the case of eggplant shipments to the north-east.

5.2.2 THE REGULATION OF MEXICAN VEGETABLE EXPORTS

There are two principal agencies responsible for the regulation of Mexican vegetable exports. The first is the Confederacion de Asociaciones Agricolas del Estado de Sinaloa (CADDES) which is an association of vegetable growers in Sinaloa.[4] The second major organization is the Confederacion Nacional de Productores de Hortalizas (CNPH) which is an umbrella organization representing state and local producer

[4]A similar organization (CAASS) represents vegetable growers in southern Sonora.

organizations.[5] In 1982 CNPH represented some 226 local associations with a combined membership of 16,000 (Bredhal et al 1983).

The above two organizations exert a powerful influence on Mexico's production and export of winter vegetables. This influence is exerted at several points in the production and marketing system beginning with the submission of recommendations to the federal government regarding the area to be planted to vegetables on federally irrigated lands. Export production quotas are also established and these are presented to state organizations which in turn solicit applications from individual producers in their state. Bredhal et al (1983) note that these applications often exceed the allotted area and a final decision must be negotiated. Table 5.4 shows the number of hectares requested by various organizations for the production of tomatoes in 1990-1991. In order to enforce the final decision on acreage allocation, CADDES and CNPH are also involved in determining the availability of irrigation water for crop production in the various areas. Sanderson (1886) notes that the Comite de Usarios meets with officials in Mexico's federally irrigated districts to determine water usage in the area. CADDES and CNPH members are well represented on these councils.

The allocation of water among the various crops is dependent on the relative priority assigned to each in the country's national agricultural policy. Top priority is officially given to sugar cane with winter vegetables being assigned the lowest rank after food crops. In fact, there has never been a shortage of water for vegetable production

[5]CNPH was formerly known as the Union Nacional de Productores de Hortalizas (UNPH).

TABLE 5.4

Number of Hectares Requested for the Production of Tomatoes by Organization and State 1990-1991

State/Organization	Number ha	%
1. BAJA CALIFORNIA	4	0.009
AAL La Isleta Mpio. de Tijuana, B.C.	4	
2. JALISCO	689	1.5
AAL Fco. I. Madero	10	
AAL de Tecomates	2	
AAL de Autlán	677	
3. MICHOACAN	105	0.2
UAR "José Ma. Morelos"	100	
AAL de El Duero	5	
4. NAYARIT	1,589	3.6
AAL de Bahia de Banderas	6	
AAL del Valle de Banderas	24	
AAL de Ruiz	41	
AAL Margen Izq. Rio Santiago	676	
AAL Prod. Cereales Leg H. Stgo. Ixc.	294	
AAL de Rosamorada	134	
AAL de Tuxpan	389	
AAL Rio Acaponeta	5	
AAL de Tecuala	10	
AAL de San Andrés	10	
5. SINALOA	40,353	90.6
AAL del Rio Fuerto Sur	5,844	
AAL Rio Sinaloa Pte.	9,015	
AAL del Rio Mocorito	1,105	
AAL del Rio Culiacán	17,782	

TABLE 5.4 (continued)

Number of ha Requested for the Production of Tomatoes by Organization and State
1990-1991

	State/Organization	Number ha	%
	AAL del Rio Lorenzo	555	
	AAL del Rio Elota	159	
	AAL Ej. del Valle del Carrizo	379	
	AAL Ej. Mpio. de Ahome	1,637	
	AAL Ej. Mpio. del Fuerte	826	
	AAL Ej. Mpio. de Guasave	947	
	AAL Ej. Mpio. de Sinaloa de Leyva	1,136	
	AAL Ej. Mpio. de Culiacán	948	
	AAL Ej. Mpio. de Angostura	20	
6.	SONORA	1,005	2.2
	Asoc. Agr. Prods. H. Junelacahui	20	
	Com. Reg. Camp. No. 4 ONC	4	
	A.P. Legs. Reg. Agr. del Mayo	200	
	AAL Prods. Hort. Yaqui-Mayo	404	
	AAL del Valle de Guaymas	200	
	AAL "Aniceto Morales Garcia"	20	
	AAL "16 de Septiembre No. 2"	29	
	AAL Prods. uva de Mesa de Hillo.	30	
	AAL de Prods. Frutas y Leg. de Hillo.	20	
	AAL "Grupo Terán"	10	
	AAL "La Laguna"	43	
	AAL "Juan González Lucero"	25	
7.	TAMAULIPAS	828	1.9
	AAL de Cd. Mante	242	
	AAL de Altamira	471	
	AAL El Bernal	115	
	TOTAL	44,573	100

Fuente: CNPH, Programación de Siembras de Hortalizas y Frutas, Temporada 1990-91.
Elaboro: CNPH, Gerencia de Planeación y Control de Exportaciones, Gerencia de Informática y Proceso de Datos.

in Sinaloa, a fact which perhaps underscores the strength of CADDES and CNPH as political lobby groups. In Sonora, vegetable producers have had to turn to wheat, sorghum and other crops due to a shortage of water for vegetable production in that state.

In addition to the above, CADDES controls the quantity and quality of vegetable exports to the United States. Changes are made in response to prices prevailing in the U.S market. During periods of depressed prices quality standards are raised in order to restrict supplies. In the case of tomatoes, CADDES may also restrict the export of smaller sizes or more mature produce. In each case the intent is to exert upward pressure on producer prices. It is also well known that CADDES monitors prices in Nogales on an hourly basis in order to ensure that local producers receive current market value for their shipments. Such monitoring also assists CADDES in providing timely assessments of the general cost effectiveness of continued exports in any period. The system of production and quality control exercised by CADDES is voluntary and, as will be noted in a later section, is designed to pre-empt the imposition of import quotas by the U.S government (Bredhal et al 1983).

The above system contrasts sharply with the organization of the Jamaican winter vegetable thrust where there was no established mechanism for generating intelligence on market conditions, and no co-ordinated system at the national level for controlling the quality of produce exported.

5.3 THE MEXICAN POLICY ENVIRONMENT

The structure of the Mexican vegetable industry has been described in the previous section. The marketing channels for export vegetables were identified in that section along with the role played by the industry's major producer organizations. This section examines the nature of the policy environment within which the Mexican vegetable industry has developed. The impact of specific policies pursued by the Mexican government is discussed along with the effect of certain fortuitous political occurrences.

The production of vegetables for export began in the late 1800s but was severely hampered by the absence of overland transit into the U.S market. At that time produce was shipped around the tip of Baja California to the Los Angeles and San Francisco markets. The completion of a rail line from Nogales, Arizona to Guasave, Sinaloa by the Southern Pacific Railroad did much to alleviate this transportation constraint, and spur increased vegetable exports. Also, a modern highway was established between Culiacan and Nogales in the mid 1950s further improving the transportation network.

The fledgling export industry was given an added fillip by the construction of several major irrigation works. Large irrigation districts were established harnessing the potential of the Fuerte, Mayo and Yaqui rivers. These projects began during the Aleman presidency and continued through the 1950s and 1960s. By the end of this period more than 3 million hectares of federal irrigation facilities were added to the

Mexican agricultural production system. Approximately one-third of these federally irrigated lands are located in Sinaloa and Sonora and greatly improve the productive potential of these states (Sanderson 1986).

The export of winter vegetables from Mexico has also benefitted from a wide range of government subsidies. The Mexican winter vegetable industry, as noted in Chapter 1, is heavily subsidised although the need for fiscal restraint has forced a re-thinking of the government's support program in recent years. In the past, irrigation water, energy, chemical fertilizers, labour and credit have all been supplied to Mexican growers at less than market price.

In the case of fertilizer and energy the Mexican government has used a number of policy instruments in its attempts to control the prices of these inputs. The government, for example, operates a national fertiliser production company, FERTIMEX, which is a key component of the country's national self-sufficiency plan (Sanderson 1986). Direct subsidies to producers are also available on fertiliser supplies purchased through the Sistema Alimentario Mexicano. Indirect subsidization of this input is provided by the government's intervention in the price of energy which goes into fertilizer production. PEMEX (Petroleos Mexicanos) which governs the national petroleum pricing system provides fuels and fertilizer feedstock from natural gas at prices below market value. Large primary producers of export crops and agribusiness firms in the irrigated districts are the principal beneficiaries of this policy.

The above policy measures have not been sufficient to negate the ravages of Mexico's domestic inflation and the associated reluctance on the part of the government to alter the exchange rate. Data provided in Table 5.5 suggest that the prices of energy and fertilizer increased significantly in Mexico over the 1975 to 1984 period. The cost of fertilizer is seen to have increased by 920% and the cost of energy by 1414% over the period. Escalation in the prices of fertilizer and energy faced by U.S producers was more moderate, 19% and 128% respectively.

From as early as 1972 the Mexican government has had to make a number of exchange rate adjustments as a result of differential rates of inflation between that country and the United States. These adjustments are reflected in the price series on fertilizer and energy presented in Table 5.5.

Bredhal et al 1983 note that over the 1973-1976 period the Mexican peso became increasingly overvalued as the government maintained its fixed exchange rate policy in the face of rapidly escalating domestic inflation (See Table 5.6). Pressure on the country's balance of visible trade with the United States forced successive devaluations in 1976 (from M$12.5:$1 to M$15.4:$1) and 1977 (to M$22.6:$1). The continuance of rapid inflation post 1977 forced further devaluations in 1981 (to M$45:$1) and a movement to a floating exchange rate in August of 1982. An equilibrium rate of M$90:$1 was established for most transactions when the peso was floated, although a rate of M$95:$1 was used in exchanging export earnings for pesos. Each successive exchange rate adjustment is seen to have sparked an increase in energy and fertilizer costs (Table 5.5). The final (1982) realignment is seen, for example, to have resulted in a 103% increase in the price of fertilizer and a 64% increase in energy prices.

It should be noted that the above escalation in fertiliser and energy prices

TABLE 5.5

Indexes of Fertilizer and Energy Prices for Mexico and the United States, 1975-1984

Base: 1977 = 100

Year	MEXICO		UNITED STATES	
	Fertilizer	Energy	Fertilizer	Energy
1975	64	70	120	88
1976	67	83	102	93
1977	100	100	100	100
1978	113	122	100	105
1979	118	142	108	137
1980	128	174	134	188
1981	148	127	144	213
1982	189	419	144	210
1983	384	686	137	202
1984	653	1,060	143	201

Source: FAO, Production Yearbook, various issues.

TABLE 5.6

Wholesale Producer Price Indexes for Mexico and the United States, 1970-1982

Base: 1975 = 100

	MEXICO	UNITED STATES
Year	WPI	WPI
1975	100.0	100.0
1976	122.3	106.4
1977	172.6	113.8
1978	199.8	122.1
1979	236.4	137.9
1980	294.3	151.5
1981	366.3	160.7
1982	696.0	165.0

Source: Bredhal et al 1983.

does not augur well for the competitiveness of the Mexican vegetable industry. These two inputs are significant components of Mexico's cost of production. Of course the loss of cost competitiveness may be negated to some extent by careful management of the exchange rate as periodic devaluations could also serve to increase the prices (in pesos) received by vegetable exporters.

Irrigation water is also subsidised by the Mexican government. Water is supplied to producers in the federally irrigated districts at prices below market value. This policy is consistent with the country's federal water law. Since the creation of the national water system in 1926 the Mexican government has been reluctant to impose cost effectiveness on the federal irrigation districts. Irrigation district officials collect only nominal user fees which are sufficient to cover the basic costs of maintaining the irrigation infrastructure (Sanderson 1986).

In terms of finance, Mexican producers also benefit from controlled credit programs which have tended to favour producers operating in the federally irrigated districts. FIRA (Fideicomiscos Instutuidos en Relacion con la Agricultura) and BANRURAL, the rural credit bank, are the principal financing agencies. FIRA offers short and medium term loans at graduated interest rates, while BANRURAL offers a more general credit program.

Apart from the above areas of support, Mexican vegetable producers also benefit from the country's low wage cost structure. The abundant supply of cheap Mexican labour is a well known feature of that country's competitive advantage. As shown in Table 5.7 the minimum daily wage rate paid to Mexican workers is a fraction

TABLE 5.7

Agricultural Wages in Mexico and Florida
1970 to 1984

($US)

Year	MEXICO Minimum daily wage	FLORIDA Average earnings per day by hired farm workers
1970	2.14	11.09
1971	2.32	11.67
1972	2.47	13.31
1973	3.10	14.95
1974	3.93	16.78
1975	4.45	17.70
1976	3.66	19.53
1977	3.88	20.67
1978	4.54	22.35[E]
1979	5.45	24.03
1980	6.59	25.70[E]
1981	5.63	27.36
1982	3.45	29.50[E]
1983	3.53	31.64
1984	4.15	-

Source: Buckley et al 1986.

E = Estimated by interpolation.

of that paid to Florida workers. For example, in 1983 the Mexican daily minimum wage was \$3.53, while the average earnings for Florida based workers was \$31.64 per day (roughly 900% higher). Sanderson (1986) notes as well that as low as the Mexican minimum wage may be, rural workers rarely receive the full minimum wage. Enforcement of the country's minimum wage legislation is quite lax in the rural areas, and faced with rising rates of unemployment the labour force has grown increasingly more desperate and willing to accept work at any price.

It should be noted that inflationary pressures within the domestic economy has resulted in increasingly vocal demands for increases in the minimum wage. As can be noted from Table 5.7 Mexico's minimum wage increased by roughly 22% (in nominal terms) over the 1975-1982 period. This increase however, paled in comparison to the rapid escalation in domestic inflation as reflected by the data on wholesale prices in Table 5.6. Over the same time period the index of Mexico's wholesale prices increased by over 500%. Wages in real terms therefore declined significantly for rural workers.

The structure and performance of the Mexican industry has also been shaped by events over which the Mexican government exercised little control. The first such event was the termination of the U.S Bracero program in 1964. This program permitted the large scale use of immigrant labour in the United States. Termination of the program served to drive up U.S input costs in vegetable production and resulted in the spontaneous flight of capital to Mexico. This was the beginning of the close relationship between Mexican producers and the business firms in Nogales, Arizona now called the

WMVDA. The importance of this association in the Mexican export program was discussed in an earlier section.

The second political event which was important in Mexico's development as a major vegetable exporter to the United States was the embargo on trade with Cuba after the 1959 revolution. Prior to that period Cuba was a significant player in the U.S market for fresh vegetables. But by 1962 Cuba had been completely ousted as a major supplier. This event created the void Mexican producers needed to expand their exports.

The above description of the policy environment facing vegetable exporters in Mexico contrasts quite sharply with the organization of the Jamaican program presented in Chapter 2. The Mexican industry is characterised by a high level of government intervention, and superior organization at the producer level. The emphasis on market intelligence and a collaborative relationship between channel members represent significant differences between the industries in both countries.

5.4 TRADE RELATIONS BETWEEN MEXICAN AND U.S. VEGETABLE PRODUCERS

Earlier sections have documented Mexico's dominance of the US residual market and the forces which have placed that country in such a favourable position. Mexico's rise to dominance in this market did not however go un-noticed by Florida producers, and from 1969 onwards there have been several attempts to pre-empt further increases in her market share. The legal challenges that have had to be overcome by

Mexican exporters in order to maintain their position in this market are described in this section.

The first obstacle that had to be overcome by Mexican exporters was associated with the US government's marketing orders. Marketing orders have their origin in the 1933 Agricultural Adjustment Act and the 1937 Agricultural Marketing Agreement. These legislative tools are designed to improve the financial lot of US producers through price and output controls (Jesse 1987). Marketing orders for vegetables set minimum size and grade requirements which are established by administrative committees and enforced by mandatory USDA inspection. It must be emphasised that the standards for produce grown and marketed in the US apply with equal force to imports from all countries.

In the case of tomatoes the operation of the marketing orders falls within the purview of the Florida Tomato Committee (FTC) which establishes size, grade and other handling restrictions in September of each year. These restrictions remain in force for the duration of the winter vegetable season.[6] The federal marketing orders for tomatoes was established in January of 1969. In that year the FTC recommended dual size restrictions: a minimum diameter of 5.79 cm for mature greens and 6.43 cm for vine ripes. Bredhal et al note that the USDA gave approval to the committee's recommendations on January 8 1969 but without public hearings.

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[6]The FTC does not establish intraseasonal volume controls as is common with some commodities e.g oranges (Shepard 1986). There are no restrictions on the volume of produce that can be marketed in the US provided that size, grade and handling restrictions are satisfied.

Objections were quickly raised to the USDA's regulation to allow mature green tomatoes to be marketed in smaller sizes than vine ripes. Mexican producers argued that the regulation unfairly discriminated against their exports most of which were vine ripes (and hence were subject to more stringent quality control). In fact, Bredhal et al (1983) noted that during the 1967/68 season almost 40% of Mexican imports would have failed to meet the minimum size restrictions.

Interestingly, it was not only Mexican exporters who reacted negatively to the USDA regulations. US importers and distributors of Mexican produce as well as consumer groups came to the defense of the foreign exporters. From January of 1969 to March of 1971 US importers of Mexican vegetables launched a series of legal challenges to the USDA regulation. Until that latter date the US courts had failed to even acknowledge the rights of importers to a hearing before the USDA.

Public hearings on the matter were finally held in the fall of 1971 and as Bredhal et al (1983) note the USDA Deputy Administrator for Regulatory programs upheld the USDA's former ruling. A new round of litigation was sparked as a result, with the WMVDA and the Consumers Union (a consumer advocacy group) filing suits.

There is a belief that Florida tomatoes which are ripened using ethylene gas en route to market are inferior to Mexican produce which is allowed to ripen on the vine. There is also a perception that the highly concentrated Florida industry was attempting to secure monopoly power and higher rents for its producers. These were among the major reasons for the involvement of US consumer groups in the legal battle.

Under pressure the USDA was forced to reverse its ruling in 1973. The dual size restrictions were promptly suspended and importer and consumer groups were given the assurance that public hearings would precede the institution of any future restrictions.

It is interesting to note that the voluntary supply control program administered by the powerful producer associations grew out of the marketing order controversy. Mexican producers freely admitted that there was a problem of oversupply in the US market, and there was speculation that the above controversy would prompt the US government to impose import quotas. In order to pre-empt stricter US controls Mexico established acreage controls, export quotas, and quality controls, which would vary in response to US prices.

Following in the wake of the marketing order dispute the South West Florida Winter Vegetable Growers Association (SWFWVGA) filed an anti-dumping suit against Mexican growers in September of 1978. The suit alleged that Mexican producers sold their produce in the US market at less than fair market value. This the SWFWVGA argued was contrary to the US anti-dumping Act of 1921 which sought to prohibit foreign firms from selling at less than fair market price in order to obtain monopoly power in the US market.

The term "less than fair market price" proved problematic in the SWFVGA suit. The US Department of the Treasury had the option of using either:

(1) The price of the commodity in the home country

(2) The import price in a third country, or

(3) A cost of production based constructed price.

The anti-dumping Act (1921) provides the Secretary of the Treasury with discretion in selecting one of the above benchmarks.

Once sales at less than fair market value are established, the extent of injury to the domestic industry (if any) must be determined. The above findings would provide a basis for assessing countervailing duties.

As Bredhal et al (1983) note the SWFWVGA case was based on the third country test of fair value. US and Canadian prices of Mexican produce were compared and dumping margins[7] of 64% of the US price were found. Injury to the Florida industry was "demonstrated" by presenting as evidence the increase in Mexico's market share from 1975/6 to 1977/8.

In 1979 the new Trade Agreement Act took effect, and responsibility for a final decision on the SWFWVGA case was handed over to the Department of Commerce. This Department launched a new investigation, and on March 1980 concluded that the Mexican exporters were not guilty of dumping in the US market.

As Bredhal et al (1983) note confusion over the economic distinction between dumping and price discrimination was responsible for the reversal of what would have been a guilty judgement. In arriving at the above verdict the prices of vegetables sold in the US were compared with prices of identical products sold by the same producers on the same day in the Canadian market. Differences between these prices were not

[7]The dumping margin is simply the difference between the weighted average third country price and the US import price.

found to be statistically significant, suggesting that price discrimination had not occurred. This however, was never the contention of the SWFWVGA which had argued that dumping had taken place. It is of course possible to dump in two markets without discriminating against consumers in either.

5.5 SUMMARY

This Chapter has examined the organization of the Mexican winter vegetable industry. It was discovered that the Mexican industry is well organized and sophisticated with a long history of success in the US market. Several factors were found to contribute to the success of the Mexican export program.

1. Favourable transportation logistics.
2. A close network of relationships between producers and distributors.
3. A focus on market intelligence and an understanding of the nature of the competition presented by Florida producers, and
4. Government policies which were generally supportive of the industry.

In addition, the industry benefitted from:

1. The elimination of Cuba as a major residual market supplier, and
2. The termination of the Bracero program.

The Chapter also drew parallels between the organization of the Mexican and Jamaican programs. The absence of a pecuniary interest in Jamaican exports by US distributors was noted.

CHAPTER 6

ECONOMETRIC MODEL OF THE U.S. WINTER VEGETABLE INDUSTRY

6.1 INTRODUCTION

The previous chapter described the structure and organization of the Mexican winter vegetable industry. The point was made that the success achieved by Mexican exporters in this market has been the result of a mix of deliberate government interventions and fortuitous political events. It was also argued that the Mexican exporters' close network of relations with agents in the marketing channel, and their highly developed systems of production, volume and quality controls, have served to strengthen their position in the U.S. residual market.

In this chapter we examine the extent to which changes in the competitive environment may be expected to provide an impetus for entry by new exporters such as Jamaica. The basic argument here is that minor exporters possess neither the financial resources nor the marketing expertise needed to challenge Mexico for the U.S. residual market. However, as was noted in Chapter 5 rising input costs may conceivably force Mexico to concede some of its market share. This represents perhaps the only avenue for growth of an export industry in countries such as Jamaica.[1]

[1]It is recognized, of course, that another avenue for growth in non-Mexican export supply is an overall increase in the size of the U.S. market which outstrips Mexico's supply capabilities. In Appendix D a demand analysis of the U.S. industry is conducted using a dynamic AIDS model. The analysis indicates that the potential for positive shifts in demand (at least for the major vegetables) is limited.

To assess the impact of escalations in input costs on Mexico's competitive position (and hence the potential for growth in non-Mexican supply) a simple econometric model of the U.S. industry is developed. The model is described in Section 6.2. In Section 6.3 the empirical results generated from the base model are presented. This is followed in Section 6.4 by the results of an impact analysis which is designed to assess the responsiveness of Mexican export supply to changes in domestic input costs (and other variables). Section 6.5 summarises the discussion and provides a few concluding observations.

6.2 STRUCTURE OF THE MODEL

In this section is described the structure of the econometric model of the U.S. vegetable market. The model is estimated for fresh tomatoes which represent the bulk of the vegetables produced and consumed in the United States.[2] The model consists of three behavioral equations and three identities. The behavioral equations describe supply and demand conditions in the U.S. market as well as the export supply response of Mexican exporters. The first of the three identities relate the acreage response of Florida producers to the corresponding level of output. The second identity aggregates Florida

[2]It would be recalled from Chapter 2 that tomatoes comprised only 3% of the total volume of Jamaican exports over the 1984-1988 period. Cucumber, pumpkins and sweet peppers were observed to be the most important crops. However, a lack of U.S. data for these commodities preclude their consideration in this analysis.

production and production from other U.S. states to arrive at total U.S. output. The final identity describes equilibrium quantity flows in the market.

The complete structural model is presented in Exhibit 6.1. It is observed that the acreage planted to tomatoes by Florida producers is hypothesized to be determined by the average Florida producer price of tomatoes and the producer price of other vegetables. The producer price of other vegetables is calculated as a Divisia index of the average Florida producer prices of carrots, celery, lettuce, and onions. Acreage planted is also hypothesized to be determined by the costs of harvesting and growing the crop. As with the producer price of other vegetables these costs are expected to be negatively correlated with the dependent variable. The producer price of tomatoes is of course expected to be positively correlated with the acreage devoted to tomato production.

Acreage response is also assumed to be influenced by the acreage planted in the previous period as well as by the occurrence of freeze conditions in Florida. As was noted in an earlier chapter, freeze conditions during the winter vegetable season have from time to time constrained the ability of producers to respond to consumer demand. This inability, as noted above, has resulted in a sharp escalation in retail prices and windfall profits for exporters. In the present model freeze conditions are represented by a dummy variable which equals 1 in years of severe freeze conditions and 0 otherwise. A positive sign is expected for the variable representing lagged acreage planted as well as for the freeze dummy.

As noted above the acreage response equation is translated into quantities supplied by an identity. In this identity it is of course assumed that acreage planted will

Exhibit 6.1
Structure of the Econometric Model

Florida Production:

$$AP_t = f(P_t^F, Po_t^F, Gc_t, Hc_t, AP_{t-1}, Freeze_t) \quad \ldots 1$$

$$Qs_t = AP_t \text{ x } \bar{\gamma} \text{ (Assume } AH_t = AP_t) \quad \ldots 2$$

U.S. Production:

$$Qs_t^{US} = Qs_t + Qs_t^{OUS} \quad \ldots 3$$

U.S. Demand:

$$Qd_t = f(P_t^r, Po_t^r, X_t, Qd_{t-1}) \quad \ldots 4$$

Mexican Export Supply:

$$ES_t = f(P_t^{Mex}, Po_t^{Mex}, W_t, F_t, AP_{t-1}) \quad \ldots 5$$

Market Equilibrium:

$$Qs_t^{ROW} = Qd_t - (Qs_t^{US} + ES_t) \quad \ldots 6$$

Where:

AH_t = Acreage harvested in Year t
AP_t = Acreage planted in Year t
P_t^F = Average producer price of tomatoes
Po_t^F = Average producer price of other vegetables
Gc_t = Per unit growing cost
Hc_t = Per unit harvesting cost
$Freeze_t$ = Dummy variable representing freeze conditions
Qs_t = Quantity of tomatoes produced in Florida
$\bar{\gamma}$ = Average Florida tomato yield
Qs_t^{US} = Total U.S. tomato production
Qs_t^{OUS} = Total tomato production of the other U.S. states
Qd_t = Quantity of tomatoes consumed in the U.S.
P_t^r = Average retail price
Po_t^r = Average retail price of other vegetables
X_t = Expenditure on vegetables
ES_t = Mexican exports of tomatoes
P_t^{Mex} = Mexican producer price of tomatoes
Po_t^{Mex} = Mexican producer price of other crops
W_t = Mexican minimum agricultural wage rate
F_t = Index of Mexican fertilizer prices
Qs_t^{ROW} = Rest of the world tomato supply

approximate closely acreage harvested. In fact, over the period covered by the data, acreage harvested averaged 97% of the total acreage planted. The use of acreage planted as a proxy for acreage harvested is therefore not likely to introduce serious errors into the analysis. It should also be recognized that Florida's production, and the production of the other U.S. states, are summed to arrive at total U.S. production (see Exhibit 6.1, equation 3).

The demand side of the model is represented by equation 4. Quantity consumed is assumed to be determined by the retail price of tomatoes and the retail price of other vegetables (in this case onions and lettuce). Again the price of other vegetables is represented by a Divisia index of average prices. Assuming weak separability, consumption of tomatoes is also hypothesized to be influenced by the total expenditure on vegetables as opposed to personal disposable income. It should be recognized that personal disposable income is not used here, as it would then be necessary to include the prices of all other commodities available for purchase by the consumer. A negative association is of course expected between quantity consumed and the own price variable. The sign on the variable representing the price of other vegetables would be dependent on whether these commodities are substitutes or complements in consumption. Expenditure is expected to be positively correlated with consumption.

As will be noted from Exhibit 6.1 demand is also expected to be determined by the quantity consumed in the previous period. It is therefore assumed that habit formation plays an important part in determining consumption in the current period. A positive sign is expected for this variable.

Equation 5 of the model describes the export supply response of Mexican producers. Exports are hypothesized to be determined by, inter alia, the average price received by Mexican tomato producers. This price is actually an adjusted U.S. retail price calculated as follows:

$$P_t^{Mex} = (P_t^{US} - t) \times R_{US}^{Mex}$$

Where:

P_t^{Mex}	=	Mexican producer price of tomatoes
P_t^{US}	=	U.S. retail price of tomatoes
t	=	MFN tariff rate
R_{US}^{Mex}	=	U.S. : Mexican exchange rate

Mexican exports are also assumed to be determined by the producer price of other crops which could in fact be produced by Mexican tomato farmers. This price is represented by an index of prices received by Mexican producers for crops sold on the domestic market.

The supply of Mexican tomato exports is also assumed to be dependent on the wage rate paid to Mexican farm workers. As is well known, labour costs are a major component of vegetable cost of production in Mexico, and so this variable is expected to be strongly (negatively) related with export supply. Similarly, the cost of fertilizers is also expected to be a major determinant of Mexican export supply response. This variable is represented by an index of fertilizer prices, and as with the wage rate is expected to be negatively associated with the volume of exports.

Finally, it is hypothesized that the supply of Mexican tomato exports in any year would be determined by Florida production in the previous period. As noted in Chapter 5 CAADES controls the volume of exports and continuously monitors market conditions in the U.S. It is expected that increased Florida production in one year would force a significant drop in farm gate and retail prices, and precipitate an increase in the quantity of foreign and domestic tomatoes consumed. In response to increased U.S. demand CAADES is expected to increase exports to the U.S. markets in the subsequent period. A positive sign is therefore expected for the acreage planted variable in the Mexican export supply relationship.[3]

An identity describing equilibrium quantity flows in the market (equation 6) completes the specification of the model. It is therefore assumed that the market for tomatoes clears and that the interaction of supply and demand yields a unique equilibrium price.

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[3]In the specification of the above export supply function it would have been useful to include some Mexican demand side variables. However, these data were not readily available.

6.2.1 FUNCTIONAL FORM AND ESTIMATION METHOD

In order to circumvent the theoretical inconsistency inherent in most linear specifications of demand and supply schedules all price and expenditure variables in the above model were normalized (see Coyle, 1989 for a discussion of the theoretical problems). In the case of the Florida supply function, the per unit growing cost was chosen as numeraire. The U.S. demand function, on the other hand, was normalized on the retail price of other vegetables, while the price of fertilizer was selected as numeraire for the export supply function. The above choices were arbitrary.

The normalized functions were expressed in logs and estimated as a complete system using two stage least squares (2SLS). In the case of the export supply schedule all prices were deflated by the index of prices received by Mexican farmers prior to normalization. Given the rapid rate of inflation in that country over the sample period (1970 - 1989) it was considered important to estimate this relationship in real terms.

6.2.2 DATA SOURCES

The complete data set used in the estimation of the model is reproduced in Appendix E and is briefly described in this subsection. Data on total production and the number of hectares planted to tomatoes in Florida were obtained from the Florida Agricultural Statistics Service publication <u>Vegetable Summary</u>, 1988-1989. This publication also contained relevant data on the number of hectares harvested and average yields. Data on growing and harvesting costs are for South-West Florida and were obtained from the Department of Agricultural Economics, University of Florida. The years of severe freeze conditions were also obtained from this latter source. Total U.S. production of tomatoes was obtained from the USDA publication, Vegetables and Specialities Situation and Outlook Yearbook, 1990.

The above USDA publication also contained data on per capita tomato consumption as well as the retail price of tomatoes and other vegetables. Producer price data were obtained from the above USDA publication, and the above data also allowed for the calculation of a time series of vegetable expenditures.

Data on Mexican vegetable exports were obtained from the Foreign Agriculture Service (FAS) of the USDA. These data were unpublished. Information on the Mexican minimum agricultural wage was obtained from Buckley et al 1986, while fertilizer prices were acquired from the FAO Production Yearbook, 1989. The above unpublished FAS data also allowed for the determination of the rest of the world supply of tomatoes to the U.S. The volume of U.S. tomato exports was calculated as a residual. MFN tariff data were obtained via personal communication with officials at the U.S. International Trade Commission in Washington.

6.3 EMPIRICAL RESULTS

This section discusses the results of the econometric estimation of the model presented in Exhibit 6.1. These were several problems associated with the estimation of the above model. Firstly, the error terms of the demand function were observed to be serially correlated as evidenced by the calculation of the Durbin Watson h statistic.[4] In terms of the acreage response function it was also observed that inclusion of the producer price of other vegetables and the lagged acreage planted variable yielded poor results.

The model was re-estimated with the above two variables omitted from the specification and the problem of serial correlation corrected. It should be noted that because equation 4 contains a lagged dependent variable as a regressor the usual Yule Walker and Maximum likelihood approaches to autocorrelation correction cannot be directly applied (SAS Institute 1988). Instead an instrumental variable method was used in which the lagged dependent variable was predicted using the other regressors and their lags. The predicted value of the lagged dependent variable was then used as a regressor in equation 4 (see Johnston 1984 for a brief discussion). The other equations of the model were estimated by Ordinary Least Squares.

The results of the revised model are presented in Exhibit 6.2. All variables in the model have the expected sign and most are significant at conventional levels. It should be noted that because the equations are expressed in log form the parameter estimates are also the elasticities. The elasticity estimates are summarized in Table 6.1 and are seen to be reasonable both in terms of sign and magnitude. The elasticity estimates are also observed to be reasonably consistent with those contained in other studies, as well as with the AIDS model estimated in Appendix D.

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[4]The demand function contains a lagged endogenous variable as a regressor and so the Durbin Watson D statistic is not valid (Pindyck and Rubinfeld 1981, Kaoutsyiannis 1977).

Exhibit 6.2
Parameter Estimates of the Base Model

$$\ln AP_t = \underset{(10.23)}{7.0209} + \underset{(3.86)}{0.474} \ln \frac{P_t^F}{Gc_t} - \underset{(-0.26)}{0.027} \ln \frac{Hc_t}{Gc_t} + \underset{(2.10)}{0.098} \, Freeze_t$$

DW = 1.61 $R^2 = 0.73$ Estimation method = OLS

$$\ln Qd_t = \underset{(1.57)}{2.66} - \underset{(-2.59)}{0.469} \ln \frac{P_t^r}{Po_t^r} + \underset{(2.73)}{1.103} \ln \frac{X_t}{Po_t^r} + \underset{(3.15)}{0.594} \ln Qd_{t-1}$$

$\bar{R}^2 = 0.97$

$$\ln ES_t = \underset{(-0.062)}{-0.20} + \underset{(2.78)}{0.457} \ln \frac{\tilde{P}_t^{Mex}}{\tilde{F}_t} \underset{(-3.46)}{-0.60} \frac{\tilde{W}_t}{\tilde{F}_t} + \underset{(2.03)}{0.66} \ln AP_{t-1}$$

$\bar{R}^2 = 0.62$ DW = 2.31 Estimation method = OLS

Note: ~ denotes variables expressed in real terms.

Note: t values are in parentheses.

Table 6.1
Summary of Elasticity Estimates

Study	U.S. Supply	U.S. Demand	Mexican Supply
Hammig and Mittelhammer (1982)	Price elasticity = 0.372	Price elasticity = -0.104	Price elasticity = 0.98
		Income elasticity = 0.150	
AIDS Model (Appendix D)	n.c.	Price elasticity = -0.623	n.c.
		Expenditure elasticity = 0.697	
Market Equilibrium Model (Chapter 6)	Price elasticity = 0.474	Price elasticity = -0.469	Price elasticity = 0.46
		Expenditure elasticity = 1.103	Wage elasticity = -0.6

n.c. = not calculated.

6.3.1 MODEL SIMULATION

The tracking ability of the model was also assessed. Table 6.2 reports summary goodness of fit statistics for the three behavioral equations of the model. The model is seen to replicate well historical trends in the data, with the highest root mean square simulation error percentage being 1.5 in the case of the Mexican export supply function. The model may therefore be expected to capture the impact of any exogenous shocks to the system.

6.4 IMPACT ASSESSMENT

As noted above the primary focus of this chapter is to assess the impact of changes in Mexican input costs on the volume of tomatoes exported to the U.S. It has been argued that changes in export supply will ceteris paribus result in the increased demand for non-Mexican supplies and improved potential for smaller exporters such as Jamaica to re-enter the market.

Tables 6.3-6.5 summarize dynamic interim and total multipliers for the system of equations. The first interim multiplier is termed the impact multiplier and it shows the immediate effect of changes in each exogenous variable on the values of the model's endogenous variables. This may be written as:

$$Y_t = DY_{t-1} + \pi_2 X_t$$

Table 6.2
Summary Goodness of Fit in Simulation

Variable	Mean Absolute % Error	Root Mean Square Error	Root Mean Square Simulation Error %
ln AP_t	0.712	0.096	0.972
ln Qd_t	0.325	0.028	0.399
ln ES_t	1.304	0.086	1.535

Table 6.3
Matrix of Interim and Total Multipliers for
Acreage Planted

Exogenous Variable	INTERIM										Total
	1	2	3	4	5	6	7	8	9	10	
ln (P_t^F / Gc_t)	0	0	0	0	0	0	0	0	0	0	0.474
ln (Hc_t / Gc_t)	0	0	0	0	0	0	0	0	0	0	0.027
$(Freeze_t)$	0	0	0	0	0	0	0	0	0	0	0.098
ln (P^r_t / Po^r_t)	0	0	0	0	0	0	0	0	0	0	0
ln (X_t / Po^r_t)	0	0	0	0	0	0	0	0	0	0	0
ln $(\tilde{P}_t^{Mex} / \tilde{F}_t)$	0	0	0	0	0	0	0	0	0	0	0
ln $(\tilde{W}_t / \tilde{F}_t)$	0	0	0	0	0	0	0	0	0	0	0
Intercept	0	0	0	0	0	0	0	0	0	0	7.021

Table 6.4
Matrix of Interim and Total Multipliers
for Quantity Demanded

Exogenous Variable	INTERIM										
	1	2	3	4	5	6	7	8	9	10	Total
$\ln (P_t^F / Gc_t)$	0	0	0	0	0	0	0	0	0	0	0
$\ln (Hc_t / Gc_t)$	0	0	0	0	0	0	0	0	0	0	0
$(Freeze_t)$	0	0	0	0	0	0	0	0	0	0	0
$\ln (P^r_t / Po^r_t)$	-0.278	-0.165	-0.098	-0.058	-0.035	-0.021	-0.012	-0.007	-0.004	-0.003	-1.154
$\ln (X_t / Po^r_t)$	0.654	0.388	0.231	0.137	0.081	0.048	0.028	0.017	0.010	0.005	2.714
$\ln (\tilde{P}_t^{Mex} / \tilde{F}_t)$	0	0	0	0	0	0	0	0	0	0	0
$\ln (\tilde{W}_t / \tilde{F}_t)$	0	0	0	0	0	0	0	0	0	0	0
Intercept	1.579	0.937	0.556	0.330	0.196	0.116	0.069	0.041	0.024	0.014	6.549

Table 6.5
Matrix of Interim and Total Multipliers for
Mexican Export Supply

	INTERIM										
Exogenous Variable	1	2	3	4	5	6	7	8	9	10	Total
ln (P_t^F / Gc_t)	0.311	0	0	0	0	0	0	0	0	0	0.311
ln (Hc_t / Gc_t)	0.017	0	0	0	0	0	0	0	0	0	0.017
($Freeze_t$)	0.065	0	0	0	0	0	0	0	0	0	0.065
ln (P^r_t / Po^r_t)	0	0	0	0	0	0	0	0	0	0	0
ln (X_t / Po^r_t)	0	0	0	0	0	0	0	0	0	0	0
ln ($\tilde{P}_t^{Mex}$ / $\tilde{F}_t$)	0	0	0	0	0	0	0	0	0	0	0.457
ln ($\tilde{W}_t$ / $\tilde{F}_t$)	0	0	0	0	0	0	0	0	0	0	-0.60
Intercept	4.61	0	0	0	0	0	0	0	0	0	4.41

Where:

π_2	=	matrix of impact multipliers
y_t	=	endogenous variable
X_t	=	exogenous variable

The above equation may be re-written as:

$$Y_t = D^2 Y_{t-2} + D \pi_2 X_{t-1} + \pi_2 X_t$$

where $D\pi_2$ shows the effect of the exogenous variable one lag back.

The above series can be stretched out to infinity (SAS Institute 1988). The total multiplier measures the long run change in the endogenous variable occasioned by a one unit change in the exogenous variable.

In the case of U.S. supply all impact and interim multipliers are zero (Table 6.3) indicating little dynamic response of this equation to exogenous shocks.[5] In the long run, however, acreage planted will be moderately affected by changes in output and input prices as well as by freeze conditions. The same is also true of the demand function where, except for expenditure, the exogenous variables appear to have a limited short run and long run impact.

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[5]Unlike the other behavioral equations of the model the acreage planted function does not exhibit a lagged structure.

More importantly we observe (Table 6.5) that Mexican export supply response is influenced, in the short run, by predominantly U.S. supply conditions. U.S. prices, production costs and weather conditions are observed to have an immediate, albeit small impact on Mexican exports. Mexican input costs, i.e. wage rates have no immediate effect although in the long run the influence of Mexican supply side factors is seen to become more important. In fact increases in the minimum wage rate are observed to be the most important factor (after the intercept) operating to depress export supply. The long run dynamic multiplier is seen to be -0.60. This value, which is less than one, suggests that even in the long run export supply will not respond significantly to labour cost increases.

The above finding is interesting as it clearly shows that the potential for Mexico's withdrawal from the market in the face of rising input (i.e. wage) costs is limited. It should also be noted that the multiplier estimate of -0.6 is consistent with that of a much earlier study by Simmons and Pomareda (1975). The authors of this study employed a linear programming model of vegetable production in Sinaloa and concluded as follows:

> It was found that, given present technologies an increase of 10% in the minimum daily wage would decrease exports by 9% for tomatoes....Given present Mexican government policies of rapidly increasing the minimum farm wage, substantial decreases in vegetable exports can be expected (other factors such as Florida production assumed constant). (Simmons and Pomareda, 1975 p. 476).

When cast in a simple dynamic framework however it is discovered that any impact of increased wage cost on Mexican exports will be experienced only in the long-term.

6.5 DISCUSSION AND SUMMARY

The above analysis has shown that Mexican wages exert a negative influence on that country's supply of tomatoes to the U.S. market. This is the result expected from economic theory. The results also suggest, however, that this variable will not be an important determinant of supply in the short run. In the more immediate term it is seen to be U.S. supply side factors which have the greatest potential to influence Mexican export performance. In the long run wage levels do become important, and are in fact the most significant determinant of Mexican exports.

Assuming no changes in U.S. production one could anticipate some modest increase in the size of the non-Mexican residual market in the long run. In the more immediate future, however, new exporters such as Jamaica would likely find opportunities in the U.S. vegetable market exceedingly limited.

CHAPTER 7

CONCLUSIONS AND POLICY RECOMMENDATIONS

7.1 INTRODUCTION

The purpose of this chapter is to summarize the major findings of the above research and to formulate a consistent set of policy recommendations that derive from the analysis. As noted in the introductory chapter this dissertation was focused on assessing the potential for the expansion of non-traditional agricultural exports from Jamaica. It was argued that changes in the fortunes of the sugar industry provided the necessary imperative for a program of export diversification.

Of the nineteen subsectors included in Agro 21, the winter vegetable subsector was singled out for case analysis. The reasons which guided this choice were identified in Chapter 1 as:

1. The winter vegetable subsector provides a rigorous test of a country's ability to develop a viable export program. The products are highly perishable and considerable organizational skill is required in field to market operations. Also, the winter vegetable market is highly competitive making cost-effective operation a sine qua non for survival and growth.

2. The establishment of the winter vegetable sector became highly politicized over the life of the program owing to the unprecedented capital intensity of the projects, the focus on foreign "high technology", and bitter reaction from the sugar lobby in response to the loss of their strategic land resource.

Despite the efforts of the Jamaican government the winter vegetable initiative, and in fact the entire Agro 21 program, collapsed after a few short years of operation. The basic thrust of this research has been to investigate the domestic and international factors which may have precluded the expansion of winter vegetable exports from Jamaica, and to assess the prospects for re-entry into the U.S. market.

This Chapter is organized into six major sections. Following the introduction is presented a re-statement of the study objectives and research methodology. The principal research findings are summarized in Section 7.3 and discussed in Section 7.4. This latter section also presents the major policy recommendations that follow from the analysis. Section 7.5 outlines the major limitations of the present study and provides some direction for future researchers in this field. The final section contains a few concluding remarks.

7.2 STUDY OBJECTIVES AND RESEARCH METHODOLOGY

The major objectives of the study may be reiterated as:

1. To review the structure and performance of the Jamaican winter vegetable industry over the period 1983 to 1988.

2. To evaluate the impact of Jamaica's technological choices and macro-economic policies on the performance of the winter vegetable industry.

3. To compare the organization of the Mexican and Jamaican winter vegetable programs and the policy environments within which they were developed.

4. To identify the economic factors which could force a withdrawal of Mexico from the U.S. winter vegetable market, and to quantify their impacts.

The impact of technological choices and macro-economic policies was assessed using the recently developed Monke-Pearson policy analysis matrix (PAM). In order to apply the matrix to the Jamaican situation a complementary system of conversion factors was developed. This system allowed for the revaluation of discounted revenue and cost streams from market to social equivalents. The system of conversion factors was developed based on national accounts data.

With respect to macroeconomic policy it was expected a priori that Jamaican government macroeconomic policy, in particular exchange rate policy, would have a deleterious impact on the vegetable export sector. It was also anticipated that the technology choices adopted by Jamaican exports, i.e. the use of advanced irrigation systems, would prove inimical to the development of the sector.

A series of field interviews with policy-makers and investors associated with the Agro 21 program provided much of the data needed to review the structure and performance of the winter vegetable sector (Objective 1). These field interviews were supplemented by the collection of published and unpublished secondary data on the industry.

Resource constraints precluded the conduct of field interviews in Mexico, and so the assessment of the policy and institutional environments in that country relied on secondary data sources.

The fourth objective above was accomplished by constructing a simple econometric model of the U.S. winter vegetable market. Demand and supply conditions in the U.S. industry were explicitly modelled as was Mexico's export supply response. It should be noted that the model is dynamic by virtue of the use of a lagged structure. This allowed for the computation of impact, interim and total multipliers and therefore an assessment of the influence of input costs (and other factors) on Mexico's export supply.

7.3 SUMMARY OF RESEARCH FINDINGS

The major findings of the study may be listed as follows:

1. The loss to the Jamaican economy from the experiment in winter vegetable exports amounted to $J77 million valued at social prices, and $J106 million valued at market prices. Distortions in the economy therefore occasioned a loss of as much as $J29 million to the industry.

2. Jamaica did not have a comparative advantage in winter vegetable exports over the period covered by the analysis. A domestic resource cost ratio estimate for the industry was calculated as -5.36. The low value of this estimate (coupled with the large social loss of $J77 million) support this conclusion.

3. Jamaican government macroeconomic policies were not supportive of the industry. In fact the sector was heavily taxed by as much as 38% during its formative years. This result is supported by an subsidy ratio to producers estimate of -0.38, and nominal protection coefficients on inputs and outputs of 1.03 and 0.77, respectively.

4. The continuance of a government program of import duty concessions would have had little impact on the profitability of the industry. Assuming no change in other government policies, those concessions would have reduced the sector's social loss to $J29 million.

5. Choice of the less capital intensive flood irrigation system was observed to reduce the social loss incurred by the largest firm in the industry. Use of both flood irrigation and the more advanced drip system, however, resulted in losses to the exporter during the 1985/6 cropping season.

6. Transportation costs were observed to comprise 12% of the industry's total costs and 28% of its domestic costs. Disaggregation of these costs revealed that freight charges (both sea and air) were the most heavily distorted link in the marketing chain.

7. Significant differences were found in the organization and support of the Mexican and Jamaican export programs. These included:

(a) A close (and pecuniary) network of relationships between Mexican producers and channel members. There was no such association inherent in the Jamaican operation.

(b) Control of quantity, quality and timing of exports to the U.S., exercised at the national level by producer associations. This level of control (and the market intelligence necessary to achieve it) was non-existent in the Jamaican program.

(c) Favourable agricultural support policies such as the provision of subsidised inputs by the Mexican government.

(d) Natural advantages available to the Mexican exporter such as a low wage cost structure and favourable transportation logistics.

8. Escalation in the Mexican minimum agricultural wage rate was not forecasted to have a significant impact on export supply, at least in the short run. Domestic U.S. supply factors were found

to be the major determinant of Mexico's vegetable exports in the short run. The potential for a significant reduction in Mexican exports (and hence growth of non-Mexican supplies) even in the long run also appear to be limited. The long run wage rate multiplier for Mexican exports was found to be -0.60.

7.4 DISCUSSION AND POLICY RECOMMENDATIONS

The assessment of the impact of the Jamaican government macro-economic policies did not produce unexpected results. The estimate of a 38% tax on the winter vegetable sector is consistent with the high rate of taxation observed by investigators in other countries. Given the level of resources invested in the establishment of the Agro 21 program (see Appendix B), it is surprising that more attention was not given to ameliorating the impact of unfavourable macroeconomic policy prior to the experiment. This observation leads to the following recommendation:

1. **Prior to further attempts at export promotion the Jamaican government is advised to harmonize its agricultural and macro-economic policies. Existing macro-economic policies should support (or at least not retard) efforts at agricultural export promotion.**

Of course adoption and implementation of this recommendation would not, in isolation, have resulted in success. Even in the absence of market distortions the winter vegetable operations would have been unprofitable. In fact, inappropriate government policy was responsible for less than a third of the loss actually experienced. Once these distortions are corrected the issue for Jamaican exporters becomes one of cost control in production and marketing.

On a more micro level this study revealed that technological choices were important in terms of increasing overall production costs for the vegetable enterprises. While it must be re-emphasized that the use of flood irrigation would not have resulted in economic success, cost considerations are obviously important in such a competitive industry[1]. The leads to the second recommendation:

2. **In further attempts at export promotion the importance of appropriate technological choices should be recognized. Efforts should be made to adopt production systems which would minimize overall production costs.**

With respect to post-farm activities it was discovered that overseas transportation was the most costly and most inefficient activity in the marketing and distribution complex. This is not entirely unexpected in an island economy such as

[1]The use of drip irrigation was observed to increase the social loss by 14% over that incurred using the flood irrigation method.

Jamaica attempting to serve market centres at some distance. The cost and availability of overseas transportation are likely to continue to hamper efforts at foreign market penetration by such economies.

Given that Jamaica is a price taker in the international market for transportation services, continued reliance on the services of commercial airlines and shipping companies is not likely to improve prospects for reductions in this cost component. The following recommendation follows from this observation.

3. **The Jamaican government, perhaps in conjunction with the private sector, needs to examine alternative approaches to reducing the cost of this service, and improving its reliability.**

The comparative analysis of the Jamaican and Mexican export programs yielded several interesting observations. The pecuniary nature of the relationship between exporters and channel members was noted above, as was the importance of favourable government policies. The point was made that Mexico's relative success has also been heavily influenced by fortuitous political events such as the termination of the Bracero program and the deterioration in U.S.-Cuban relations. This unique combination of factors cannot be duplicated by Jamaican exporters, and so there is need for formulation of an alternative model.

While the formulation of a new export strategy for Jamaica does not fall within the scope of the present research the following recommendation can be made:

4. **In the development of any future export promotion programs for winter vegetables it would be necessary to cultivate a close relationship with existing channel members. Failing this it would be imperative that Jamaican exporters maintain some type of presence in the market in order to provide relevant market intelligence and ensure the efficient movement of product through the marketing chain.**

The results of the econometric analysis of the U.S. vegetable industry were not encouraging for Jamaican exporters. If one assumes no other changes in the competitive environment other than an increase in the Mexican minimum wage, the potential for growth in non-Mexican supplies in the short run is limited. Sharp increases in the real Mexican wage are not likely to force a withdrawal of this country from the U.S. market. Even in the long run, when wage costs become more important the impact on export supply is less than proportional. If the analysis of the tomato market is indicative of what will be found in other product areas, e.g. cucumbers and sweet peppers, the U.S. winter vegetable market would offer few prospects for new entrants.[2] This leads to the fifth and final recommendation.

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[2]Note that this study has not focused on the rapidly growing speciality vegetable segment of the market. The above conclusions may or may not apply to products in this segment.

5. **In any future attempts at export diversification care should be exercised in project selection. The incorporation of each sector into the export program should be preceded by detailed and careful analysis of the foreign market. The competitive environment should be carefully assessed and realistic prospects for market penetration established.**

7.5 LIMITATIONS OF THE PRESENT STUDY AND FUTURE RESEARCH DIRECTIONS

Several issues have been left unresolved by the present study. These issues are identified and discussed in this section. The first issue which must be addressed in future work is the establishment of a clearer link between overvaluation of the exchange rate and Jamaica's export performance. The observation that a heavy tax was levelled on exports over the 1982-1986 period, and that the exchange rate was overvalued during most of that period needs to be more concretely analyzed. It may not be possible to apply econometric techniques to this problem given the paucity of data on Agro 21, but a more precise statistical relationship is required. Such an analysis could perhaps be conducted without reference to the Agro 21 program.

The policy analysis of the program should also be extended to the other Agro 21 sectors. In particular it would be useful to compare the impact of government policies on one (or perhaps all) of the self-sufficiency sectors.[3] This should not be difficult given that a complete set of conversion factors has already been developed in this study, although revisions would again be necessary in light of recent price liberalisations.

More work is also needed in terms of identifying alternatives for reducing the cost of transportation and marketing. As noted earlier this is likely to be a key component of any revitalized export initiative. This study has stopped short of discussing and evaluating the options available. Also, the issue of the use of monopoly power on the part of shipping companies serving the region needs to be investigated. As indicated in Chapter 4 Jamaican exporters pay rates in excess of world levels for this service despite the absence of specific government price policies in this sector.

This research has also not generated specific guidelines on the issue of technology choices. It has been argued above that there is potential for decreasing production costs by adoption of more appropriate technologies. These alternatives need to be identified and evaluated for all crops considered and under different climatic and soil conditions.

In terms of the econometric analysis, there is a need to expand the range of products considered to include both the major vegetables consumed in the U.S. as well as the speciality vegetables which have been growing in importance. It would be interesting to determine whether the negative conclusions arrived at above will also apply to this product segment.

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[3]See Appendix B for a discussion of the self-sufficiency component of the program.

7.6 CONCLUDING STATEMENT

The need for increased agricultural exports cannot be discounted. The constraints on economic development imposed by declining employment creation and foreign exchange generation are real and are not likely to disappear without proper project planning and implementation. While the Agro 21 program has effectively failed to achieve these two objectives, the program itself represents an important step forward.

It is imperative that Jamaican (and other Caribbean) policy-makers learn from the experiences of Agro 21 so that the mistakes of the past are not repeated. It is hoped that this dissertation would be a contribution to our understanding of how these errors could be avoided in the future.

APPENDICES

APPENDIX A

AN OVERVIEW OF THE STRUCTURE AND PERFORMANCE OF THE JAMAICAN AGRICULTURAL SECTOR

A.1 INTRODUCTION

The purpose of this appendix is to critically review the structure and performance of the Jamaican agricultural sector over the ten year period prior to the implementation of the Agro 21 development program.[1] The analysis presented here will provide an appropriate backdrop against which to discuss the rationale for the institution of the program, as well as a benchmark for a formal performance assessment. The first of these issues is taken up in Appendix B and the second in Appendix C.

This appendix is divided into five major sections. Following the introduction, the geographical characteristics of the island are discussed. A structural analysis of the agricultural sector follows in the third section where issues such as the size distribution of farms, land tenure arrangements, and the organization of domestic marketing are discussed. The fourth section is important, and analyzes the performance of the sector in terms of production, food imports, contribution to Gross Domestic Product (GDP) and other macroeconomic indicators. The fifth and final section summarizes the discussion.

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[1]The choice of the decade preceding the establishment of the Agro 21 program is arbitrary, and other periods may be as useful in providing a benchmark for assessment.

A.2 GEOGRAPHICAL CHARACTERISTICS OF THE ISLAND

The island of Jamaica is situated in the Caribbean sea roughly 145,000 km south of Cuba and west of Haiti. At its greatest length the island is 238,000 km long, and roughly 84,000 km wide at its greatest width. Recent Food and Agriculture Organization (FAO) data (summarized in Exhibit A.1) put the country's land area at a little over 1 million hectares. According to FAO estimates, 207,000 hectares (21% of the total) were under temporary crops in 1986, while 62,000 hectares (or 6% of the total area) were under permanent crop cultivation.

Climatic conditions on the island are tropical and rainfall is seasonal and highly variable. Royes and Baccus (1988) note that lowlying coastal areas receive between 76 and 152 cm of rain, whereas areas of higher elevation may average as much as 762 cm per year. Average annual rainfall for the island as a whole is roughly 188 cm. St. Catherine and Clarendon, two parishes of particular interest for purposes of this study[2], are below average in terms of annual precipitation. Average annual rainfall for St. Catherine and Clarendon are 165 and 152 cm respectively.

Daily mean annual temperatures on the island vary between 16 degrees C and 28 degrees C, but may be as high as 32 degrees C in lowlying coastal areas. In the St. Catherine and Clarendon areas mean annual temperatures range from 18 degrees C - 31 degrees C in January/February, to 21 degrees C - 32 degrees C in July/August.

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[2]It would be remembered from Chapter 2 that all but one of the vegetable enterprises was sited in these two parishes.

When combined with the low level of annual precipitation in these areas, such high surface temperatures make irrigation essential to crop production. The rate of water evaporation on the southern coastal plains, it should be noted, is roughly 193 cm per year.

In terms of sunshine, Jamaica enjoys eleven to thirteen hours of sunshine per day depending on the month of the year and the elevation. The island receives most hours of sunshine in the May to July period and least in December.

The Jamaican terrain may best be described as mountainous, and hillside agricultural cultivation, with its attendant soil erosion consequences, is a perennial problem. The author is not aware of any reliable estimates of the rate of soil loss on the island, but Royes and Baccus (1988) have argued that the decline in production of coffee and bananas is partly attributable to the loss of fertile, water retentive topsoil.

There is substantial variation in soil types across Jamaica's fourteen parishes. In St. Catherine and Clarendon the major soil types are Caymanas clay loam (a Mollisol), and Sydeham and Churchpen clays (Vertisols). The Caymanas clay loams vary from very high PH to calcareous and are generally well drained. The Sydeham and Churchpen clays are acidic but less free draining. The above soil types are low in available nitrogen, high in phosphorous and moderately high in potassium. In addition, the high PH conditions associated with these soils have resulted in the "fixing" of certain trace elements such as zinc, sulphur, iron, manganese, and boron (USAID n.d).

Exhibit A.1
Jamaica's Land Utilization

Total area of the island (including land area under water)	= 1.099 m ha
Land area (excluding area under water)	= 1.083 m ha
Permanent crop lands (i.e land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest e.g cocoa and coffee)	= 62,000 ha
Permanent pasture	= 195,000 ha
Forest and woodland	= 189,000 ha
Other land (includes unused but potentially productive land, built-on land areas, waste land, parks etc.)	= 430,000 ha

Source: Food and Agriculture Organization, Production Yearbook, 1987.

Caymanas soils are well suited to vegetable crops, soybean, corn, red beans and papaya provided provisions are made for ensuring adequate irrigation. Sydeham and Churchpen clays support the cultivation of sugar cane, soybeans, corn, sorghum and tomatoes. The point to be noted here is that barring considerations of costs of production, Jamaica has the climatic and soil conditions necessary to produce a wide range of crops for the domestic and export markets.

A.3 THE STRUCTURE OF JAMAICAN AGRICULTURE

Agriculture in Jamaica is often described as being dualistic. There exists a plantation sector which has traditionally produced crops such as sugar, cocoa, coffee and bananas for the protected markets of North America and Europe. The plantation sector historically has controlled the best available lands and, being dominated by large and powerful transnational corporations (TNCs), enjoyed ready access to international finance. The primary objective of economic agents of the plantocracy is profit maximization (Beckford 1972).

Existing side by side with the plantation sector is a peasant or subsistence economy. Unlike the plantation sector the peasantry is geared toward production of food crops for the domestic market. The peasant economy functions on marginal lands with low levels of technology and binding financial constraints. Also, economic agents in this sector operate with the maximization of family welfare as their major objective. (See Beckford 1972, and Carloni 1984 for a more complete treatment of the dual economy).

If the issue of land distribution is examined in more detail, a marked skewness in the distribution of Jamaican farm land is immediately apparent. The data are presented in Table A.1. From this table it is observed that a very small percentage of farms (less than 1%), in the greater than 40 ha size grouping, control almost 40% of the cultivated agricultural acreage. The average farm size in this group was 289 ha which is large by Jamaican standards. In contrast, 77% of the total number of farms, in the less than 2 ha size range controlled less than 21% of the operated farm acreage. The average farm size in this category was less than 1 ha. Farming in Jamaica is therefore dominated by a large number of small farm units and a small number of relatively large holdings. The above pattern of land distribution has existed for decades, and in fact prompted Jefferson to write in 1972 that:

> The distribution of farm acreage among the various size groups of farms reflects a fundamental characteristic of agricultural activity in Jamaica which has proven to be one of the most formidable obstacles to the modernization of agriculture (Jefferson, p. 83.)

The above statement is as true of Jamaica in the 1980's as it was when written in the early 1970's. If one accepts the premise that modernization of Jamaica's traditional agricultural system is a prerequisite to successful participation in international markets then the above statement has serious implications for Jamaican exports.

Associated with the problem of land distribution is the issue of insecurity of land tenure. Data in Table A.2 illustrate that in 1982 only 16% of the total number of owner operated acres under cultivation was associated with farms in the < 2 ha group.

TABLE A.1

Farm Size Distribution in Jamaica, 1982

Size Grouping	Number of Farms and Percentage of Total	Number of Hectares and Percentage of Total	Number of ha/Farm
< 2.03	119,907 (77.2%)	77,185 (20.6%)	0.64
2.03 - < 4.1	22,595 (14.5%)	58,369 (15.6%)	2.58
4.1 - < 10.1	9,837 (6.3%)	55,208 (14.8%)	5.61
10.1 - < 20.3	1,774 (1.14%)	23,315 (6.23%)	13.14
20.3 - < 40.5	591 (0.38%)	15,495 (4.14%)	26.22
> 40.5	500 (0.32%)	144,584 (38.6%)	289.17
TOTAL	155,204	374,156	

Source: Calculated from Ministry of Agriculture, Farmers' Register, 1982.

Note: Percentages may not sum to 100 due to rounding.

Note: Apart from owned and rented land the acreage figures in this table reflect adjustments for land which is used free of rent, land which is leased to other farmers, and land which has been given away.

TABLE A.2

Owner Operated and Rented Farm Acreage by Size Grouping

Size Grouping	Number of Owner Operated Farm Hectares	%	Number of Rented Farm Hectares	%
< 2.0	49,362.08	16	25,161.88	43
2.0 - < 4.1	37,346.87	12	11,779.99	20
4.1 - < 10.1	37,730.61	13	8,158.64	14
10.1 - < 20.3	17,710.48	6	2,851.04	5
20.3 - < 41.0	12,440.79	4	1,736,64	3
> 41.0	146,514.46	49	9,140.36	16
TOTAL	301,105.29	100	58,828.56	100

Source: Ministry of Agriculture, Farmers' Register, 1982.

This contrasts with the situation in the largest farm size category in which it is observed that almost 49% of the total owner operated acreage in 1982 was associated with farms in the > 40 ha size category.

Examination of the data for rented farm acreage reveals a quite different situation. In the case of farms in the < 2 ha category, almost 43% of the total rented land was associated with farms in this size group. In contrast, farms in the > 40 ha size category contributed only 16% to the total pool of rented land in 1982.

The vast number of small farmers in Jamaica, it would appear, do not have title to the land they farm and, therefore, are likely to have little incentive to make long run capital improvements to their holdings[3], even though such improvements could conceivably contribute to increased agricultural productivity. The implications for the export oriented development of the sector are clear, and any program of agricultural diversification will have to address the land tenure problem.

Turning to the issue of capital utilization in the agricultural sector one is immediately struck by the paucity of data to allow meaningful analysis of this aspect of structure. Using data from the 1961-2 Agricultural Census, Jefferson was able to discern that there was a trend toward increasing mechanization with increase in farm size (Jefferson 1972). The above inference, though based on crude data from the early 1960's, is unlikely to have changed significantly over the period under study.

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[3]The above conclusion will, of course, be influenced by the existence of long-term tenancy agreements, and the nature of the crops (i.e. whether short or long-term) produced.

If one is prepared to accept the number of tractors in use as a crude measure of the degree of capital utilization, one can say that Jamaica has tended to lag behind Mexico and the Dominican Republic, two of her major LDC competitors in the agricultural export arena (Table A.3). Again, if one accepts the need for modernization of the Jamaican system prior to the launch of an effective export program, this low level of capital utilization does not augur well for Jamaican exports.

Before concluding this section on the structure of agriculture, it would be instructive to examine briefly the organization of the country's marketing system as this too represents a serious impediment to successful export promotion and diversification.

The domestic marketing of agricultural products in Jamaica is dominated by a system of "higglers". These informal traders typically collect small quantities of agricultural produce from geographically dispersed production units for distribution. Higglers may in some cases also provide their clients with assistance in reaping the crop as well as with credit.

No facilities for cooling and packing are available to these traders and so they are constrained to handling relatively small volumes of produce. As Rao (1990) notes:

> It is widely believed that small farmers are severely handicapped by their poor access to markets and excessive reliance on the higgler network which is thought to be inefficient and monopolistic (Rao 1990, p.183).

TABLE A.3

Number of Tractors in Use, Selected Years

Year	NUMBER OF TRACTORS IN USE		
	Jamaica	Dominican Republic	Mexico
1974-76	2,467	2,807	98,667
1979	2,750	3,050	114,000
1980	2,800	3,300	120,000
1981	2,870	3,320	125,000

Source: FAO, Production Yearbook, Various issues.

Rao (1990) goes on to argue that:

> [T]he efficiency of the higgler network is tied to the level of prosperity of the farmers whom they serve and the availability of roads, transportation services and other infrastructure (Rao 1990, p.183).

These services are generally lacking in rural Jamaica.

In 1962 the Government of Jamaica (GOJ) established the Agricultural Marketing Corporation (AMC) with a mandate to improve the domestic marketing of agricultural products on the island. Consistent with the performance of agricultural marketing boards throughout the Caribbean, however, the AMC did not perform well and:

> [B]y 1983 it had to be admitted that the AMC had proved a most expensive institution which had failed to disturb the dominant role performed by the higgler or trader in local agricultural food products in the domestic market (Royes and Baccus, 1988 p. 103).

The failure of the AMC should not be construed as an endorsement of the higgler system, however, for as Rao (1990) correctly points out the higgler network continues only because of the absence of viable alternatives. In summary, domestic marketing continues to represent a serious challenge to the process of agricultural modernization in Jamaica.

A.4 THE PERFORMANCE OF THE JAMAICAN AGRICULTURAL SECTOR

This section reviews the performance of the Jamaican agricultural sector over the period 1972 to 1982. The analysis will be conducted at a macro level with no attempt made to evaluate in detail the performance of individual crop or livestock subsectors.

In 1972, agriculture, forestry and fishing contributed U.S $198 million to the Jamaican economy. This represented a little over 7% of total GDP of U.S $ 2,771 million. By 1982 this sector's contribution stood at U.S $ 256 million, but its contribution to total GDP remained roughly unchanged at 7.6% of total GDP (Table A.4). The stagnation of agriculture's contribution is, interestingly enough, attributable to the lacklustre performance of the export subsector. In 1972, export agriculture contributed U.S $ 46.9 million to overall GDP, but only U.S $42.8 million in 1982. Further, as a percentage of total GDP, this sector's contribution fell from 1.7% to 1.3%.

Sugar, Jamaica's most important export crop, has not fared well in international markets. World sugar prices have been low and unstable (Exhibit A.2), domestic production has fallen off, and there has been increased protectionist action by the U.S. government. The world prices of other major exports such as coffee and cocoa have also been low, although domestic production of these crops has been more buoyant over the 1972-82 period. The overall result, however, has been a decline in the importance of export agriculture.

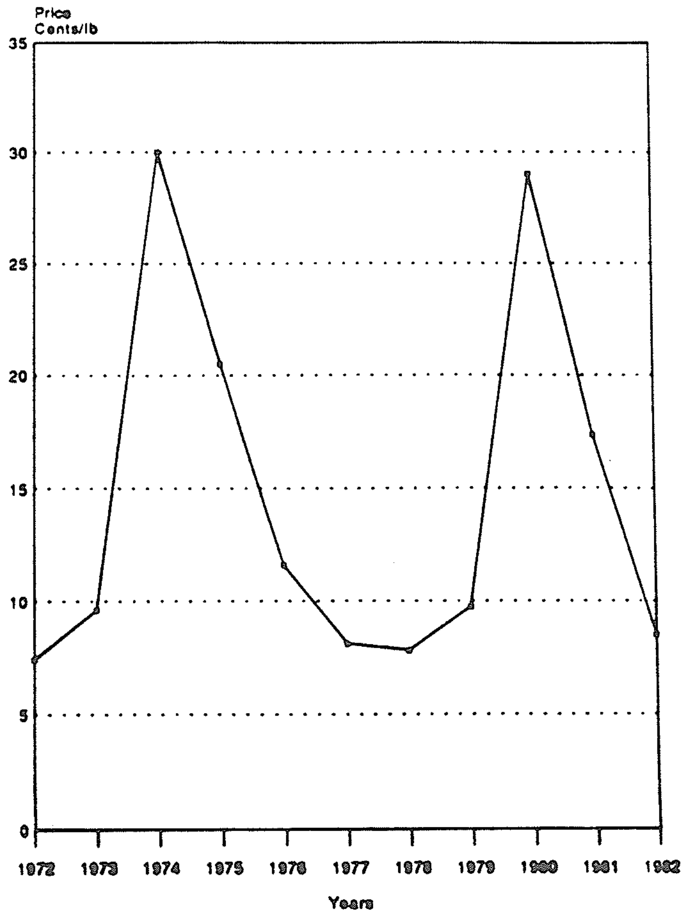
TABLE A.4

Agriculture's Contribution to Gross Domestic Product
(Constant U.S. $ m)

Year	Total GDP	Agric. Forestry Fishing	%	Export Agric.	%	Domestic Agric.	%
1972	2,770.8	198.1	7.15	46.9	1.71	81.0	2.92
1973	2,529.5	174.7	6.90	36.3	1.44	70.4	2.78
1974	2,476.7	178.3	7.19	39.6	1.61	77.0	3.11
1975	2.452.6	181.5	7.40	36.3	1.47	80.3	3.28
1976	2,228.7	182.9	8.21	39.6	1.77	74.8	3.38
1977	2,186.0	187.9	8.60	31.9	1.47	83.6	3.81
1978	1,169.4	110.1	9.41	19.5	1.68	53.7	4.58
1979	3,480.2	296.5	8.52	53.4	1.52	142.5	4.11
1980	3,259.1	271.9	8.34	44.5	1.34	135.4	4.15
1981	3,339.9	278.1	8.33	44.5	1.32	140.7	4.19
1982	3,371.8	256.2	7.59	42.8	1.28	122.9	3.66

Source: PIOJ, Social and Economic Survey, Various issues.

Exhibit A.2


Price
Cents/lb
35
30
25
20
15
10
5
0
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
Years

Domestic agriculture, on the other hand, posted significant gains over the period, despite some fluctuations. In 1972, domestic agriculture accounted for U.S $ 81 million, or 3% of total GDP. At the end of the period the contribution from this branch of agriculture had improved to U.S $123 million or 4% of total GDP. Domestic agriculture's best year was 1979 when the sector contributed U.S $ 143 million to the Jamaican economy. Despite the relatively strong performance of the domestic food sector, however, Jamaica's dependence on foreign food supplies increased over the study period.

In 1972 Jamaica's food import bill stood at US $118.2 million, but by 1982 had increased to US $234.8 million (Table A.5). The foreign exchange leakage represented by such enormous food imports is particularly troubling in a country critically short of foreign exchange reserves. The situation is even more unpalatable when it is recognized that cereals and meat products, items which can be produced domestically, represent a large proportion of the above foreign exchange costs.

As further evidence of the poor performance of the sector, one need only examine the available data on production and employment. Table A.6 presents per capita production indices for the period 1972-82. Overall, agricultural production declined significantly over the period, with the loss clearly attributable to a reduction in crop output. Interestingly, the production of livestock products increased marginally over the period.

TABLE A.5

Jamaica's Food Import Bill
($ U.S. m)

Year	Value (US $ m)
1972	118.2
1973	137.9
1974	200.9
1975	196.3
1976	200.5
1977	165.1
1978	193.4
1979	152.8
1980	224.8
1981	251.7
1982	234.8

Source: FAO, Trade Yearbook, Various issues.

TABLE A.6

Indices of Per Capita Agricultural Production
(1974 / 6 = 100)

Year	Agricultural Indices	Crop Indices	Livestock Indices
1972	108.16	115.77	88.35
1973	102.41	101.39	101.68
1974	103.48	102.58	101.45
1975	97.08	97.78	97.78
1976	99.43	99.65	100.79
1977	102.44	103.39	103.60
1978	117.06	122.60	104.55
1979	96.46	95.60	105.09
1980	90.48	85.99	108.24
1981	88.35	86.96	109.49
1982	89.51	86.93	110.04

Source: FAO, Production Yearbook, Various issues.

The proportion of the Jamaican population actively engaged in agricultural pursuits also declined over the study period (Table A.7). In 1975, 25% of the country's population was involved in agriculture, but by 1982 this percentage had decreased to just over 19%. While a reduction in the number of people employed in agriculture is often associated with the process of modernization and growth of the sector, this view is clearly not supported by the other performance indicators discussed earlier.

A.5 SUMMARY

This appendix has reviewed certain aspects of the structure and performance of the Jamaican agricultural sector. Beginning with a general discussion of some geographical features of the island it was pointed out that climatic conditions are amenable to the production of a wide range of agricultural crops.

Section A.3 discussed the structure of Jamaican agriculture and here it was established that there persists a marked skewness in the island's pattern of land distribution. The system is dominated by a large number of small holdings, and a small percentage of large farms. The issue of land tenure was also raised in this section and the argument was advanced that small farmers tended to not own the land they operated, and that this insecurity could act as a disincentive to long run capital improvements. Domestic marketing arrangements were also examined in this section, and the point was made that the system of domestic marketing on the island was extremely inefficient.

TABLE A.7

Jamaican Population Engaged in Agriculture, 000's

Year	Total Population	Agricultural Population	%
1975	2,029	504	24.8
1976	2,058	493	23.9
1977	2,104	486	23.1
1978	2,133	475	22.3
1979	2,162	464	21.5
1980	2,188	453	20.7
1981	2,220	443	19.9
1982	2,253	432	19.2

Source: FAO, Production Yearbook, Various issues.

Section A.4 reviewed the performance of the sector over the 1972-82 pre-Agro 21 period. The general decline in the sector as measured by such macro-economic indicators as contribution to GDP, employment and food imports was noted.

APPENDIX B

DESCRIPTION OF THE AGRO 21 PROGRAM: PHILOSOPHY, OBJECTIVES, INSTITUTIONS AND TARGETS

B.1 INTRODUCTION

Appendix A recorded the poor performance of the Jamaican agricultural sector over the period 1972 - 1982. The purpose of this appendix is to provide a detailed description of the Agro 21 Development Program, an approach to export promotion and diversification based on the use of advanced technologies. Such a description, it should be emphasised, is a necessary prerequisite to any formal evaluation of the program's performance, or any assessment of the constraints to its implementation. The evaluation of the program's performance is examined in Appendix C.

The present appendix deals first with the underlying philosophy and rationale for the institution of the program. This is undertaken in section B.2. The discussion in this section uses as a base, material on the performance of the Jamaican agricultural sector presented in the preceding appendix. Section B.3 deals with the institutional setting for the implementation of the program. The various organizations involved are identified, and their roles described in this section. The mechanism for inter-institutional coordination is also clarified in this discussion. The issue of funding for the implementation and operation of the program is a matter which is also touched on briefly in section B.3. Section B.4 examines the various crop and livestock subsectors that form part of the program, and the performance targets that were established for each. The fifth and final section of the appendix summarizes the discussion.

B.2 THE AGRO 21 PHILOSOPHY AND OBJECTIVES

The Agro 21 development program was established in October of 1982 by the now defunct Seaga Administration in an attempt to make dynamic a sluggish Jamaican agricultural sector. The significance of the name Agro 21 is conveyed in a statement from the then Prime Minister, Edward Seaga:[1]

> It is called Agro 21 because if it uses well these new opportunities no better commemoration of the 21st Anniversary of the Independence of Jamaican can be offered to our people than a programme to blaze a new trail both in and on the LAND WE LOVE (Emphasis in the original, Daily Gleaner October 29, 1983).

The essential element of the program was large scale, capital intensive cultivation of nontraditional agricultural commodities for the "hard currency" export markets of North America and Europe. Earnings from the export branch of agriculture declined from U.S $ 46.9 million in 1972 to U.S $42.8 million by 1982, as was noted in Appendix A, underscoring the need for the program's export orientation. The

[1]Originally there were 21 commodities included in the Agro 21 initiative and some have argued that an alternative rationale for the name of the program derives from this observation.

alleviation of unemployment, particularly in rural Jamaica, was also cited as a major potential benefit of the program.

The Agro 21 initiative also included a self-sufficiency component under which certain commodities, viz; beef, dairy products, fish and rice would be produced to substitute for food imports in these categories. The haemorrhaging of the country's meagre foreign exchange reserves to finance the import of food which could be produced domestically has already been noted in Appendix A. Jamaica's food import bill, it would be remembered, increased from US \$118 million to US \$235 million over the 1972-82 period, with a large percentage of the leakage attributable to imported cereals.

Given the fiscal constraints experienced by the Jamaican government at the time, and the urgings of the International Monetary Fund (IMF) for budgetary restraint and movement to a more free market economy, it was well recognized that the Government could not be the program's lead financing agency. The local and foreign private sectors were, therefore, invited to become key players in the diversification effort, and the Jamaican Government was relegated to a supportive role in the diversification experiment.

The inadequacy of the Jamaican agricultural technological base was also well recognized at the time of program planning, as were the limitations imposed by such traditional technologies on an expanded role for nontraditional exports. Efforts were, therefore, made to import the most advanced agricultural technologies (e.g drip irrigation, and computerized aquaculture systems) for use in the various farming enterprises. The need to transfer new and improved technologies to the local farming community was also recognized by the architects of the initiative. Transfer was to be effected through the implementation of the mother farm-satellite farm concept. This concept, as is well known, involves the establishment of large and successful mother farms in particular geographic regions which would provide to smaller farms in the area access to new technologies and marketing channels in a formal contractual setting. The system, when well established, should be symbiotic, with the large farms gaining additional productive capacity and the "satellites" access to distribution channels, technical advice and economies of scale not ordinarily open to them.

Another important feature of the program was its focus on the divestment of idle and under-utilized state owned sugar lands to private sector investors involved in the crop diversification effort. Approximately 81,000 ha of land were to be put into cultivation of nontraditional exports over the first four years. In the first year of operation roughly 8,100 ha were earmarked for divestment from three Government owned sugar estates on the St. Catherine plains.

USAID, quoting a recent World Bank study, has argued that because of declining international sugar prices, reduced operational efficiency and a low level of capital investment in the industry, Jamaica should reduce her sugar production to 225,000 tons/year. This, it was argued, would be sufficient to meet EEC quota and domestic consumption requirements, discounting further preferential access to the U.S. market. This level of production could be satisfied by the output of two large government owned factories - Monymusk and Frome (USAID n.d).

The specific objectives of the program may now be stated more precisely. The major objectives are summarized in the National Planning Agency's (NPA) (now called the Planning Institute of Jamaica, or PIOJ) Master Plan and may be reiterated as follows:

1. The transformation and modernization of the agricultural sector beginning with the subsectors/projects targeted for Agro 21 and the creation of a major conduit through which private and institutional capital and technology can be mobilized for further development and growth of the Jamaican economy.

2. The achievement of strong annual growth in the foreign exchange contribution of the agricultural sector during the next four years in order to bolster current efforts aimed at achieving a positive net international reserves position in the shortest possible time frame.

3. The achievement of strong annual growth in direct employment in agriculture during the four year period 1983/4 to 1986/7.

4. The utilization of opportunities for the generation of income, creation of jobs and the building and development of infrastructure in rural Jamaica in order to effect significant improvements in the quality of life in the countryside, wherever idle land exists (National Planning Agency n.d).

The end result of the successful implementation of the Agro 21 program was to have been a dynamic export oriented and diversified agricultural sector capable of reversing the slide in foreign exchange generation and employment creation. The program, properly implemented, was to have led to a higher rate of return to Jamaica's land resources. Further, the program was to have had a demonstrative impact on the local farming community inspiring a commercial and business-like approach to primary agricultural production.

B.3 THE INSTITUTIONAL SETTING

In this section the major institutions involved in the Agro 21 program are identified, and their roles in the diversification process discussed.

The Agro 21 Secretariat

The key institution in the implementation of the Agro 21 program was the Agro 21 Secretariat. Established in October 1983 as a subsidiary of the National Investment Bank of Jamaica (NIBJ), this organization was given a leading and high profile role in the diversification experiment. The Secretariat, set up within the Office of the Prime Minister (OPM), was mandated to prepare background technical reports on various potential projects, screen prospective investors, and facilitate the formation of joint venture partnerships. The NPA/PIOJ in its Master Plan states the functions of the Secretariat as, inter alia:

1. Establishing information sourcing networks and data accumulation systems for the creation of an industry data bank to provide among other things information on crops, f.o.b. sale prices, transportation costs, wholesale and retail pricing, market demand, and volume/price sensitivities on an ongoing basis.

2. Collaborating with Jamaica National Investment Promotion Ltd. (JNIP) to expand the list of investors for agribusiness investment and undertaking joint investigation with the Jamaica National Investment Corporation (JNIC) and JNIP into specific investment opportunities for potential investors.

3. Checking land[2] currently under cultivation or planned for cultivation in order to assess and advise on the relevant development strategy to be employed; and

4. Advising on the establishment or improvement of procedures for the orderly development of systems to link the operations of the producer with the secondary and tertiary stages of processing, shipping and marketing.

[2]These lands, of course, refer only to state owned land earmarked for divestment.

The Secretariat was staffed with local and ex-patriot agricultural experts and was viewed as a rapid response, problem solving institution. Salaries at the Secretariat were pegged higher than public sector guidelines in order to attract quality staff members, many of whom were attracted from the Ministry of Agriculture. All professional staff at the Secretariat were on short term contracts - a regulation adopted to reduce the tendency for "empire building" (USAID n.d).

In 1985 the Secretariat was incorporated, and became known as the Agro 21 Corporation, and therefore enjoyed an expanded slate of business capabilities as provided under Jamaican company law. Commensurate with these expanded powers, the Agro 21 Corporation became the executing agency for the USAID Crop Diversification and Irrigation Project (CD/I).

The CD/I must be regarded as an essential part of the Government's initiative. In fact it represented the first tentative step towards implementation and operationalization of the Agro 21 program. The CD/I was approved on September 9th 1985 and its stated purpose "...[was] to reinforce the institutional capacity of Agro 21 to develop private agricultural investment in Jamaica" (USAID n.d).

The key element of the CD/I was the rehabilitation of the Rio Cobre irrigation works on the St. Catherine Plains. The availability of irrigation water had previously been identified as a major obstacle to crop diversification in this parish. Another key component of the CD/I was the provision of funds for a small farmer linkage (mother farm-satellite farm) project as discussed earlier.

Agro 21 Supporting Institutions

Exhibit B.1 below depicts the organizational framework initially proposed by the NPA/PIOJ for the implementation of Agro 21. A steering committee, chaired by the Prime Minister, was established in June of 1983 to coordinate the activities of all agencies associated with the program. Members of the committee were drawn from several organizations: the Agro 21 Corporation, Ministry of Agriculture (Min Ag), JNIC/NIBJ, JNIP/Jampro, USAID, the Agricultural Credit Bank (ACB), Department of Statistics, and the Scientific Research Council.

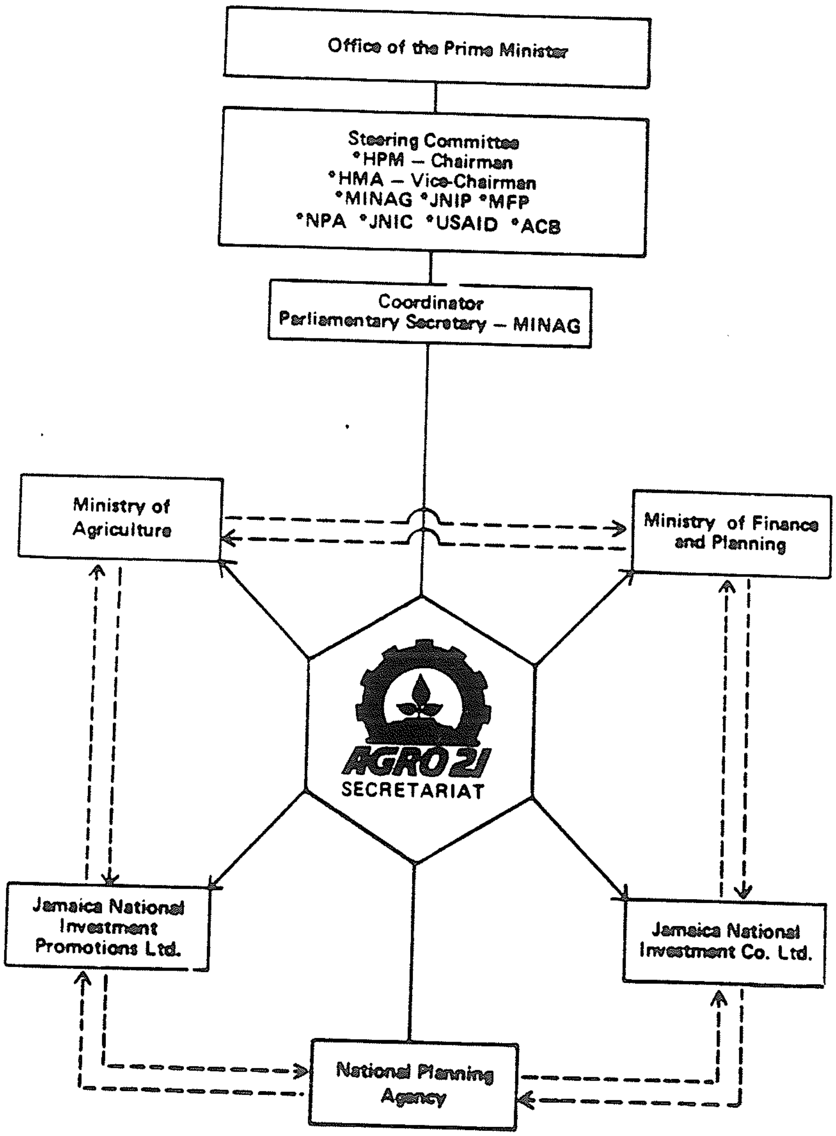
The committee met once per week. The steering committee had overall responsibility for the formulation of policy with respect to the program and for the evaluation of all its projects.

Below the steering committee and playing a central role as depicted in the Exhibit is the Agro 21 Secretariat /Corporation. The role and functions of this entity were outlined earlier.

Associated with the Program in a supportive role was the Ministry of Agriculture (Min Ag). According to the NPA/PIOJ Master Plan the major responsibilities of Min Ag were *inter alia*:

Exhibit B.1

The Agro 21 Organizational Structure



Source: NPA, Master Plan, n.d.

1. The development of a land resource and capability plan for the entire country, prioritized in terms of the requirements of Agro 21.

2. The provision of technical support in animal and plant protection and quarantine, and livestock development.

3. Reorientation of the extension services to:

   (a) disseminate the new technologies to the small farmer community

   (b) to assist farmers in the process of applying new technologies in high yielding varieties and crops best suited to their environment and having prospects for exports.

The welfare and development of small farming in Jamaica was retained by Min Ag while responsibility for large scale production was to be handled by the Agro 21 Corporation.

As depicted in the Exhibit, JNIP/Jampro also played a supportive role in the program. The major functions of this organization were to bring together potential investors with suitable projects, evaluate potential investors, and to process and disseminate information required by prospective investors. The role of this organization was, therefore, promotional and facilitating in scope. The obvious duplication of the functions performed by the Secretariat and JNIP/Jampro is to be noted at this point as this functional overlap proved to be a source of much inter-agency conflict.

The important functions of planning, monitoring and reviewing the process of implementation of the entire program were performed by NPA/PIOJ. This agency was responsible for the development of detailed project profiles for specific agricultural subsectors as well as for the establishment of performance targets.

The JNIC/NIBJ functioned as the investment arm of the Government of Jamaica and held government's equity in a number of public sector/private sector joint ventures. The Master Plan also states that the JNIC/NIBJ would provide interim management facilities during the formative stages of project development.

The NPA/PIOJ organizational framework reproduced in Exhibit B.1 depicts the Ministry of Finance and Planning in a supportive role. The Master Plan, however, contains no reference to the function(s) to be performed by this institution and in reality this Ministry was not involved in program implementation.

B.3.1 FINANCING REQUIREMENTS AND INSTITUTIONAL SOURCES

In this subsection the financing requirements of the Agro 21 program are discussed and sources of funds identified. The capital cost of the CD/I project was US $24 million of which USAID provided US $13 million as a developmental grant and US $5 million as a loan. Loan funds were repayable over a 25 year period (including a grace period of 10 years) at a rate of 2% for the first five years, 3% during the remainder of the grace period and 5% thereafter. All loan repayments were to be made in US funds. The Government of Jamaica contributed US $6 million to the CD/I project in the form of land resources for on-farm development.

According to the Master Plan, the entire Agro 21 program (inclusive of the initial CD/I project) was expected to utilize U.S $177 million for operational expenses in the 1984-87 period. Apart from USAID's contribution of U.S $ 18 million, funds for the program's operation were expected from the World Bank, EEC and the Government of Japan, among others. At the time of publication of the Master Plan, however, some U.S $126 million were outstanding.

B.4 AGRO 21 PERFORMANCE TARGETS

Having reviewed the philosophy and objectives of the Agro 21 program and described the functions of the various institutions involved in its implementation, the discussion will now focus on the performance targets the initiative was designed to achieve.

Before proceeding, however, it would be wise to note that the program under study was heavily politicized[3] and that the term "Agro 21" in fact became a catch-all expression for any export oriented agricultural operation involving non-traditional products. Some export operations, for example, initiated prior to the formal launch of

[3]It should be recognised that Agro 21 was more than a technical program for the development of the agricultural sector. During the 1989 elections the program itself became a centrepiece for a debate on the stewardship of the Seaga government.

the program became subsumed under the Agro 21 heading. In the material which follows Agro 21 projects are identified as those listed in the NPA/PIOJ Master Plan, although it is recognized that this may overstate the actual coverage of the initiative.

The Agro 21 development program focused on nineteen subsectors (Exhibit B.2). These subsectors identified as List I included only projects for which detailed economic and agronomic analyses had been conducted. List I projects were further subdivided into three categories based on their degree of readiness for implementation. Status A projects were in the most advanced stage, planning was almost complete, land had been identified and finance sourced. Status B projects were those where land and investors had been identified but finance was not yet in place. Status C projects on the other hand were the least prepared and in these cases either suitable land or suitable investors (but not both) had been identified.

The NPA/PIOJ in its Master Plan also makes reference to a secondary list of possible projects (List II) the economic viability of which had yet to be established. The List II projects are illustrated in Exhibit B.3. Very little work (if any) was actually conducted on List II projects and for this reason projects in this category are not considered further.

Exhibit B.2

List 1 Projects

1. Winter Vegetables	2. Banana	3. Ethnic Crops
4. Tobacco	5. Coconuts	6. Coffee
7. Rice*	8. Afforestation	9. Citrus
10. Pineapples	11. Beekeeping	12. Aloe Vera
13. Ornamental Horticulture	14. Cassava	15. Orchard Crops
16. Aquaculture*	17. Dairy*	18. Beef*
19. Cocoa		

* These sectors were designed to save foreign exchange via import substitution, as part of the self-sufficiency component of the Agro 21 program.

Source: NPA, Master Plan, n.d.

Exhibit B.3

List 11 Projects

1. Spices	2. Small Ruminants	3. Macademia Nuts
4. Mushrooms	5. Strawberry	6. Soya
7. Sorghum	8. Bamboo	9. Grapes
10. Ethanol	11. Sunflower	12. High Yielding Cane
13. Cotton	14. Corn	15. Jojoba
16. Winged Beans		

Source: NPA, Master Plan, n.d.

B.4.1 ACREAGE PERFORMANCE TARGETS

The Master Plan suggests that over the first four years of Agro 21 operation some 75,000 ha of idle and underutilized land were to have been put into productive use (Table B.1). Enterprises which were to have made the greatest contribution to increased cultivated acreage were beef, dairy, afforestation and coconuts. It should be noted that up to the time of publication of the Master Plan some 36,000 ha had been identified for status A projects. It should be emphasized at this point that the performance targets in this and subsequent subsections were revised several times over the life of the program in response to observations on their actual performance.

B.4.2 EMPLOYMENT PERFORMANCE TARGETS

Table B.2 illustrates the employment performance targets established for the various List I subsectors. A total of 104,442 new jobs were to have been created over the first four years. Greatest employment contributions were to have been made by the winter vegetable, tobacco and banana subsectors. These three crop categories were targeted to provide 60% of the total number of new jobs created. Over the 4 year period, employment was targeted to increase by some 121%.

TABLE B.1

Agro 21 Acreage Performance Targets (ha)

Subsector	Year 1	Year 2	Year 3	Year 4	Total
Winter Vegetables	405	810	1,215	810	3,240
Banana	405	1,418	1,418	1,418	4,659
Coffee	810	1,013	1,701	1,742	5,266
Ethnic Crops	810	810	709	506	2,835
Tobacco	243	162	405	405	1,215
Coconut	2,430	2,025	2,025	2,025	8,505
Rice	405	972	810	608	2,795
Afforestation	2,045	2,608	3,216	3,621	11,490
Citrus	405	608	608	810	2,431
Pineapple	81	162	243	243	729
Beekeeping*	(1,000)	(2,000)	(4,000)	(5,000)	(12,000)
Aloe Vera	61	182	203	162	608
Ornamental Horticulture	81	142	203	263	689
Cassava	203	608	405	405	1,621
Orchard Crops	405	810	1,215	1,620	4,050
Aquaculture	122	284	405	405	1,216
Dairy	304	2,430	2,734	4,982	10,450
Beef	506	2,511	4,496	4,050	11,563
Cocoa	203	405	405	405	1,418
TOTAL	9,924	17,960	22,416	24,480	74,780

* Number of hives.

<u>Source</u>: NPA, <u>Master Plan</u>, n.d.

TABLE B.2

Agro 21 Employment Performance Targets

Subsector	Number of Jobs				
	Year 1	Year 2	Year 3	Year 4	Total
Winter Vegetables	3,000	6,000	9,000	6,000	24,000
Banana	1,500	5,250	5,250	6,000	18,000
Coffee	800	1,000	1,680	1,720	5,200
Ethnic Crops	1,400	1,400	1,150	650	4,600
Tobacco	4,200	2,800	7,000	7,000	21,000
Coconut	250	208	208	208	874
Rice	220	480	400	300	1,400
Afforestation	1,262	1,610	1,986	2,234	7,092
Citrus	270	405	405	540	1,620
Pineapple	40	80	120	120	360
Beekeeping	60	120	240	300	720
Aloe Vera	150	450	500	400	1,500
Ornamental Horticulture	800	1,400	2,000	2,600	6,800
Cassava	100	300	200	200	800
Orchard Crops	200	400	600	800	2,000
Aquaculture	75	175	250	250	750
Dairy	150	1,200	1,350	2,460	5,160
Beef	50	248	444	404	1,146
Cocoa	200	400	400	400	1,400
TOTAL	14,727	23,926	33,183	32,586	104,442

Source: NPA, Master Plan, n.d.

B.4.3 EXPORT VOLUME PERFORMANCE TARGET

The export volume performance targets for the program are presented in Table B.3. Because of differences in the units of measurement meaningful annual totals cannot be computed. However, the winter vegetable subsector was expected to contribute a total of 161,000 tons to the country's export volume over the first four years of Agro 21 operation. Exports in year 1 were expected to be roughly 9,000 tons and by year 4 approximately 72,000 tons - a phenomenal increase of 700%. Remarkable export volume increases (over 2000%) were also expected from banana cultivation.

Significant volume increases were also anticipated from the self sufficiency subsectors over the 4 year period. Rice production, according to the Master Plan, would increase by 538%, milk by 5,140% and beef by 1,500%.

B.4.4 FOREIGN EXCHANGE TARGETS

In terms of foreign exchange earnings and savings the Agro 21 program was expected to contribute an additional U.S $198 million to the Jamaican economy over the first four years. Winter vegetable (U.S $70 million) and banana production (U.S $32 million) were expected to be among the major contributors to gross foreign exchange earnings/savings. (Table B.4)

TABLE B.3

Agro 21 Export Volume Performance Targets

Subsector	Year 1	Year 2	Year 3	Year 4	Total
Winter Vegetables (t)	8,960	26,880	53,760	71,680	161,280
Banana (t)	4,000	22,000	54,000	98,000	178,000
Coffee (000 boxes)	-	-	-	16	16
Ethnic Crops (t)	14,565	27,555	40,822	50,314	133,256
Tobacco*	302	504	1,008	1,512	3,326
Coconuts	-	-	-	-	-
Rice**	2,946	9,418	14,774	18,791	45,929
Afforestation	-	-	-	-	-
Citrus (000 boxes)	-	-	-	35	35
Pineapple (000 t)	4	11	22	32	70
Beekeeping:					
Honey (gals)	-	3,750	12,750	32,250	48,750
Wax (lbs)	-	375	1,275	3,225	4,875
Aloe Vera:					
(000' gals)	-	500	3,250	8,000	11,750
Ornamental Horticulture:					
(m blooms)	6	18	39	59	121
(m tips)	1	3	6	9	19
Orchard Crops	215	1,075	2,150	3,761	7,202
Aquaculture:					
Fish	-	131	436	873	1,440
Shrimp	-	28	274	548	904
Dairy (m qrts)**	1	6	17	33	57
Beef (m lbs)	1	2	4	6	12
Cocoa	-	52	206	437	695

* Includes import substitutes.
** Import substitutes.

Source: NPA, Master Plan, n.d.

TABLE B.4

Agro 21 Gross Foreign Exchange Performance Targets
(U.S. $ m)

Subsector	Year 1	Year 2	Year 3	Year 4	Total
Winter Vegetables	9.48	15.45	20.54	24.64	70.11
Banana	1.93	5.77	9.42	15.38	32.50
Coffee	-	-	-	0.38	0.38
Ethnic Crops	7.85	8.21	8.12	9.24	33.42
Tobacco	2.28	2.06	2.46	2.78	9.58
Rice*	1.10	1.90	1.99	2.27	7.26
Citrus	-	-	-	0.06	0.06
Pineapple	0.71	1.08	1.44	1.89	5.12
Beekeeping	-	0.01	0.03	0.06	0.10
Aloe Vera	-	0.81	3.52	7.80	12.13
Ornamental Horticulture	1.71	2.71	3.89	5.28	13.59
Cassava	0.22	0.49	0.49	0.58	1.78
Orchard	0.09	0.26	0.34	0.66	1.35
Aquaculture	-	0.67	1.47	2.65	4.79
Dairy	0.11	0.62	1.11	1.94	3.78
Beef	-	-	0.16	0.89	1.05
Cocoa	-	0.06	0.17	0.32	0.55
TOTAL	25.48	40.10	55.15	76.82	197.55

Source: NPA, Master Plan, n.d.

Increased domestic rice cultivation was expected to save the country roughly U.S $ 7 million over the four year period. As was noted in Appendix A cereal imports constitute a major component of Jamaica's massive food import bill. Increased cassava and ethnic crop production were also expected to slow down the rate of foreign exchange leakage to finance these imports. The overall rate of increase in foreign exchange earnings/savings from the List I subsectors was expected to be an optimistic 200% over the first four years.

B.5 SUMMARY

This appendix has sought to describe the essential elements of the Agro 21 program as outlined in the original program document. The Agro 21 philosophy of commercial, export-oriented agricultural production based on advanced on-farm technologies was discussed in Section B.2. Section B.3 examined the role and function of the various institutions involved in the program.

The performance targets established for the crop and livestock sectors described as List I were examined in Section B.4 It was noted in that section that winter vegetables, banana and tobacco were expected to make the greatest contribution to employment creation and foreign exchange earnings. The phenomenal rates of increase expected in the various performance indicators that were targeted were also noted. Foreign exchange earnings/savings were, for example, expected to increase by 200%

over the 4 year period, while the rate of increase in employment creation was expected to be 121% (or 30% per year).

APPENDIX C

AN OVERVIEW OF THE PERFORMANCE OF THE AGRO 21 DEVELOPMENT PROGRAM, 1984-1988

C.1 INTRODUCTION

Having completed the description of the Agro 21 program and examined in some detail its institutions, objectives and targets, an evaluation of the program's actual performance may now be undertaken. The Agro 21 program was formally announced in October 1982 and had a relatively short life span of about five years, being disbanded by the incoming Manley Administration after the general elections in February 1989.[1] Our review, therefore, covers the period 1984 to 1988 inclusive, although even at the time of writing some "Agro 21 type" projects continue to operate on the island.

The ephemeral nature of the program, and the consequent paucity of data, preclude the use of econometric techniques in analyzing the actual impact of the program. In the ensuing discussion the performance of the program is quantified, however, and comparisons made with historical trends and government established targets.

[1]The Agro 21 program was the subject of a number of formal evaluations over its life (see for example, Development Alternatives (1989) and Systems for Executive Managers (1984). It is difficult to say, however, whether the program was disbanded on the basis of these evaluations or for political reasons.

In the discussion which follows, the performance of the export and self sufficiency components of the program are evaluated separately in sections C.2 and C.3 respectively. Actual performance data on foreign exchange earnings, savings, employment creation and acreage under cultivation are presented and analyzed in these sections. Section C.4 examines the performance of the program in terms of other areas of importance such as capital inflows to the agricultural sector, the transfer of technology and government's ability to bring unused and underutilized sugar lands into diversified crop production. Section C.5 closes the appendix and here an attempt is made to summarize the results of the evaluation process and to render a reasoned verdict on the success or failure of the program in meeting its objectives.

C.2 THE EXPORT PERFORMANCE OF THE AGRO 21 PROGRAM

In this section we undertake an evaluation of the actual performance of the export component of the Agro 21 program relative to government established targets. One immediate problem which must be faced in conducting such an evaluation is that, because of the methodology employed, it is impossible to state categorically that changes in the magnitudes of certain performance indicators are attributable solely to the existence of the program. We are unable, given the short time series of data, to prove the existence of any causal relationship between the application of the program's policy instruments and changes in performance indicators.

In the case of certain crops with long gestation periods such as cocoa and coffee, actual performance data over the 1984 to 1988 period cannot reasonably be attributed to any policy announced in 1983. For this reason performance data for these crops (though available) are not reported.

C.2.1 FOREIGN EXCHANGE EARNINGS

Table C.1 below shows gross foreign exchange earnings from the various subsectors of the Agro 21 program in millions of U.S. dollars. Also shown in the table is the NPA/PIOJ four year projected performance of each subsector, and the deviations from average targeted performance. Although the Agro 21 program was predicated on the diversification of Jamaican agriculture away from sugar, export earnings for this crop are reported for comparative purposes.

Data in Table C.1 indicate that the selected nontraditional crops exported earned roughly US $111 million for the Jamaican economy over the 4 year period under review. This performance, however, paled in comparison to the US $253 million generated from sugar exports over the same four year period.

Also important is the fact that the Agro 21 program (i.e the subsectors selected for this evaluation) failed to meet NPA/PIOJ average performance targets by an estimated US $6 million. Most disappointing perhaps was the performance of the winter vegetable effort which posted a negative deviation from target of approximately US $9

TABLE C.1
Gross Foreign Exchange Earnings and Deviations from Targets
(US $m)

Subsector	Actual Earnings 1984/85	1985/86	1986/87	1987/88	Average Earnings	Average Target	Deviation
Vegetables	6.72	9.0	2.7	1.72	5.04	13.94	-8.90
Banana	1.60	4.10	9.1	18.9	8.43	6.98	+1.45
Ethnic Crops	-	-	8.0	9.50	8.75	6.06	+2.69
Pimento	6.5	6.7	5.4	4.95	5.9	n.a.	n.a.
Ornamen-tals	0.98	2.5	3.0	3.05	2.38	2.75	-0.37
Orchard Crops	0.62	2.37	1.6	0.60	1.29	0.29	+1.00
Tobacco	0.32	0.25	0.4	0.34	0.33	1.76	-1.43
Total (non-traditional)	16.74	24.92	30.2	39.06	-	-	-5.56
Sugar	66.0	49.8	63.7	73.8	63.3	n.a.	n.a.
Total (all crops)	82.74	74.72	93.9	112.86	-	-	-

Source: NPA, Master Plan, n.d. and unpublished PIOJ data.

million. Based on earlier discussions it will be remembered that the winter vegetable subsector was expected to be a major contributor to the program's foreign exchange earnings. Overall, three subsectors generated positive deviations from target and an equal number negative deviations. It needs to be pointed out at this stage that the data in Table C.1 refer to gross foreign exchange earnings and no cognizance is taken of the foreign exchange input used to generate these returns.

While no data are available on the actual foreign exchange usage of the various subsectors, one can reasonably assume that it was significant. Jamaica's performance in the provision of agricultural inputs of equipment, fertilizer, seed, chemicals etc. from domestic sources is well known to be weak (Mandle 1985).

However, some crude estimates of net foreign exchange earnings may be obtained using PIOJ estimates of fixed capital requirements of the subsectors, and certain restrictive assumptions. If one assumes that the PIOJ was correct in its projections of capital requirements for the various subsectors (i.e. the amount of fixed capital projected for use was in fact consumed in the program's operation), that 100% of the fixed capital requirements was imported, and that foreign recurrent expenditures were small relative to fixed costs (and can therefore be ignored), crude "net" foreign exchange earnings may be computed as in Table C.2.

When total foreign exchange earnings are adjusted for fixed capital consumption, the foreign exchange benefits of the program fall from US $110 million to US $24 million, over the four year period.

TABLE C.2
Net Foreign Exchange Earnings from Selected Crop Subsectors
($ U.S. m)

Subsector	Total Earnings	Projected Fixed Capital Requirements	Net Earnings
Vegetables	20.14	5.60	14.54
Banana	33.70	12.60	21.10
Ethnic Crops	17.50	3.18	14.32
Pimento	23.55	-	-
Ornamentals	9.53	32.30	-22.77
Orchard Crops	5.19	8.20	-3.01
Tobacco	1.31	1.80	-0.49
TOTAL	110.92	63.68	23.69

Note: Fixed capital requirements obtained from NPA's Master Plan, n.d.

Given the small (and possibly negative) foreign exchange gains from the approach, the analysis raises serious questions about the viability of a Jamaican agricultural development strategy predicated on imported technological inputs. The crude estimates of the net foreign exchange gains from the program presented above suggest the need for a greater focus on the use of domestic inputs in the process of agricultural transformation.[2]

C.2.2 EMPLOYMENT CREATION

Agro 21's performance in the area of job creation also fell short of expectations. Table C.3 presents data on the actual levels of employment created in the various subsectors, along with Government projections and deviations from average targeted performance. Actual performance data for ethnic crops, pimento and orchard crops were unavailable and so these crops are omitted from the analysis. Again, employment data for sugar are shown only for comparative purposes.

Actual employment fell short of targeted employment by an estimated 2,000 jobs for the four crops considered in the analysis. The greatest deviation from target was in the area of tobacco production where actual employment creation fell short of projections by almost 4,000 jobs. Overall, however, the program did generate an

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[2] The above conclusion would, of course, be invalid if the projects considered can be shown to generate direct and indirect social benefits in excess of their social costs. The examination of the foreign exchange balance presented here is not intended as a complete analysis of the issue.

TABLE C.3
Employment Creation and Deviation from Target, 1984-1988

Sector	Actual Employment 1984	1985	1986	1987	Average No. of Jobs	Average Target	Deviation
Vegetables	5,075	9,000	3,000	2,500	4,894	6,000	-1,106
Banana	4,750	7,619	7,169	6,600	6,534	4,500	+2,034
Ethnic Crops	n.a.	n.a.	n.a.	n.a.	n.a.	1,150	-
Pimento	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-
Ornamentals	909	2,509	2,807	4,000	2,556	1,700	+856
Orchard Crops	n.a.	n.a.	n.a.	n.a.	n.a.	500	-
Tobacco	2,032	1,292	2,320	728	1,593	5,250	-3,657
Total (non-traditional)	12,766	20,420	15,296	13,828	-	-	-1,872
Sugar	4,200	4,100	4,000	4,000	4,075	n.a.	-
TOTAL	16,966	24,520	19,296	17,828	-	-	-

Source: NPA Master Plan, n.d. and unpublished PIOJ data.

additional 62,000 new jobs in the agricultural sector over the 1984 to 1988 period, 38,000 jobs more than created by the sugar industry over the same period. It would be remembered from our earlier discussions on the philosophy and objectives of Agro 21 that one of the major motivations for implementation of the program was the alleviation of rural unemployment. It is therefore instructive to examine the record of unemployment in the rural areas where the program was expected to have had its greatest impact. Examination of the Master Plan reveals that the Status A projects were to be implemented primarily in seven key parishes. Table C.4 shows the rates of unemployment in these parishes over the period 1984 to 1987.

The rate of rural unemployment is observed to have fallen in five of the seven parishes, with the most substantial decline occurring in the parish of St. Ann. Marginal increases in the rate of unemployment were recorded for the parishes of St. Thomas and Manchester. At this point the caveat noted earlier should perhaps be reiterated, no claim is made that there is necessarily a causal relationship between the institution of the program and the reduction in the rates of rural unemployment. Such a relationship may or may not exist.

Based on the foregoing, one can conclude that at the end of the Agro 21 planning period, rural unemployment was lower, but that the program itself fell slightly short of government projections. Before the notion of success in employment creation is embraced too tightly, however, it should also be pointed out that most of the jobs generated were of a seasonal nature, and that the abrupt cessation of the program may

TABLE C.4
Rate of Unemployment by Parish, 1984-1987

Parish	RATE OF UNEMPLOYMENT (%)			
	1987	1986	1985	1984
St. Andrew*	19.9	22.2	30.0	26.0
St. Thomas	31.7	34.4	21.9	26.7
St. Mary	22.1	27.5	28.3	26.4
St. Ann	13.6	14.7	17.7	20.2
Manchester	16.9	11.4	13.4	12.3
Clarendon	26.9	25.7	28.3	33.3
St. Catherine	25.8	28.0	32.2	31.0

* Considered an urban parish.

Source: Calculated from Statin, The Labour Force.

have done much to damage the psyche of those workers whose expectations were raised and then dashed as the program collapsed.

C.2.3 ACREAGE UNDER CULTIVATION

The Agro 21 program, over the 1984-1988 period, seemed to have made its major contribution in terms of expanding the acreage under cultivation. According to the Master Plan some 48,600 new hectares were to have been put into export crops over a four year period. If the analysis is limited to those crop subsectors with which we have been dealing, it is noted that the program actually exceeded projections by almost 5,265 ha (Table C.5).

As shown in Table C.5 shortfalls in the acreage cultivated were only experienced in the case of winter vegetables and tobacco, and even in these cases the negative deviations were small.

It should be noted that the above analysis does not necessarily relate to acreage diverted from sugar cultivation since some of the 34,000 ha under cultivation may have been in diversified crop production prior to Agro 21. The issue of divestment of sugar lands will be taken up in a later section.

The analysis of the data in Table C.5 also reveals that in terms of cultivated acreage the crop diversification program was a long way from matching the acreage under sugar production. Over the Agro 21 implementation period, some 162,000 ha

TABLE C.5
Acreage Planted to Export Crops and Deviation from Target

Subsector	Actual Acreage 1984	1985	1986	1987	Average Acreage	Average Target	Deviation
Vegetables	587	1,418	506	466	744	810	-66
Banana	1,924	3,086	2,903	2,673	2,647	1,215	1,432
Ethnic Crops	n.a.	n.a.	4,455	4,536	4,496	608	3,888
Ornamen-tals	96	259	397	405	289	172	117
Pimento	2,268	2,268	2,268	2,268	2,268	n.a.	-
Orchard Crops	n.a.	n.a.	n.a.	n.a.	-	-	-
Tobacco	206	131	235	122	173	304	-131
Sub-Total (000's)	5.08	7.16	10.76	10.47	-	-	5.6
Sugar (000's)	42.9	40.3	40.3	40.5	41.0	n.a.	n.a.
TOTAL (000's)	47.98	47.46	51.6	50.97	-	-	-

Source: PIOJ, unpublished data.

were planted to sugar which was roughly five times the acreage devoted to nontraditional crops.

C.2.4 THE PERFORMANCE OF THE SELF-SUFFICIENCY PROGRAM

In this section is analyzed the performance of the Agro 21 self-sufficiency program. This component of the initiative, it would be remembered, was designed to save scarce foreign exchange via import substitution. The self-sufficiency program targeted four commodities, viz: rice, fish, dairy and beef for increased production.

Foreign Exchange Savings

Overall, domestic production of the commodities identified above saved the Jamaican government an estimated US $191 million over the 1984 to 1988 period. The subsectors making the greatest contribution to the result were dairy (US $65.3 million) and beef (US $111.6 million) (Table C.6).

The overall deviation from targeted performance of the self sufficiency program was a positive US$ 44 million, although the projections established for beef and dairy are suspiciously low.[3] If the data in Table C.6 are to be believed, however, the

[3] An alternative explanation for the high positive deviation in the case of beef and dairy in the incorrect reporting of the actual foreign exchange savings by the PIOJ.

TABLE C.6
Gross Foreign Exchange Savings and Deviations from Targets
(U.S. $m)

Subsector	Savings 1984	1985	1986	1987	Average Savings	Average Target	Deviation
Rice	1.33	1.42	0.8	0.76	1.08	1.37	-0.29
Aquaculture	0.73	1.66	3.0	4.70	2.50	1.45	+1.05
Dairy	15.5	16.0	16.5	17.3	16.3	0.84	+15.46
Beef	29.6	25.8	29.4	26.8	27.9	0.50	+27.40
TOTAL	47.6	44.88	49.70	49.56	-	-	+43.62

Source: NPA, Master Plan, n.d. and unpublished PIOJ data.

selfsufficiency component of the Agro 21 program performed creditably relative to government expectations.

As with foreign exchange generation, programs designed to save foreign exchange reserves also have an input cost. Using the value of the fixed capital requirements of the program as a proxy for its foreign exchange input, we note a US $60 million reduction in the estimate of foreign exchange savings (Table C.7). Interestingly, the high foreign capital requirements of the aquaculture project actually led to a US $9 million loss to the Jamaican economy. Again, if the data for beef and dairy are correct, the foreign exchange position of the self-sufficiency program is encouraging.

It is also instructive to place the foreign exchange savings position of the Agro 21 program in a more macro context. This may be done by calculating foreign exchange savings of domestic production to foreign exchange food expenditure ratios. These ratios give an indication of the potential of the self-sufficiency program to contribute to further reductions in the country's food import bill. A ratio of 1.0 would indicate that the country is saving as much in terms of the domestic production of food as it is spending on food imports. A ratio of less than 1.0 suggests that the foreign exchange leakage for food imports exceeds the foreign exchange value of domestic food production, and that there is scope for expansion of the self sufficiency effort. Finally, ratios greater than 1.0 are obviously desirable and indicate that the foreign exchange value of domestic production exceeds the foreign exchange value of imports.

TABLE C.7
Net Foreign Exchange Savings, Self-Sufficiency Program
(U.S. $m)

Subsector	Gross Savings	Fixed Capital Requirements	Net Savings
Rice	4.31	3.18	1.13
Aquaculture	10.09	18.60	-8.51
Dairy	65.30	23.50	41.80
Beef	111.60	15.60	96.00
TOTAL	191.30	60.88	130.42

Source: NPA, Master Plan, n.d. and unpublished PIOJ data.

It should be noted that the above ratios are not indexes of self sufficiency, which are normally defined as the proportion of domestic consumption which is produced locally. Such indexes cannot be calculated at a disaggregated level for Jamaica due to a lack of accurate consumption data.

The ratios of foreign exchange value of domestic production to the foreign exchange value of food imports are shown in Table C.8. The estimates are uniformally less than 1.0 and quite low, suggesting that the self sufficiency program contributed little to a reduction in the country's food import bill. Also, no discernible trend in this direction can be observed over the four year period. When viewed in this light, therefore, the impact of the self sufficiency program must be described as minimal.

C.2.5 CAPITAL INFLOW, LAND DIVESTMENT AND TECHNOLOGY TRANSFER

Having examined in some detail the export and self-sufficiency components of the program the discussion will now focus on the issues of capital inflows, land divestment and the transfer of technology. Consideration of these areas, in conjunction with our earlier discussion of foreign exchange generation and employment, should allow for a comprehensive evaluation of the performance of the Agro 21 program.

It should be recalled from earlier discussions that the mobilization of local and foreign private capital was a major objective of the Agro 21 program. It would also be remembered that JNIP/JAMPRO was the agency with primary responsibility for attracting suitable investors. Data provided by Jampro suggest that this organization

TABLE C.8
Ratio of Domestic Production to Imports,
1984-1988

Production/Imports	1984/85	1985/86	1986/87	1987/88
Foreign Exchange Value of Domestic Production, (A)	47.16	44.88	49.70	49.56
Food Import Bill, (B)*	136.00	132.00	134.00	144.00
(A/B)	0.35	0.34	0.37	0.34

*Note: Data are for calendar years.

Source: PIOJ, Social and Economic Survey; and Data in Table C.6.

assisted some 183[4] projects over the 1984-1988 period and was able to attract to these projects a total of US $124 million. In the three years prior to the formal announcement of Agro 21, Jampro assisted 81 agribusiness projects and attracted some US $45 million. The projects, however, appear to be quite small by international standards with the average rate of capitalization per project being as low as US $200,000 in 1988.

Unfortunately, Jampro's data do not allow for an easy assessment of the proportion of the capital for project development which came from foreign sources and so the extent to which foreign investors were actually encouraged to invest in Jamaican agriculture is not clear. Before ending the discussion on capital inflows, it is important to note that the data reported in Table C.9 may actually under-represent the investment in Jamaican agriculture as projects were not legally required to register with (and be assisted by) Jampro.

The discussion will now turn to the issue of land divestment. The divestment of idle and underutilized sugar lands was a central theme of the Agro 21 strategy, and so it is useful to examine the program's record of performance in this area.

Data provided by the Agro 21 Corporation and presented in Table C.10 indicate that a total of 10,290 ha had been divested at the time of program closure. Some 4,582 ha (or 45%) of which had been devoted to export crops and the remainder to the self sufficiency program. As was pointed out in Appendix B a total of 74,780 ha were to have been put into diversified crop and livestock production over a four year period, with 65% earmarked for the export component of the program. The available

[4] 53 of the projects initiated between 1981 and 1989 have since closed.

TABLE C.9
Capital Inflows to Agro 21 Program

Year	Capital Investment ($ U.S. m)	Number of Projects	Capital Investment Per Project
Pre Agro 21:			
1981-1983	45.4	81	0.56
Post Agro 21:			
1984	44.3	39	1.13
1985	16.8	41	0.40
1986	25.4	46	0.55
1987	33.1	37	0.89
1988	4.4	20	0.22
TOTAL (1984-88)	124.0	183	

Source: JNIP/JAMPRO, unpublished data.

evidence suggests, therefore, that overall the divestment program to move sugar lands into diversified crop and livestock production achieved a mere 14% of its target.

Additional information contained in Table C.10 indicates that Cabinet had approved the divestment of some 3,000 ha but that no formal transfer had taken place. Approximately 4,000 ha remained available for immediate divestment, while an additional 3,000 ha could not be divested for various legal and political reasons.

The third and final indicator of the performance of the Agro 21 program to be discussed in this section is the extent of technology transfer. The Agro 21 development strategy is predicated on the use of advanced on-farm technology which would be transferred to the local farming community via mother farm-satellite farm (MS) arrangements described in the previous appendix.

The Agro 21 Master Plan, however, contains no specific targets with respect to the establishment of these MS operations which makes it difficult to objectively evaluate the performance of this aspect of the program. The general view that emerged from discussions with the management of the small farmer linkage program and other officials was that the program failed. Successful mother farms, which form the corner stone of the strategy could not be established in a timely manner, and therefore, the benefits of technology transfer were non-existent.

TABLE C.10
Performance of the Agro 21 Land Divestment Program

Land Use	NUMBER OF HECTARES			
	Divested to Cabinet Approved Investors	Approved But Not Divested	Available for Divestment	Cannot Be Divested
Export	4,582	1,337	467	2,035
Self-sufficiency	5,708	1,618	3,048	1,037
Other	-	-	-	81
TOTAL	10,290	2,955	3,515	3,153

Source: Agro 21 Corporation, Unpublished data.

C.2.6 SUMMARY AND CONCLUDING OBSERVATIONS

This appendix has attempted to describe the performance of the Agro 21 program in the areas of foreign exchange generation/savings, employment creation, acreage under cultivation as well as capital inflows, technology transfer and land divestment. The export and self sufficiency components of the program were evaluated separately.

The analysis indicated that with respect to net foreign exchange earnings the program performed poorly, generating only US$24 million over a four year period. The export component of the program did, however, create an additional 62,000 new jobs over the 1984-1988 period, and the rate of rural unemployment was seen to decline in a number of key rural parishes.

The self sufficiency program was observed to have made very little impact on the country's massive food import bill, though the program did save the Jamaican economy roughly US $190 million over its short life span. The beef and dairy subsectors performed creditably over the period and the program was able to post a positive deviation from target of roughly US $44 million.

A total of US $124 million of capital investment was attracted to the Jamaican agricultural sector over the life of the program, but performance in the areas of land divestment and technology transfer left much to be desired.

Overall, the Agro 21 program seems to have fallen short of expectations in several key areas and so the overall judgement of the program's performance must be considered negative. The program will be described as having failed to meet its original objectives, although it should be borne in mind that in some areas the program was able to exceed its original targets.

APPENDIX D
STRUCTURAL CHANGE IN THE U.S. DEMAND FOR FRESH VEGETABLES

D.1 INTRODUCTION

The present appendix seeks to test for structural changes in the demand for fresh vegetables in the United States and to forecast growth in consumer demand. As noted in an earlier chapter growth in US consumer demand for vegetables which outstrips the capacity of Mexico to supply could lead to an overall expansion in the demand for non-Mexican imports, and provide a stimulus for new entrants into the market. Apart from growth in demand the analysis presented in this appendix will also provide Jamaican exporters with useful information on price and expenditure elasticities. The major research objectives to be accomplished in this appendix may be stated more succinctly as:

1. To provide forecasts of growth in the US demand for fresh vegetables;

2. To calculate price and expenditure elasticities for the major vegetables consumed in the United States; and

3. To test for structural change in the demand for fresh vegetables.

In the interest of brevity the discussion will focus explicitly on the demand for tomatoes, carrots, celery, onions and lettuce which, constitute over 80% of the fresh vegetables consumed in the United States.

This appendix is divided into 4 major sections. Section D.2 which follows the introduction is concerned directly with describing the structure of the model and its theoretical foundation. In Section D.3 the data used in the econometric estimation, simulation and forecasts are identified. Certain adjustments to the data set that were attempted in order to ensure a more theoretically well specified model are also described in this section. Section D.4 provides the results of the estimation process and the tests for structural demand shifts. The final section summarizes the discussion. The raw data used in model estimation are presented in Appendix E.

D.2 MODEL DEVELOPMENT AND THEORETICAL FOUNDATION

Elementary demand theory postulates that the quantity of a commodity demanded by consumers would be a single valued function of prices and income given strict quasi-concavity of the underlying utility function (Henderson and Quandt 1980). The prices alluded to above are the price of the commodity in question, as well as the prices of related commodities (i.e. substitutes and complements). Demand functions are also assumed to be homogenous of degree zero in prices and income, i.e if all prices and income change by the same proportion, quantities demanded would remain unchanged.

This is a reasonable assumption as it implies the absence of money illusion in the consumer's budget allocation process.

In empirical estimation of demand functions it is usual to use personal disposable income as the income variable in the demand specification. All prices and income have traditionally been deflated by a general price index, such as the CPI, and the relationship specified in a simple linear form. As Coyle (1989) has recently noted however, if demand functions are homogenous of degree zero in prices and income then a fundamental contradiction exists between the simple linear function described above and the assumption of zero homogeneity. In fact, estimation of such functions reduces to the "estimation" of a single point on the demand curve, i.e. the intercept term.

Beginning with an expenditure or cost function, duality concepts may be employed to circumvent the above problem and provide a theoretically consistent set of demand relations. The consumer's budget allocation problem may be stated as:

$$\text{Minimize } X = p \times q$$

$$\text{s.t } v(q) = u$$

The consumer faced with a given set of prices (p) seeks to minimize total expenditure (X) by appropriate choices of the quantities consumed, (q) and so maintain a given level of utility (u). The optimal choice of q may be substituted into the original minimization problem to define the relevant expenditure (cost) function, c(u, p). We have:

$$c(u,p) = \text{Min}(q)\ [p \times q: v(q) = u]$$

The above cost function is assumed to be homogenous of degree one in prices, increasing in u and non-decreasing in p. The function is also assumed to be concave in commodity price space, and continuous with defined first and second derivatives. More importantly, the price derivative of the expenditure function yields the Hicksian (compensated) demands.

The resultant Hicksian demands are expected to satisfy the restrictions of adding up and homogeneity of degree zero in prices. These restrictions, of course, imply the absence of money illusion in the budget allocation process and satisfaction of the consumer's budget constraint. The Slutsky matrix of compensated price derivatives is also expected to be negative semidefinite indicating consistency in the consumer's choices and a negatively sloped demand schedule. It should be noted at this point that symmetry and negative semidefiniteness of the Slutsky matrix ensures that the Hicksian demand functions integrate up to the concave homogenous expenditure function discussed earlier.

In the present research the consumer demand relationship is represented by an Almost Ideal Demand System (AIDS) equation (Deaton and Muelbauer 1980a). Beginning with an expenditure (cost) function of the form:

$$\log c\ (u,p) = \alpha_o + \Sigma_k\, \alpha_k \log P_k + \tfrac{1}{2}\, \Sigma_k\, \Sigma_j\, \tau_{kj} \log P_k \log P_j + u\, \beta_o\, \Pi_k\, P_k^{\beta k}$$

Where α_i, β_i and τ_{ij} are parameters to be estimated, P is a vector of retail prices and u is a given level of utility. The expenditure function, as noted above, defines the minimum level of expenditure necessary to attain a specific level of utility given the existing level of retail prices. By application of Shepard's lemma the price derivative of the above expenditure function yields the underlying demand function.

The demand relationship, in budget share form, may be stated as:

$$w_i = \alpha_i + \Sigma\, \tau_{ij} \ln P_j + \beta_i \ln (X/P) \quad \ldots 1$$

Where:

w_i = Share of total U.S expenditure on vegetables which is allocated to the ith vegetable, i.e (P_i x Qd_i/X).

P_i = Retail Price of the ith U.S produced vegetable.

Qd_i = Quantity of the ith U.S produced vegetable consumed.

P_j = Price of the jth vegetable (substitutes or complements).

X = Total expenditure on vegetables.

P = Index of vegetable prices.

It should be clear from the above share equation that the AIDS model is based on the concept of weak separability between groups of commodities. The share equation may, in fact, be seen as the second stage of a two stage budgeting process. In the first stage of the consumer decision problem expenditures are allocated to broad groups of commodities e.g food, clothing and housing, while at the second stage group expenditures are allocated to individual items within the broad group. We may write the consumer's utility function as:

$$u = f[V_1 (Q_1), V_2 (Q_2) \ldots V_g (Q_g) \ldots. V_n(Q_n)]$$

Here the consumer's total commodity vector Q is partitioned into n subvectors and preferences are, therefore, weakly separable. Deaton and Muellbauer (1980a) point out that the above separable utility function implies the existence of subgroup demands of the form:

$$Q_i = G_{gi} (X_g, P_g)$$

in which demand is solely dependent on the level of expenditure X_g on items in the group g, and on prices of component commodities of the group.

In the AIDS share equation P is defined as:

$$\ln P = \alpha_0 + \Sigma\alpha_j \ln P_j + 1/2 \Sigma\Sigma \tau_{ij} \ln P_i \ln P_j \ldots 2$$

As Green and Alston (1990) note, however, the above price index may create empirical difficulties in the estimation process when annual price data are used. These authors suggest the use of a Stone (1953) geometric price index, (P^*), which is computed as:

$$\ln P^* = \Sigma\, w_k \ln P_k \quad ....3$$

Where w_k is the mean of the budget share over the sample period. Models that use the Stone price index are referred to as Linear Approximate AIDS models (Blanciforti and Green 1983). In the estimation of the AIDS model the appropriate choice of the price index, i.e whether (2) or (3), is usually dictated by the empirical results and the desire for computational convenience.

The following set of restrictions apply in the estimation of the above AIDS model for a system of several consumer demand functions:

$$\Sigma_i \alpha_i = 1, \quad \Sigma_i\, \tau_{ij} = 0, \quad \Sigma_i \beta_i = 0 \quad ....4$$

$$\Sigma_j\, \tau_{ij} = 0 \quad ....5$$

$$\tau_{ij} = \tau_{ji} \quad ....6$$

Provided restrictions (4) to (6) hold, equation (1) will satisfy the property of homogeneity in prices and income. Further, the adding up condition and Slutsky's symmetry condition would also be satisfied.

It should be noted at this stage that negativity of the Slutsky matrix is not guaranteed by the imposition of the above restrictions. It is, therefore, useful to check the diagonal elements of the substitution matrix for nonpositiveness, i.e $S_{ij} \leq 0$. Deaton and Muellbauer (1980b) argue, however, that it may be easier in practice to use, not the eigenvalues of the Slutsky matrix, S_{ij} but $K_{ij} = (P_i\, P_j\, S_{ij}) / X$, which have eigenvalues with the same signs as S_{ij}. The K_{ij} are calculated as:

$$K_{ij} = \tau + \beta_i\, \beta_j \log(X/P) - w_i\, \delta_{ij} + w_i\, w_j$$

Where δ_{ij} is the Kronecker delta. The negativity of the Slutsky matrix may, therefore, be established directly from the estimated parameters of the AIDS model with a minimum of computational difficulties.

It should be noted in passing that the inability to ensure negativity by a priori imposition of theoretical restrictions applies to all flexible functional forms. A cursory review of the applied literature using duality theory reveals, however, only a few studies which report a check of negativity.

The AIDS model as presented above is also flexible and provides a first order approximation to any underlying demand system, as well as satisfies perfect aggregation over consumers. The model is also simple to estimate in practice and does not require the use of nonlinear econometric techniques. These properties of the AIDS model make it clearly superior to the simple linear specifications discussed above but also provides the applied economist with certain advantages in the ease of estimation not found in more complicated functional forms such as the translog. The above properties have served to entrench the use of the AIDS model in empirical applications (See for example, Haden 1990; Moschini and Meilke 1989; Eales and Unnevehr 1988; and Hein and Wessells 1988).

With respect to econometric estimation, the system of share equations may be estimated using three stage Least squares (3SLS), a systems procedure which takes account of the correlation which exists between the error terms of the share equations.[1] The correlation arises because the sum of the budget shares is one by definition. The efficiency of the econometric estimates may be improved using 3SLS which considers the entire set of equations as a single large system to be estimated. The only complication that arises with the use of 3SLS is that because budget shares sum to one the contemporaneous covariance matrix is singular and so one of the share equations must be dropped during the estimation process. The resultant estimates should, however, be invariant to the equation dropped assuming that the error terms are serially independent (Barten 1969).

It should also be noted that given the two stage budgeting process implied by the structure of the AIDS model additional instruments were used in the estimation process. These instruments were: personal disposable income, an index of prices paid for bread and bakery products, an index of prices paid for meat, poultry, fish and eggs, and finally an index of prices paid for dairy products.

[1]If OLS is used the resulting estimates will be consistent but will lack the efficiency of the 3SLS estimates (Pindyck and Rubinfield 1981).

Uncompensated price elasticities of demand from the AIDS and the Linear Approximate AIDS models are given simply as:

$$n_{ij} = \delta_{ij} + \{ \tau_{ij} - ß_i \, d \ln P / d \ln Pj \} / w_i$$

Compensated price elasticities are also easily calculated as:

$$\Phi_{ij} = \tau / w_i - \delta_{ij} + w_j \, [ß / w_i + 1]$$

While expenditure elasticities are given by the expression:

$$E_{ij} = [\, ß_i \, / \, w_i + 1]$$

Where δ_{ij} is the Kronecker delta which has a value of 1 for $i=j$ and a value of 0 for $i \neq j$. All other symbols are as defined above.

D.2.1 DEMAND SIDE DYNAMICS AND STRUCTURAL CHANGE

In the seminal work on AIDS by Deaton and Muellbauer (1980b) autocorrelation of the error terms was observed to be a serious problem for some of the commodity groups studied and led to the rejection of formal tests of homogeneity and symmetry. Blanciforti and Green (1983) have argued that the misspecification of the

Deaton and Muellbauer model was the result of the exclusion of the dynamics of consumer behaviour. Habit formation according to the former authors must be adequately captured to avoid model misspecification.

The incorporation of dynamics in the static AIDS model may be accomplished in several ways such as the inclusion of lagged per capita consumption in the share equation or the lagged value of the share of expenditure in the share equation (Blanciforti, Green and King 1986). The first difference of the static model used by Eales and Unneveher (1988) may also be appropriate in capturing demand side dynamics. The latter formulation may be written as:

$$\Delta w_i = \Sigma_j \gamma_{ij} \Delta \ln p_j + B_i \Delta \ln (X/P)$$

The suppression of the intercept term in the first difference model is to be noted. Inclusion of the intercept and a test of its significance provides a simple indication of the existence of structural changes in demand (Eales and Unneveher 1988). Significance of the intercept term in a dynamic AIDS model indicates that gradual exogenous parallel shifts have occurred over the sample period. This test is admittedly naive given that structural changes may also be due to changes in parameters associated with the various other price and expenditure variables in the model.

Alternative approaches are available which allow the researcher to test for constancy in all the coefficients of the model. For example, Moschini and Meilke (1989) use a gradual switching regression approach within the framework of an AIDS model to test for structural change in meat demand. With this approach the dynamic model is reparameterized by incorporation of a variable, h_t which represents the path of adjustment. We have:

$$w_{it} = \alpha_i + \tau_i h_t + \Sigma(\beta_{ij} + \Phi_{ij} h_t) P_{jt} + (\beta_i + \Phi_i h_t) X_t + \Sigma(\alpha_{ik} + \tau_{ik} h_t) D_k + u_t$$

Where D is a vector of seasonal dummies.

Ignoring seasonality which is not likely to be a major factor influencing vegetable consumption, the estimating equation may be written as:

$$\Delta w_{it} = \tau \Delta h_t + \Sigma_j [\beta_{ij} \Delta P_{jt} + \Phi_{ij} \Delta (h_t P_{jt}] + \beta_i \Delta X_t + \Phi_i \Delta h_t X_t$$

The dynamic path of adjustment may be given by t/T which represents a smooth linear adjustment in the coefficients over time (Farley and Hinich 1970). Alternatively, t may be a dummy variable which equals 0 for the first half of the sample period and 1 thereafter. In this case a simple Chow test for structural change is implied. A third alternative is for the period of adjustment to be broken down such that:

$$h_t = 0 \text{ for } t = 1 \ldots. t_1.$$

$$h_t = (t - t_1) / (t_2 - t_1) \text{ for } t = t_1 \ldots t_{2-1};$$

$$h_t = 1 \text{ for } t = t_2 \ldots. T.$$

This final approach corresponds to the gradual switching regression model used by Moschini and Meilke. It should be recognized that if $t_1 = 0$ and $t_2 = T$ that the gradual switching approaches reduces to the linear adjustment model. A test of structural change in either of the models presented above is equivalent to a test of parameter constancy, i.e $\tau = 0$ and $\Phi = 0$. The test may, of course, be applied to all time dependent variables or to any subset of time adjusted regressors thereby allowing the researcher to isolate the source(s) of the structural changes.

D.2.2 THE DEMAND FOR IMPORTED TOMATOES

In an earlier chapter it was pointed out that Mexican tomatoes are shipped to the U.S in a vine ripened condition, while U.S produced tomatoes are ripened with ethylene gas in transit to retail outlets. It was argued that for the above reason U.S consumers perceived domestically produced tomatoes as somehow inferior to imports. This would suggest a need to treat U.S and imported tomatoes as differentiated products and to specify separate demand schedules for each.

The need to distinguish between tomatoes based on origin of production is perhaps emphasized when it is recognized that U.S produced tomatoes received an average price $13.79/cwt lower than imported tomatoes over the period 1970-1988. This observation certainly lends support for the notion that U.S produced tomatoes are in fact perceived as inferior products. It should be noted that in order to make the above price comparison the price of imported tomatoes was adjusted forward by the extent of the marketing margin in each year, and the retail price of tomatoes (which is an average of the prices of domestic and imported tomatoes at the retail level) was adjusted to retrieve the retail price of U.S produced tomatoes. The adjustments are described in more detail in Section D.3.

To formally test the appropriateness of specifying a separate import demand function, a t test of the differences in the means of the two adjusted price series was conducted, using standard statistical procedures for distributions with unequal variances (Steele and Torrie 1980). It was found that the hypothesis of no difference between the average price received by domestic and foreign producers was rejected at the 95% level (See Exhibit D.1). In this research, therefore, U.S produced and imported tomatoes are treated as differentiated products, and a separate demand schedule is specified for each.

The import demand function is again represented as an AIDS equation in budget share form. The arguments of the import demand function are the same as for the domestic consumer demand relationship except that the own price is represented by the import price at the retail level, and the budget shares are the shares of U.S expenditure on vegetables allocated to imported tomatoes.

$$w_i = \alpha_i + \Sigma \tau \ln P_j + \ln (X/P) \;....7$$

Exhibit D.1

Test for Equality of Means: Import and Retail Prices

Mean of adjusted retail price ($\bar{Y}_1$) = \$62.44/cwt

Mean of adjusted import price ($\bar{Y}_2$) = \$76.23/cwt

Standard error of adjusted retail prices (S_1) = 13.45

Standard error of adjusted import prices (S_2) = 18.73

Variance of adjusted retail prices $(S_1)^2$ = 180.89

Variance of adjusted import prices $(S_2)^2$ = 350.81

$$S(\bar{Y}_1 - \bar{Y}_2) = \sqrt{(S_1)^2/n_1) + (S_2)^2/n_2)}$$

$$= \bar{Y}_1 - \bar{Y}_2 / S(\bar{Y}_1 - \bar{Y}_2)$$

$$\text{Effective d.f} = \frac{\{(S_1)^2/n_1 + (S_2)^2/n_2\}^2}{[(S_1)^2/n_1)^2/(n_1-1)] + [(S_2)^2/n_2)^2/(n_2-1)]}$$

Where:

$S(\bar{Y}_i - \bar{Y}_j)$ = Standard error of the difference in the means.

Based on the above standard formulas:

$t' = 2.41$, Effective d.f = 29, Tabulated t (d.f=29, p=0.05) = 2.045

Where:

w_i = Share of total U.S expenditure on vegetables which is allocated to imported tomatoes; i.e (P_m Q_m/X).

P_m = Import price of tomatoes at the retail level.

Q_m = Quantity of imported tomatoes consumed.

P_j = Price of the jth vegetable (substitutes or complements).

X = Total expenditure on vegetables.

P = Index of vegetable prices.

D.3 DATA REQUIREMENTS AND SOURCES

The data set used in the estimation of the structural model described above spans the period 1970 to 1988. The complete data set is reproduced in Appendix E but here an attempt will be made to highlight some of the adjustments that were attempted in order to ensure theoretically consistent estimation.

Data on per capita consumption were obtained from USDA's Vegetables and Specialties: Situation and Outlook Report. These data represent consumption of fresh tomatoes irrespective of source of supply i.e, whether U.S. or foreign. Retail price data were obtained from USDA's Vegetables and Specialties: Situation and Outlook Yearbook. These data represent the average price of fresh domestic and imported vegetables at the retail level. The adjusted retail price of U.S. fresh tomatoes used to test for the differentiation of U.S and imported tomatoes was computed using the average retail price, the import price at the retail level, (i.e import value divided by the quantity imported and adjusted to the retail level), and the shares of domestic produce and imports in total U.S. consumption; viz

$$P_r = (P_r(Ave) - W_m \times P_m)/W_d$$

Where:

P_r = Retail price of domestic tomatoes.

$P_r(Ave)$ = Average retail price of domestic and imported tomatoes.

W_m = Share of imported tomatoes in U.S consumption.

P_m = Import price of fresh tomatoes at the retail level.

W_d = Share of domestic tomatoes in U.S consumption.

The various prices and weights used in the calculations are shown in Table D.1. In the test of significance for differences between the means of the import and domestic prices it was necessary to ensure comparability, i.e the test must be performed for the price series at the same level in the marketing channel.

To ensure comparability between the import and domestic prices one could adjust the import price forward to the retail level and use the adjusted import price and retail price in the testing procedure. Alternatively, one could use the U.S. average producer price and the import price and invoke the assumption that the marketing

Table D.1

Adjustment of the U.S Retail Price of Fresh Tomatoes

Year	Average Retail Price	Adjusted Import Price	Share of Imports in U.S. Consumption	Share of Domestic Production in U.S. Consumption	Adjusted Retail Price
1970	42.0	45.57	0.26	0.73	41.30
1971	46.6	50.84	0.25	0.75	45.20
1972	47.0	54.63	0.23	0.77	44.72
1973	48.2	52.75	0.28	0.72	46.43
1974	54.8	61.84	0.24	0.76	52.57
1975	57.8	60.11	0.22	0.78	57.15
1976	57.8	67.09	0.24	0.76	54.87
1977	67.8	77.33	0.29	0.71	63.90
1978	69.5	81.09	0.28	0.72	64.99
1979	-	-	0.24	0.76	-
1980	67.4	99.49	0.21	0.79	58.86
1981	77.0	95.73	0.17	0.83	73.16
1982	73.9	94.50	0.15	0.85	70.26
1983	79.1	88.10	0.16	0.84	77.39
1984	80.7	88.90	0.23	0.77	78.25
1985	77.8	99.40	0.22	0.78	71.71
1986	82.4	88.73	0.23	0.77	80.50
1987	82.3	89.89	0.22	0.78	80.16

Source: Author's calculations.

margins for domestic and foreign produce are the same, and constant over time. However, given that this assumption is unlikely to hold, all import prices were adjusted to the retail level.

In order to adjust the import price in the case of the first alternative, it was necessary to compute the marketing margin. The first step in the process was to calculate a weighted average of the producer and import prices with the shares of domestic and foreign produce in total U.S. consumption used as weights. The marketing margin was calculated as the difference between the average retail price (of domestic and imported fresh tomatoes) and the weighted average import and producer prices. An adjusted producer price may, of course, also be calculated by addition of the marketing margin to the average producer price. The results of the procedure are shown in Table D.2.

General time series data on the U.S. economy such as the CPI and population were obtained from the U.S. Department of Commerce Bureau of the Census, Statistical Abstract of the U.S., 1989.

D.4 ECONOMETRIC RESULTS

The econometric estimates of the static AIDS model assuming product differentiation in the tomato market are provided in Table D.3. The results as presented are not encouraging. A significant number of coefficients (60%) are statistically different from zero at the 95% level or better and the parameter estimates appear to be reasonable

Table D.2

Adjustment of U.S Import and Average Producer Prices

Year	Marketing Margin ($/cwt)	Adjusted Producer Price ($/cwt)	Adjusted Import Price ($/cwt)
1970	36.76	47.96	45.57
1971	40.04	53.94	50.84
1972	39.60	54.40	54.63
1973	40.77	56.77	52.75
1974	46.37	63.67	61.84
1975	49.37	67.97	60.11
1976	48.30	67.40	67.09
1977	57.70	78.20	77.33
1978	59.40	79.00	81.09
1979	-	-	-
1980	54.50	75.10	99.49
1981	65.60	86.90	95.73
1982	61.90	84.40	94.50
1983	67.30	91.40	88.10
1984	68.50	94.10	88.90
1985	64.60	88.70	99.40
1986	70.70	95.80	88.73
1987	70.00	96.00	89.89

Source: Author's calculations.

Table D.3

Parameter Estimates: Disaggregated Static Model

	COMMODITY				
Price/ Expenditure	Domestic Tomatoes	Foreign Tomatoes	Carrots	Celery	Onions
Intercept	0.2555* (0.0270)	0.2316* (0.0287)	0.1749* (0.0358)	0.0482* (0.0088)	0.290* (0.013)
Domestic Tomatoes	0.1358* (0.0295)	-0.0747* (0.0269)	0.0325 (0.0278)	-0.0397* (0.0069)	-0.054* (0.013)
Foreign Tomatoes	-0.0747* (0.0269)	0.1259* (0.0328)	-0.0172 (0.0257)	0.0064 (0.0059)	-0.04* (0.013)
Carrots	0.0325 (0.0278)	-0.0172 (0.0257)	0.0158 (0.0468)	-0.043* (0.0122)	0.012 (0.014)
Celery	-0.0397* (0.0069)	0.0065 (0.0059)	-0.0434* (0.0121)	0.085* (0.0076)	-0.009* (0.003)
Onions	-0.0538* (0.0125)	-0.0403* (0.0128)	0.0123 (0.0137)	-0.009* (0.0032)	0.090* (0.011)
Expenditure	-0.0054 (0.0299)	0.0585 (0.0339)	0.1081* (0.0228)	-0.141* (0.0072)	-0.019 (0.016)
DW	0.107	0.014	0.067	0.032	0.035

Note: Standard errors are in parentheses.

Note: * represents statistical significance at the 95% level or better.

in terms of magnitude. More importantly, however, the Durbin Watson D statistics (DW) are uniformly low indicating that this model is seriously misspecified. It should be noted that the system of equations was estimated using 3SLS with the equation for lettuce omitted to avoid singularity of the error covariance matrix. All theoretical restrictions were imposed a priori. An alternative version of the static model was also estimated with product homogeneity in the tomato market assumed, i.e assuming no difference between U.S. produced and imported tomatoes. The estimates are reported in Tables D.4, but again are not particularly good. The number of statistically significant coefficients is slightly reduced (54%) and all but one of the DW statistics suggest the presence of positive autocorrelation of the error terms and model misspecification.

It was pointed out in the previous section that misspecification of the static AIDS model may well be the result of omission of dynamic elements in the formulation. The importance of habit formation in the budget allocation process was stressed in an earlier section of this Appendix. An attempt was, therefore, made to incorporate dynamics into the model by adoption of a first difference specification.[2] Assuming product differentiation in the tomato market and a dynamic specification with all theoretical restrictions imposed yielded the results presented in Table D.5. Roughly 57% of the coefficients are statistically significant at the 95% level or better including all own price coefficients. For the most part, the DW statistics are significantly improved indicating that the incorporation of dynamics into the model (even in this simplified form)

[2]The model was also estimated using the lag of the expenditure share as a regressor. This variable was not found to be significant at conventional levels and the overall results were not significantly improved.

Table D.4

Parameter Estimates: Aggregate Static Model

Price/ Expenditure	Tomatoes	Carrots	Celery	Onions
	COMMODITY			
Intercept	0.543* (0.024)	0.213* (0.028)	-0.008 (0.011)	0.252* (0.015)
Tomato	0.026 (0.026)	0.047 (0.028)	0.003 (0.009)	-0.076* (0.013)
Carrots	0.047 (0.028)	0.034 (0.0422)	-0.091* (0.016)	0.009 (0.014)
Celery	0.0029 (0.009)	-0.091* (0.016)	0.100* (0.011)	-0.012* (0.005)
Onions	-0.0766* (0.0131)	0.0094 (0.0147)	-0.012* (0.005)	0.079* (0.013)
Expenditure	0.018* (0.023)	0.1669* (0.025)	-0.16* (0.011)	-0.025 (0.021)
DW	0.009	0.030	1.99	0.086

Note: Standard errors are in parentheses.

Note: * represents significance at the 95% level or better.

Table D.5

Parameter Estimates: Disaggregate Dynamic Model

	COMMODITY				
Price/ Expenditure	Domestic Tomatoes	Foreign Tomatoes	Carrots	Celery	Onions
Domestic Tomatoes	0.130* (0.028)	-0.024 (0.019)	-0.026 (0.024)	-0.024* (0.010)	-0.055* (0.010)
Foreign Tomatoes	-0.024 (0.019)	0.069* (0.028)	-0.024 (0.019)	0.001 (0.006)	-0.021 (0.011)
Carrots	-0.026 (0.024)	-0.024 (0.019)	0.102* (0.029)	-0.047* (0.010)	-0.004 (0.010)
Celery	-0.024* (0.010)	0.001 (0.006)	-0.047* (0.011)	0.081* (0.008)	-0.011* (0.004)
Onions	-0.055* (0.010)	-0.021 (0.011)	-0.004 (0.010)	-0.011* (0.004)	0.091* (0.009)
Expenditure	-0.148* (0.173)	0.130 (0.100)	0.186* (0.069)	-0.098* (0.024)	-0.069 (0.059)
DW	2.785	2.161	2.316	2.491	3.171

Note: Standard errors are in parentheses.

Note: * represents statistical significance at the 95% level or better.

more closely represents the behaviour of the demand side of this market. It would be noticed, however, that the domestic tomato and onion equations have particularly high DW statistics which may indicate the presence of negative serial correlation in the first differenced model.

It should be pointed out at this point that DW statistics are designed for single equation tests of autocorrelation and so their precise interpretation in the context of a system equation framework is a moot issue (Bewley and Young 1987). In this research the DW statistic is taken as a rough guide only to the presence of serial correlation. It is recognized that more precise approaches for testing for autocorrelation in a system framework are available based on the work of Berndt and Savin (1975), but these are based on asymptotic properties and so are likely to have little validity in the present research.

For purposes of comparison the dynamic AIDS model was reestimated assuming the absence of product differentiation in the tomato market (Table D.6). The results indicate a considerable improvement over the static formulation with a higher percentage of statistically significant parameters (65%). The DW statistics are also all uniformly higher than in the static version but again in the case of onions negative autocorrelation may be present. In the dynamic version of the aggregate model all own price coefficients are significant with the exception of tomatoes and carrots.

Table D.6

Parameter Estimates: Aggregate Dynamic Model

Price/ Expenditure	COMMODITY			
	Tomatoes	Carrots	Celery	Onions
Tomatoes	0.041 (0.027)	0.019 (0.030)	-0.003* (0.017)	-0.056* (0.011)
Carrots	0.018 (0.030)	0.0582 (0.0427)	-0.073* (0.015)	-0.004 (0.013)
Celery	-0.004 (0.011)	-0.073* (0.015)	0.091* (0.01)	-0.014* (0.004)
Onions	-0.056* (0.011)	-0.004 (0.013)	-0.014* (0.004)	0.074* (0.011)
Expenditure	-0.095 (0.085)	0.202* (0.093)	-0.106* (0.036)	-0.005 (0.077)
DW	2.48	2.54	2.40	3.05

Note: Standard errors are in parentheses.

Note: * represents significance at the 95% level or better.

D.4.1 TEST FOR NEGATIVE SEMIDEFINITENESS

The properties of the AIDS model were fully discussed earlier. In all estimations presented so far the theoretical restrictions of adding up, homogeneity and symmetry were imposed a priori. However, it was pointed out earlier that imposition of these restrictions do not guarantee that the Slutsky substitution matrix would be negative semidefinite which is an essential property for the estimated model to be consistent with expenditure minimizing behaviour. In this subsection negative semidefiniteness of the Slutsky matrix is tested.

Following Deaton and Muellbauer's recommendation the eigenvalues of the Slutsky matrix, S_{ij} are not computed. Instead the eigenvalues of the substitution effects, K_{ij} are derived which have the same signs as S_{ij} and are computationally easier to establish. For the disaggregated dynamic model which assumes product heterogeneity in the tomato market, K_{ij} values are as shown in Table D.7. The own substitution effects (main diagonal elements) are all negative with the exception of carrots, indicating that despite the imposition of the required theoretical restrictions negativity of the Slutsky matrix is violated for this particular model. The positive value of the own substitution effect for carrots suggests a positive relationship between the demand for this commodity and its own price, a result that is definitely not consistent with theory.

Nonpositiveness of the diagonal elements of the Slutsky matrix was also tested for the aggregate dynamic model. Here the main diagonal elements were found to carry the requisite negative signs indicating that the demand functions are indeed

Table D.7
Substitution Effects: Disaggregated Dynamic Model

Commodity	PRICE OF Domestic Tomatoes	Foreign Tomatoes	Carrots	Celery	Onions
Domestic Tomatoes	-0.084	0.018	0.011	-0.005	-0.02
Foreign Tomatoes	0.018	-0.038	-0.030	0.024	0.003
Carrots	0.011	-0.030	0.009	-0.029	0.016
Celery	-0.005	0.024	-0.029	-0.012	-0.0045
Onions	-0.02	0.003	0.016	-0.0045	-0.037

negatively sloped and consistent with the assumption of an inverse relationship between price and quantity demanded (Table D.8).

Table D.9 shows the eigenvalues of the matrix of substitution effects for both the aggregate and disaggregate models. Negative semidefiniteness requires that all eigenvalues be non-positive (Chiang 1984). The results are disappointing. The hypothesis of negative semidefiniteness and expenditure minimization behaviour on the part of the consumer is rejected in the case of both models.

It should be noted that substitutability/complementarity relationships may also be established by examination of the results contained in Table D.8. If $K_{ij} < 0$ the products are complementary while if $K_{ij} > 0$ the corresponding product are viewed as substitutes. For example, tomatoes and onions may be viewed as complementary products as are carrots and celery, and celery and onions. Substitutability relationships are, however, observed for tomatoes and carrots, tomatoes and celery, and celery and carrots.

D.4.2 PRICES AND EXPENDITURE ELASTICITIES

Despite the unexpected results of the test of negative semidefiniteness uncompensated price and expenditure elasticities were computed for both dynamic models and these are reported in Tables D.10 and D.11. Several observations may be made with respect to the estimates. Firstly, with the exception of the own price of carrots in the

Table D.8
Substitution Effects: Aggregate Dynamic Model

Commodity	PRICE OF Tomatoes	Carrots	Celery	Onions
Tomatoes	-0.204	0.063	0.027	-0.0022
Carrots	0.063	-0.0404	-0.086	0.0087
Celery	0.027	-0.086	-0.0031	-0.0012
Onions	-0.0022	0.0087	-0.0012	-0.0527

Table D.9
Eigenvalues: Aggregate and Disaggregate Dynamic Models

Disaggregate Model	Aggregate Model
0.0487	0.0679
-0.0267	-0.0522
-0.0356	-0.0770
-0.0453	-0.2394
-0.1031	-

Table D.10
Compensated Elasticities: Disaggregated Dynamic Model

	COMMODITY				
Price/ Expenditure	Domestic Tomatoes	Foreign Tomatoes	Carrots	Celery	Onions
Domestic Tomatoes	-0.407	0.417	0.569	-0.244	-0.233
Foreign Tomatoes	-0.035	-0.117	0.040	0.006	-0.080
Carrots	-0.059	-0.047	0.516	-0.486	0.017
Celery	-0.041	0.232	-0.256	-0.166	-0.025
Onions	-0.131	0.139	0.425	-0.114	-0.305
Expenditure	0.459	2.260	3.196	-0.007	0.517

Table D.11
Compensated Elasticities: Aggregate Dynamic Model

Price/ Expenditure	COMMODITY Tomatoes	Carrots	Celery	Onions
Tomatoes	-0.623	0.917	0.018	-0.158
Carrots	0.104	-0.138	-0.74	0.019
Celery	0.057	-0.593	-0.049	-0.033
Onions	-0.042	0.385	-0.126	-0.413
Expenditure	0.697	3.43	0.123	0.836

disaggregate model all own price elasticities are negative and therefore consistent with theory. Secondly, price elasticities are for the most part inelastic and consistent with the results of other studies (e.g. Hammig and Mittlehammer 1980; Shonkwiler and Emerson 1982; and Nuckton 1980).[3]

Considering only the results from the aggregate model (Table D.11), it is also observed that the demand for fresh vegetables in the United States is quite inelastic with respect to changes in expenditure.[4] The only exception being carrots with an expenditure elasticity close to 3.5, and perhaps onions with an estimate close to unity. Changes in consumer expenditure are likely to have their greatest impact on these two product areas which account for roughly 47% of the total vegetable budget.

D.4.3 STRUCTURAL CHANGE IN VEGETABLE DEMAND

In this section we examine the issue of structural change in the demand for fresh vegetables. Knowledge of the existence of fundamental changes in the structure of demand is of tremendous importance to policy makers concerned with penetration of the U.S. vegetable market. Given that most other LDC exporters do not have the financial

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[3] Note that these are compensated elasticities while the estimates reported in most studies are Marshallian.

[4] Note that the price and expenditure elasticity estimates for tomato generated by the aggregate dynamic model are reasonably close to those developed in Chapter 6. Price elasticity was calculated as -0.469 and expenditure elasticity was 1.10 based on the simultaneous equation system used in that chapter.

resources and marketing capabilities of the Mexicans, positive shifts in demand over time represent one major avenue for growth in the size of the export market.

To test for structural change in the demand for vegetables the Farley-Hinich approach was used in which a linear adjustment path is assumed in the reparameterized dynamic AIDS model. As noted earlier a test of parameter constancy constitutes a test for structural change.

The estimates for the time adjusted version of the aggregate dynamic model are shown in Table D.12, while the results from the testing procedure are shown in Table D.13. It is noted that the hypothesis of no structural change in demand is accepted for all commodities studied with the exception of celery. In the case of this commodity structural change is observed to be associated with the expenditure coefficient intercept and indeed all variables appearing in the celery demand function. It should be noted that a negative relationship between expenditure on celery and the share of the consumer's budget allocated to that commodity was observed (see Table D.6). This suggests a shift in consumer preferences away from this commodity.

D.4.5 MODEL SIMULATIONS AND FORECASTS

The purpose of this section is to provide forecasts of changes in the endogenous variables of the AIDS model (i.e. expenditure shares) over a 10 year period. Despite the problem of theoretical inconsistency forecasts are provided from the aggregate dynamic model. The model was first simulated over the period of the original

Table D.12
Parameter Estimates: Time Adjusted Aggregate Model

Price/ Expenditure	COMMODITY Tomatoes	Carrots	Celery	Onions
Intercept	0.1446 (0.1231)	0.1803 (0.1197)	-0.484 (0.0471)	-0.0208 (0.1501)
Tomatoes	0.1303 (0.0256)	-0.0507 (0.0272)	-0.0622 (0.0112)	-0.0174 (0.0206)
Carrots	-0.0507 (0.0272)	-0.0067 (0.0469)	0.1007 (0.0162)	-0.0433 (0.0249)
Celery	-0.0622 (0.01119)	0.1007 (0.0162)	-0.0063 (0.0085)	-0.0322 (0.0076)
Onions	-0.0174 (0.0205)	-0.0433 (0.0249)	-0.0322 (0.0076)	0.0929 (0.0241)
Expenditure	-0.2303 (0.1636)	-0.1816 (0.2054)	0.4286 (0.0643)	-0.0167 (0.1897)
Tomatoes (Time Adjusted)	-0.1455 (0.0417)	0.1139 (0.0216)	0.0840 (0.0176)	-0.0523 (0.0365)
Carrots (Time Adjusted)	0.1139 (0.0256)	0.1139 (0.0216)	-0.2719 (0.0221)	0.0441 (0.0417)
Celery (Time Adjusted)	0.0840 (0.0176)	-0.2719 (0.0221)	0.1494 (0.0182)	0.038 (0.0131)
Onions (Time Adjusted)	-0.0523 (0.0365)	0.0441 (0.0416)	0.0384 (0.0131)	-0.0302 (0.0438)
Expenditure (Time Adjusted)	-0.0309 (0.2207)	0.3737 (0.1769)	-0.5849 (0.0790)	-0.132 (0.258)
DW	2.267	2.357	1.987	3.08

Table D.13
Structural change: Test of Parameter Constancy

Commodity	Coefficient Subset Tested	F. Statistic	Prob > F
Tomatoes	All Coefficients:	0.057	0.812
	Expenditure:	0.009	0.923
	Intercept:	0.659	0.422
Carrots	All Coefficients:	1.763	0.192
	Expenditure:	2.129	0.153
	Intercept:	1.081	0.305
Celery	All Coefficients:	36.53*	0.0001
	Expenditure	26.106*	0.0001
	Intercept:	50.47*	0.0001
Onions	All Coefficients:	0.071	0.79
	Expenditure:	0.125	0.726
	Intercept:	0.009	0.924

Note: * represents significance at the 95% level or better.

data set to test its tracking ability through time. Ten year forecasts with the associated upper and lower 95% confidence intervals were also generated.

The performance of the aggregate dynamic model is presented in Exhibits D.2 to D.5 and summary goodness of fit statistics for this model are provided in Table D.14. The tracking ability of the model is acceptable with very few turning points in the data completely missed. All root mean square simulation errors are less than one indicating a good fit with the actual data. Actual and predicted values of the endogenous variables are summarized in Appendix E.

Forecasts of the endogenous variables to 1998 are made using an autoregressive procedure in SAS and the results are summarized in Tables D.15 - D.18. The predictions suggest that by the end of the forecast period the largest positive change in expenditure would occur in carrot consumption followed by tomato consumption. Further, positive expenditure share changes are predicted for all commodities with the exception of celery which is expected to continue its downward slide. In the case of those commodities experiencing positive changes in quantity demanded it is recognized that growth will be far from explosive.

D.5 SUMMARY AND DISCUSSION

This chapter has presented the results of the econometric estimation of an AIDS model of U.S vegetable demand. Neither the aggregate or disaggregate versions of the model was found to be consistent with theory and the overall empirical results were not as good as expected. The price elasticities of demand for U.S vegetables were, however, found to be inelastic and, therefore, consistent with the results of earlier studies. Expenditure elasticities were also found to be reasonably inelastic with the notable exceptions of carrots and to some extent onions. The expenditure elasticity calculated for carrots was 3.43, while that for tomatoes was 0.836. The demand for vegetables was also found to exhibit little structural shifts over the sample period (1970 - 1988). Only in the case of celery was any notable change detected. It was observed that expenditure on celery has been declining over time suggesting a major shift in consumer preferences away from this particular commodity.

While the above results must be interpreted with caution the results of the forecasting experiments and tests for structural change do not augur well for potential exporters to this market. Overall growth in demand appears to be very limited and so this avenue for expansion of non-Mexican supplies appears to be effectively closed.

Exhibit D.2
Tomatoes: Change in Actual and Predicted Expenditure Shares

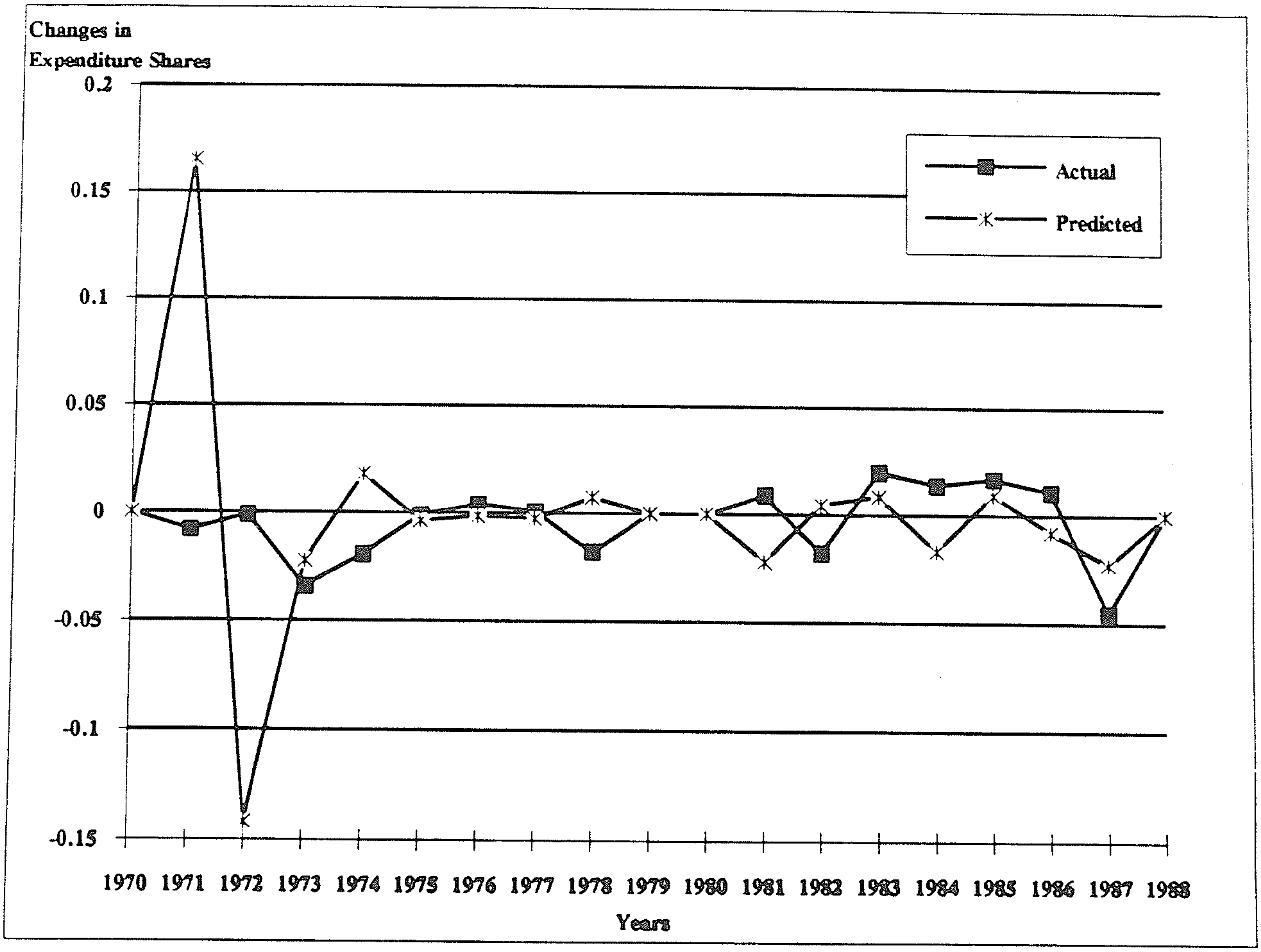

Exhibit D.3
Carrots: Change in Actual and Predicted Expenditure Shares

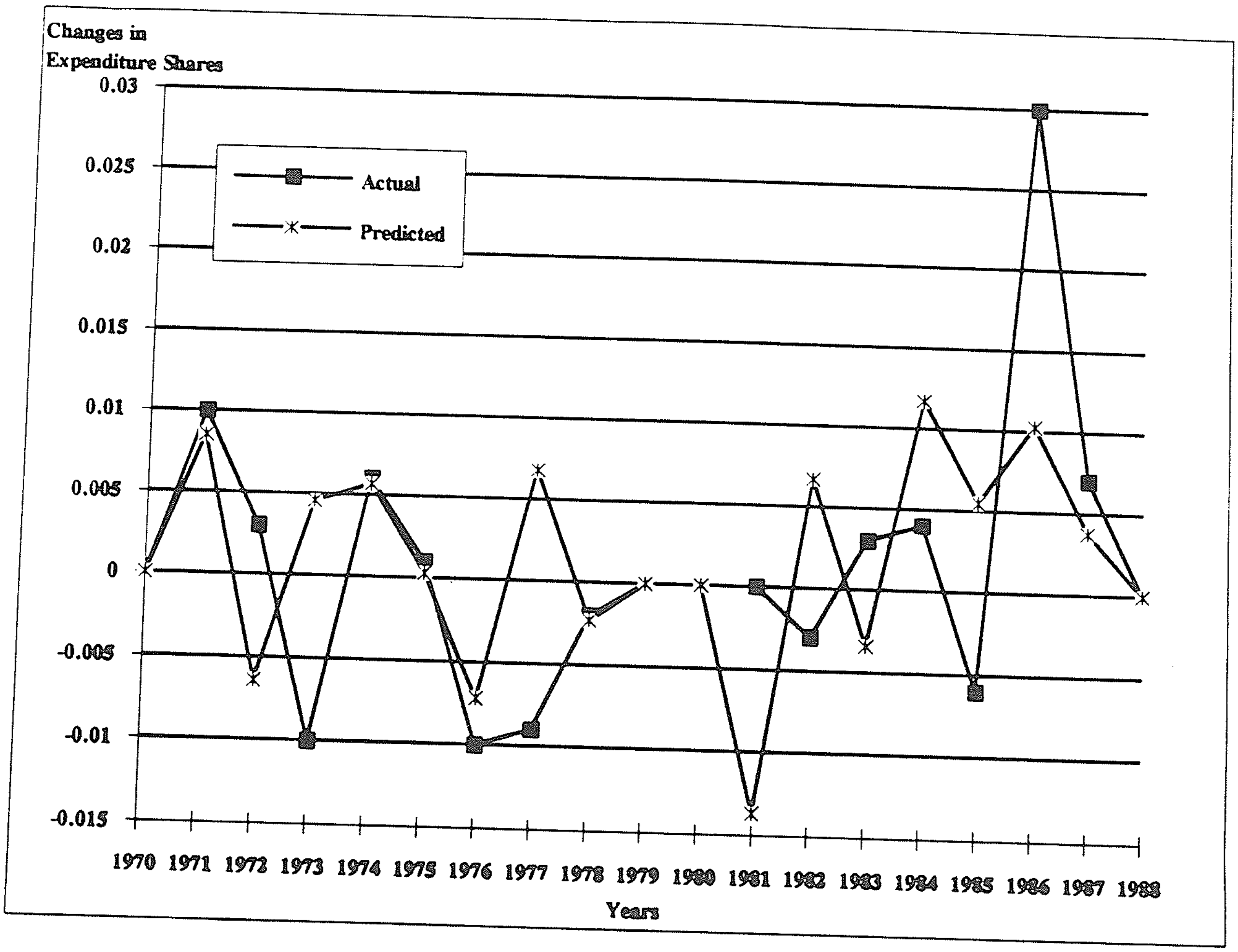

Exhibit D.4
Celery: Change in Actual and Predicted Expenditure Shares

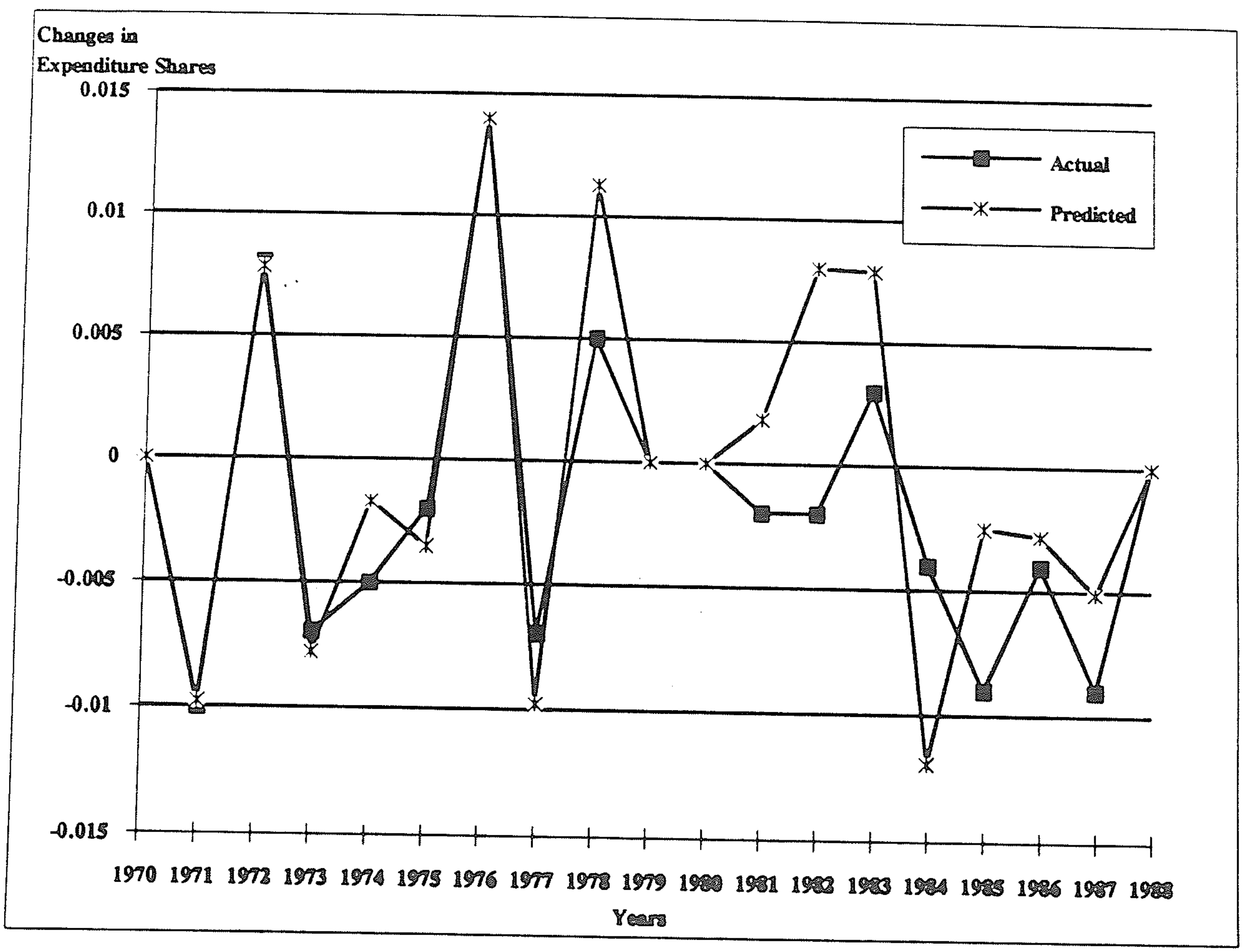

Exhibit D.5
Onions: Change in Actual and Predicted Expenditure Shares

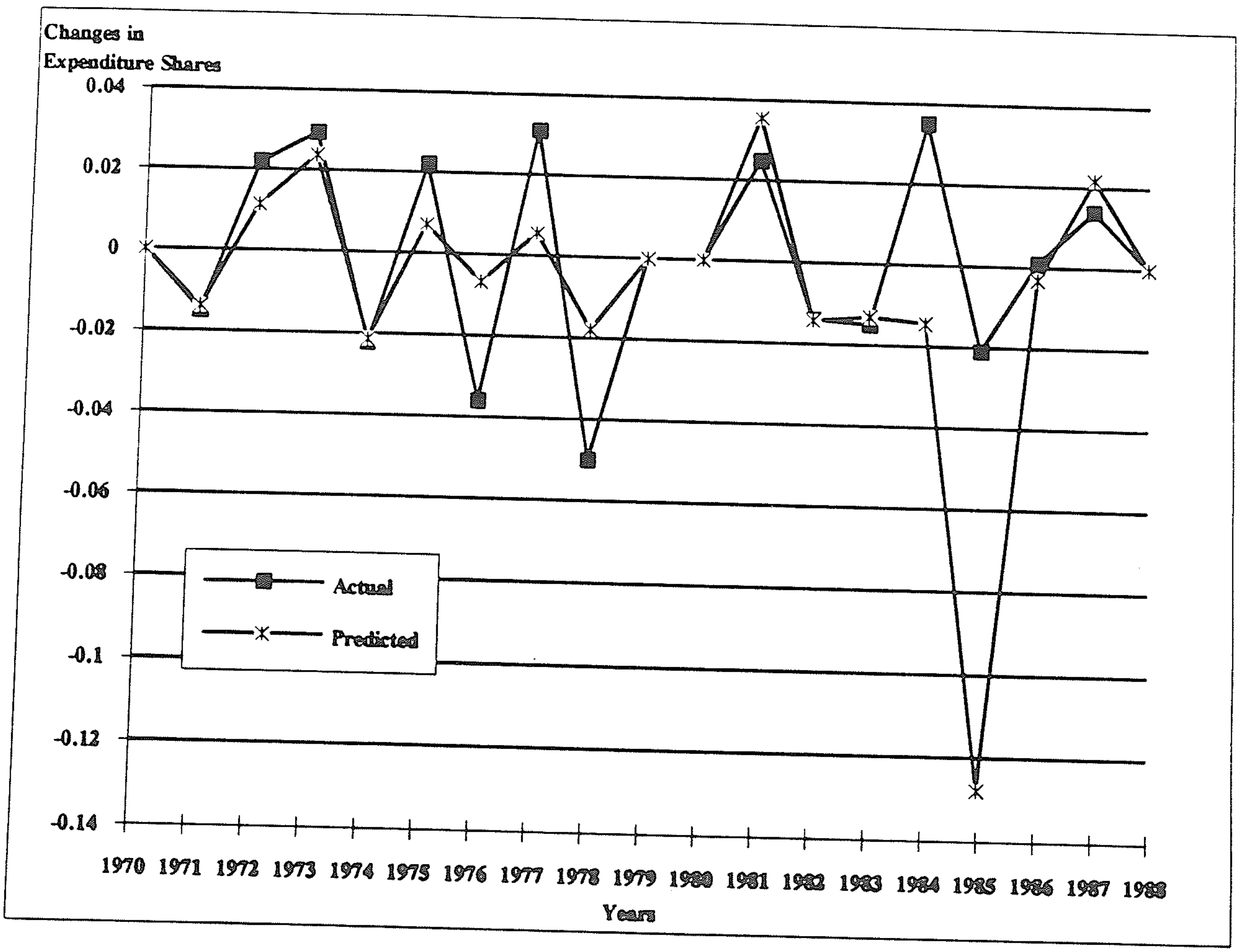

Table D.14
Aggregate Dynamic Model: Statistics of Fit

Commodity	Root Mean Square Simulation Error
Tomatoes	0.0181
Celery	0.0039
Carrots	0.0099
Onions	0.0155

Table D.15
Forecasts: Change in Tomato Expenditure Shares

Year	Forecast	Lower 95% Level	Upper 95% Level
1989	0.0019	-0.0433	0.0473
1990	0.0024	-0.0437	0.0487
1991	0.0029	-0.0442	0.0500
1992	0.0033	-0.0448	0.0515
1993	0.0038	-0.0454	0.0531
1994	0.0043	-0.0461	0.0546
1995	0.0047	-0.0467	0.0563
1996	0.0052	-0.0475	0.0579
1997	0.0056	-0.0483	0.0597
1998	0.0061	-0.0491	0.0615

Table D.16
Forecasts: Change in Carrot Expenditure Shares

Year	Forecast	Lower 95% Level	Upper 95% Level
1989	0.0073	-0.0150	0.0296
1990	0.0078	-0.0149	0.0306
1991	0.0084	-0.0148	0.0316
1992	0.0089	-0.0147	0.0327
1993	0.0095	-0.0147	0.0337
1994	0.0101	-0.0147	0.0349
1995	0.0106	-0.0147	0.0360
1996	0.0112	-0.0147	0.0372
1997	0.0117	-0.0148	0.0384
1998	0.0123	-0.0148	0.0396

Table D.17
Forecasts: Change in Celery Expenditure Shares

Year	Forecast	Lower 95% Level	Upper 95% Level
1989	-0.0047	-0.0203	0.0109
1990	-0.0050	-0.0209	0.0109
1991	-0.0053	-0.0215	0.0110
1992	-0.0055	-0.0222	0.0111
1993	-0.0058	-0.0228	0.0112
1994	-0.0061	-0.0234	0.0113
1995	-0.0063	-0.0241	0.0114
1996	-0.0060	-0.0248	0.0116
1997	-0.0068	-0.0255	0.0117
1998	-0.0071	-0.0262	0.0119

Table D.18
Forecasts: Change in Onion Expenditure Shares

Year	Forecast	Lower 95% Level	Upper 95% Level
1989	0.0057	-0.0563	0.0679
1990	-0.0017	-0.0673	0.0639
1991	0.0029	-0.0648	0.071
1992	0.0022	-0.069	0.0696
1993	0.0019	-0.0691	0.0730
1994	0.0010	-0.0672	0.0737
1995	0.0016	-0.0728	0.0761
1996	0.0014	-0.0748	0.0775
1997	0.0016	-0.076	0.0796
1998	0.0015	-0.0783	0.0815

APPENDIX E

DATA: ECONOMETRIC MODELS

Table E.1
Vegetable Prices
(¢/cwt)

Year	Carrots	Celery	Lettuce	Onions	Tomatoes
1970	1,770	2,020	1,660	1,610	4,200
1971	2,060	1,950	1,900	1,430	4,660
1972	2,150	2,360	1,910	1,770	4,700
1973	2,200	2,400	2,340	2,520	4,820
1974	2,320	2,390	2,360	2,080	5,480
1975	2,700	2,660	2,320	2,450	5,780
1976	2,550	3,040	2,660	2,310	5,780
1977	3,210	3,390	2,660	2,910	6,780
1978	3,060	3,940	3,800	2,430	6,950
1979	-	-	-	-	-
1980	3,320	3,810	4,520	2,720	6,740
1981	3,660	4,230	4,870	4,000	7,700
1982	3,560	4,260	5,560	3,240	7,390
1983	3,680	4,760	5,540	2,940	7,910
1984	3,940	4,800	5,120	3,690	8,070
1985	3,610	4,220	5,380	2,950	7,780
1986	3,820	4,700	5,280	3,120	8,240
1987	3,580	4,630	6,190	4,180	8,230
1988	3,800	5,060	6,280	3,790	8,340

Source: USDA Vegetable and Specialities Yearbook 1989.

Table E.2
Vegetables: Per Capita Consumption
(cwt)

Year	Carrots	Celery	Lettuce	Onions	Tomatoes
1970	0.060	0.073	0.224	0.124	0.121
1971	0.061	0.073	0.224	0.131	0.113
1972	0.065	0.071	0.224	0.126	0.121
1973	0.067	0.076	0.231	0.125	0.125
1974	0.069	0.074	0.235	0.139	0.118
1975	0.064	0.069	0.235	0.134	0.120
1976	0.064	0.074	0.242	0.131	0.126
1977	0.051	0.070	0.258	0.135	0.124
1978	0.056	0.073	0.256	0.137	0.132
1979	0.065	0.074	0.259	0.147	0.128
1980	0.070	0.078	0.268	0.137	0.134
1981	0.071	0.077	0.257	0.131	0.132
1982	0.073	0.078	0.256	0.152	0.134
1983	0.075	0.074	0.256	0.153	0.137
1984	0.079	0.075	0.260	0.161	0.153
1985	0.076	0.074	0.249	0.165	0.161
1986	0.113	0.070	0.253	0.179	0.172
1987	0.144	0.071	0.268	0.167	0.169
1988	0.118	0.077	0.277	0.183	0.178

Source: USDA Vegetable and Specialities Yearbook 1989.

Table E.3
Vegetable Expenditure
($/cwt)

Year	Carrots	Celery	Lettuce	Onions	Tomatoes
1970	2.55	3.54	8.92	4.79	12.19
1971	2.91	3.30	9.85	4.34	12.19
1972	3.14	3.77	9.61	5.01	12.78
1973	3.08	3.82	11.31	6.59	12.61
1974	2.99	3.31	10.3	5.40	12.09
1975	2.97	3.15	9.37	5.64	11.92
1976	2.69	3.71	10.60	4.98	11.99
1977	2.54	3.70	10.69	6.12	13.09
1978	2.66	4.18	14.14	4.84	13.33
1979	-	-	-	-	-
1980	2.70	3.46	14.09	4.33	10.50
1981	2.79	3.50	13.43	5.62	10.91
1982	2.68	3.43	14.67	5.08	10.21
1983	2.77	3.53	14.21	4.51	10.86
1984	3.02	3.49	12.90	5.76	11.96
1985	2.60	2.96	12.71	4.62	11.88
1986	4.13	3.15	12.79	5.35	13.57
1987	4.79	3.05	15.40	6.48	12.91
1988	-	-	-	-	-

Source: Author's calculations
Note: Based on real prices.

Table E.4
Expenditure Shares

Year	Carrots	Celery	Lettuce	Onions
1970	0.079	0.111	0.279	0.142
1971	0.089	0.101	0.302	0.127
1972	0.092	0.109	0.280	0.147
1973	0.082	0.102	0.302	0.178
1974	0.088	0.097	0.304	0.156
1975	0.089	0.095	0.284	0.178
1976	0.079	0.109	0.312	0.142
1977	0.070	0.102	0.296	0.173
1978	0.068	0.107	0.361	0.123
1979	-	-	-	-
1980	0.077	0.099	0.402	0.126
1981	0.077	0.097	0.370	0.151
1982	0.074	0.095	0.407	0.137
1983	0.077	0.098	0.396	0.122
1984	0.081	0.094	0.347	0.157
1985	0.075	0.085	0.366	0.136
1986	0.105	0.081	0.328	0.137
1987	0.112	0.072	0.361	0.151
1988	-	-	-	-

Source: Author's calculations.

Table E.5
Imported and U.S. Produced Tomato Expenditure Shares

Year	Imported	U.S. Produced
1970	0.109	0.280
1971	0.101	0.280
1972	0.100	0.270
1973	0.106	0.230
1974	0.095	0.260
1975	0.084	0.270
1976	0.098	0.260
1977	0.119	0.240
1978	0.111	0.230
1979	-	-
1980	0.096	0.200
1981	0.065	0.240
1982	0.057	0.230
1983	0.057	0.250
1984	0.081	0.240
1985	0.098	0.240
1986	0.089	0.260
1987	0.074	0.230
1988	-	-

Source: Author's calculations.

Table E.6
Stone Price Index

Year	Stone Index
1970	60.76
1971	63.43
1972	65.10
1973	68.92
1974	63.30
1975	61.68
1976	61.68
1977	65.63
1978	68.92
1979	-
1980	58.32
1981	62.49
1982	59.68
1983	59.20
1984	58.44
1985	54.43
1986	56.99
1987	60.09
1988	-

Source: Author's calculations.

Table E.7
Tomato: Change in Actual and Predicted Expenditure Shares

Year	Actual	Predicted
1970	-	-
1971	-0.008	0.165
1972	-0.011	-0.142
1973	-0.034	-0.022
1974	0.019	0.0177
1975	-0.001	-0.0037
1976	0.004	-0.0015
1977	0.001	-0.0025
1978	-0.018	0.0075
1979	-	-
1980	-	-
1981	0.009	-0.0219
1982	-0.018	0.0047
1983	0.020	0.0085
1984	0.014	-0.0166
1985	0.017	0.0095
1986	0.011	-0.0077
1987	-0.045	-0.0225
1988	-	-

Table E.8
Celery: Changing in Actual and Predicted Expenditure Shares

Year	Actual	Predicted
1970	-	-
1971	-0.010	-0.0098
1972	0.008	0.0079
1973	-0.007	-0.0079
1974	-0.005	-0.0018
1975	-0.002	-0.0035
1976	0.014	0.0140
1977	-0.007	-0.0098
1978	0.005	0.01128
1979	-	-
1980	-	-
1981	-0.002	-0.0018
1982	-0.002	0.0080
1983	0.003	0.0079
1984	-0.004	-0.0119
1985	-0.009	-0.0025
1986	-0.004	-0.0028
1987	-0.009	-0.0051
1988	-	-

Source: Author's calculations

Table E.9
Carrots: Change in Actual and Predicted Expenditure Shares

Year	Actual	Predicted
1970	-	-
1971	0.010	0.0085
1972	0.003	-0.0064
1973	-0.010	0.0046
1974	0.006	0.0057
1975	0.001	0.0003
1976	-0.010	-0.0072
1977	-0.009	0.0068
1978	-0.002	0.0023
1979	-	-
1980	-	-
1981	0.000	-0.0137
1982	-0.003	0.0067
1983	0.003	-0.0034
1984	0.004	0.0117
1985	-0.006	0.0055
1986	0.030	0.0103
1987	0.007	0.0038
1988	-	-

Source: Author's calculations.

Table E.10
Onions: Change in Actual and Predicted Expenditure Shares

Year	Actual	Predicted
1970	-	-
1971	-0.015	-0.0139
1972	0.022	0.0115
1973	0.029	0.0238
1974	-0.022	-0.0213
1975	0.022	0.0072
1976	-0.036	-0.0067
1977	0.031	0.0057
1978	-0.050	-0.0179
1979	-	-
1980	-	-
1981	0.025	0.0351
1982	-0.014	-0.0142
1983	-0.015	-0.0131
1984	0.035	-0.0144
1985	-0.021	-0.1277
1986	0.001	-0.0031
1987	0.014	0.0219
1988	-	-

Table E.11
Data: Model of the U.S. Vegetable Market

Year	No. of Hectares Planted to Tomatoes, Florida (AP)	No. of Hectares Harvested, Florida (AH)	α = AP/AH
1970	17,415	16,484	0.95
1971	17,982	17,658	0.98
1972	18,914	18,549	0.98
1973	14,378	14,054	0.98
1974	12,839	12,758	0.99
1975	15,674	15,512	0.99
1976	17,496	13,770	0.79
1977	17,051	16,808	0.99
1978	16,727	16,524	0.99
1979	17,375	17,091	0.98
1980	19,035	18,752	0.99
1981	16,727	16,403	0.98
1982	18,468	18,468	1.0
1983	19,967	19,278	0.97
1984	20,007	19,197	0.96
1985	19,724	19,521	0.99
1986	21,708	21,587	0.99
1987	23,085	23,004	0.996
1988	25,313	24,584	0.97

Source: Florida Agricultural Statistics Service, Florida Agricultural Statistics Vegetable Summary 1988-1989.

Table E.12
Data: Model of the U.S. Vegetable Market

Year	Total U.S. Production (mt)	Florida Average Producer Price, Tomatoes $/mt	Producer Price of Other Vegetables
1970	911,700	299.04	0.451
1971	891,350	358.62	0.554
1972	996,250	361.09	0.612
1973	977,800	393.79	0.713
1974	1,004,050	409.25	0.617
1975	1,055,700	411.71	0.772
1976	1,088,600	475.10	0.771
1977	994,750	473.31	0.744
1978	1,120,400	490.56	0.950
1979	1,164,600	468.83	0.861
1980	1,269,650	491.68	1.0
1981	1,299,050	468.38	1.191
1982	1,338,450	662.14	1.050
1983	1,363,100	611.97	1.236
1984	1,408,150	514.30	1.122
1985	1,487,000	682.75	1.020
1986	1,568,050	697.09	1.157
1987	1,620,700	627.2	1.277
1988	1,792,750	835.07	1.243

Source: 1. USDA Vegetables and Specialities Situation and Outlook Yearbook. 1988.

2. Author's calculations.

Table E.13
Data: Model of the U.S. Vegetable Market

Year	Yield (mt/ha)	Florida Production (mt)	Production, Other States (mt)
1970	15.8	275,157	636,543
1971	16.5	296,703	594,647
1972	16.7	315,864	680,386
1973	21.9	314,878	662,922
1974	28.3	363,344	640,706
1975	25.3	396,552	659,148
1976	23.5	411,156	677,444
1977	22.8	388,763	605,987
1978	27.0	451,629	668,771
1979	30.4	528,200	636,400
1980	27.6	525,366	744,284
1981	34.4	575,409	723,641
1982	31.8	587,282	751,168
1983	31.1	620,974	742,126
1984	33.7	674,236	733,914
1985	34.3	676,533	810,467
1986	34.2	742,414	825,636
1987	37.0	854,145	766,555
1988	32.0	810,016	982,734

Source: Florida Agricultural Statistics Service. Florida Agricultural Statistics Vegetable Summary. 1988-1989.

Table E.14
Data: Model of the U.S. Vegetable Market

Year	Growing Cost W. Central Florida ($/ha)	Harvesting Costs W. Central Florida ($/ha)
1970	367.9	350.8
1971	425.2	466.0
1972	490.3	520.5
1973	540.8	658.2
1974	711.2	717.5
1975	704.3	761.8
1976	714.2	713.9
1977	737.4	654.1
1978	728.5	845.3
1979	-	-
1980	828.31	1,500.9
1981	992.2	1,728.1
1982	953.3	1,463.9
1983	990.5	1,125.2
1984	1,067.6	1,765.9
1985	996.9	1,424.0
1986	887.5	1,598.0
1987	1,197.2	1,424.0
1988	1,489.2	1,394.0

Source: Department of Agricultural Economics, University of Florida. (Unpublished).

Table E.15
Data: Model of the U.S. Vegetable Market

Year	Domestic Consumption (mt)	U.S. Personal Disposal Income ($)	U.S. Retail Price ($/mt)	Retail Price of Other Vegetables
1970	1,090,594	3,382	940.8	0.422
1971	1,033,476	3,608	1,043.8	0.444
1972	1,120,930	3,846	1,052.8	0.478
1973	1,169,643	4,302	1,079.7	0.618
1974	1,114,868	4,655	1,227.5	0.580
1975	1,145,293	5,063	1,294.7	0.609
1976	1,214,404	5,468	1,294.7	0.652
1977	1,207,373	5,957	1,518.7	0.705
1978	1,299,181	6,614	1,556.8	0.853
1979	1,274,109	7,318	-	0.343
1980	1,349,877	8,002	1,509.8	1.0
1981	1,343,507	8,809	1,724.8	1.170
1982	1,377,849	9,721	1,655.4	1.215
1983	1,422,531	10,350	1,771.8	1.183
1984	1,603,508	11,257	1,807.7	1.189
1985	1,703,660	11,862	1,742.7	1.155
1986	1,838,050	12,486	1,845.8	1.158
1987	1,834,034	13,143	1,843.5	1,412
1988	1,949,102	-	1,868.2	1,386

Sources:
1. USDA Vegetable and Specialities Situation and Outlook Yearbook. 1989.
2. U.S. Department of Commerce Bureau of the Census Statistical Abstract of the United States. 1989.
3. Author's calculations.

Table E.16
Data: Model of the U.S. Vegetable Market

Year	Per Capita Expenditure (P x Q/Population) ($)
1970	13.33
1971	14.08
1972	15.27
1973	17.88
1974	18.27
1975	19.23
1976	20.63
1977	23.33
1978	26.80
1979	28.25
1980	30.12
1981	33.74
1982	35.29
1983	34.50
1984	38.34
1985	36.67
1986	38.01
1987	44.01
1988	46.15

Source: Author's calculations.

Table E.17
Data: Model of the U.S. Vegetable Market

Year	Mexican Exports (mt)	Mexico's Minimum Agricultural Wage (Pesos)
1970	290,764	26.75
1971	258,682	29.06
1972	264,124	30.9
1973	339,801	38.7
1974	267,897	49.09
1975	253,605	55.6
1976	294,198	79.91
1977	356,251	88.31
1978	369,283	103.44
1979	322,170	124.33
1980	294,601	154.44
1981	236,596	200.84
1982	267,224	365.00
1983	332,604	550.00
1984	369,598	860.00
1985	380,305	-
1986	431,337	-
1987	406,777	-
1988	362,733	-

Sources: 1. USDA Foreign Agricultural Service. (Unpublished).
2. Buckley, 1986.

Table E.18
Data: Model of the U.S. Vegetable Market

Year	Row Exports
1970	2,590
1971	2,298
1972	2,068
1973	1,805
1974	2,374
1975	3,652
1976	2,160
1977	2,942
1978	1,655
1979	1,393
1980	1,021
1981	1,946
1982	1,588
1983	2,241
1984	4,302
1985	-
1986	-
1987	-
1988	-
1989	-

Source: Author's estimates.

Table E.19
Calculation of Mexican Producer of Tomatoes
(Pesos)

Year	Mexican Producer Price (Pesos)
1970	11,174.5
1971	12,462.0
1972	12,574.5
1973	12,910.8
1974	14,758.3
1975	15,598.3
1976	19,217.0
1977	33,264.0
1978	34,427.1
1979	-
1980	33,648.1
1981	41,110.0
1982	90,722.8
1983	207,167.7
1984	295,472.3
1985	435,666.4
1986	1,100,603.7
1987	2,492,326.8
1988	4,140,133.4
1989	4,913,301.7

Source: Author's calculations.

Note: Based on adjustment of the U.S. retail price (see text).

Table E.20
Mexican Input Prices

Year	Fertilizer 1968 = 100
1970	-
1971	104
1972	105
1973	107
1974	133
1975	133
1976	164
1977	209
1978	237
1979	235
1980	268
1981	309
1982	395
1983	803
1984	1,365
1985	2,032
1986	3,819
1987	-
1988	-

Source: FAO *Production Yearbook*.

Table E.21
Index of Prices Received by Mexican Producers

Year	Base 1968 = 100
1970	-
1971	-
1972	-
1973	-
1974	187
1975	220
1976	219
1977	295
1978	324
1979	393
1980	560
1981	739
1982	991
1983	1,971
1984	3,427
1985	5,392
1986	10,343
1987	-
1988	-

Source: FAO Production Yearbook.

Table E.22
Indexes of Non-vegetable Retail Prices
Base: 1967=100

Year	Cereal and Bakery Products	Meat, Poultry, Fish & Eggs	Dairy Products
1970	108.9	116.5	111.8
1971	113.9	116.9	115.3
1972	114.7	128.0	117.1
1973	127.7	160.4	127.9
1974	166.1	163.9	151.9
1975	184.8	176.4	156.6
1976	180.6	178.9	169.3
1977	183.5	177.5	173.9
1978	199.9	204.3	158.6
1979	220.1	234.2	207.1
1980	246.4	242.2	227.4
1981	271.1	252.8	243.6
1982	283.3	262.2	247.0
1983	292.4	261.2	250.0
1984	304.9	266.7	253.3
1985	316.9	263.6	258.0
1986	325.5	275.1	258.3
1987	336.9	290.9	264.8
1988	358.4	300.9	271.0

Source: Statistical Abstract of the United States, various issues.

APPENDIX F

INTERVIEW PARTICIPANTS AND THEIR INSTITUTIONAL AFFILIATIONS[1]

1. Ken Britto - Director, Finance, Agro 21 Corporation
2. Joe Hendricks - Director, Livestock Operations, Agro 21 Corporation
3. Shariq Ghaaznavi - Director, Crop Operations, Agro 21 Corporation
4. Cecil Taffe - Director, Planning, Agro 21 Corporation
5. Rauder Yeudya - Manager, Spring Plains
6. Ian Maxwell - Crop Manager, Halse Hall
7. Joseph Green - Crop Manager, Halse Hall
8. George Mignott - President, Cane Farmers Association
9. Vernon Morris - Director, Small Farmer Development, Agro 21 Corporation
10. Vivian Rochester - Chief Agricultural Specialist, USAID
11. John Williams - Managing Director, National Investment Bank Jamaica
12. Aaron Parke - Manager, Agribusiness, Jampro
13. Mable Tenn - Manager, Halse Hall
14. David Moschette - Partner, Trewlany Vegetables

[1]Institutional affiliations and titles refer to the Agro 21 period. Respondents may no longer fill these positions.

APPENDIX G

THE IMPACT OF GOVERNMENT POLICY ON TRADITIONAL AGRICULTURAL EXPORTS IN JAMAICA

The purpose of this appendix is to investigate the impact of Jamaican government policy on the traditional export sector. The analysis follows from earlier discussion in which it was argued that the primary objective of the Agro 21 program was the diversification of the Jamaican agricultural export base away from traditional commodities such as sugar. It has already been demonstrated in an earlier chapter that government policies discriminated against the export of non-traditional commodities, i.e. winter vegetables, and resulted in heavy private and social losses. It is logical to question, given the policy framework in effect at the time, whether or not the country would have been relatively better off by continuing its focus on the traditional export commodities.

In the analysis which follows the above question is answered with respect to the sugar industry. This traditional export crop was chosen given that a major plank of the Agro 21 initiative was the divestment of unused or under-utilised sugar cane lands. The methodology employed is the Monke-Pearson Policy Analysis Matrix (PAM) which was used in the analysis of the winter vegetable sector in Chapter 4. As already mentioned the PAM generates a number of useful performance ratios which can be used to determine the impact of government policies on any specific commodity system. These ratios also allow for easy comparisons across alternative systems.

The appendix is brief and is organised as follows. After the introduction is presented a discussion of the details of model construction in section G.2. This is followed by the presentation of the empirical findings, and a comparison of the results from the sugar industry model and those generated earlier for the winter vegetable sector. Section G.3 summarises the discussion.

G.2 MODEL CONSTRUCTION AND DATA SOURCES

To analyse the impact of domestic policies on the sugar sector a PAM was developed based on a hypothetical model of the industry. The model constructed was based on the following assumptions:

1. That the same acreage was devoted to sugar as to the production of winter vegetables.

2. That sugar cane yields would average 30t/acre, this being the average historical yield of a large tract of land in the parish of Clarendon which was divested to winter vegetable production.

3. The tons cane/tons sugar (TS/TC) ratio would be average for the industry, 10.54:1.

The level of capital investment in the sugar industry and the wisdom of further capital expenditure, in the face of low international prices, has been a hotly debated issue in Caribbean agricultural policy for some time. In this research, therefore, two scenarios are elaborated. The first assumes that all capital equipment in the industry is old and fully depreciated. Its value is, therefore, treated as a sunk cost. The alternative scenario involves the assumption that over the 1982-1987 period there was significant new capital expenditure in the industry. The actual level of capital expenditure is assumed to be based on historical investment levels and the acreage assumptions stated earlier.

G.2.1 DATA SOURCES

Data required for the development of the PAMs for the sugar industry were obtained from a recently published report of a Commission of Enquiry into the Jamaican sugar industry (Sugar Industry Commission, 1988). The conversion factors used are the same as those calculated in Chapter 3.

G.3 EMPIRICAL RESULTS

The performance criteria for the two sugar scenarios are summarised in Table B.1 along with the estimates reported earlier for the winter vegetable sector. Under the second scenario (i.e. sunk capital costs) the sugar industry registers a social profit of $J7.7 million. Under the assumption of new capital investment the industry reports a loss of approximately $J24 million. This it would be recognised is less than half the loss actually incurred by the winter vegetable industry over the period of analysis.

Additional analytical results coming out of the comparison of the winter vegetable and sugar models are also presented in Table G.1. It is interesting that the SRP estimates for all models approximate 30%, although non-traditional exports attracted the highest rate of taxation. This is indeed ironic given the urgent need for diversification of the country's agricultural exports.

In the case of input costs it is observed that the NPCI for the sugar model assuming no new capital investment is highest (1.13) but that in all three cases government policies acted to raise input prices above world equivalent levels. Similarly, it is observed that government policies had a depressing effect on the prices received for both traditional and non-traditional exports, and that the effect was the same across sectors.

The DRC and PRC reflect the results on the private and social profitability of the industry. The ratios indicate that only under the assumption of no new investment is any level of private or social profitability achieved in the hypothetical model. Ignoring any productivity improvements stemming from new capital investment it would appear that Jamaica would not have enjoyed a comparative advantage in sugar production were such investments to be made.

G.4 SUMMARY

The above has been an analysis of the impact of government policy on the traditional export sector. Based on the application of the Monke-Pearson PAM to the sugar industry it was discovered that Jamaica would have sustained lower private and social losses had the country continued its focus on the production of sugar, given the policy environment existing during the

Table G.1

Sugar PAM Performance Ratios and Industry Profitability

Ratio	Sugar Industry (new investment)	Sugar Industry (no new investment)	Vegetable Industry
NPCO	0.77	0.77	0.77
NPCI	1.01	1.14	1.03
DRC	-1.42	0.65	-5.36
SRP	-0.34	-0.32	-0.38
EPC	1.56	0.76	2.71
PC	1.31	0.06	1.38
PCR	-1.03	0.97	-2.23
Private Profit/Loss($Jm)	-31.45	0.47	-105.50
Social Profit/Loss($Jm)	-23.93	7.67	-76.57

Source: Author's calculations.

Agro 21 era. In fact, assuming no additional capital expenditures the industry generates a small social profit despite "soft" world prices.

The above does not suggest, however, that from a strategic perspective Jamaica would have been better off without the Agro 21 program. For as elaborated in Chapter 1, continued reliance on sugar exports has already begun to prove problematic.

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