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THE DEMAND FOR IMPORTS

The Case of Barbados 1954–1970

WALLACE JOEFIELD-NAPIER

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THE DEMAND FOR IMPORTS: THE CASE OF BARBADOS 1954 – 1970

This study attempts to analyse Barbados' demand for imports as a source of food, raw materials for industries and government revenue on which the economy depends.

It therefore examines both the short and long run determinants of that country's consumption of imports over the 1954–1970 period. The aim of the study is to "fill the existing gap" in the analysis of Barbados' demand for imports.

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PREFACE

In this monograph we explore some recent developments in econometric theory and their applications to the trade data of Barbados.

This is the first attempt at estimating import demand functions for various categories of imports into Barbados over the review period 1954 — 1970. The emphasis throughout is to present as clearly as possible, both the general problem Barbados faced in terms of its imports, as well as some specific problems of estimating import demand functions for small developing economies.

The monograph is organised into five chapters. The first provides a background to the study and highlights some of the factors which influenced the structure of demand for imports over the review period. The second looks at the basic problems of specifying and estimating import demand functions, and various approaches to the solution of some of these problems. The third chapter presents the estimates of static import demand functions for Barbados over the review period. The fourth chapter provides estimates of import demand equations based on a functional categorization of commodities. In the last chapter we present a summary of our findings.

Wallace Joefield-Napier

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THE DEMAND FOR IMPORTS: THE CASE OF BARBADOS 1954 — 1970

By W. Joefield — Napier

Introduction

One of the significant features of the Barbadian economy over the period 1954—1970, has been its heavy reliance on imports, not only as a source of food and raw material inputs to industry but also as a major source of Government revenue. In this context of critical dependence on imports we would expect the analysis of the foreign sector to be much more than an esoteric exercise. The findings of such a study may, in general, form the basis of many of the policies that a particular government may wish to initiate.

In the case of Barbados, no rigorous analysis has ever been undertaken of the structure of its imports. As a consequence of this shortcoming, very little is known of the demand behaviour which underlies the trade figures. In addition, because neither aggregated nor dis-aggregated import demand equations have ever been estimated for this economy, it also meant that with a few exceptions, almost all of the Barbadian Government's policies were carefully aimed at intervention in the foreign sector (for example, policies initiated after the devaluation of the pound sterling in 1967 and the U.S. dollar in 1970) and could not have been much more than spasmodic exercises.

Given the existing paucity of analysis of the foreign sectors of Caribbean economies in general and of Barbados in particular, it is very important for us to recognise the immense value of estimated import elasticity coefficients. In this respect, it is interesting to note that if the estimated elasticity coefficient indicates that a particular commodity is price inelastic, then it is evident that the government can increase its revenue by the introduction of higher import duties without significant shortfalls in the volume of import. Conversely if the estimated elasticity coefficient indicates that the demand for the particular commodity is price elastic, then the Government (if pursuing a policy of import replacement) can precipitate a drastic reduction in imports simply by raising import duties.

This study is an attempt to fill the existing gap in the analysis of Barbados demand for imports. The study examines both the short run and the long run determinants of Barbados' consumption of imports over the period 1954—1970. Estimates of the direct price and income elasticies for twenty two community groups of retained imports were computed by regression methods. It should be noted that the elasticities thus obtained may be measured either by means of the explanatory variables or over a given range. However, in this study, the import elasticities were measured by means of the variables in the case of the linear model. In addition, by incorporating the idea that import demand elasticities can either be short or long run, recourse can be made to various dynamic formulations. Unfortunately, due to the lack of adequate computing facilities, we cannot present such estimates in this study and, instead, will confine ourselves to theoretical formulations of dynamic models.

For easy exposition, this study is divided into five chapters. Chapter One gives a brief analysis in the trends in Barbados import demand. Chapter Two reviews the theory which underlies the formulation of import demand models as well as the models utilised in the study, and Chapter Three discusses the data and the problems of estimation posed by the models chosen for the empirical work. Statistical results are presented in Chapter Four and the final chapter contains a summary as well as the conclusions of the study.

CHAPTER ONE

TRENDS IN BARBADOS' IMPORTS: 1954—1970

With the help of available statistical information, it is possible to trace the behaviour of imports and its relationship to developments in the economy during the period 1954—1970. It is worthy of note that on the whole, the relationship between national income and imports over the period of analysis indicated a pattern that was consistent with the under-developed nature of the economy and conformed to the colonial stereotype increases in national income, as a consequence of increases in export earnings which led to an expansion of the consumption of imported goods and services. Thus, because of the import biased nature of the Barbadian economy, there tended to be a direct relationship between an increase in productivity in export agriculture and imports of both consumer and capital goods. A positive relationship was also evident between industrial goods production and the import of raw materials and industrial goods.

However, the trends in imports can be more clearly highlighted by an examination of the disaggregated import data over the period of analysis and it is to this task that we shall now turn.

Table 1 gives a time series of Barbados' imports in terms of S.I.T.C. grouping for 1954—1970 in current prices. Table 2 presents the same information on a per capita basis. The percentage composition of imports in current price and 1965 base year price is given in Tables 3 and 4 respectively.

As the data on Table 1.3 indicate, imports of food (SITC 0) fell from 31.39 per cent in 1954 to 20.93 per cent in 1970. Decreases were also evident in the importation of beverages and tobacco (SITC 1); crude

TABLE 1.1 BARBADOS IMPORTS BY SECTIONS OF THE S.I.T.C. 1954 — 1970

(Current Prices)
Bds. $000

S.I.T.C. SECTIONS

	0	1	2	3	4	5	6	7	8	9	
Period	Food	Beverages & Tobacco	Crude Materials (in Edible Except Fuels)	Mineral Fuels Lubricants & Related Materials	Animal & Vegetable Oils & Fats	Chemicals	Manufac-tured Goods Classified Chiefly by Material	Machinery & Transport Equipment	Miscella-neous Manufac-tured Articles	Miscella-neous Trans-actions	Total
1954	15,304.8	1,257.0	3,386.8	2,435.4	1,097.7	3,901.8	10,030.1	5,635.7	3,391.4	2,322.7	48,763.4
1955	16,831.0	1,404.2	3,668.9	2,786.9	622.3	4,334.9	12,975.9	6,495.4	3,847.4	2,277.6	55,244.6
1956	17,859.3	1,621.6	4,744.2	3,074.8	846.9	5,029.8	12,948.6	7,857.0	4,808.1	2,524.5	61,314.8
1957	19,161.1	2,152.7	4,038.1	3,134.8	831.3	6,019.7	14,651.2	10,219.9	5,334.4	2,764.6	68,297.8
1958	20,952.5	2,154.8	3,693.9	3,634.3	546.5	5,521.0	15,958.4	12,370.0	5,908.5	2,633.9	73,373.9
1959	21,224.3	2,220.8	3,706.5	4,078.4	642.9	5,993.6	16,289.4	11,494.9	6,783.9	2,427.2	74,862.0
1960	21,907.6	2,194.4	4,384.8	4,253.2	483.6	5,963.7	18,410.6	15,215.9	7,794.4	2,691.2	83,299.4
1961	23,218.3	1,894.4	3,967.3	4,350.2	396.2	6,441.0	17,417.1	12,176.0	7,653.5	2,748.5	80,262.5
1962	24,067.8	1,982.3	3,578.5	11,178.6	246.2	7,064.2	16,872.5	12,786.2	8,420.6	2,900.6	89,097.5
1963	26,907.5	2,025.9	4,250.7	13,713.2	550.7	6,966.6	18,656.2	13,619.9	8,918.4	3,262.3	98,871.4
1964	29,031.0	2,128.6	3,545.6	11,270.8	568.3	8,576.1	20,948.1	18,069.1	10,975.9	3,760.5	108,873.9
1965	31,869.6	2,120.9	3,876.7	11,796.5	807.8	8,330.5	23,206.5	18,929.7	11,347.2	3,979.8	116,265.2
1966	34,088.2	2,384.3	4,406.7	13,149.1	763.6	9,779.3	27,202.4	22,252.8	13,085.7	3,999.1	131,111.2
1967	32,533.8	2,345.6	4,980.1	11,609.2	1,114.7	10,945.5	27,199.1	25,674.7	13,805.5	3,845.0	134,053.2
1968	38,578.4	3,327.3	5,946.9	16,622.2	1,601.3	12,262.7	31,525.1	35,069.4	17,468.6	5,603.1	168,024.9
1969	42,426.9	3,822.4	6,279.5	14,796.5	2,155.7	14,358.0	40,080.2	40,771.3	23,765.6	6,097.4	194,553.6
1970	49,196.4	5,223.7	6,899.0	12,990.7	3,102.4	16,984.4	49,017.0	55,971.7	28,400.5	7,219.1	235,004.9

Source: Barbados External Trade Report (various issues).

TABLE 1.2 BARBADOS PERCENTAGE COMPOSITION OF IMPORTS (IN CURRENT PRICES)*

BY SECTIONS bf THE S.I.T.C., 1954 — 1970

	S. I. T. C. SECTIONS										
	0	1	2	3	4	5	6	7	8	6	
Period	Food	Beverages & Tobacco	Crude Materials (in Edible Except Fuels)	Mineral Fuels Lubricants Etc.	Animal & Vegetable Oils & Fats	Chemicals	Manufactured Goods Classified Chiefly by Material	Machinery & Transport Equipment	Miscellaneous Manufactured Articles	Miscellaneous Transactions	Total
1954	31.39	2.58	6.95	4.99	2.25	8.00	20.57	11.56	6.95	4.76	100.00
1955	30.47	2.54	6.64	5.04	1.13	7.85	23.49	11.76	6.96	4.12	100.00
1956	29.13	2.64	7.74	5.01	1.38	8.20	4.12	12.81	7.84	4.13	100.00
1957	28.05	3.15	5.91	4.59	1.22	8.81	21.45	14.96	7.81	4.05	100.00
1958	28.56	2.94	5.03	4.95	.75	7.52	21.75	16.86	8.05	3.59	100.00
1959	28.35	2.97	4.95	5.45	.86	8.01	21.76	15.35	9.06	3.24	100.00
1960	26.30	2.63	5.26	5.11	.58	7.16	22.10	18.27	9.36	3.23	100.00
1961	28.93	2.36	4.94	5.42	.49	8.03	21.70	15.17	9.54	3.42	100.00
1962	27.02	2.22	4.02	12.55	.28	7.93	18.94	14.35	9.45	3.25	100.00
1963	27.21	2.05	4.30	13.87	.56	7.05	18.87	13.77	9.02	3.30	100.00
1964	26.66										
1965	27.42	1.82	3.33	10.15	.69	7.17	19.96	16.28	9.76	3.42	100.00
1966	26.00	1.82	3.36	10.03	.58	7.46	20.75	16.97	9.98	3.05	100.00
1967	24.27	1.75	3.72	8.66	.83	8.16	20.29	19.15	10.30	2.87	100.00
1968	22.96	1.98	3.54	9.89	.95	7.30	18.76	20.88	10.40	3.33	100.00
1969	21.89	1.96	3.23	7.61	1.11	7.38	20.60	20.95	12.22	3.13	100.00
1970	20.93	2.22	2.93	5.53	1.32	7.23	20.86	23.82	12.09	3.07	100.00

*Derived from Table 1.

TABLE 1.3 BARBADOS PER CAPITA IMPORTS BY SECTION OF THE S.I.T.C., 1954 — 1970

	0	1	2	3	4	5	6	7	8	9
Period	Food	Beverages & Tobacco	Crude Materials (in Edible Except Fuels)	Mineral Fuels Lubricants & Related Materials	Animal & Vegetable Oils & Fats	Chemicals	Manufactured Goods Classified Chiefly by Material	Machinery & Transport Equipment	Miscellaneous Manufactured Articles	Miscellaneous Transactions
1954	67.24	5.52	14.88	10.70	4.82	17.14	44.07	24.76	14.90	10.21
1955	73.47	6.13	16.02	12.16	2.72	18.92	56.64	28.36	16.79	9.94
1956	77.78	7.06	20.66	13.39	3.69	21.91	56.40	34.22	20.94	11.00
1957	82.52	9.27	17.39	13.50	3.58	25.92	63.10	44.01	22.97	11.91
1958	91.22	9.38	16.08	15.82	2.38	24.04	69.47	53.85	26.72	11.47
1959	91.01	9.52	15.89	17.49	2.76	25.70	69.85	49.29	29.09	10.41
1960	93.38	9.35	18.69	18.13	2.06	25.42	78.48	64.86	33.22	11.47
1961	99.18	8.09	16.95	18.58	1.69	27.51	74.40	54.32	32.69	11.74
1962	101.34	8.35	15.07	47.07	1.04	29.74	71.04	53.84	35.46	12.21
1963	111.83	8.42	17.67	57.00	2.29	28.96	77.54	56.61	37.07	13.56
1964	118.83	8.71	14.51	46.14	2.33	35.10	85.75	73.96	44.93	15.39
1965	130.08	8.66	15.82	48.15	3.30	34.00	94.72	94.72	46.32	16.24
1967	129.87	9.36	19.88	46.34	4.45	43.69	108.58	102.49	55.11	15.35
1968	152.60	13.16	23.52	65.75	6.33	48.51	124.70	138.80	69.10	24.12
1969	167.30	20.60	24.76	58.35	8.50	56.62	158.04	160.77	93.71	28.47
1970	204.13	21.68	28.63	53.90	12.87	70.47	203.39	232.25	117.84	29.95

Source: Barbados External Trade Report (various issues).

TABLE 1.4 BARBADOS PERCENTAGE COMPOSITION OF IMPORTS (1965 PRICES)*
BY SECTIONS OF THE S.I.T.C., 1954 — 1970

	S.I.T.C. SECTIONS							
	0	1	2	3	4	5	6	7
Period	Food	Beverages and Tobacco	Crude Materials (inedible Except Fuels)	Minerals, Fuels, Lubricants, etc.	Chemicals	Manufactured Goods Classified Chiefly by Materials	Machinery and Transport Equipment	Miscellaneous Manufactured Articles
1954	22.34	1.90	5.24	3.96	9.75	32.28	18.14	11.45
1955	22.17	1.82	4.60	4.97	9.35	30.84	20.92	9.56
1956	25.98	2.44	6.04	4.56	9.61	24.70	14.22	8.98
1957	26.03	2.01	5.13	3.68	8.79	20.74	16.78	7.84
1958	21.25	2.30	2.84	3.68	6.42	16.07	14.16	5.92
1959	27.24	2.68	3.69	4.09	7.93	22.85	15.93	8.58
1960	25.16	2.52	4.34	5.99	7.64	22.37	18.68	8.64
1961	28.04	2.22	4.53	7.38	8.11	21.40	15.34	8.75
1962	24.05	1.86	3.52	8.89	7.39	17.57	14.86	8.52
1963	30.04	2.17	4.49	12.22	8.08	21.54	15.41	4.82
1964	25.32	1.85	3.02	14.75	7.53	19.66	15.55	9.05
1965	27.41	1.82	3.33	10.15	7.17	19.96	16.28	9.80
1966	25.44	1.84	3.20	9.88	7.45	22.42	18.60	10.53
1967	21.40	1.54	2.87	8.61	8.94	20.32	17.43	9.63
1968	22.56	1.72	2.49	14.95	6.94	19.65	17.68	10.31
1969	21.24	1.76	2.20	10.94	7.70	20.38	18.81	12.70
1970	20.23	2.07	2.40	12.97	7.72	22.00	21.78	11.78

Source: Derived from Table 3.

materials (SITC 2;); animal and vegetable oils and fats (SITC 4); chemicals (SITC 5) and miscellaneous transactions (SITC 9).

In the case of beverages and tobacco imports (SITC 1), the fall in the group's percentage share of total imports over the seventeen years was marginal, that is, a fall from 2.58 per cent of the total in 1954 to 2.22 per cent in 1970. A more substantial decrease was evident in crude materials (SITC 2) whose share in total imports fell from 6.95 per cent in 1954 to 2.93 per cent in 1970.

Minerals fuels (SITC 3) only showed a slight increase in the proportional distribution of total imports, rising from 4.99 per cent in 1954 to 5.53 per cent in 1970. Nevertheless, the sinificance of the marginal increase in mineral fuels and lubricant imports can easily be exaggerated in view of the almost total dependence of Barbados on hydro-carbon fuel imports. But, the setting up of an oil refinery in Barbados in the 1960's reduced its dependence on external sources for many of the by-products of the petroleum industry (for example, kerosene and gasoline) and one of the consequences of this lessening dependence seemed to have been a fall in the proportionate share of the group in the total.

The downward trend in imports into Barbados of animal and vegetables oils and fats (SITC 4) highlights the influence that shifts in domestic production and utilisation, as well as in the diversification of exports markets, can have on the value and quantum of imports of a recipient country, despite the existence of a regional agreement formulated for the specific purpose of enhancing trade between countries.

In the case of the Caribbean from the inception of the Oils and Fats Agreement during the Second World War and until the mid-1960's a regional specialisation in oils and fats production and processing became evident with Dominica, Grenada, St. Lucia and St. Vincent being the major exporters of the raw material, copra. Barbados as well as Trinidad became processing centers and the main exporters of the finished products namely margarine, cooking oil, lard, laundry and toilet soap, and coconut meal. While this specialisation stimulated the export trade in copra, there were, at times, marked fluctuations in production in the exporting countries which led to corresponding variations in imports in the processing centers, but, more importantly, it also led to sharp variations in the prices of manufactured oil products.

The variations in the import of oils and fats into Barbados are highlighted in Table 1.3. As the data show, imports of oils and fats (the major component being copra) fell gradually between 1954 and 1957, and significantly in the next year. In 1959, there was a partial increase in these imports but, in succeeding years the downward trend continued until 1962 when the value reached an all time low of 0.28 per cent of total imports.

From 1962 onwards, the value of oils and fats import into Barbados fluctuated in an upward trend, but was still below the 1954 level. By 1970, this category of imports represented only 1.32 per cent of total imports as compared to 2.24 per cent in 1954.

The protracted decline in Barbados' oil and fats imports since the late 1950s can be traced to several major factors on the supply side. But, the most important of these factors were associated with natural disasters such as the "yellow ring" disease and Hurricanes Janet in 1957, Edith and Flora in 1963. Supply was also influenced by purely economic factors such as the development of the Windward Islands banana industry and the rapid expansion of copra processing facilities in what were formerly the major centres of copra exports.

The problem of the 'yellow ring' disease as it relates to the Caribbean coconut industry is well documented and there is no need to go into any detail here. Suffice it to say that it is the major factor that has led to the decline in Caribbean coconut production in post-war years. On the other hand, insufficient attention has been paid to the role of hurricanes in the decline of the Windward Islands copra exports. In 1957 and again in 1963, Hurricanes Janet, Edith and Flora decimated large numbers of coconut plantations in the Windward Islands (especially in St. Lucia and Dominica) thus leading to serious shortfalls in the production and exports of copra in those years. Given the fact that coconut trees take approximately eight years to reach full maturity, the downswing in production, evident in the years after 1957, suggests a link between the decline in coconut production and the decline in Barbados' imports of copra which became more evident after 1960.

Among the economic factors leading to a decline in the production of copra, and hence exports, was the rapid development of the banana industry in the Windward Islands. There were two dimensions to this. First of all, in islands where the supply of arable lands was extremely limited (a notable example in this group being St Lucia), the rapid expansion of banana cultivation took place at the expense of lands previously allocated to both coconut and domestic food crop production. This resulted not only in the decline of copra exports to Barbados but, more importantly, it made these small economies more vulnerable to fluctuations in the prices of imported foodstuff including, vegetable oils. A second dimension which became evident in islands where the scarcity of land was not so pronounced (for example, Dominica) was the fact that the expansion of banana cultivation actually led to an increase in the production of coconuts. However, that expansion was geared towards supplying the needs of the British market. In other words, the expansion of the banana industry in a few islands led to a deversification of markets which enhanced the production of coconuts which was initiated by two factors: the availability of adequate shipping facilities as a result of the regularity of banana boats; and the favourable prices for both green and dry nuts that prevailed on the British markets in the 1960s. Given the competitive demand between dry and green nuts, one would expect that increases in the price of green nuts would lead to shortfalls in the supply and exports of copra. While, apparently, increases in the price of green coconuts in the United Kingdom did lead to a reduction in the supply of copra to Barbados, shortfalls in supply to the Barbadian market was further exacerbated by the development of a booming trade in copra between the Windward Islands and the United Kingdom. The extent and rapidity with which the Windward Islands — United Kingdom coconut trade developed can be gleaned from the fact that in the case of Dominica, the exports of fresh nuts increased from just over 11,000 pounds (weight) valued at $455 in 1965 to over 473,000 pounds valued at $25,659 in 1958. Correspondingly, the exports of dry coconuts rose from 837,300 pounds, valued at $34,705 in 1964 to over 1.5 million pounds valued at $77,311 in 1968.

After 1965, the downward slide in copra exports from the Windward Islands to Barbados was further accelerated by the movement towards greater processing of copra within the home markets of the copra exporting territories. The speed and extent of the change from exporting to home processing was extraordinary. Again in the case of Dominica, the available figures indicate that between 1965 and 1967, the value of copra exports dropped from $365.8 thousand to $173.3 thousand, while over the same period, the value of coconut oil, produced locally, rose from $11.1 thousand to $120.1 thousand. It may also be of interest to note that the increased processing of copra within the Windward Islands led not only to a loss of markets to Barbadian exporters of manufactured oil and fat products such as laundry and toilet soaps, margarine, and coconut oil and meals, but it also led to a complete reversal in the trade in many of these items. In fact, Barbados became a net importer of such items as margarine and soaps from the Windward Islands.

Given that Barbados experienced difficulties in obtaining copra from the Windward Islands after the mid-1950s, the question that must be asked in "why Barbadian processors of copra did not switch to alternative sources of supply of the raw material, copra?" While the available information does not provide clearcut answers to this question, two possible reasons may have been the increases in the price of copra on the world market and the rapid fall in the price of copra substitutes, such as soya beans. Thus, over the period 1965—1968, the switch towards alternative forms of oils and fats raw materials imports as well as the importation of processed copra-based oils and fats products from the Windward Islands may have been an economically more feasible proposition for Barbados than to rely heavily on uncertain and high cost supplies of copra from traditional sources.

Chemical imports fell from 8.00 per cent of total imports in 1954 to 7.23 per cent in 1970. On the other hand, manufactured goods (SITC 6) which represented a larger proportion of total imports than crude materials and mineral fuels, appear to have increased significantly over the period of analysis. Among the products included in this group, textile imports more than doubled in value. However, the major component was woven synthetic fabrics which provided the main input into the domestic garment industry. Imports of iron and steel products as well as cement had also risen as a consequence of the boom in the building industry in the 1950s and 1960s, but in the 1970s, the import of cement declined as local production increasingly replaced imports. Other manufactured goods which became increasingly important, especially after 1960, include wood panels, paper and glass products and aluminum building parts, all of which reflected the rapid growth of effective demand within the Barbadian economy.

Given the emphasis placed upon import replacement and export promotion by the Barbadian government, at least since the promulgation of the Industrial Incentives Act, 1963, and the Industrial Development (Export Industry) Act, 1963, the trend evidenced in imports of manufactured goods seems to indicate only marginal success in the implementation of the government's industrialisation policies. To be sure, both quantitative and qualitative changes in domestic manufacturing activities did occur, as evidenced by the increase in the sector's contribution to the Gross Domestic Product from $12.2 million (current prices) in 1960 to $27.5 million in 1970, and by the expanded range of products manufactured locally, for example, processed foodstuffs, beverages, garments, soap, metal and wooden furniture, electronic equipment, pharmaceutical products and costume jewellery. But up to 1970, the manufacturing sector was in the main engaged in traditional activities, such as dressmaking, tailoring and handicrafts. Even in cases of new manufacturing activities, these were highly dependent up to 1970 on imported raw materials, and were mainly geared towards supplying the needs of the domestic market. However, the small size of the local market, together with the monopolistic nature of firms (due to the encouragement given to enclave type activities by government and the consequence of the historical evolution of a few large family owned enterprises) meant that most manufacturing enterprises operated far below their full capacity. It is the lack of initiative in expanding capacity which accounts for the failure of the manufacturing sector to maximise the opportunities provided by a rapidly expanding regional market after 1968. As a result Barbadian consumers were deprived of the benefits of greater economies of scale.

The most rapid increase in imports seems to have occurred in the machinery group, together with transport equipment (SITC 7), but these imports were heavily weighted in favour of non-producer goods. Thus, the importation of non-commercial motor vehicles rose from $2.03 million in 1954 to $9.24 million in 1970 while heavy duty transport equipment moved from $2.20 million to $9.09 million over the same period. Imports of electrical equipment for household use rose from $1.71 million to $20.94 million as compared to the recorded increase for non-electrical machinery from $2.08 million to $16.70 million. Overall, the group rose from 11.56 per cent of total imports in 1954 to 23.85 per cent in 1970. Significant increases were also recorded in the importation of miscellaneous manufactured articles (SITC 8) whose share in the total rose from 6.95 per cent in 1954 to over 12.00 per cent in 1970.

The series in Table 1.4 highlights the trends in the relative proportions of the SITC components of total imports in real terms. This series, in contrast with the changes in the proportions of the current price series (Table 1.3), leads to some interesting conclusions. For example, immediately after 1954 real food imports fell. However, there was a reversal of this trend by 1956 so that food imports grew quite rapidly up to 1965 with some fluctuations. After 1966, the downward trend in real food imports was again evident. This, when compared with the current price series, indicates a rise in the price of most of the items included in the group and when the export price index is taken into consideration it further signifies a deterioration in the net barter terms of trade.

Evidently increases in the price of grains and food stuffs on the world market played an important role in the deterioration of food terms of trade in the case of Barbados. Nevertheless, there was also the influence of internal factors, such as inadequate agronomic research (especially in the area of pest control), a reduction in agricultural acreage, rapid population growth, and an exodus of young people from employment in agriculture. We shall postpone our examination of these factors for the time being and proceed with our discussion of the other commodity groups.

Rapid increases in the years up to 1960 were also evident in the case of real beverages and tobacco imports into Barbados, but the peak in this group's proportional share in total imports did not coincide with that of food. Thus, by 1963, when real food imports reached its peak of 30.4 per cent of total real imports beverages and tobacco's share was only 2.17 per cent which was below the peak of 2.68 per cent attained in 1959. After 1963, real imports of beverages and tobacco declined continuously until the end of our period of analysis.

The value of crude materials imports fell by nearly one-half in real terms between 1954 and 1958 but rose by three-fifths over the 1958 level in the next three years, reaching a peak of 4.53 per cent of total imports in 1961. Following a decline in 1962, imports of this commodity group increased in 1963, reaching 4.49 per cent of total imports as against 3.52 per cent in 1962. However, imports fell in the succeeding years, and by 1970 crude materials accounted for less than 3.0 per cent of total real imports.

Increase in Barbados real imports of crude materials in the 1950s and the decline after 1963 may be explained by the fact that after the Second World War there was an enhanced demand for housing which could not have been satisfied previously due to the disruption in shipping during the hostilities. The pent up demand for lumber which was then the major building material was met in the main from Canadian sources at relatively low prices. In the more recent period, however, increases in the price of Canadian, lumber, as a consequence of the world wide demand for news print and other wood by-products, together with changes in the materials used in the Barbadian construction industry (due to the emphasis placed on using domestically produced building materials such as limestone and clay bricks), appear to be the factors which contributed most to the decline in real crude material imports.

In conformity with the results obtained in our analysis of the current price series, the relative share of mineral fuels and lubricants in real total imports was small in 1954 (3.96 per cent), but by 1970, the groups share has risen by nearly four-fold to 12.94 per cent total real imports. However, growth over the period was quite unsteady; most of the increase was concentrated in the post-1960 period and even so, for a few years, notably 1966 and 1967, when there were declines in the value of this form of imports.

With respect to real chemical imports, the shifts in total import share was not as pronounced as the current price series. In fact while in 1954 chemical imports represented 9.75 per cent of all goods imported into Barbados in real terms, by 1970, the proportional share had fallen to 7.72 per cent, a drop of only 2.03 per cent.

Annual movements in real imports of manufactures are of interest for two main reasons. Firstly, a smooth progressive increase from year to year would give an indication that Barbadian manufacturers were still in the 'import stage', in that they were unfamiliar with, or lacked confidence in satisfying the needs of local consumers, and, as such, they must continue to depend on the protection afforded by Government. Secondly, over the period, fluctuations above and below an upward trend would lend credence to the view that world monetary changes, especially in the period up to 1960, increased the price of manufactures by confining Barbadian importers to the relatively expensive United Kingdom market.

During the period 1954—1958 real impacts of manufactures (Table 1.4) were on a strong downward trend, mainly on account of the currency restrictions on U.S. dollars within the sterling area, imposed after the devaluation of the pound sterling in 1949. Other factors leading to increases in the trading prices of this group of imports were: (a) the shortages in the United States home market brought about by the diversion of resources toward the Korean war, and (b) the shortages created on the international market by the conscious policies pursued by United States producers to satisfy the residual home demand for manufactures at the cessation of Korean hostilities. The year 1954 saw an increase in the real value of imported manufactured goods, but in the succeeding two years a fall in real value was again evident due, in the main, to fluctuations in sterling on the international money market. Since 1963, the trend has been evidenced by numerous fluctuations and seems to have been due to variations in exchange rates in the United States dollar. By 1963, the latter country was experiencing great difficulty with its currency and, at that point in time, was a major source for Barbados manufacture imports.

Both machinery and transport equipment imports as well as miscellaneous manufactures imports experienced absolute increases in real terms over the seventeen years of our analysis. Thus the percentage share of the former group in the total moved up from 18.14 per cent in 1954 to 21.78 per cent in 1970, an increase of 3.64 per cent. On the other hand, the increase in miscellaneous manufacturers was not as great, representing 11.45 per cent of total real imports in 1954 and 11.78 per cent in 1970.

It may be useful to conclude our analysis of the trends in the components of real imports by reviewing the more outstanding features of our findings. In this respect, our analysis seems to indicate that there were significant fluctuations in the prices of many of the components of the manufactured goods group and this probably led to an erosion of the standard of life of the Barbadian consumer. In other words, the tendency towards fluctuations in the price of imported manufactures probably accelerated the imposition of import restrictions in order to improve the competitive position of domestic manufacturing industries vis-a-vis imports. The high price of the locally manufactured products was an added cost to the consumer. Our analysis also indicated that in the post-1960 period, there were major increases in the prices of crude materials, chemicals and food.

Apart from the growth in real aggregate imports, and additional area that must be investigated relates to the manner in which the import groupings changed in real per capita terms over our period of analysis.

In this context, the available evidence on Table 5 indicates that per capita import of food decreased by 11.27 per cent between 1954 and 1970, while per capita import of crude materials and minerals fuels moved from 7.39 and 5.62 per cent of total per capita imports in 1954 to 2.40 and 12.97 per cent in 1970, respectively. Per capita imports of chemicals, decreased from 13.74 per cent of total per capita imports in 1954 to 7.71 in 1970. While the latter fall in imports seemed to be significant, it was not as great as manufactured goods imports which fell from 45.51 per cent of total per capita imports in 1954 to 22.00 per cent in 1970 (a fall of 23.51

TABLE 1.5 BARBADOS IMPORT TRADE (PER CAPITA)

ANALYSIS BY SELECTED SECTIONS OF THE S.I.T.C., 1954 — 1970

	0	1	2	3	5	6	7	8
Period	Food	Beverages and Tobacco	Crude Materials	Mineral Fuels, Lubricants etc.	Chemical	Manufactured Goods Classified Chiefly by Materials	Machinery and Transport Equipment	Miscellaneous Manufactured Articles
1954	76.84	6.53	18.03	13.71	33.52	111.09	62.38	39.39
1955	85.76	7.06	17.80	19.24	36.17	119.31	80.90	36.99
1956	93.51	8.78	21.75	16.43	35.58	88.89	51.24	32.31
1957	85.80	7.39	18.88	13.55	32.34	76.28	61.71	28.84
1958	100.11	10.83	13.39	17.37	30.25	75.69	66.75	27.89
1959	102.88	10.12	13.94	15.45	29.98	84.47	60.21	32.41
1960	101.10	10.13	17.42	24.04	30.69	89.88	75.01	34.69
1961	111.73	8.86	18.06	29.42	32.31	85.27	61.12	34.85
1962	107.87	8.37	15.79	39.89	33.18	78.87	66.68	38.23
1963	120.01	8.69	17.96	48.85	32.30	86.10	61.61	19.27
1964	123.63	9.04	14.73	72.00	36.76	96.00	75.92	44.17
1965	130.11	2.66	15.82	48.15	34.00	94.69	77.29	46.32
1966	127.78	9.26	16.09	49.63	37.41	112.61	93.40	52.89
1967	118.92	8.55	16.08	96.38	44.73	112.84	96.71	53.44
1968	144.23	10.98	15.94	95.55	44.34	125.63	113.00	69.92
1969	144.02	11.96	14.93	97.17	52.24	138.20	127.51	86.15
1970	167.21	17.06	19.86	107.20	63.77	181.79	179.83	97.35

Source: Barbados External Trade Report.

per cent). As was expected, per capita import of machinery and transport equipment declined marginally between 1954 and 1970, moving from 25.57 per cent in the former year to 21.76 per cent in the latter year. Finally, a marginal per capita decrease was also evident in the case of miscellaneous manufactured goods imports. Here it may be noted that while this category of import represented 16.15 per cent of total per capita imports in 1954, by 1970 its share fell to 11.78 per cent. So far our analysis has indicated that there has been a substantial reduction in Barbados per capita food imports in real terms and a slight fall in imports of machinery and transport equipment. It thus becomes necessary to investigate, in somewhat more detail, the apparent disparity in the rates of growth of these two categories of imports.

Attention will now be focused on the trends in the importation of machinery and transport equipment. When Maizels [12] analysed the long term trend in imports of both developed and developing economies, he found that despite the rapid economic growth evidenced by both types of economies, the percentage imports of machinery and transport equipment in the developed economies was quite stable but there was a rapid increase in this category of imports in the developing economies in terms of current prices. On the basis of his findings he postulated two hypotheses. First, that the amount of machinery and transportation goods imported by a particular country increased in proportion to the rate of growth of aggregate income and secondly, that as industrialisation within a country proceeds from an earlier to a more mature phase, and as the demand for manufactures expands the proportion of home demand that is met from home production tends to grow and the import content of consumption tends to decline.

Despite certain pecularities inherent in the Barbadian economy, Maizel's first hypothesis throws much light on the economic significance of economic growth and import dependence of that economy. His hypothesis that an increase in aggregate income (that was also concommitant with rapid economic growth which itself has the effect of raising the share of machinery and transportation goods, notwithstanding the increase in the price of industrialised goods on the world's market) seems to have some validity in the Barbadian case, since the period of rapid machinery and transportation imports was also the period during which Barbados achieved its most rapid rate of growth in aggregate income, that is, the post-1960 period.

In so far as Maizel's second hypotheses is concerned, it would seem that Barbados' industrialisation process is at its infancy, for, despite the growth of home production in recent years, there has not been an appreciable decline in the import content of consumption.

While the reasons for the high food import bill cannot be cleafly identified, it has been suggested that some of the contributory factors at the time were (a) the reduction of lands allocated to farming; (b) rapid population growth; and (c) a shifting of population from agricultural pursuits to other jobs in the manufacturing and tourism sectors.

These factors will now be examined in some detail. In 1969, the **Barbados Economic Review** reported that acreages in agricultural crops had fallen as a result of the withdrawal of agricultural land for construction purposes. In as much as most of the construction undertaken within the Barbadian economy in recent times was brought about by the rapid growth in the tourist industry as well as an expansion in the population, the preceding statement implies that a significant proportion of the arable land available was utilised for the building of hotels and other facilities for the tourist industry, as well as for the building of dwelling houses.

Using the number of applications, by type, to the Barbados Town and Country County Planning Division for permission to construct as a rough indicator of construction activity, the figures in Table 1.6. show that since

TABLE 1.6
APPLICATIONS FOR PLANNING PERMISSION*, 1965 — 1970

Applications by Type	1965	1966	1967	1969	1970
	(1)	(2)	(3)	(4)	(5)
(a) Sub Divisions	251	245	336	353	324
(b) Private Residence	219	185	218	252	361
(c) Alterations and Additions	117	72	45	56	72
(d) Commercial & Industrial	66	63	75	93	57
(e) Reconstruction & Renovations	25	25	19	34	41
(f) Retentions	32	23	31	71	76
(g) Extensions	15	27	51	52	32
(h) Hotels	7	10	30	122	29
(i) Others	—	—	23	116	128
Total	732	650	828	1,156	1,120

*Up to 1964 only gross figures were given.

Source: Barbados Town and Country Planning Division.

1965 the majority of applications were made for sub-divisions (the cutting up of land into building lots) closely followed by applications for the construction of private residences. By contrast, the number of applications for the construction of hotels over the six years (1965—1970) were less than 500. Taking into consideration that many of the houses built over the period may have been owned by Barbadians living abroad and rented to tourists for a significant part of any year, the preceding figures on hotel construction may lead one to underestimate the impact of the tourist sector on the dimuintion of agricultural lands. Nevertheless, this factor should not be over-emphasised, for even as early as 1962 when the tourist industry was in its infancy, there was a noticeable shortfall in the acreages devoted to domestic food crop production.

The second explanation suggested for the rapid dimunition of agricultural lands and hence the increased dependence of Barbadian population over the period of analysis. This hypothesis seems to be more plausible than the previous one, in that one of the major characteristics of the Barbadian economy since 1954 was the rapid growth of population. For example, in 1954 the population of Barbados stood at 228.4 thousand or a density of nearly 1,375 persons per square mile. By 1970, the population and the density per square mile had increased to 241.0 thousand and 1,452 persons respectively. Such large increases meant both an increase in the demand for housing and an accentuation of the demand for food. Given that the quantum of land in Barbados is limited, the expansion in housing could only have been achieved by encroaching on available agricultural lands and a likely consequence of such encroachments would have been decreased agricultural production and increased importation of food.

While population growth and increased building activity may have caused a decline in agricultural lands and thereby exacerbated the shortages in domestic food supply, other factors have often been cited as being major contributors to this decline. One such factor was the shift from domestic food crop production to the production of export crops. Emtage [4] indicated that "acreages and output of sugar expanded at the expense of local production [of food crops] and there is no doubt that the Commonwealth Sugar Agreement (C.S.A.), bringing, as it has done, a guaranteed market and price, has been partly responsible for this trend".

From a close examination of the available information one cannot identify clearly the extent to which expansions in sugar cane production were responsible for the decline in domestic food crop production. If, as Persaud [18] has indicated, mixed farming was practised extensively on sugar estates in Barbados (through the inter-cropping of food crops and sugar cane, especially during the ratooning period), then it is reasonable to assume that any expansion of sugar cane acreage would have led to corresponding increases in food crop production. In as much as such expansion did not take place, then one could agree with Persaud that "the shortfalls on the part of food crops from sugar estates have to be attributed to a change in the practice of ratooning". But even so, there is no conclusive evidence available to this author to suggest that changes in ratooning did take place.

It is possible, however, that the consolidation of sugar estates may have caused a sharp decline in the land holdings of small peasants (See Table 1.7) and since these small farmers were the main producers of domestic food crops such declines may have led to an overall reduction in the supply of food. It has, of course, been argued that a decline in small farm holdings does not necessarily lead to a decline in output, moreso, if yield per acre is rising. While this point has some validity, it does not seem to be relevant in the Barbadian situation, for the available evidence in Table 8 indicates that between 1964 and 1971, there was a marked decline in many (if not most) of the food crops produced locally.

TABLE 1.7

DISTRIBUTION OF FARMS BY SIZE AND

ACREAGE; — 1946 and 1961

		1946		1961
Size of Farms	No. of Farms	Total Acreage	No. of Farms	Total Acreage
0	26,415	5,300	23,752	5,760
1	4,201	7,401	3,675	6,126
5	270	1,744	199	1,262
10	162	2,949	76	1,720
50	22	1,674	17	1,187
100	49	7,807	42	6,650
200	133	42,632	1,101	35,950
500	37	24,370	41	26,403
Total Acreage		93,880	27.912	84,458

Source: Census of Agriculture, 1946, 1961.

TABLE 1.8

ESTIMATED YIELD PER ACRE OF PRINCIPAL FOOD CROPS ON INSPECTED ESTATES: 1946 — 1971

Towns/Acres

Year	Yams	Sweet Potatoes	Corn	Eddoes	Pulses	Cassava
1964/65	5.4	7.6	1.0	2.0	2.0	—
1965/66	5.1	7.6	1.0	2.0	2.0	5.0
1966/67	5.0	7.5	1.0	2.5	2.0	5.0
1967/68	3.5	7.1	1.0	2.0	2.0	5.0
1968/69	3.8	7.1	1.0	2.0	2.0	5.0
1969/70	5.0	4.6	1.0	2.7	2.0	5.0
1970/71	5.0	5.0	0.5	0.7	2.0	5.0

Source: Barbados Abstract of Statistics 1969, Barbados Statistical Service.

Finally, if we use per acre yield of food crops as a rough measure of production then it would seem that the reduction in food crop acreages in the 1960s when compared to the 1950s meant a relinquishing of an average of approximately 120,000 tons of domestic food supply per annum.

Turning to the question of labour shift from agricultural pursuits to other employment in manufacturing and tourism, there is no doubt although the available evidence on labour movements in Barbados is meagre, that the higher paid and less tedious jobs in both the manufacturing and tourism sectors would have attracted a significant proportion of the population who were previously engaged in or who potentially would have been engaged in agriculture. The net effect of any such movement from agriculture would, no doubt, be a decline in domestic food production.

The direction of Barbados import trade seemed to have undergone dramatic changes over the period of analysis. (See Table 9). For example, at the beginning of the period, the sterling area accounted for approximately 61 per cent of Barbados total import trade; however, by 1970, this figure fell to nearly 47 per cent. It is important to note that this fall in imports was not confined solely to the sterling area. Significant shortfalls were also experienced in Barbados imports from Canada. In more concrete terms, the available figures indicate that while Barbados imports from the United Kingdom represented 40.0 per cent of Barbados total imports in 1954, by 1970 this figure fell to 30.4 per cent. Correspondingly, while in the initial year of our analysis, Canada exported 18.2 per cent of all the goods imported into Barbados, by 1970 its share of Barbados total imports fell to 10.5 per cent. The country that gained most from this shift in Barbados' pattern of imports seems to have been the United States, for while in 1954, Barbados obtained only 6.6 per cent of her imports from the U.S.A. by 1970, this figure rose to 21 per cent.

In terms of value, Barbados' five most important trading partners over the period 1954—1970 were the United Kingdom, Canada, United States, O.E.C.D. countries, and other Caribbean territories, in order of importance. Together, these five countries made up 87.5 per cent of Barbados imports in 1954; 84.5 per cent in 1958; 80.9 per cent in 1962; 78.2 per cent in 1966 and 81.6 per cent in 1970.

Turning to Barbados' import trade with other Caribbean territories, the figures on Table 1.10 indicate that the increase in her imports from sister territories in the Caribbean has not been significant. In this context, while Barbados total imports from Caribbean sources represented approximately 9.44 per cent of total imports in 1954, in 1970 this figure fell slightly to 9.42 per cent. Over our period of analysis, that is, 1954—1970, trade with other Caribbean territories made up only 9.84 per cent of total Barbados imports.

Although from a global point of view it would seem that the structure of Barbados imports was not highly oriented towards Caribbean sources, it would be wrong to conclude that there has not been a definite trend towards increasing importance of intra-regional trade. In other words, since the inception of CARIFTA in 1968, there has been an upward progression in Barbados imports from Caribbean sources, but moreso from the relatively more industrialised economies of Jamaica and Trinidad and Tobago. On closer examination of Table 10, it can be seen that Trinidad and Tobago increased its share of Barbados imports from 4.9 in 1954 to 7.2 per cent in 1970, thereby maintaining its position as Barbados' most important regional trading partner. Correspondingly, Jamaica's export to Barbados rose from 0.6 per cent in 1954 to 1.70 per cent in 1970.

On the other hand, Guyana, being less industrialised than either of the previously mentioned territories, did not offer effective competition in the

TABLE 1.9

DIRECTION OF BARBADOS IMPORT TRADE — 1954—1970 ($ 000)

Year	Total Import	U.S.	Canada	Other $ Area	Total Sterling Area	U.K.	B.W.I.	Total OEEC	Netherland & Possessions	Rest of the World
1954	48,763	3,227	8,875	3,227	29,898	19,329	4,602	4,632	1,805	629
1955	55,245	4,176	9,074	627	34,091	22,307	5,386	5,273	2,130	920
1956	61,315	4,277	10,218	1,551	36,090	23,182	5,946	7,498	2,380	901
1957	68,298	6,151	9,812	898	40,471	26,892	6,322	8,618	2,915	1,255
1958	73,374	8,420	9,054	950	42,292	28,418	7,064	8,610	3,675	2,016
1959	74,862	8,698	8,816	1,257	44,662	29,913	7,517	8,150	3,661	1,766
1960	83,299	10,925	8,605	2,013	47,650	32,748	4,874	10,787	4,528	2,109
1961	80,263	12,788	8,301	2,738	43,154	20,152	7,488	10,219	4,022	2,097
1962	89,098	12,747	8,740	6,630	45,718	29,697	8,797	11,994	5,879	2,251
1963	98,871	13,249	11,146	10,052	48,868	30,080	9,806	11,646	4,897	2,391
1964	108,874	17,591	12,920	8,321	52,260	32,567	9,197	12,738	4,908	2,856
1965	116,265	18,401	14,166	10,265	55,154	34,446	10,318	12,129	3,709	3,030
1966	131,111	24,062	15,500	103,992	59,966	39,575	10,207	14,457	4,486	222
1967	134,053	26,220	16,807	9,818	59,525	38,317	14,008	15,855	4,290	3,988
1968	168,025	34,940	22,589	11,919	71,980	45,889	17,609	19,869	6,920	4,141
1969	194,554	43,587	21,532	6,633	87,436	56,154	—	27,539	12,236	5,649
1970	235,005	49,303	24,635	8,417	110,164	71,496	22,141	29,449	9,959	9,976

Source: Barbados External Trade Report (various issues)

TABLE 1.10

BARBADOS IMPORTS FROM THE COMMONWEALTH CARIBBEAN, 1954—1970 ($'000)

Year	Antigua	Belize	Dominica	Grenada	Guyana	Jamaica	Montserrat	St. Kitts	St. Lucia	St. Vincent	Trinidad & Tobago	Other Caribbean
1954	N.A.	9.9	371.4	11.9	2,272.3	271.1	2.2	55.3	552.6	530.9	2,388.9	N.A.
1955	.5	N.A.	429.8	19.1	2,601.0	173.9	2.5	58.1	402.0	536.6	3,426.6	N.A.
1956	28.7	N.A.	355.4	24.6	2,470.7	264.4	8.7	62.5	596.9	570.6	3,872.4	N.A.
1957	35.2	60.1	444.1	59.1	1,878.9	201.9	2.6	35.2	786.5	583.2	4,020.8	51.1
1958	7.6	20.9	382.3	16.7	1,310.1	238.7	5.9	57.7	704.0	623.3	4,884.3	34.7
1959	18.1	42.4	420.7	13.9	2,417.8	235.7	3.0	60.6	583.2	631.6	5,461.2	45.7
1960	12.9	34.9	545.8	.9	2,489.2	332.5	3.1	23.5	667.9	1,119.9	5,668.9	49.7
1961	18.6	76.3	566.9	4.5	2,665.4	309.2	4.0	11.3	258.8	1,114.1	5,104.7	69.9
1962	9.2	.4	463.9	7.4	2,815.5	240.6	7.7	16.2	483.8	742.1	6,473.6	2.9
1963	16.5	.2	408.5	11.6	2,693.1	548.3	4.6	50.5	1,044.1	653.1	6,935.5	0.5
1964	3.4	0.1	360.4	5.7	2,924.0	654.6	5.6	46.6	1,012.6	613.5	6,733.7	1.5
1965	4.6	—	460.2	4.8	2,743.6	728.3	19.1	44.1	859.1	497.1	6,460.6	43.3
1966	5.7	155.1	275.1	10.5	2,848.5	889.5	2.9	55.1	1,130.6	448.2	7,347.1	50.5
1967	28.0	199.9	256.9	18.5	3,007.4	1,057.8	1.1	28.0	915.3	403.4	7,350.4	238.0
1968	37.5	215.4	339.6	5.7	2,993.4	2,204.5	9.5	37.5	906.7	403.6	9,877.7	275.7
1969	9.0	413.8	211.3	17.5	3,493.9	2,890.3	10.9	9.0	551.6	544.6	13,297.1	66.9
1970	7.5	99.4	350.5	30.0	4,308.7	3,997.5	17.4	7.5	188.1	438.3	16,920.2	94.7

Source: Barbados External Trade Reports (various issues)

same line of goods, but maintained its position as the most important regional supplier of grain (rice) and hardwood to the Barbadian market. The relative share of Guyana's exports in the Barbadian market nevertheless fell from 4.66 per cent in 1954 to 1.83 per cent in 1970.
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A greater insight as to the benefits of CARIFTA in terms of intra-regional trade can also be gleaned from the fact that while in 1968 the value of Trinidad and Tobago exports to Barbados was $9.9 million, by 1970 the figure rose to $16.9 million. Jamaican exporters experienced the most rapid gains on the Barbadian market, with exports increasing from $1.06 million in 1968 to almost $4.0 million in 1970. After 1968, Guyana, exports to Barbados showed marginal improvement rising from $3.0 million in 1968 to only $4.3 million in 1970.

So far, the trends in Barbados imports from Caribbean sources clearly highlight the growing importance of the regional market after 1968, but the overwhelming dominance of Trinidad and Tobago among Caribbean suppliers deserves a comment. In this respect Trinidad and Tobago had four major advantages in trading with Barbados when compared with other Caribbean territories. Firstly, Trinidad and Tobago is the most industrially of the Commonwealth territories. Secondly, it is the only Caribbean territory that has exploitable quantities of petroleum which is, of course, one of Barbados' major imports. Thirdly, Trinidad and Tobago is of closer proximity to Barbados than Jamaica and Guyana, her major Caribbean competitors in the Barbadian market. Fourthly, Trinidad and Tobago has a longer history of trading with Barbados than the two previously mentioned territories. Mainly on account of the preceding reasons, Trinidad and Tobago became the major recipient of the benefits of Barbados marginal trade reorientation towards the Caribbean region.

The other Caribbean trading partners of Barbados deserve some mention. Since 1968, there has been a relative decline in Barbados imports from the Leeward and Windward Islands. Because of the similarity of production structures and the relative expensiveness of goods and services from these islands as compared to external and other Caribbean sources, the stagnation of Barbados imports from the smaller territories was, undoubtedly, due not so much to the introduction of an economic bloc and its associated teething problems, as to the lack of changes in the comparative advantage and comparative cost structure in the regional market for food. The static nature of Barbados imports from the smaller CARIFTA territories, especially during the latter part of the 1960s, can, in the main, be attributed to the following factors:- (a) the availability of credit from traditional exporters; (b) to a certain extent, the availability of exports from metropolitan economies and (c) the intial disadvantages of conducting trade (as an integrated part of a regional market) between Caribbean territories.

CHAPTER TWO

BARBADOS IMPORT DEMAND EQUATIONS: SPECIFICATION AND ESTIMATION PROBLEMS

Having discussed the trends and direction of Barbados import trade over the period 1954—1970, we are now in a position to formulate a general hypothesis of the demand for imports in Barbados. Before undertaking such an exercise, it must be recognised, however, that in the empirical analysis of import demand for any country the selection of an appropriate hypothesis is one of the major problems with which the researcher is faced. Nonetheless, most of the problems that do exist in so far as our formulation of the hypothesis is concerned can be solved by making recourse to economic theory.

The basic hypothesis underlying our analysis is that variations in import demand can be explained by variations in output (or income) and the relative price of imports and import substitutes.

Theoretically, the demand for an imported commodity should reflect the difference between the home supply of and home demand for the given commodity. But such a relationship owes its validity to the assumption that both home produced and imported commodities are identical. Evidently, this is not the case for Barbados where many of the commodities imported are not produced at home and where home produced and imported goods are generally not identical. In such a context, we may not be departing too far from reality by making the assumption that the import demand for many commodities coincides with the home demand. By adopting this assumption the, problem of estimating an import demand function for Barbados can simply be reduced to a problem of estimating the Barbados home demand equation for the selected commodities.

The theoretical justification for estimating import demand functions for commodities that are objects of final consumption can then be obtained by resorting to the neo-classical theory of consumer behaviour which indicates that a consumer allocates his income among different commodities in such a manner as to maximise his satisfaction. Consumer demand theory indicates that the consumer's demand for a given commodity is a function of his income as well as the prices of the other commodities he consumes. In addition, the view is also held that the demand function should satisfy the properties of homegeneity, negativity and symmetry.

It is important to note, that while the theory of consumer demand provides the microeconomic foundation of individual demand functions, resort must be made to empirical data in order to estimate such functions. But, problems exist with the use of empirical data, for in practice the data that is available relate to the aggregation of consumers rather than individual consumers. In order to surmount the aggregation problem, the assumption is generally made that the aggregated demand function is a summation of individual demand functions. However, it has been shown by Theil (19) that the adoption of such an assumption is empirical demand studies is fraught with difficulties for it suggests that all consumers face the same institutional arrangements and have identical tastes. In other words, in empirical demand analysis, the adoption of such an assumption is likely to lead to the problem of aggregation bias. Nonetheless, such an assumption was adopted in the study because of the impracticability of estimating import demand functions for individual consumers.

Turning to the estimation of import demand functions for producers goods, the theoretical justification for such functions in this study is provided by the neo-classical theory of the firm according to which the entrepreneur attempts to produce a given output at that point where his marginal revenue is equal to his marginal cost so that his profits are at a maximum.

Our demand function for imports follows a standard approach involving the estimation of the equation:

$$M_{it} = F^{it}(Y_t, P_{it}, \ldots, Z_{it}, U_{it}) \tag{1}$$

where M_{it} is the import demand for the 'i'th commodity in year 't' F^i is the function whose mathematical form is to be specified; Y_t is a measure of real gross national income or some other activity variable; P_{it} is the relative price of the 'i'th commodity; Z_{it} indicates other explanatory variables and U_{it} is a disturbance term indicating the effects of other variables that were not explicitly introduced into the equation (that is, errors of measurement in M_{it} as well as errors in the functional specification).

It must be noted that while economic theory indicates that the

TABLE 2.1

BARBADOS IMPORTS BY SECTION OF THE S.I.T.C., 1954—1970

Period	Food	Beverages &	Crude Materials in Edible Except Fuels	Mineral Fuels Lubricants & Related Materials	Animal & Vegetable Oils & Material	Chemicals	Manufactured Goods Classified Chiefly by Articles	Machinery & Transport Equipment	Miscellaneous Manufactured	Miscellaneous Transactions	Total
1954	15,304.8	1,257.0	3,386.8	2,435.4	1,097.7	3,901.6	10,030.1	5,635.7	3,391.4	2,322.7	48,783.4
1955	16,831.0	1,404.2	3,669.9	2,786.9	622.3	4,334.9	12,975.9	6,496.4	3,847.4	2,277.6	55,244.6
1956	17,859.3	1,621.6	4,744.2	3,074.8	846.9	5,029.8	12,948.6	7,857.0	4,808.1	2,524.5	61,314.8
1957	19,161.1	2,152.7	4,038.1	3,134.8	831.3	6,019.7	14,651.2	10,229.9	5,334.4	2,764.6	68,297.8
1958	20,952.5	2,154.8	3,693.9	3,634.3	546.5	5,521.0	15,958.4	12,370.0	5,906.5	2,533.9	73,373.9
1959	21,224.3	2,220.8	3,706.5	4,078.4	542.9	5,993.6	16,289.4	11,494.9	6,783.9	2,427.2	74,862.0
1960	21,907.6	2,194.4	4,384.8	4,253.2	483.6	5,963.7	18,410.6	15,215.9	7,794.4	2,591.2	82,299.4
1961	23,218.3	1,894.4	3,967.3	4,350.2	396.2	5,441.0	17,417.1	12,176.0	7,653.5	2,748.5	80,262.5
1962	24,067.8	1,982.3	3,578.5	11,178.6	246.2	7,064.2	16,872.5	12,786.2	8,420.6	2,900.6	89,097.5
1963	26,907.5	2,025.9	4,250.7	13,713.2	550.7	6,966.6	18,656.2	13,619.9	8,918.4	3,262.3	98,871.4
1964	29,031.0	2,128.5	3,545.6	11,270.8	568.3	8,576.1	20,948.1	18,069.1	10,975.9	3,760.5	108,973.9
1965	31,869.6	2,120.9	3,876.7	11,796.5	607.8	8,330.5	23,206.5	18,929.7	11,347.2	3,979.8	116,265.2
1966	34,088.2	2,384.3	4,406.7	13,149.1	763.6	9,779.3	27,202.4	22,252.8	13,085.7	3,999.1	131,111.2
1967	32,533.8	2,345.6	4,980.1	11,609.2	1,114.7	10,945.5	27,199.1	25,674.7	13,805.5	3,945.0	134,053.2
1968	38,578.4	3,327.3	5,946.9	16,622.2	1,601.3	12,262.7	31,525.1	35,089.4	17,468.6	5,603.1	168,024.9
1969	42,426.9	3,822.4	6,278.5	14,796.5	2,155.7	14,358.0	40,080.2	40,771.3	23,765.6	6,097.4	194,553.6
1970	49,196.4	5,223.7	6,899.0	12,990.7	3,102.4	16,984.4	49,017.0	55,971.7	28,400.5	7,219.1	235,004.9

Source: Barbados External Trade Report (various issues).

demand for an imported commodity is a function of all prices and income as well as being homogeneous of degree zero, and gives the restrictions that must be imposed on the sign and size of the parameters, it unfortunately says very little on the form of the demand function. In other words, the mathematical form of the demand function cannot be specified in an a priori manner so that the choice of an appropriate functional form must largely be based on practical consideration as well as intuition. In so far as intuitive considerations are concerned, our choice of Barbados import demand functions in this study was determined by the a priori validity of the functional forms as well as by their goodness of fit and simplicity.

The shortness of our time series imposed significant restriction on the number of explanatory variables that could have been introduced in the various import demand equations. In view of the preceding constraints, our analysis of Barbados imports was confined to relative price and real income variables, moreover, we also found it advisable to experiment with at least two different specifications, these being, the linear and log-linear functional forms.

If the assumption is made that the given commodity is not produced at home, i.e. it is solely imported, then the linear and log-linear forms of the import demand equations can be specified as:-

$$Mit + a_1 + a_2 Yt + a_3 \frac{PM}{Ph} \qquad (2)$$

and

$$\log Mit = \log a_1 + a_2 \log Yt + a_3 \log \frac{PM}{Ph} \qquad (3)$$

where

Mit = the quantity of the *ith* commodity imported in year *t*.

Yt = a measure of real gross national income or some other activity variable in year *t*.

PM = the price index of the imported commodity.

P_h = some general price index of Barbados and the *a*'s are the parameters to be estimated.

It was shown by Koyck [II] that the income or activity variable utilised in the estimation of an import demand function must be closely related to the commodity or class of commodities being analysed. Thus, it is felt that imported commodities which are the object of final consumption should have as their activity variable, real disposable income, while raw material imports should have as their activity variable the output of the specific industry within which the raw material was utilised. In addition, the view is also held that, if import taxes and tariffs flucutate from time to time, appropriate adjustments should be made in import prices.

Unfortunately, these refinements could not be incorporated in this study of Barbados import demand, mainly because of the paucity of the relevant data. Hence, the activity variable utilised for all categories of imports was Real Gross Domestic Product, while the price variable was the all-item consumer price index. In so far as the signs of the parameters are concerned, economic theory indicates that the sign of the income or activity variable should be positive. Alternatively, the sign of the relative price term should be negative.

Turning to the price and income elasticities of imports demand, economic theory indicates that for the linear function these will vary depending on the levels of the relevant variables. However, in the case of the demand function that is linear in the logs, the elasticities obtained will be constant. In other words, in the latter case the elasticities will be the estimated coefficients.

Alternative specifications for import demand functions that have close substitutes at home can also be represented by:

$$M_{it} = a_1 + a_2 Y_t + a_3 \frac{P_m}{P_h} + a_4 \frac{P_s}{P_n} \qquad (4)$$

and

$$\text{Log } M_{it} = \log a_1 + a_2 \log Y_t + a_3 \log \frac{P_m}{P_h} + a_4 \log \frac{P_s}{P_h} \qquad (5)$$

where the variables M_{it}, P_m and P_h have the same meaning as before and P_s represents the price of home substitutes.

In the above specifications the cross-elasticity of import demand is expected to be positive. In other words, the above specifications indicate that any increase in the relative price of the home produced commodity will lead to a switching of consumption from the relatively expensive home produced goods to the less expensive imported commodity. It must be realised however, that the degree of switching will in the main be determined by the extent of the price change as well as the magnitude of the cross-elasticity of demand.

It must also be recognised that the specifications given in Equations (2a and 2b) above are not unique as the same relationship between home produced and imported commodities can be represented as follows:

$$M_{it} = a_1 + a_2 Y_t + a_3 \frac{P_m}{P_h} \qquad (6)$$

and

$$M_{it} = \log a_1 + a_2 \log Y_t + a_3 \log \frac{Pm}{P_h} \qquad (7)$$

Finally, if the assumption is made that the imported and home produced commodities are **identical**, the import demand for that commodity reflects the difference between total consumption and home supply of the given commodity. While it is unlikely for such a situation to exist in the case of Barbados, if any commodity satisfies such a requirement, the import demand equation can be written as:

$$M_{it} = a_1 + a_2 Y_t + a_3 \frac{P_m}{P_h} - S \qquad (8)$$

In the above equation, the domestic supply (S) is then assumed to be determined by exogenous variables.

The difference between close substitutes and identical commodities is that in the first case the influence on home supply is exerted by imports through its effect on the price of the home substitute, while conversely, increases in the home supply may directly affect the quantum of imports. However, in the case of identical products no divergence of prices could occur.

Assuming that the demand functions have been correctly specified, it is expected that the coefficient of supply should be unity. Hence, the linear and linear-logarithmic forms of the import demand equation for identical commodities can then be written as:

$$M + S = d_1 + d_2 Y_t + d_3 \frac{P_m}{P_h} \qquad (9)$$

and

$$\log (M + S) = \log d_1 + d_2 \log Y_t \; d_3 \log \frac{P_m}{P_h} \qquad (10)$$

In the empirical estimation of import demand equation, it is necessary to include variables other than the activity and price variables, for example, a time trend and/or variables representing special influences on imports. However, while it was rcognised that a time trend may have been important in explaining the variation in Barbados imports, such a variable was excluded from the study mainly because we felt that one of the major explanatory variables (deflated G.D.P.) had, itself, a pronounced upward trend over the period of analysis.

In so far as special influences on imports were concerned, we felt that, because of the small size and relative openess of the Barbadian economy, it had a high sensitivity to political and economic shocks, both externally propagated and internally generated. Hence, in order to gauge the extent of the sensitivity of the domestic economy, we introduced a dummy variable 'D' defined to have a value of unity for 1968 and subsequent years (the period over which we felt the devaluation of the pound sterling would have influenced imports) and zero for the preceding years. We also felt that the effects of rapid population growth in post war years would have been of considerable interest. In order to show the effects of population growth on import demand, the models were adjusted in such a way that real per capita retained imports $Ml = (M/Ph)/(Pop)$ and became the dependent variable, and real per capita income $(Yl = (Y/Ph)/(Pop)$ an explanatory variable. It must be noted that, while we could have incorporated population as an explicit variable in the import demand equation, the above procedure was preferred, mainly on the ground that population and real income were so highly correlated that a problem would have been created in distinguishing their separate effects.

So far our discussion has been confined to the static import demand relationship wherein the consumers adjust themselves to changed conditions within some given time period. It must be recognised however, that for many commodities the adjustment may extend over several time periods, in which case the import demand function will represent a dynamic relationship. Dynamic demand analysis is based on the premise that current decisions are influenced by past behaviour, but as Griliches [5] indicated there are several ways in which such a relationship can be formulated.

One procedure rests on the assumption that the demand for a given commodity is a linear function of relative prices and income. In such a case a distributed lag can be specified as follows:

$$M_t = \sum_{i=o}^{\infty} \alpha_i P_{t-i} + \sum_{i=o}^{\infty} \delta_i (Y/P_h)_{t-i} \tag{11}$$

$$M_t = \alpha_o + \sum_{i=o}^{n} \alpha_i (P_m/P_h)_{t-1} + \sum_{i=o}^{n} \delta_i (Y/P_h)_{t-1} \tag{12}$$

Equation (12) states that a change in imports of $ai \triangle (Y/Ph)$ *in* period $(t+l)$ is determined by a change in income at time 't' as well as by a change in relative prices over the same period. Furthermore, if the assumption is made that such a change in income is maintained, then the total or long-run effect will be given by:

$$\sum_{i=o}^{n} \delta_i [\triangle (Y/P_h)] \tag{13}$$

One of the major shortcomings of the preceding formulation, however, is that it could exhaust all available degrees of freedom. In such a case, even if the lagged variables are confined to a small set, the usual test statistics may no longer be valid, hence the precision of the estimated coefficient may be suspect. To some extent, the preceding problems may be minimised by imposing a priori restrictions on the forms of the parameters, α_i and δ_i. In this context, Koyck [II] suggested that efficient estimates can be obtained by assuming that (i) the parameters decline geometrically and (ii) the distributed lag model is of the form

$$M_t = \sum_{i=o}^{\infty} \alpha \delta^i (P_m/P_h)_{t-i} \qquad o \leqslant \delta < 1 \tag{14}$$

In such a case, the distributed lag model can be transformed into the equivalent specification

$$M_{it} = \alpha(P_m/P_h) + \delta M_{it-1} \tag{15}$$

where α and $\alpha/(1 - \delta)$ represents the shortrun and longrun reactions respectively. From the reaction coefficients we can then obtain the speed of adjustment as $(1 - \alpha) = \delta$

It is known that in equilibrium $Mt = Mt = Mt—1$, hence from equation (15) we have

$$\delta M_t = \alpha [P_m/P_h] \tag{16}$$

and by a process of substitution of equation (16) into (15) and by further rearranging the equation we obtain the additional result

$$\triangle M_t = \delta [\overline{M} - M_{t-1}] \tag{17}$$

Thus, equation (17) states that the lower the value of δ the slower will be the adjustment of current quantity demanded to the equilibrium quantity demanded and the converse also holds.

An alternative approach is the "stock adjustment approach" suggested by Nerlove [14]. In this approach the long run 'desired demand' for imports can be specified as

$$M_t^* = \beta_o + \beta_1 (Y/P_h)_t + \beta_2 \left(\frac{P_m}{P_h}{}_t\right) + e_t \tag{18}$$

In the above formulation the assumption is made that current demand adjusts by a constant fraction (δ) to deviations of current from longrun (or equilibrium) demand and this relationship can be depicted as follows:

$$M_t - M_{t-1} = \delta(M_t^* - M_{t-1}) \qquad o \leqslant \delta < 1 \tag{19}$$

By substituting equation (18) into equation (19) we then obtain

$$Mt = \delta\beta o + \delta\beta_2(Y/Ph)_t + \delta\beta_4\left(\frac{P_m}{Ph}\right)_t + (1-\delta)M_{t-1} + \delta e_t \qquad (20)$$

Like the Koyck formulation the coefficient 'δ' in the 'stock adjustment model' is generally interpreted as the speed of asjustment. Hence, the closer it is to unity the faster is the speed of adjustment. Finally, the estimates of the coefficients βo, $\beta 1$, and $\beta 2$ can be obtained by dividing the estimated parameters by one minus the estimated coefficient of Mt — 1.

Equations (6). (7) were the basic forms utilised in this study. There were four statistical problems associated with the estimation of these equations. These are listed and discussed here as follows:- (a) The properties and relevance of the point estimation of the parameters in the static model; (b) errors of measurement in the variables; (c) auto-correlation among the residuals; and (d) finally, the problem of multicollinearity.

The properties and relevance of ordinary least squares

It is well known that, provided the basic assumptions of our linear model are satisfied, the ordinary least squares procedure provides the best linear unbiased estimates of the parameters. In addition, provided that the disturbance term is normally distributed, then the transformation of our linear import demand equation into its log-liner form does not introduce any violation of the error structure assumptions needed for ordinary least squares. In such a case we will also be provided with best linear unbiased estimates of the parameters α and β denoted by 'a' and 'b'. This is not to say that the application of ordinary least squares to import demand equations has not been criticised on several grounds. The low price elasticities that were obtained in the early post-war studies of import demand led Orcutt [16] to criticise the use of the ordinary least squares procedure on five grounds: First, in import demand equations there is a high tendency for the relative price variable to be correlated with the error term, thus leading to least squares bias. Secondly, more often than not errors in observations are likely to exist in the explanatory variables. Thirdly, the aggregated data utilised in such studies invariably give undue weights to goods with relatively low elasticities. Fourthly, in his own empirical work on import demand, Orcutt found that short run elasticities were generally lower than the long run elasticities and, finally, that the price elasticities of import demand were probably much larger for large price changes than for small price changes.

While there is persuasive theoretical and empirical evidence for admitting the possibility of Orcutt's second and third arguments, Paraskevopoulous [17] felt that all of "these sources of bias, except simultaneity were generally methodical difficulties related to econometric method problem". Hence he failed to see why such problems were emphasised in connection with ordinary lest squares in general and its application to the estimation of international price elasticities in particular.

The simultaneous equation bias argument was refuted by Klein and others [9] who felt that Orcutt's argument as to the difficulty of disentangling the demand influence of the price and quantity variables in import demand analysis from their influence on supply has so˙ e merit for large economies but this was not the case in "international trading relationship putting a small country's demand or supply against an overwhelming world's market". In the latter situation they showed on logical grounds that import prices for a small economy will be given by the world supply and demand conditions, so that least squares bias can be expected to be insignificant or even zero. In such cases, it would be proper to utilise ordinary least squares to estimate the import demand functions.

As Paraskevopolous has shown, it is possible to apply a logical extension of Klein's argument to a small economy which has a negligible influence on world trade. Therefore, relying quite heavily on the work of Paraskevopolous [17], we shall now attempt to show the relevance of Klein's argument in the Barbadian context. First of all, by restoring to the use of equation (6), we can specify Barbados import functions as:

$$M_t = a_1 + a_2 Y_t + a_3 \frac{P_m}{P_h} + u \qquad (21)$$

Where M_t = quantity of Barbados imports (in real terms)

Y_t = real G.D.P. in Barbados

P_m = price of imported commodities

P_h = general level of prices in Barbados

u = the error term, and

a's the parameters to be estimated

Next we assume that ordinary least squares can be applied directly to the above equation, in which case unbiased estimates of the parameters (a's) can be obtained if we regard the disturbance term 'U' to be independently distributed of the explanatory variables Y_t and *Pm/Ph.* We further assume that Barbados import price (*Pm*) is determined by foreign demand for the particular Commodities (*D w*), the existing price level on the world's market (*Pw*) and the quantity of Barbados imports (*M*). Under these conditions, we can show Barbados import price relationship as:

$$P_m = \beta_1 + \beta_2 D_w + \beta_3 P_w + \beta_4 M + u \quad (22)$$

where u is the error term with zero mean and constant variance.

Now let us assume that the rest of the world's (R.O.W.) demand (Dw) is a function of its income (Yw), the price of the imported commodity (Pm), and the existing price level (Pw). In such a case, the foreign demand function can be written as:

$$D_w = a_1 + a_2 Y_w + a_3 P_m + a_4 P_w + e \quad (23)$$

where 'e represents the error term having zero mean and constant variance. Let equations (22) and (23) be reformulated in deviation terms. Then:

$$P_m = \beta_2 \; d_w + \beta_3 P_w + \beta_4 M + u \quad (24)$$

and

$$d_w = a_2 Y_w + a_3 P_m + a_4 P_w + e \quad (25)$$

Therefore, substituting for dw from (25) into (24) we obtain $pm = B2 \, yw$

$$P_m \equiv \beta_2 a_2 Y_w + \beta_3 a_3 P_m + (\beta_2 a_4 + \beta_3) P_w$$

$$+ \beta_4 m + \beta_2 e + u \quad (26)$$

By multiplying by v and taking expectations, we get:

$$E(P_m v) = \beta_2 a_2 E(y_w v) + \beta_2 a_3 E(p_m v)$$

$$+ (\beta_2 a_4 + \beta_3) E(p_w v) + \beta_4 E(mv) + \beta_2 E(ev) + E(vu) \quad (27)$$

Let us now consider the effects of changes in prices and income in the Barbadian import demand model. From the previous discussions, it is clear that Barbados does not possess monopolistic power in world trade in so far as both its imports and exports are concerned. Therefore, variations in the quantum of its imports (M) will have no effect on the prices of imports (Pm), and both the R.O.W. income and price levels can be considered as being exogenous to Barbados import demand model. Therefore we get:

$$\beta_2 a_2 E(y_w v) = o$$

and

$$(\beta_2 a_4 + \beta_3) E(p_w v) = o \quad (28)$$

Substituting the preceding results into equation (27) we now have the following relation:

$$E(p_m v) = \beta_2 a_3 \; E(p_m v) + \beta_4 E(mv) + \beta_2 E(ev) + E(vu) \qquad (29)$$

or

$$E\,(pmu) = \frac{\beta_2 \, E\,(e\,u) + E\,(vu)}{1 - \beta_2 \, a_2} \qquad (30)$$

Since by 1970 Barbados had attained a level of development significantly different from that of her major trading partners, it is not unrealistic to also assume that shifts in her import demand and R.O.W. demand wil be dissimilar both in magnitude and in timing. Accordingly, we have

$$\beta_2 E(ev) = o \qquad (31a)$$

Let us now assume that the exporting industry is sited in the R.O.W. and that it exhibits constant returns to scale. In such a case we obtain

$$E\,(vu) = 0 \qquad (31b)$$

And if the assumption is made that shifts in R.O.W. supply and Barbados import demand are statistically independent, we derive the additional result:

$$E\,(p_m v) = o \qquad (32)$$

From the above results it also follows that the supply function for Barbados imports will be infinitely elastic. In other words, because Barbados is a price taker in international trading relations, her imports are predetermined.

Following this trend of discussion it also can be shown that the general level of prices in Barbados is largely predetermined, mainly as a consequence of the fact that price levels tend to be determined by the macroaggregates: total output, wage levels, aggregate money income and the general economic policy of the Barbadian Government. This being the case, it will do no harm to reality if the assumption is made that relative prices (*Pm/Ph*) included in the import demand function are exogenous . Analogously, as most of the commodities imported into Barbados do not affect income directly, the income variable can also be considered as being exofenous in the import demand equation. It must be noted however, that in the case of raw materials, our assumption may not be entirely true. Nevertheless, in as much as very little is known about the effect of the imports of such raw materials on Barbados production function, we make the assumption that if biases do exist they will be minimal in the Barbadian situation.

In conclusion, it would seem that for a small country such as Barbados, whose imports form a relatively small proportion of total world exports, the argument of Orcutt about least squares bias may not only be invalid but also misleading. It is only in the case of large countries whose import demand can affect the price of the commodities being imported that such a criticism seems valid. But, even in such cases, recourse can be made to simultaneous equations procedures in order to disentangle the price effect on both supply and demand.

In this study, there exists the possibility that the variables utilised in the import demand equations may not have been measured exactly. For example, we can postulate that each of the observed variables (o) is equal to the sum of the true values (T) and some other error term, in which case they can be specified as follows:

$$M^{o} = M^{T} + U \qquad (33)$$

$$Y^{o} = Y^{T} + V \qquad (34)$$

$$(Pm/Ph)^{o} = (Pm/Ph)^{T} + 2 \qquad (35)$$

Now if we had utilised the original model, that is,

$$M^{o} = a_{o} + a_{1} Y^{T} + a_{2} (Pm/Ph)^{T} + u \qquad (36)$$

Then it can be respecified as

$$M^{o} = a_{o} + a_{1} (Y^{o} - V) + a_{2} [(Pm/Ph) - Z] + e \qquad (37)$$

where

$$e = [u - a_{1} V - a_{2} Z] \qquad (38)$$

If the above conditions holds, then the least squares estimators of the parameters β and α will no longer be consistent as is generally assumed [Kmenta, 10] 1971 p. 316). This problem can be obliviated to a large extent by utilising in the import demand equation some prior knowledge that is available about the import demand elasticities, say, for example, information about the export supply elasticities from Barbados' main trading partners. In such a case, consistent estimates on β and α can then be found. In the absence of such information (which is certainly the case for Barbados), we made the heroic assumption that all variables, particularly the independent variables, were measured without errors. While such an assumption has the added advantage of allowing us to concentrate on 'errors in the equation', it must be borne in mind that 'errors in variables' still remains one of the unsolved problems in econometric research.

One of the assumptions of our statistical import demand model was that the error terms of successive observations were not correlated with each other, that is,

$$E(U_i U_j) = \begin{cases} o \text{ for } i \neq j & i, j = 1, \ldots, n \\ \sigma_u^2 \text{ for } i = j & i = j \quad i, j = 1, \ldots, n \end{cases} \tag{39}$$

Im many cases, however, the preceding assumption may be invalidated because the successive errors may be interdependent. In such a case we say that the errors are auto-correlated. Auto-correlation in the error term may arise from (a) misspecification of the relationship between the ordinary least squares. Hence, if the true relationship between the variables is nonlinear and we instead use a linear function, auto-correlation is likely to arise among the error terms if the true functions are serially independent; and (b) the ommission of important variables whcih are themselves serially correlated.

While the application of least squares to an import demand equation in which the disturbances are auto-correlated gives unbiased estimates of the parameters, the variances associated with each parameter will be under-estimated if we use the conventional formula *u 2 (M / M) —/ to* estimate these variances and in any case these will not be minimal.

In this study, Durbin-Watson [3] 'd' statistic defined as

$$dw = \frac{\sum_{t=2}^{n} \left(U_t - U_{t-1}\right)^2}{\sum_{t=1}^{n} V_t^2} \qquad 2(1-\rho) \tag{40}$$

has been utilised to detect the presence of auto-correlation, where U_t is the value of the t^{th} residual and ρ the coefficient of serial correlation. While the use of the *'d'* statistic tends to be valid in the case of the static model it must be noted that in the case of the dynamic model, the value of this statistic tends to be biased towards two (see Wallis and Nerlove [15]).

In order to alleviate the problem of auto-correlation several methods have been suggested, for example, Kmenta [10] indicated that a first order auto-correlation structure of the form

$$e_t = p\, e_{t-l} + v_t \qquad (41)$$

and $$E\, v_t\, v_t = 0 \quad t_t \neq t'$$

$$/p/ < 1$$

be assumed and estimates of (p) be used to transform the original data. To this transformed data, ordinary least squares can then be applied in order to obtain efficient estimates of the parameters. Additional procedures that have been suggested for the solution of the auto-correlation problems are the Dhrymes [2] search procedure and the Cochrane-Orcutt [1] iterative procedures.

In this study of Barbados import demand empitical estimates were not undertaken, utilising the above procedures simply because we did not have access to the appropriate computer soft-ware.

In the estimation of import demand functions, the assumption of linear independence of the explanatory variables may not be valid in many cases so that we are generally faced with the problem of multicollinearity. The existence of multicollinearity among the explanatory variables make it difficult if not impossible to obtain an estimate of the separate influence of each independent variable on the dependent variable. In the extreme case in which there is an exact linear relationship between the two explanatory variables in our import demand equation (for example, $Y = s + gPm/Pb$), we will be unable to form (M^1M^1) because the matrix (M^1M) will be zero. In such a case, the least squares procedure breaks down. A warning sign for the presence of multicollinearity is the largeness of the standard errors of our estimated parameters.

While a partial solution to the multicollinearity problem can be obtained by the addition of other information about the variables, the unavailability of relevant information precluded the use of such a pro- cedure in this study.

In the preceding sections, we attempted to (a) obtain concrete mathematical forms of the import demand equations, and (b) outline the main statistical procedures and problems inherent in the estimation of the parameters of the various forms of the import demand equations.

In this final section, certain criteria will be established on the basis of which the empirical results will be evaluated. in general, there are two major objectives of empirical analysis of import demand, the first being to provide a good picture of import demand relationships over the period covered by the sample data and the second, to make accurate forecasts beyond the sample period. The extent to which the first objective will be attained will be determined by criteria such as the coefficient of determination, the standard errors, the Durbin-Watson statistic, a priori expectations as to the signs of the coefficient, and the best mathematical forms of the import demand equations.

(i) The Coefficient of Determination, R^2

It has become customary in econometric analysis to measure the goodness of fit of a particular equation by the magnitude of R2. In other words, in the import demand equations the size of the coefficient of determination (R2) indicates the degree to which the explanatory variables (real GDP and relative prices) explain variations in the dependent variable (retained imports).

It must be clearlyunderstood, however, that this statistic does not indicate any casual relationship between explanatory and dependence variables. In this respect, if R^2 is insignificant, then this is a fairly reliable indicator that the particular import model being tested violated the theoretical foundations upon which it was based. Similarly, if R^2 is significant but the coefficients do not possess the correct signs, this is also an indicator that the theoretical bases of the model have been violated.

(ii) The Standard Errors

The estimated standard errors of the coefficients are shown in parentheses beneath their respective coeficients. in this study the simple rule of thumb adopted was that an estimated parameter which is at least greater in magnitude, then its standard error refutes the hypothesis that the true value of the estimated parameter is zero. (See Houthakker and Taylor [6]).

(iii) The Durbin Watson 'd' Statistic

This statistic provides us with a method of detecting the presence of auto-correlation in the residuals. As we indicated earlier, the presence of auto-correlation is often indicative of our not having taken explicitly into consideration certain important variables which may have influenced import demand. Nevertheless should the 'd' statistic be indicative of auto-correlation appropriate measures have to be taken in order to reduce if not eliminate it.

(iv) A priori Expectations as to the sign and size of the estimated coefficients

While the above criteria are indispensable for evaluating Barbados import demand equations, resort still has to be made to certain theoretical and practical considerations in assessing the efficiency of these functions.

In this respect, while we have shown earlier that economic theory imposes certain restrictions on the import demand equations, it unfortunately says nothing about the size of the estimated parameter. Because of this apparent shortcoming of economic theory, resort has to be made to practical considerations when adjudging the most appropriate size of the estimated coefficients (parameters). The term practical considerations as used here simply means relying on common sense and/or values obtained in similar empirical studies of the import demand functions of developing economies.

(v) The Best Mathematical Form of the Demand Functions

So far we have discussed various functional forms of the import demand function. For example, we have examined static linear functions, the logarithmic transformation of non-linear import demand equation and dynamic functions with lagged dependent variables as explanatory variables. But, as was also indicated earlier, this wide choice of import demand functions was largely determined by pragmatic reasons due to the lack of any a priori information about the exact mathematical form of such functions. At this juncture, it must be noted that such ambiguity is not confined solely to import demand functions. Economic theory is also ambiguous about the variables entering an individual's consumption function. In view of the preceding shortcomings (in so far as the functional forms utilised were concerned) we had no alternative but to formulate several variants of the import demand equation, each differing in terms of mathematical forms as well as the set of variables included. Once the alternative forms were estimated, we utilised criteria (i) — (iv) above in determining either to accept a functional form as being the best, or to reject all the functional forms tried so far and formulate new ones.

Turning now to the second objectives of import demand analysis, that is forecasting, it was recognised that this is the most rigorous criterion for evaluating the empirical results. Nevertheless, no attempt was made in this study to test the predictive ability of the import demand equations.

Finally, as we indicated in our introduction, the elasticity coefficients for the various linear models wer obtained by using the mean values of both dependent and independent variables.

CHAPTER THREE

STATIC EMPIRICAL IMPORT DEMAND RELATIONSHIPS

Having dealt with a description of the trends in Barbados imports in chapter one, as well as the theoretical models utilised and problems of estimation in chapter two, we shall now present our analysis of the empirical results as obtained from the application of ordinary least squares to eight S.I.T.C. sections as well as to the various functional groupings that are reported in the appendix.

In order to facilitate our exposition of the results and to distinguish the equations pertaining to the functional forms chosen, we have adopted the following procedure. First, the equations pertaining to the models based on aggregated data are numbered as follows: 1a, 1b, 2a, 2b etc.,/ where the numbers 1, 2 etc./ indicate that the particular equation must be interpreted as an import demand equation based on aggregated data. In addition, it must be noted that the letters 'a' and 'b' above denote the alternative functional forms. In this context, 'a' represents the linear form of the particular import demand equation and 'b' the logarithmic form.

Secondly, the equations based on per capita data are numbered as follows:

1.1a, 1.1b etc.,

where the numbers 1.1, 2.2 etc. indicate that per capita data was used in a particular equation and 'a' and 'b' have the same meaning as above. Finally, in our discussion of the results obtained we shall indicate what we consider as being the best fitting equation by an asterisk. Let us now turn to the results that were obtained.

THE RESULTS

Import Demand Equations for Food, S.I.T.C. 1954—1970

Despite the fact that Barbados is primarily an agricultural economy, imports of food represented over 25 per cent of total imports over our period of analysis, that is 1954 — 1970. We emphasise, however, that the bulk of food imports consisted of dairy products, cereals, meat and fish, which in fact represented over 80 per cent of food imports. Inasmuch as most of the commodities enumerated above went towards consumption by households, we should ideally, have used disposable income as the activity variable. However, because of the paucity of data on this variable we found it virtually impossible to obtain the appropriate series; hence real Gross Domestic Product was chosen as a proxy.

The problem of finding an appropriate series was not confined to the income variable but also related to the domestic price index. Specifically, as some of the food items consumed locally had been produced by Barbados farmers, allowance ought to have been made in the relative price variable for such locally produced food. In other words, import prices ought to have been made in the relative price variable for such locally produced food. In other words, import prices ought to have been deflated by a corresponding price index of domestic substitutes. However, the non-availability of the relevant data on the prices of domestically produced food forced us to resort to the use of the **All item Consumer Price Index** as a proxy for the price level of domestically produced food. Finally, an attempt was made to introduce the effects of the devaluation of the pound sterling in 1967 into the import demand equation as well as the effects of population changes by a dummy variable and per capita data respectively.

The results obtained from applying both the linear and log-linear functional forms to the aggregated and per capita data show that all the estimated parameters had the correct signs, and with a few exceptions were statistically insignificant. In this context, the exceptions were the price parameters in equations ($1.1a^1$) and $1.1b^1$). With regard to the explanatory power of the estimated equations, it can be observed that this varies from .309 to .972 depending upon the combination of explanatory variables and type of data. Invariably, however, the explanatory power of the estimated equations were greatest when the dummy variable (D) was included in a equation.

The estimated equations were as follows:-

$$1a \quad (M_f)^* = 21918.387 - \underset{(129.515)}{138.145} \left(\frac{P^m_f}{Ph}\right) + \underset{(.0717)}{0.132} \left(\frac{Y}{Ph}\right) + \underset{(2149.218)}{3029.058} (D)$$

$$R^2 = 0.966 \quad S.E. = 1832.488 \quad D.W. = 1.536$$

1a[1] $(M_f) = 1916.944 - 11.776 \dfrac{(P_f^m)}{(P_h)} + .011 \dfrac{(Y)}{(P_h)}$

(2.054) (.003)

$R^2 = 0.753$ S.E. = 427.298 D.W. = 1.596

1b $\text{Log}\,(M_f)^* = 7.663 - 1.195\,\text{Log}\,\dfrac{(P_f^m)}{(P_h)} + .678\,\log\,\dfrac{(Y)}{(P_h)}$

(.513) (.081)

$+ .5173\ (D)$

(.141)

$R^2 = .960$ S.E. = .070 D.W. = 1.774

1[1] b[1] $\log\,(M_f) = 4.071 - 723\,\log\,\dfrac{(P_f^m)}{(P_h)} + .590\,\log\,\dfrac{(Y)}{(P_h)}$

(.425) (.150)

$R^2 = .773$ S.E. = .162 D.W. = 1.749

1.1a[1] $(M_f)^* = 12.165 + .213\,\dfrac{(P_f^m)}{(P_h)} + .131\,\dfrac{(Y)}{P} + 17.658\ (D)$

(.129) (.015) (5.584)

$R^2 = .972$ S.E. = 6.071 D.W. = 1.933

1.1a[1] $\dfrac{(M_f)}{N} = 7.313 - .039\,\dfrac{(P_f^m)}{(P_h)} + .010\,\dfrac{Y^0}{(P_h)}$

(.062) (.005)

$R^2 = .521$ S.E. = 2.664 D.W. = 2.338

1.1b[1] $\log\,\dfrac{(M_f)^*}{N} = -\ .291\ .186\,\log\,\dfrac{(P_f^m)}{(P_h)} +.649\,\log\,\dfrac{Y^0}{(P_h)}$

(.148) (.074)

$+ .143\ D$

(.051)

$R^2 = .966$ S.E. = .058 D.W. = 1.932

1.1b[1] $\log\,\underline{(M_f)} = 1.525 - .438\,\log\,\dfrac{(P_f^m)}{(P_h)} +.419\,\log\,\dfrac{(Y)^0}{(P_h)}$

(.058) (.395)

$R^2 = .309$ S.E. = .383 D.W. = 2.278

In so far as test for serial correlation was concerned, the high values of the D.W. statistics for all equations, except equation (1a), led us to reject the null hypothesis of zero first order correlation. In the case of equation (1a), the estimated D.W. statistic fell in the inconclusive range, hence the result obtained must be interpreted with caution. Despite the apparent shortcoming of equation (1a), it was chosen along with equations (1b), (1.1a), and (1.1b) as the best fitting equations.

Turning to the relative prices and income elasticities derived from the above equations, it will be observed on Table A2 that, while the former elasticity varied from .990 to 1.195, elasticity was well below unity. The high average value of the price of elasticity, in addition to its negative sign suggests that increases in the relative price of food over the period of analysis led to a fall in Barbados import demand.

On the other hand, the value of the income elasticity indicates that food import (as a group) was treated as a necessity by Barbados consumers. This result was not unsuspected seeing that in the post-1954 period there was a general relaxation of clauses of the Defence Act of 1942 in addition to a rapid increase in urbanisation. In other words, the cessation of hostilities in 1945 meant that there was not as great an urgency for Barbados to be self sufficient in food, but the high relative increase in the real income of the Barbadian consumer in post-war years and consequently the rapid increse in urbanisation also meant that Barbadian consumers, being unable to satisfy their basic food demand from available home supplies, placed greater reliance on food imports from foreign markets.

Finally, it is interesting to note that the devaluation of the pound sterling in 1967, seemed to have played an important role in Barbados import demand for food. In fact, for all equations within which the dummy variable was introduced to account for the changes in Barbados exchange rates vis-a-vis exchange rates of its major trading partners, the estimated parameters had the correct signs and were statistically significant.

Import Demand Equations for Beverages and Tobacco, SITC 1

For the period under review beverages and tobacco comprised approximately 18 per cent of total imports. However, the bulk of this was comprised of such items as whisky, wines, cigars and cigarettes. Since beverages and tobacco went, in the main, towards final consumption, the most appropriate variable would have been real disposable income. Nonetheless, because of the problems associated with the derivation of the above series we opted for the use of real G.D.P. as a proxy. Problems of deriving an appropriate domestic price index were not peculiar to the relative price of food imports in that the problem also existed for this commodity group. Here again we use the All item price index as the deflator of the import price of tobacco and beverages. Applying the two functional forms to both aggregate and per capita data, we derived the equations given below:

$$2a \quad Mbt = 2528.736 - \underset{(4.225)}{10.775} \frac{P^{m}_{bt}}{(P_h)} + \underset{(.203)}{.005} \frac{(Y)}{(P_h)} + \underset{(292.853)}{867.383} \; (D)$$

$$R^2 = .861 \quad S.E. = 342.642 \quad D.W. = 0.652$$

$$2a^1 \quad Mbt = 5820.676 - \underset{(9.184)}{17.622} \frac{P^{M}_{bt}}{P} + \underset{(.003)}{.001} \frac{(Y)}{(P_h)}$$

$$R^2 = 0.458 \quad S.E. = 452.693 \quad D.W. = 0.975$$

$$\underline{2b} \quad \log Mbt^{*} = 6.416 - \underset{(.371)}{.614} \log \frac{P^{M}_{bt}}{(P_h)} + \underset{(.345)}{.722} \log \frac{(Y)}{(P_h)} + \underset{(.275)}{.762} \; (D)$$

$$R^2 = .864 \quad S.E. = .134 \quad D.W. = 1.639$$

$$\underline{2b^1} \quad \log Mbt = 10.436 - \underset{(.272)}{.520} \log \frac{P^{M}_{bt}}{(P_h)} + \underset{(.105)}{.025} \log \frac{(Y)}{(P_h)}$$

$$R^2 = .455 \quad S.E. = .115 \quad D.W. = .831$$

$$\underline{2.2a} \quad \frac{(Mbt)}{N} = 10.759 - \underset{(.055)}{.033} \frac{P^{M}_{bt}}{(P h)} + \underset{(.006)}{.002} \frac{(Y)^0}{(P_h)} + \underset{(1.972)}{4.475} \; (D)$$

$$R^2 = .691 \quad S.E. = 2.340 \quad D.W. = 1.71$$

$$\underline{2.2a^1} \quad \frac{(Mbt)}{N} = 21.204 - \underset{(.025)}{.017} \frac{(P^{M}_{bt})}{(P_h)} - \underset{(.004)}{.004} \frac{(Y)^0}{(P_h)}$$

$$R^2 = .269 \quad S.E. = 2.234 \quad D.W. = 1.704$$

$$2.2b \quad \log \frac{(M_{bt})}{N} = 3.453 - \underset{(.991)}{.245} \log \frac{P^M_{bt}}{(P_h)} - \underset{(.450)}{.039} \log \frac{(Y)}{(P_h)} + \underset{(.282)}{.500} \; (D)$$

$R^2 = .521 \quad S.E. = 357 \quad D.W. = 1.643$

$$2.2b^1 \quad \log \frac{(M_{bt})}{N} = 4.536 - \underset{(.193)}{.660} \log \frac{(P^m_{bt})}{(P_h)} - \underset{(.134)}{.151} \log \frac{(Y)^0}{(P_h)}$$

$R^2 = .320 \quad S.E. = 128 \quad D.W. = 2.069$

When one examines the evidence relating to the linear loglinear functional forms of the import demand equations for beverages and tobacco, one finds that the estimated parameters of both the relative price and dummy variables had the correct signs. On the other hand, the sign of the estimated parameter of the income variable did not conform to our a priori theoretical expectation in many cases. In fact, in three of the four variants of the import demand equations that were estimated, the parameter of the income variable was negative. The coefficients of the three variables were in all cases relatively small, lying essentially between .001 to .151 depending on the combination of explanatory variables, type of data and functional form. To a large extent, the models chosen did not fit the data adequately, for even when a high explanatory power was evident, the D.W. statistic indicated a high incidence of serial correlation in the disturbance terms.

On the basis of R^2, standard error and D.W. statistic we chose equations (2b) as the best fitting equation. As indicated on Table A1, the price elasticity of beverages and tobacco imports was well below unity, thus indicating that there was hardly any substitution between home produced and imported commodities. The estimated real G.D.P. income elasticity had the expected sign and was highly significant. On the other, the size of the above coefficient which was also well below unity confirms our a priori expectations about the relationship between imported beverages and tobacco and the level of growth of the Barbadian economy.

In other words, the rapid growth of the tourist industry in general and the income of Barbadian households in particular meant that there was an upward shift in Barbadians' preference for the more exotic alcoholic beverages. Of course, associated with the preceding factor, was the fact that the tourist who frequented the local hotels also had a specific preference for beverages and tobacco manufactured in metropolitan economies.

Import Demand Equations for Crude Materials, SITC 2

Imports of crude materials comprised a heterogeneous group of commodities. However, a significant proportion of this group consisted of items such as hides and skins, cotton cloth and fertilisers.

Furthermore, to a large extent, crude materials that were imported over the period of analysis went towards the production of final goods; thus the level of industrial production seemed to be a more appropriate activity variable than real G.D.P. However, when one remembers that a major component of real G.D.P. was the output of the industrial sector and that the behaviour of the non-industrial sector also had a direct effect on the demand for crude materials, we do not think that too great harm was done to reality by using real G.D.P. as a proxy for the level of economic activity in the industrial sector.

This is not to say that problems do not exist when real G.D.P. is used as the activity variable. In this context, one of the major problems that existed was related to the treatment of stocks. Evidently, over the period of analysis there may have been substantial stocks in crude materials from time to time. In the event that such stocks of crude materials existed, it meant that the domestic demand, in a given period, may have been met not only from imports but also by a depletion of existing stocks. In such a case, account must be taken of the fluctuation in stocks. Unfortunately, we were unable to examine the role of stocks in the import demand function for crude materials and this was mainly due to the scarcity of data on such a variable. Notwithstanding this apparent shortcoming in our analysis, we do believe that meaningful import demand function can still be obtained for this commodity group by making use of real G.D.P., relative prices and the dummy variable as our explanatory variables.

The estimated import demand equations for crude materials are given below:-

$$\underline{3a}\ Mcm = 7463.582 - \underset{(9.128)}{26.509}\ \frac{(P^{M}_{cm})}{(P_h)} - \underset{(.002)}{.004}\ \frac{(Y)}{P} + \underset{(384.195)}{835.390}$$

$$R2 = .648 \quad S.E. = 402.289 \quad D.W. = 1.477$$

$$\underline{3a^1}\ Mcm^* = 7349.289 - \underset{(35.918)}{66.194}\ \frac{(P^{m}_{cm})}{(P_h)} + \underset{(.023)}{.165}\ \frac{(Y)}{(P_h)}$$

$$R^2 = .918 \quad S.E. = 3123.362 \quad D.W. = 2.062$$

$$3b \quad \log Mcm = 13.406 - \underset{(.271)}{.772} \log \frac{(P^{m}_{cm})}{(P_h)} - \underset{(.119)}{.128} \log \frac{(Y)}{(P_h)} - \underset{(.090)}{.191} (D)$$

$R^2 = .642$ S.E. = .102   D.W. = 1.496

$$3b^1 \quad \log Mcm^{*} = -18.118 - \underset{(.281)}{487} \log \frac{(P^{m}_{cm})}{(P_h)} + \underset{(.307)}{2.363} \log \frac{(Y)}{(P_h)}$$

$R^2 = .917$ S.E. = .312   D.W. = 2.038

$$3.3a \quad \frac{(Mcm)}{N} = 23.916 - \underset{(.026)}{.025} \frac{(P^{m}_{cm})}{(P_h)} - \underset{(.006)}{.007} \frac{(Y)^0}{(P_h)} + \underset{(1.936)}{1.843} (D)$$

$R^2 = .364$ S.E. = 2.242   D.W. = 1.674

$$3.3a^1 \quad \frac{(Mcm)^{*}}{(N)} - 19.494 - \underset{(.177)}{.347} \frac{(P^{m}_{cm})}{(P_h)} + \underset{(.026)}{.165} \frac{(Y)^0}{(P_h)}$$

$R^2 = .885$ S.E. = 15.972   D.W. = 1.922

$$3.3b \quad \log \frac{(Mcm)}{N} = 5.525 - \underset{(.202)}{.226} \log \frac{(P^{cm}_{m}}{(P_h)} - \underset{(.170)}{.261} \log \frac{(Y)^0}{(P_h)} + \underset{(.104)}{.108} D$$

R 2 = .414   S.E. = .128   D.W. = 1.736

$$3.3b^1 \quad \log \frac{(Mcm)^{*}}{N} = - 6.177 - \underset{(396)}{.489} \log \frac{(P^{m}_{cm})}{(P_h)} + \underset{(.407)}{1.886} \log \frac{(Y)^0}{(P_h)}$$

$R^2 = .812$ S.E. = .461   D.W. = 2.004

Looking at the import demand equations that were base on the aggregate data, it can be observed that there is no significant difference between the two functional forms that were used. In this respect, it will be seen that the explanatory power of both the linear and log-linear forms tends to be much lower when the dummy variable has been introduced, being .648 and .642, respectively. In addition, in both cases the activity variable had estimated parameters which were exceedingly small and of the wrong sign.

The omission of the dummy variable led to significant improvements in the fit of both models as indicated by the high R^2 of .918 and .917 respectively. The D.W. statistic was also superior in the latter equations, being 2.062 and 2.038 respectively.

Turning to the estimated equations that were obtained when the two functional forms were applied to the per capita data, we also see the same phenomena occurring when the dummy variable was introduced into the individual equations, that is, relatively small R^2 and negative activity parameters. A vast improvement in the fit of the models occurred when the dummy variables were omitted and in case of the linear model, we had an R^2 of .885 as compared to .812 in the log-linear model. On the basis of R^2, standard errors and D.W. statistics we chose equations (3a), ($3b^1$), ($3.3a^1$) and $3.3b^1$) as being the best representatives of the Barbadian import demand for crude materials.

It would appear from the selected equations that the relative price elasticity for crude material imports was very low, varying form .487 to .489. This seems to indicate that there was marginal, if any, substitution between home produced and imported crude materials. In other words, the Barbadian consumer treated crude material imports as necessities. With regard to the activity elasticities, it will be seen in Table A1 that for all the selected equations, the value of this coefficient was well above unity in addition to having the correct sign. These results confirm the view which is generally held that over the period of analysis, there was a gradual shift towards mechanisation and modernisation within the Barbadian economy.

Import Demand Equations for Fuels, SITC 3

Over the period of analysis the share of fuels in total imports was a little under 8.0 per cent. Included in this group of imports were items such as cool, crude petroleum and petroleum products. Nevertheless, the bulk of imports in this group was petroleum and petroleum products which represented over 90 per cent of fuel imports.

Inasmuch as fuels were used by both households (as an item of final consumption) and manufacturing firms (as a raw material input) the use of real G.D.P. as the activity variable seemed appropriate. It must be remembered, however, that since the mid-1950s Barbados has been satisfying part of its domestic needs for fuels from local sources of gas. In addition, since 1965 Mobil Oil refinery had been in operation in Barbados.

As a consequence of the above factors, we would expect that significant changes occurred in the quantum and composition of Barbados fuel imports in the post-1960 era.

On account of the preceding factors the quantity and price indices (Laspeyres and Paasche respectively) that were utilised in the study are likely to be biased. In order to take account of such biases, dummy variables marking the periods when domestic supply augmented imports ought to have been introduced in the import demand equations. Unfortunatley, this approach was not pursued in the study; hence the results obtained must be interpreted with caution.

In equations (4a) — ($4.4b^1$) below, we present the estimated coefficients that were obtained when our alternative functional forms (linear and log-linear) were applied to the aggregated and per capita data. Our results indicate that there existed a close functional relationship between fuel imports and the explanatory variables, relative prices, real G.D.P. and the devaluation of sterling in 1967. In this respect, the explanatory power of the estimated equations varied between .816 and .947, depending on the contribution of explanatory variables and type of data used.

$$\underline{4a}\ Mfe = -\ 7972.355 -.\ 14.949 \left(\frac{P^m_{fe}}{P_h}\right) + .131 \left(\frac{Y}{P_h}\right) + 6362.043\ (D)$$
$$(39.983) \qquad (.124) \qquad (2968.967)$$

$R^2 = .940$ S.E. = 2786.323 D.W. = 2.045

$$\underline{4a^1}\ Mfe = 10206.641 - 130.157 \left(\frac{P^m_{fe}}{P_h}\right) + .073 \left(\frac{Y}{P_h}\right)$$
$$(20.914) \qquad (.032)$$

$R^2 = .947$ S.E. = 848.791 D.W. = 1.889

$$\underline{4b}\ \log Mfe = 16.862 + .124 \log \left(\frac{P^m_{fe}}{P_h}\right) + 2.135 \log \left(\frac{Y}{P_h}\right) + .415\ (D)$$
$$(.336) \qquad (.348) \qquad (.722)$$

$R^2 = .927$ S.E. = .305 D.W. = 1.530

$$\underline{4b^1}\ \log Mfe^{*} \cdot 2.406 - 1.216 \log \left(\frac{P^m_{fe}}{P_h}\right) + 1.023 \left(\frac{Y}{P_h}\right)$$
$$(.205) \qquad (.110)$$

$R^2 = .928$ S.E. = .096 D.W. = 1.421

$$4.4a \quad \frac{(Mfe)}{(N)} = -\ 20.524 \ - \underset{(.247)}{.297} \frac{(P^{m}_{fe})}{(P_h)} + \underset{(.037)}{.158} \frac{(Y)^0}{(P_h)} + \underset{(18.379)}{5.492}\ D$$

$R^2 = .886 \quad S.E. = 16.518 \quad D.W. = 1.8820$

$$4.4a^1 \quad \frac{(Mfe)^*}{(N)} = 42.155 - \underset{(.094)}{.515} \frac{(P^{m}_{fe})}{(P_h)} + .069 \frac{(Y)^0}{(P_h)}$$

$R^2 = .917 \quad S.E. = 3.822 \quad D.W. = 1.829$

$$4.4b \quad \log\ (Mfe) = -\ 6.2255 - \underset{(.591)}{.284} \log \frac{(P^{m}_{fe})}{(P_h)} + \underset{(.514)}{1.743} \log \frac{(Y)^0}{(P_h)} + \underset{(.529)}{.254}\ (D)$$

$R^2 = .816 \quad S.E. = .475 \quad D.W. = 1.347$

$$4.4b^1 \quad \log \frac{(Mfe)^*}{(N)}\ 2.632 - \underset{(.218)}{1.135} \log \frac{(P^{m}_{fe})}{(P_h)} + .951 \log \frac{(Y)^0}{(P_h)}$$

$R^2 = .889 \quad S.E. = .101 \quad D.W. = 1.834$

It is interesting to note that the inclusion of the dummy variable did not enhance the explanatory power of the estimated equation. In fact, for every variant of the import demand equation, the inclusion of this led to a fall in R^2. While all of the estimated parameters had the correct signs, in a few cases they were statistically insignificant and this was especially evident in the case of the dummy variables.

The reasons for this peculiar result is not quite clear, for the high values of the D.W. statistic in almost all of the equations indicated an absence of serial correlation in the error terms. Using our general criterial of R^2 standard error and D.W. statistic, we selected equations ($4a^1$), ($4b^1$) (4.4a) and ($4.4b^1$) as the best fitting import demand equations for fuel.

As shown on Table A1, the relative price elasticity varied from .515 to —1.135. In addition, they all had the correct signs and were statistically significant. Inasmuch as three of the selected equations had a price elasticity that was well below unity we can safely say the Barbadian consumer considered fuel imports as being a necessity. The activity elasticity for fuel was approximately 1.02 per cent for for logarithmic import demand function.

The fact that a 10 per cent increase in real G.D.P. led to increases in fuel imports from 1.023 to 10.23 per cent was not too surprising, considering the widespread usage of fuels by both households and industry in a developing economy such as Barbados. In this context, the result obtained clearly indicates that the quantity of gas that was obtained within Barbados over period of analysis was totally inadequate in meeting home demand. Moreover, the rapid increase in the number of cars and other gas — using vehicles increased Barbados dependence on external sources for unrefined petroleum.

Import Equation for Chemicals, SITC 5

Barbados imports of chemicals constituted a significant and rapidly increasing proportion of her total imports during the period 1954—1970. For example, in 1954 this group of imports represented approximately .21 per cent of total imports, whereas by 1970 its share rose to .93 per cent.

Inasmuch as the demand for chemical imports is a derived demand, the rapid increase in the import of this group of commodity, as evidenced previously, can, in the main, be explained by rapid increases in the level of industrial activity within the Barbadian economy over the period of analysis. In the event that our preceding explanation of the rapid increase in this group of imports is valid, then, logically, the activity variable ought to be the level of industrial activity.

However, because of the paucity of data we were unable to use such a variable and increase resort had to be made to the use of real G.D.P. as a proxy. In so far as the relative price variables were concerned, this was obtained by simply dividing the All item Consumer Price Index into the import price index chemicals.

Finally, in order to gauge the effect of the pound sterling devaluation in 1967, we introduced the previously discussed dummy variable into the equations.

The import demand equations that were obtained by applying the linear and log-linear functional forms to the data at both the aggregate and per capita levels are given below:

$$\underline{5a}\ Mch^{*} = 10016.105 - \underset{(23.468)}{111.751}\ \frac{P^{m}_{ch}}{(P_h)} + \underset{(.010)}{.061}\ \frac{Y}{(P_h)} + \underset{(813.323)}{1223.964}\ (D)$$

$$R^2 = .995 \quad S.E. = 812.867 \quad D.W. = 1.546$$

5a[1]

$$Mch = 25829.320 - \underset{(67.717)}{325.559}\ \frac{(P^{m}_{ch})}{(P_h)} + \underset{(.028)}{.195}\ \frac{(Y)}{(P_h)}$$

$R^2 = .883$ S.E. $= 3530.317$ D.W. $= 1.871$

5b

$$\log Mch^{*} = 3.830 - \underset{(.221)}{.989}\ \frac{(P^{m}_{ch})}{(P_h)} + \underset{(.147)}{.815}\ \log\ \frac{(Y)}{(P_h)} + \underset{(.082)}{.158}\ (D)$$

$R^2 = .945$ S.E. $= - .088$ D.W. $= 1.572$

5b[1]

$$\log Mch = 2.833 - \underset{(.209)}{1.085}\ \log\ \frac{(P^{m}_{ch})}{(P_h)} + \underset{(.156)}{1.022}\ \log\ \frac{(Y)}{(P_h)}$$

R 2 $= .873$ S.E. $= .133$ D.W. $= 1.864$

5.5a

$$\frac{(Mch)^{*}}{(N)} = 42.128 - \underset{(.094)}{.393}\ \frac{(P^{m}_{en})}{(P_h)} + \underset{(.011)}{.049}\ \frac{(Y)^{0}}{(P_n)} + \underset{(3.215)}{8.049}\ (D)$$

R 2 $= .945$ S.E. $= 3.257$ D.W. $= 1.551$

5.5a[1]

$$\frac{(Mch)}{(N)} = 2.073 - \underset{(.352)}{.995}\ \frac{(P^{m}_{ch})}{(P_h)} + \underset{(.050)}{.286}\ \frac{(Y)^{0}}{(P_h)}$$

R2 $= .857$ S.E. $= 17.730$ D.W. $= 1.808$

5.5b

$$\log \frac{(Mch)^{*}}{(N)} = 3.244 - \underset{(.210)}{.819}\ \log\ \frac{(P^{m}_{ch})}{(P_h)}\ \underset{(.157)}{.626}\ \log\ \frac{(Y)^{0}}{(P_h)} + \underset{(.077)}{.218}\ D$$

$R^2 = .933$ S.E. $= .083$ D.W. $= 1.619$

5.5b[1]

$$\log \frac{(Mch)}{(N)} = -2.648 - \underset{(.264)}{.718}\ \log\ \frac{(P^{m}_{ch})}{(P_h)} + \underset{(.309)}{1.606}\ \log\ \frac{(Y)}{(P_h)}$$

R 2 $= .830$ S.E. $= .193$ D.W. $= 1.874$

Earlier in our theoretical discussion we indicated that two of the explanatory variables (activity and dummy) are expected to have a positive relation to imports, whereas the third, relative prices, must have a negative relationship with imports. Our results presented above are in accordance with our expectations. In addition, all of the explanatory variables are significant at the 5 per cent or more level. In fact, the explanatory power of all three independent variables is quite good, being no less than 93.3 per cent in any of the equations. Correspondingly, the relative prices and activity variables alone account for no less than 83.3 per cent of the variation in any equation. Serial correlation is not a problem in so far as our estimated import demand equations are concerned for, as can be observed in every equation, the D.W. statistic is above the upper limit at both the 5 per cent and 1 per cent levels.

Comparing the two functional forms, it would seem that the linear form provides a better fit when both the aggregate and per capita data are used. Using our general criteria of R^2s standard error and Darbin-Watson statistic, we selected equations (5a), (5b), (5.5a) and (5.5b) as being the best fitting variants of the import demand equation for chemicals.

The low relative price elasticities obtained from the selected equations were not unexpected and indicate that Barbadian consumers treated this group of import as necessities. The preceding result is corroborated by the magnitude of the activity elasticities which were all below unity.

Import Demand Equations for Manufacturers, SITC 6

The largest proportion of this group of imports consisted of metals (mainly iron and steel), textiles as well as clothing. In value terms, the above items represented approximately .45, .37 and .26 per cent respectively of manufactured imports over the period 1954 — 1970.

However, a smaller but no less significant proportion of manufactured imports consisted of paper, rubber, wood, leather products and glass. On the whole, imports of manufactured goods represented no less than 20.50 per cent of total imports over our period of analysis. Like fuels, the import of manufactured goods consisted of many items that went towards final consumption as well as items that were utilised in the production of finished goods. In such a case, our use of real G.D.P. as the activity variable seemed appropriate. Nonetheless, as in the case of the previous commodity group, there still exists the problem of taking into account the substitutability, the price index of imported manufactured goods should have been deflated by the domestic wholesale price index of finished manufactured goods. Suffice it to say, that in the study we did not pursue this approach but instead the All item Consumer Price Index was used as the deflator of the import price series.

As we indicated earlier, over the period of analysis Barbados obtained most of her imports of manufactured goods, especially motor vehicles, from the sterling and dollar areas, hence we feel that the devaluation of the pound sterling in 1967 may have produced a dampening effect on Barbados dollar imports. Thus we expect the estimated coefficients of the dummy variable to be positive and statistically significant.

The results of the regressions are given in the equations with standard errors below the estimated coefficients:

6a Mmf = 27445.082 − 247.926 (P$^{m}_{mf}$/P$_h$) (66.466) + .127 (Y/P$_h$) (.036)

+ .7325.801 (D) (2874.104)

R^2 = .923 S.E. = 2991.539 D.W. = .865

6a[1] Mmf* = 2376.070 − 236.333 (P$^{m}_{mf}$/P$_h$) (84.662) + .272 (Y/P$_h$) (.044)

R^2 = 0.876 S.E. = 4250.906 D.W. = 1.469

6b log Mmf = 5.731 − .850 (P$^{m}_{mf}$/P$_h$) (.192) + 0.684 log (Y/P$_h$) (.177)

+ .267 (D) (.097)

R^2 = .922 S.E. = .110 D.W. = .954

6b[1] log Mmf* = − 5.384 − .729 log (P$^{m}_{mf}$/P$_h$) (.265) + 1.561 log (Y/P$_h$) (.274)

R^2 = .857 S.E. = .193 D.W. = 1.509

6.6a (Mmf) = 128.881 − 1.193 (P$^{m}_{mf}$/P$_h$) (.246) + .132 (Y/P$_h$)^0 (.036)

+ 23.574 (D) (0.842)

R^2 = .931 S.E. = 11.035 D.W. = 0.986

6.6a[1] $\frac{(Mmf)^*}{(N)} = -\ 7.869 + 0.331 \frac{(P^m_{mf})}{(P_h)} + .024 \frac{(Y)^0}{(P_h)}$

$\qquad\qquad\qquad\qquad\qquad (.211) \qquad\qquad (.016)$

$R^2 = .957$ S.E. = .927 D.W. = 1.467

6.6b $\log \frac{(Mmf)}{(N)} = .047 - .481 \frac{(P^m_{mf})}{(P_h)} + 1.004 \log \frac{(Y)^0}{(P_h)}$

$\qquad\qquad\qquad\qquad (.214) \qquad\qquad (.298)$

$+ .407 \ (D)$

$R^2 = .912$ S.E. = .147 D.W. = 1.007

6.6b[1] $\log \frac{(Mmf)^*}{(N)} = -\ 2.383 - 1.182 \log \frac{(P^m_{mf})}{(P_h)} + 1.804 \log \frac{(Y)^0}{(P_h)}$

$\qquad\qquad\qquad\qquad\qquad (.131) \qquad\qquad (.167)$

$R^2 = .950$ S.E. = .136 D.W. = 1.700

As expected, the estimated equations, the relative price, activity and dummy regression coefficients had the theoretically correct signs and were highly significant. In addition, the high R^2 clearly indicated that most of the variation in the imports of manufactures was explained by these explanatory variables. It was interesting to observe, however, that while the inclusion of the dummy variable enhanced the explanatory power of the variations equations, there was a corresponding increase in the incidence of serial correlation in the disturbance terms.

On the basis of R^2 standard errors and D.W. statistics equations ($6a^1$) ($6b^1$), ($6.6a^1$) and ($6.6b^1$) seemed to be the best fitting formulations of the estimated equations; hence they were chosen to represent Barbados import demand for manufactures. As shown on Table A2, the relative price and activity elasticities obtained from these equations were highly significant in addition to having the correct signs. The fact that the relative price elasticity varied from between .880 and .850 indicates that there were marginal substitution possibilities between home produced and imported manufactures. This result is not too surprising when one takes into consideration the fact that the bulk of semi-manufactured goods that were imported into Barbados during the period were in the main commodities that could not have been produced domestically.

The estimated activity elasticity was well above unity for each of the equations chosen. These results seemed reasonable when we consider that over the period of analysis one of the major thrusts of the Barbados Government's policy was in the area of import replacement. Finally, our estimated results seem to indicate that the explanation of the imports of manufactures was due in the main to the activity variable, real G.D.P.

Import Demand Equations for Machinery and Transport Equipment, SITC 7

Over the period of analysis, the second largest group of Barbadian imports after food, was machinery and transport equipment. This group of imports represented approximately 17.82 per cent of total imports in value terms.

This group of imports was not homogenous, in that it consisted of various categories of machinery and transport equipment. In this context, capital goods formed the major share (80 per cent) and the remainder consisting mainly of private transport vehicles and electrical equipment. Inasmuch as capital goods imports went mainly towards the replacement of worn machinery and the expansion of the existing capital stock, business fixed investment in plant and capital stocks would have been the ideal activity variable.

Hampered by the lack of appropriate data on such a series, we used real G.D.P. as a proxy for the level of economic activity on the business sector. In the case of imported machinery and transport equipment, there did not exist as great a problem in obtaining an appropriate domestic price index as was the case of other forms of imports, simply because most of the commodities that were included under this heading were not produced within the Barbadian economy over our period of analysis. This being the case, our use of the All item consumer price index as the deflator of the import price index seemed justified. The esitmated equations that were obtained by applying the two functional forms to the aggregate and per capita data are given below.

$$\underline{7a}\ M_{mte} = 7449.328 - \underset{73.241}{148.892}\ \frac{P^{m}_{mfe}}{(P_h)} + \underset{(.049)}{.170}\ \frac{(Y)}{(P_h)} + \underset{(3140.319)}{9502.094}\ (D)$$

$R^2 = .929$ S.E. $= 3379.107$ D.W. $= 0.975$

$$\underline{7a^1}\ M_{mte}{}^{*} = 1158.441 - \underset{(16.549)}{100.562}\ \frac{(P^{m}_{mfe})}{(P_h)} + \underset{(.014)}{.138}\ \frac{(Y)}{(P_h)}$$

$R^2 = .941$ S.E. $= 1921.944$ D.W. $= 1.579$

$$\underline{7b}\ \log M_{mte} = -\ .276 - \underset{(.221)}{.494}\ \log \frac{(P^{m}_{mte})}{(P_h)} = \underset{(.273)}{1.035}\ \log \frac{(Y)}{(P_h)} + \underset{(.127)}{.398}\ (D)$$

$R^2 = .921$ S.E. $= .151$ D.W. $= .982$

$$\underline{7b^1}\ \log M_{mte}{}^* = -5.028 - \underset{(.415)}{1.313}\ \frac{(P^m_{mte})}{(P_h)} + \underset{(.479)}{1.707}\ \log \frac{(Y)}{(P_h)}$$

$R^2 = .967$ S.E. $= .118$ D.W. $= 1.644$

$$\underline{7.7a}\ \frac{(M_{mte})}{(N)} = 30.380 - \underset{(.298)}{.651}\ \frac{(P^m_{mte})}{(P_h)} + \underset{(.053)}{.175}\ \frac{(Y)^0}{(P_h)} + \underset{(12.644)}{39.426}\ D$$

$R^2 = .921$ S.E. $= 13.917$ D.W. $= 1.022$

$$\underline{7.7a^1}\ \frac{(M_{mfe})}{(N)}^* = -.439 - \underset{(.065)}{.413}\ \frac{(P^m_{mte})}{(P_h)} + \underset{(.015)}{.146}\ \frac{(Y)^0}{(P_h)}$$

$R^2 = .936$ S.E. $= 7.785$ D.W. $= 1.573$

$$\underline{7.7b}\ \log \frac{(M_{mte})}{(N)}^* = -1.063 - \underset{(.146)}{1.023}\ \log \frac{(P^m_{mte})}{(P_h)} + \underset{(.229)}{1.478}\ \log \frac{(Y)^0}{(P_h)} + \underset{(.119)}{.228)}\ D$$

$R^2 = .962$ S.E. $= .125$ D.W. $= 2.055$

$$\underline{7.7b^1}\ \log \frac{(M_{mte})}{(N)} = 4.847 - \underset{(.503)}{1.203}\ \log \frac{(P^m_{mte})}{(P_h)} + \underset{(.084)}{.931}\ \log \frac{(Y)^0}{(P_h)}$$

$R^2 = .953$ S.E. $= .081$ D.W. $= 2.295$

In all of the equation given here, the regression coefficients carry the signs suggested by economic theory and were highly significant. However, the inclusion of the dummy variables in the estimated equations did not lead to the expected improvement in the fit of the models. Hence, in about every case, but one, (equation (7.7b), the inclusion of this variable led to a fall of the explanatory power of the estimated equation as well as a high incidence of several correlations in the errors terms. Employing our usual criteria, we selected equations ($7a^1$), ($7b^1$), ($7.7a^1$) and ($7.7b^1$) as our preferred equations. The estimated price elasticity varied from .447 to 1.313 depending on the functional form and type of data utilised on the analysis. Nevertheless, the wide variation in values clearly indicated that the reaction of Barbadian consumers towards changes in the price of this category of imports was mixed. In other words, the result indicates that the Barbadian consumer was quite sensitive to changes in relative prices.

The estimated activity elasticities were well above unity varying from .904 to 1.707. These high values indicate that the relative progress in industrialisation as well as the relatively high rates of growth in per capita real G.D.P. were associated with a rather high import demand for machinery and transport equipment. As we suspected and as our estimated results indicated, most of the variation in the import of machinery and transport equipment was due to real G.D.P.

Import Demand Equations for Miscellaneous Manufactures, SITC 8

Imports of miscellaneous manufactures formed the smallest category of imports after beverages and tobacco and accounted for approximately 9.98 per cent of total imports between 1954 and 1970. While this group of imports consisted of a heterogeneous set of commodities, it seemed to have made up the bulk of it. In fact, over our period of analysis more than 35.76 per cent of miscellaneous manufactured imports consisted of clothing and footwear, while the remainder consisted mainly of spare parts, and photographic and laboratory equipment destined to replace worn out machinery and to supplement light manufacturing within the Barbadian economy. Thus, like manufactured imports, real business production seemed to be the most appropriate activity variable. For reasons that were previously discussed in detail above, we were unable to use such a variable in this study; hence real G.D.P. was the activity variable. It will be appreciated, however, that because of the high correlation between investment and real G.D.P. our choice of this variable, as a proxy for real business production, did not seem to be too unrealistic. To obtain the relative price variable, the import price index of miscellaneous manufactures was deflated by the All Item Consumer Price Index. The dummy variable which has been discussed in detail before was also introduced into the demand equations. Using both the linear and log-linear functional forms in conjunction with the aggregate and per capita data respectively, we obtained the results presented below:

$$\underline{8a}\ M_{mm} = .3977.391 - \underset{(13.478)}{74.695}\ \frac{(P^{m}_{mm})}{(P_h)} + \underset{(.015)}{.094}\ \frac{(Y)}{(P_h)} + \underset{(1336.881)}{5175.160}\ (D)$$

$R^2 = .973$ S.E. $= 1359.413$ D.W. $= 1.278$

$$\underline{8a^1}\ M_{mm}{*} = 63049.363 - \underset{(18.934)}{689.623}\ \frac{(P^{m}_{mm})}{(P_h)} + \underset{(.031)}{.365}\ \frac{(Y)}{(P_h)}$$

$R^2 = .960$ S.E. $= 4463.262$ D.W. $= 1.957$

$$8b \quad \log M_{mm}^{*} = -2.806 - \underset{(.137)}{1.164} \log \frac{(P^{m}_{mm})}{(P_h)} + \underset{(.171)}{1.459} \log \frac{(Y)}{(P_h)} + \underset{(.103)}{.201} \, (D)$$

$R^2 = .975 \quad S.E. = .108 \quad D.W. = 2.546$

$$8b^1 \quad \log M_{mm} = 5.035 - \underset{(.491)}{1.208} \, \text{Log} \frac{(P^{m}_{mm})}{(P_h)} + \underset{(.074)}{.950} \log \frac{(Y)}{(P_h)}$$

$R^2 = .965 \quad S.E. = .079 \quad D.W = 2.773$

$$8.8a \quad \frac{(M_{mm})}{(N)} = 13.999 - \underset{(.055)}{.308} \frac{(P^{m}_{mm})}{(P_h)} + \underset{(.017)}{.098} \frac{(Y)^0}{(P_h)} + \underset{(5.541)}{20.545} \, (D)$$

$R^2 = .970 \quad S.E. = 5.652 \quad D.W. = 1.387$

$$8.8a^1 \quad \frac{(M_{mm})^{*}}{(N)} = 261.858 - \underset{(1.318)}{2.859} \frac{(P^{m}_{mm})}{(P_h)} + \underset{(.037)}{.363} \frac{(Y)^0}{(P_h)}$$

$R^2 = .946 \quad S.E. = 19.473 \quad D.W. = 1.973$

$$8.8b \quad \log \frac{(M_{mm})^{*}}{(N)} = 1.838 - \underset{(.530)}{348} \log \frac{(P^{m}_{mm})}{(P_h)} + \underset{(.084)}{.788} \log \frac{(Y)}{(P_h)} + \underset{(.241)}{.456} \, (D)$$

$R^2 = .970 \quad S.E. = .068 \quad D.W. = 1.273$

$$8.8b^1 \quad \log \frac{(M_{mm})}{(N)} = 2.545 - \underset{(0.721)}{1.051} \log \frac{P^{m}_{mm}}{(P_h)} + \underset{(.109)}{1.114} \frac{Y^0}{(P_h)}$$

$R\,2 = .946 \quad S.E. = .103 \quad D.W. = 1.578$

Overall, the explanatory power of the equations was quite good, varying from .946 to .973. However, a comparison of the equations based on per capita data, with those utilising data which was not deflated by population, indicates that the explanatory power of the latter equations was generally higher. Thus, it would seem that the population changes which occurred within Barbados over our period of analysis did not affect the import demand for miscellaneous manufactures to any great extent.

The superior fit of the models based on aggregated data is also substantiated by the fact that the Durbin-Watson statistics obtained for these equations are generally higher than those obtained from the equations based on the disaggregated data. On the basis of our general criteria we selected equations (8b) and (8.8b 1) as being the best indicators of Barbados aggregate and per capita demand for miscellaneous manufactured goods imports.

The higher than unity values of the price elasticity coefficients in both equations indicate that Barbadian consumers treat imports of miscellaneous manufactured goods as luxuries and the correspondingly high activity elasticities indicate that substantial benefits can be gained by substituting locally produced manufactured goods that fall within this category of imports.

CHAPTER FOUR

THE ESTIMATED IMPORT DEMAND EQUATION FOR FUNCTIONAL CATEGORIES OF COMMODITIES, BARBADOS, 1954 — 1970

In the previous section our effort was directed towards obtaining estimates of import demand equations for various categories of commodities classified according to the S.I.T.C. In this section we shall extend our analysis to commodities which are gruped according to functions or end use.

Inasmuch as imports classified according to end use or on functional lines go towards the satisfaction of households and industry demand, any activity variable used in a particular import demand function ought to vary with the given commodity being analysed, for example,real disposable income ought to be used when estimating the import demand of commodities that go towards final consumption. Foe the same reason, the level of industrial activity ought to be used as the activity variable in the import demand equations of commodities that are utilised as industrial inputs. Furthermore, in cases where disposable income is used as the activity variable, allowance must also be made for its distribution among the population. In this study, we were faced with the problem of inadequate economic statistical data and this inhibited our use of such fine distinctions in regard to the activity variable. In other words, because of the existing weakness in the Barbadian National Income Statistic we had no other alternative but to follow the procedure that was employed in our analysis of imports classified according to the S.I.T.C.: that is, we used real G.D.P. as a proxy for the activity and income variable.

In as far as the relative variable was concerned, the procedure that was utilised in the previous section was also followed. In other words, no adjustment was made in the domestic price component of the composite relative price term for variations in prices of locally produced substitutes to the imported items. Neither were allowances made in import prices for duties and/or taxes.

Notwithstanding the apparent weakness of our analysis due to the omission of the above factors, an attempt was made to measure the effect of population changes in the import demand of commodities classified according to end use. We also examined the role of the devaluation of the pound sterling in 1967. Finally, the data utilised in this section of the study extended over the same period as our previous analysis, that is, 1954—1970.

Import Demand Equations for the Functional Group: Consumer Goods

A significant proportion of Barbados imports over the period, 1954—1970 was in the form of consumer goods. Within this group of imports were items such as foods, beverages, durables, and non-durables. It goes without saying, however, that food formed the major component, representing over 50.74 per cent of consumer goods imports between 1954 and 1970.

Next in order of importance came non-durables, closely followed by durables. Together these two groups represented over 49.26 per cent of total consumer goods imports. Turning to the variables utilised in the import demand equations, the dependent variables were obtained by simply deflating the quantum of consumer goods imports at current prices by its price index (import) based on 1965 prices.

On the other hand, the income variable was represented by a G.D.P. series based on 1965 prices. The relative price variable which measures the substitutability between imported and home produced imports was obtained by dividing the All Item Consumer Price Index into the import price index for consumer goods. Finally, in order to measure the influence of the devaluation of the pound sterling in 1967, we introduced the dummy variable (D) having the value of unity in 1967 and subsequent years and zero elsewhere. We may note that allowance was made in each import demand equation for population change by dividing both the dependent and income variable by the total population over the periods of analysis.

The estimated equations that were obtained when both the linear and log-linear functional forms were used are given below

$$\underline{9a}\ M_{con} = 24977.082 - \underset{(305.281)}{208.710} \frac{(P^{m}_{con})}{(P_h)} + \underset{(.035)}{.300} \frac{(Y)}{(P_h)} + \underset{(3877.996)}{10613.688)} (D)$$

$$R^2 = .975 \quad S.E. = 3689.286 \quad D.W. = 1.019$$

$$\underline{9a^1} \quad M_{con}^{*} = 28270.223 - \underset{(64.345)}{442.047} \frac{(P^{m}_{con})}{(P_h)} + \underset{(.023)}{.321} \frac{(Y)}{(P_h)}$$

$R^2 = .968$ S.E. $= 3429.677$ D.W. $= 1.474$

$$\underline{9b} \ \log M_{con}^{*} = 2.831 - \underset{(.535)}{.413} \log \frac{(P^{m}_{con})}{(P_h)} + \underset{(.314)}{.827} \log \frac{(Y)}{(P_h)} + \underset{(.068)}{.166} \ (D)$$

$R^2 = .976$ S.E. $= .068$ D.W. $= 1.569$

$$\underline{9b^1} \ \log M_{con} = 1.812 - \underset{(.167)}{1.049} \log \frac{(P^{m}_{con})}{(P_h)} + \underset{(.097)}{1.22} \log \frac{(Y)}{(P_h)}$$

$R^2 = .955$ S.E. $= .103$ D.W. $= 1.550$

$$\underline{9.9a} \ \underline{(M_{con})} = 105.835 - \underset{(1.343)}{.848} \frac{(P^{m}_{con})}{(P_h)} + \underset{(.041)}{.292} \frac{(Y)^0}{(P_h)} + \underset{(16.736)}{44.099} \ (D)$$

$R^2 = .965$ S.E. $= 16.315$ D.W. $= 1.055$

$$\underline{9.9a^1} \ \underline{(M_{con})^{*}} = 117.540 - \underset{(.269)}{1.865} \frac{(P^{m}_{con})}{(P_h)} + \underset{(.027)}{.325} \frac{(Y)^0}{(P_h)}$$

$R^2 = .962$ S.E. $= 14.367$ D.W. $= 1.497$

$$\underline{9.9b} \ \log \underline{(M_{con})} = 2.647 - \underset{(.238)}{.889} \log \frac{(P^{m}_{con})}{(P_h)} + \underset{(.177)}{.982} \log \frac{(Y)^0}{(P_h)} + \underset{(.116)}{111} \ (D)$$

R2 $= .949$ S.E. $= .103$ D.W. $= 1.554$

$$\underline{9.9b^1} \ \log \frac{(M_{con})^{*}}{(N)} = .451 - \underset{(.195)}{874} \log \frac{(P^{m}_{con})}{(P_h)} + \underset{(.240)}{1.274} \frac{(Y)^0}{(P_h)}$$

R2 $= .825$ S.E. $= .174$ D.W. $= 1.249$

The evidence from the set of equations is that all the estimated parameters has signs that were expected and, with a few exceptions, were statistically significant at the 5 per cent probability level or higher. The departures from the above tendency were the price parameters in equations (9a), (9b), and ($9.9a^1$) and the dummy variable parameter in equation(9.9b).

As can be observed, the explanatory variables were quite adequate in protraying the functional relationship between the dependent variable and themselves. In this context, R^2 was extremely high, varying from .825 to .975. It would also seem that the devaluation of sterling had a perceptible effect on Barbados consumer goods imports.

Using the criteria of R^2 standard error and D.W. statistic, we selected equations ($9a^1$), (9b), ($9.9a^1$) and ($9.9b^1$) as being ideal representatives of Barbados import demand. In Table A2, we see that the relative price elasticity ranged from .460 to .840 depending on the functional form, type of data and combination of explanatory variables. Inasmuch as most of the equations had price elasticity coefficients well below unity, it is reasonable to conclude that food imports were considered as a necessity by Barbadian consumers. These results also indicate that the possibility of closing the gap between imported and domestically produced consumer goods is rather slim.

The income elasticity derived from the above equations was below unity as shown in Table A2. Given the rapid growth on income, due to expansion in overall economic activity within the Barbadian economy over the period 1954—1970, the latter results were not unsuspected.

Import Demand Equations for the Functional Group: Food

As we indicated earlier, imports of food form the major component of consumer goods imports, notwithstanding the fact that a significant proportion of food was grown locally. To obtain the dependent variable on the estimating equations, we deflated the quantum of food imports at current prices by its corresponding import price index based on 1965 prices.

In so far as the income variable was concerned, real G.D.P. was used as a proxy for this variable, as was explained previously. However, in order to measure the substitutability of imports to home produced food, the All Item Consumer Price Index was divided into the import price index. Finally, in order to measure the influences of the devaluation of the pound sterling in 1967, the dummy variable (D) having the value of unity in 1968 and subsequent years and zero elsewhere was introduced into the import demand equations.

The estimated import demand equations based on the two functional forms are given below

12a $M_{ff} = 34075.449 - \underset{(116.527)}{282.878} \frac{(P^m_{ff})}{(P_h)} + \underset{(.014)}{128} \frac{(Y)}{(P_h)} + \underset{(1595\ 946)}{427.154}\ (D)$

$R^2 = .970$ S.E. = 156.894   D.W. = 1.539

$12a^1$ $M_{ff}^* = 4660.438 - \underset{(24.298)}{45.331} \frac{(P^m_{ff})}{(P_h)} + \underset{(.001)}{.011} \frac{(Y)}{(P_h)}$

$R^2 = .985$ S.E. = 378.775   D.W. = 1.538

12b $\log M_{ff} = 7.241 - 1.242 \log \frac{(P^m_{ff})}{(P_h)} + \underset{(.074)}{.721} \log \frac{(Y)}{(P_h)} + \underset{(.064)}{.001}\ (D)$

$R^2 = .968$ S.E. = .065   D.W. = 1.651

$12b^1$ $\log M_{ff}^* = 7.586 - \underset{(1.304)}{2.268} \log \frac{(P^m_{ff})}{(P_h)} + \underset{(.102)}{.870} \log \frac{(Y)}{(P_h)}$

R = .919   S.E. = .205   D.W. = 1.852

12.12a $\frac{(M_{ff})}{(N)} = 155.903 - \underset{(.480)}{1.278} \frac{(P^m_{ff})}{(P_h)} + \underset{(.015)}{.122} \frac{(Y)^0}{(P_h)} + \underset{(6.443)}{1.029}\ (D)$

$R^2 = .962$ S.E. = 6.265   D.W. = 1.547

$12.12a^1$ $\frac{(M_{ff})}{(N)} = 155.903 - \underset{(.480)}{1.278} \frac{(P^m_{ff})}{(P_h)} + \underset{(.015)}{.122} \frac{(Y)^0}{(P_h)} + \underset{(6.443)}{1.029}$

$R^2 = .962$ S.E. = 6.265   D.W. = 1.547

$$\underline{12.12a^1} \quad \frac{(M_{ff})^*}{(N)} = -\,.308 + \underset{(.018}{.015}\,\frac{(P^{m}_{ff})}{(P_h)} + \underset{(.003)}{.010}\,\frac{(Y)^0}{(P_h)}$$

$R^2 = .655 \quad S.E. = 1.723 \quad D.W. = 1.550$

$$\underline{12.12b} \quad \log \frac{(M_{ff})}{(N)} = -\,.376 + \underset{(.037)}{0.23}\,\log \frac{(P^{m}_{ff})}{(P_h)} + \underset{(.242)}{.340}\,\log \frac{(Y)^0}{(P_h)} + \underset{(.149)}{.348}\,(D)$$

$R^2 = .771 \quad S.E. = .183 \quad D.W. = .810$

$$\underline{12.12b^1} \quad \log \frac{(M_{ff})}{(N)} = -\,6.100 + \underset{(.511)}{172}\,\log \frac{(P^{m}_{ff})}{(P_h)} + \underset{(.250)}{1.324}\,\log \frac{(Y)^0}{(P_h)}$$

$R^2 = .880 \quad S.E. = .193 \quad D.W. = .859$

As the results show, the different variants of the models fits the data quite adequately if R^2 is used as the sole criterion. However, a closer examination of the results also indicate that the incidence of autocorrelation in the individual equations was particularly high. To some extent, the latter result may have been due to the existence of a direct relationship between the dummy variable and the disturbance term. In fact, in almost every equation where the dummy variable was introduced the estimated coefficient was statistically insignificant and its exclusion generally led to an enhancement in the fit of the model.

Turning now to the signs of the estimated coefficients, it can also be observed that all of the activity variables had the correct sign. But this was not the case with the coefficients of the price variables which tended to be both positive and statistically insignificant when per capita data were used. The preceding results are probably due to the existence of a direct relationship between population growth and some other variable which was omitted from the model. This point is substantiated by the fact that in each of the equations which contained a positive price coefficient, the Durbin Watson statistic was extremely small.

Because equations ($12a^1$), ($12b^1$) and ($12.12a^1$) had higher R2 and Durbin-Watson statistics as well as lower standard errors they were chosen as the preferred equations for the functional group 'food'. The activity elasticities obtained from these equations were greater than unity and varied from .064 to .870 per cent depending upon the functional form and type of data used. In addition, the import demand for this group of commodities also seemed to be quite sensitive to changes in relative prices for the estimated price elasticities were all well above unity, varying from

.182 to 2.268. The preceding results clearly indicate that from a functional point of view most consumers within Barbados treated food imports as luxuries. These results are not too surprising given the influence of the tourist industry on Barbados food imports.

Import Demand Equations for Functional Group: Beverages

Utilising real G.D.P. relative prices and the dummy variables, the estimated import demand equation for this group of consumer items is given below for alternative formulations of both the linear and log-linear models. In the case where the linear model was applied to the aggregate data, the relative price variable had the expected negative sign, while both the income and dummy variables had positive signs.

The log linear model did not fit this type of data very well for when the dummy variable was included in the equation the estimated parameter was positive but was statistically insignificant. Further, the exclusion of the dummy variables did not lead to an improvement in the fit of the functions. In fact, as can be observed, when this variable was excluded the sign of the relative price variable became theoretically unacceptedable as well as being statistically insignificant. Despite these shortcomings, the overall fit of the model was quite good, varying from .835 to .986 depending upon the combination of variables.

Turning to the linear models based on per capita data, it can be seen from the estimated equations that the relative price variables were statistically insignificant and even in one case the sign was incorrect. The use of the log-linear model only led to marginal improvements in the fit, and even so we see that the dummy variables were invariably statistically insignificant. It must be noted, however, that when the log-linear formulation was applied to the per capita data and the dummy variable was excluded, this led to a noticeable improvement in the fit of the model.

Overall, it would seem that the incidence of serial correlation in all the estimated equations was quite high. On the basis of our criteria as to the signs of the parameters, R^2, standard errors and D.W. statistic we selected equations (13.13b[1]) as being the best fitting equation.

Import demand Equation for Functional Group: Beverages

13a $$M_{fb} = 3762.294 - \underset{(26.77)}{36.763} \left(\frac{P^m_{fb}}{P_h}\right) + \underset{(.001)}{.011} \left(\frac{Y}{P_h}\right) + \underset{(229.651)}{237.386} (D)$$

R2 = .986 S.E. = 381.020 D.W. = .455

$\underline{13a^1}$ $M_{fb} = -\ 819.316 - 26.861\ \frac{(P^m_{fb})}{(P_h)} + .063\ \frac{(Y)}{(P_h)}$
(15.753) (.013)

$R^2 = .835$ S.E. = 1542.400 D.W. = .384

$\underline{13b}$ $\log M_{fb} = 6.423 - 1.987 \log \frac{(P^m_{fb})}{(P_h)} + .857 \log \frac{(Y)}{(P_h)}$
(1.424) (.107)

$+\ .083\ (D)\ 11.49$
(.146)

$R^2 = .921$ S.E. = .211 S.W. = .375

$13b^1$ $\log M_{fb} = 7.371 + .190 \log \frac{(P^m_{fb})}{(P_h)} + 1.275 \log \frac{(Y)}{(P_h)}$
(.519) (.226)

$R^2 = .893$ S.E. = .196 D.W. = .347

$\underline{13.13a}$ $\frac{(M_{fb})}{(N)} = 3.781 + .005\ \frac{(P^m_{fb})}{(P_h)} + .004\ \frac{(Y)}{(P_h)}^0$
(.016) (.004

$+\ 3.168)\ (D)$
(1.286)

$R^2 = .782$ S.E. = 1.477 D.W. = 0.765

$\underline{13.13a^1}$ $\frac{(M_{fb})}{(N)} = -\ 5.632 - .121\ \frac{(P^m_{fb})}{(P_h)} + .068\ \frac{(Y)}{(P_h)}^0$
(.190) (.104)

$R^2 = .830$ S.E. = 6.235 D.W. = 1.016

$\underline{13.13b}$ $\log \frac{(M_{fb})}{(N)} = -\ 5.552 + .524 \log \frac{(P^m_{fb})}{(P_h)} + .981 \log \frac{(Y)}{(P_h)}^0$
(.535) (.323)

$+\ .250\ (D)$
(.160)

$R^2 = .900$ S.E. = .184 D.W. = 1.157

$\underline{13.13b^1}$ $\log \frac{(M_{fb})}{(N)} = 2.449 - 1.033 \log \frac{(P^m_{fb})}{(P_h)} + 1.019 \log \frac{(Y)}{(P_h)}^0$
(.325) (.136)

$R^2 = .914$ S.E. = .132 D.W. = 1.489

The relative price elasticity, as obtained from this equation, was marginally above unity. The fact that this coefficient did not differ significantly from unity indicates that the Barbadian consumer was not very sensitive to changes in the relative price of beverages. To some extent, such a result is surprising for given the penchant to impose high taxes on alcoholic beverages (so-called luxury items) we expected a higher price elasticity.

The above unity value of the income elasticity indicates that there has been a direct relationship between economic growth and beverage imports. In other words, our result shows that in general a 10 per cent increase in per capita income leads to 10.2 per cent increase on beverage import, if prices are assumed to be constant.

Import Demand Equations for the Functional Group: Consumer Durables

The share of consumer durables in the imports of consumer goods was nearly 11.49 per cent over the period, 1954 — 1970. However, the available evidence indicates that a rapid acceleration of this form of imports took place during the post-1960 period, that is, within the period of rapid industrialisation. This phenomena does not seem strange for it must be remembered that one of the consequences of Barbados' industrialisation programme was a general increase in disposable incomes and it is reasonable to assume that without Government's restrictions on the importation of consumer durables, a significant proportion of such increases in income would have gone towards the purchase of durables manufactured overseas.

The dependent variable was obtained by dividing the quantum of durable imports by its import index based on 1965 prices. In so far as the price index was concerned, adjustments, ideally should have been made for tariffs and taxes. Furthermore, the domestic wholesale price index for durables ought to have been utilised as the deflator of the adjusted import price index. However, this was not done on account of the paucity of data. As an alternative, we divided the All item Consumer Price Index into the unadjusted import price index of durables to form the relative price index.

The estimated linear and log-linear import demand equations obtained when both aggregate and per capita data were used are given below.

$$\underline{14a} \quad M_{fd} = -\ 1563.586 + \underset{(51.856)}{8.357}\ \frac{(P^{m}_{fd})}{(P_h)} + \underset{(.018)}{.043}\ \frac{(Y)}{(P_h)} + \underset{(1445.790)}{2060.772}\ (D)$$

$$R^2 = .859 \quad S.E. = 1488.531 \quad D.W. = 1.080$$

$$\underline{14a^1} \quad \underline{M_{fd}^*} = 27221.281 - \underset{(77.053)}{307.312} \left(\frac{P^m_{fd}}{P_h}\right) + \underset{(.021)}{.126} \left(\frac{Y}{P_h}\right)$$

$$R^2 = .923 \quad S.E. = 2884.441 \quad D.W. = 1.326$$

$$\underline{14b} \quad \log M_{fd} = -5.233 + \underset{(.542)}{.577} \log \left(\frac{P^m_{fd}}{P_h}\right) + \underset{(.293)}{.943} \log \left(\frac{Y}{P_h}\right) + \underset{(.162)}{.268} (D)$$

$$R^2 = .912 \quad S.E. = .185 \quad D.W. = 1.113$$

$$\underline{14b^1} \quad \log M_{fd}^* = 6.440 - \underset{(.303)}{1.287} \log \left(\frac{P_{fd}}{P_h}\right) + \underset{(.137)}{.766} \log \left(\frac{Y}{P_h}\right)$$

$$R^2 = .915 \quad S.E. = .142 \quad D.W. = 1.491$$

$$\underline{14.14a} \quad \left(\frac{M_{fd}}{N}\right) = -3.465 - \underset{(.182)}{.166} \left(\frac{P^m_{fd}}{P_h}\right) - + \underset{(.013)}{.072} \left(\frac{Y}{P_h}\right)^0 + \underset{(.002)}{.003} (D)$$

$$R^2 = .861 \quad S.E. = 5.912 \quad D.W. = 1.099$$

$$\underline{14.14a^1} \quad \underline{(M_{fd})^*} = 77.364 - \underset{(.336)}{1.075} \left(\frac{P^m_{fd}}{P_h}\right) + \underset{(.021)}{.161} \left(\frac{Y}{P_h}\right)^0$$

$$R^2 = .919 \quad S.E. = 11.357 \quad D.W. = 1.867$$

$$\underline{14.14b} \quad \log \left(\frac{M_{fd}}{N}\right)^* = 2.705 - \underset{(.275)}{.755} \log \left(\frac{P^m_{fd}}{P_h}\right) + \underset{(.314)}{.777} \log \left(\frac{Y}{P_h}\right)^0 + \underset{(.076)}{.265} (D)$$

$$R^2 = .950 \quad S.E. = .105 \quad D.W. = 1.520$$

$$\underline{14.14b^1} \quad \log \left(\frac{M_{fd}}{N}\right) = 3.456 - \underset{(.130)}{1.357} \log \left(\frac{P^m_{fd}}{P_h}\right) + \underset{(.131)}{1.088} \log \left(\frac{Y}{P_h}\right)^0$$

$$R^2 = .942 \quad S.E. = .094 \quad D.W. = 2.590$$

As our estimated results show, the explanatory power of all of the estimated equations was quite high, varying from .859 to .942 depending on the functional form, type of data and combination of explanatory variables.

However, it is interesting to note that when both the linear and log-linear functional forms were applied to the aggregated data, the exclusion of the dummy variable (D) led to a significant improvement in the fit. To a larger extent, this peculiar state of affairs may have been due to serial correlation in the error terms. Thus in variants of the models where the dummy variable is an explanatory variable, the values of the D.W. statistics are quite low varying from 1.080 to 1.113. The use of per capita data led to some improvement in the fit of the linear model, R^2 being .861 and .919 when the dummy variable was included and excluded respectively.

The log-linear model fitted the per capita data much more adequately than the former model and here we have the R^2 varying from .950 to .942 when the dummy variable was included and excluded respectively. It must be noted, however, that the linear model still indicated a high incidence of serial correlation in the error term.

Turning to the regression coefficients, our results show that all had the theoretically correct signs and in almost every case were statistically significant, the only exception to this general rule being equation (14.14a) where the relative price parameter was statistically insignificant. On the basis of R^2, standard errors and D.W. statistic, we chose equations ($14a^1$), $14d^1$), (14.14^1) and ($14.14b^1$) as the best fitting variants of the linear and log-linear formulations of the import demand equations for durables.

From Table A2 we see that the activity elasticity for durable imports varies from .766 to 3.153 depending on the combination of explanatory and functional forms. These below unity values of the activity elasticity were not entirely unsuspected in that it clearly reflects the view that was previously held that the thrust of the Barbados industrialisation programme, while geared towards import replacement, did not attain the results that were expected.

A high degree of variation was also evident in the relative price elasticity which varied from 1.287 to 4.586. The greater than unity values of this parameter clearly indicate that over the period of analysis Barbadian consumers were not insensitive to changes in the relative prices of durables.

Import Demand Equations for the Functional Group: Non-Durables

Non-durables constituted nearly 15.50 per cent of total Barbados imports of consumer goods over the period 1954—1970. This group included textiles and medicine which accounted for approximately 37.2 per cent and 29.5 per cent respectively of total consumer goods imports. In our estimation of the import demand equations, the dependent variable was obtained by aggregating the physical quantities of its components.

To measure the substitutability between imported and domestically produced non-durables, the domestic prices entering the demand equation for non-durables should be represented by the price of non-durables produced at home. Unfortunately, the unavailability of such an index forced us to introduce the All item Consumer Price Index into the equations. To measure the effect of sterling devaluation in 1967, the dummy variable (D) taking the value of unity in 1967 and subsequent years and zero elsewhere was introduced in to the various formulations of the import demand equation for non-durables. The estimated equations for both the linear and log-linear functional forms are given below.

15a $$M_{fnd} = 21511.160 - \underset{(88.660)}{202.157} \frac{(P^m_{fnd})}{(P_h)} + \underset{(.024)}{.097} \frac{(Y)}{(P_h)} + \underset{(2802.232)}{.5582.738} (D)$$

$R^2 = .941$ S.E. $= 2619.974$ D.W. $= 1.899$

15a[1] $$M_{fnd}^* = 28025.301 - \underset{(23.373)}{340.418} \frac{(P^m_{fnd})}{(P_h)} + \underset{(.011)}{.147} \frac{(Y)}{(P_h)}$$

$R^2 = .973$ S.E. $= 1289.444$ D.W. $= 2.238$

15b $$\log M_{fnd} = 6.318 - \underset{(.381)}{.957} \log \frac{(P^m_{fnd})}{(P_h)} + \underset{(.158)}{.650} \log \frac{(Y)}{(P_h)} + .193\ D$$

$R^2 = .926$ S.E. $= .138$ D.W. $= 2.069$

15.b[1] $$\log M_{fnd}^* = 2.968 - \underset{(.128)}{1.356} \log \frac{(P^m_{fnd})}{(P_h)} + \underset{(.114)}{1.088} \log \frac{(Y)}{(P_h)}$$

$R^2 = .948$ S.E. $= .093$ D.W. $= 2.218$

15.15a
$$\frac{(M_{fnd})}{(N)} = 75.973 - \underset{(.266)}{.788}\,\frac{(P^{m}_{fnd})}{(P_h)} + \underset{(.021)}{.114}\,\frac{(Y)^0}{(P_h)} + \underset{(7.587)}{26.085)}\,(D)$$

$R^2 = .959$ S.E. $= 8.529$ D.W. $= 1.153$

15.15a[1]
$$\frac{(M_{fnd})^*}{(N)} = 120.667 - \underset{(.096)}{1.481}\,\frac{(P^{m}_{fnd})}{(P_h)} + \underset{(.012)}{.150}\,\frac{(Y)^0}{(P_h)}$$

R2 $= .970$ S.E. $= 5.223$ D.W. $= 2.344$

15.15b
$$\log \frac{(M_{fnd})^*}{(N)} = 4.441 - \underset{(.127)}{1.217}\,\log \frac{(P^{m}_{fnd})}{(P_h)} + \underset{(.156)}{.830}\,\log \frac{(Y)^0}{(P_h)} + \underset{(.072)}{(.172)}\,(D)$$

$R^2 = .960$ S.E. $= .081$ D.W. $= 1.315$

15.15b[1]
$$\log \frac{(M_{fnd})}{(N)} = -\ 11.630 - \underset{(.244)}{.176}\,\log \frac{(P^{m}_{fnd})}{(P_h)} + \underset{(.301)}{.252}\,\log \frac{(Y)^0}{(P_h)}$$

$R^2 = .929$ S.E. $= .270$ D.W. $= 1.591$

It is obvious from the above estimated equations that the regression coefficients had the theoretically expected signs and were all statistically significant at the 10 per cent level, the only exception being equation ($15.15b^1$) where the relative price coefficient was insignificant. It also seems from the high values of the Durbin-Watson statistic that serial correlation did not pose a problem, except in the case of equations (15.15a) and (15.15b) where the D.W. statistic fell in the inconclusive range.

Reverting to our use of the well discussed criteria of R^2,s, standard errors and D.W. statistic, we selected equations ($15a^1$), ($15b^1$), ($15.15a^1$) and 15.15b) as being the best fitting equations. From Table A2 we see that the import demand elasticities with respect to relative prices were well above unity when the models were applied to the aggregated data. Conversely, the relative price elasticity obtained from the models based on per capita data tended to be quite small. The wide variations in the magnitudes of the above elasticities are of interest because they indicate that, while on an aggregated basis Barbadian consumers consider non-durable imports as luxuries, this is no longer the case when the effects of population changes and its redistributive effect is taken into consideration (that is, non-durable imports are looked upon as necessities in this case).

The real income elasticity obtained from the selected equations ranged from 1.088 to 1.076 and these high values clearly suggest that the level of economic activity (income) played an important role in Barbados demand for non-durables. Overall, the real income variable seemed to have been mainly responsible for Barbados' import demand for durables over the period of analysis.

Import Demand Equations for the Functional Group: Raw Materials

One of the peculiarities of Barbados industrialisation in post-war years is that it was largely based on the raw materials from foreign sources. To some extent, this heavy emphasis on imported raw materials can be attributed to the fact that Barbados has mainly been a monocrop economy and whatever linkages existed between the agricultural and industrial sectors were marginal.

Over the period 1954 — 1970, imports of raw materials represented nearly 29.1 per cent of total imports. But it must be clearly understood that this group of imports consisted of a conglomerate of commodities. In this context, oil seeds seemed to have formed the bulk of raw material imports and over the period of analysis represented nearly 36.7 per cent of this group. Smaller in volume, but of no less importance, were items such as animal feeds and tobacco which represented 32.8 and 18.5 per cent respectively of total raw material imports.

Turning to the variables included in the estimated equations, the dependent variable (aggregate and per capita raw material imports) were obtained by simply aggregating the current values of the components of the group and dividing the total value by the appropriate import price index and total population respectively. In so far as the explanatory variables, relative price, real G.D.P. and the dummy variable were concerned, more or less the same procedure outlined above in the case of consumer goods was followed. It must be noted however, that because raw material imports were in the main utilised by the industrial sector in the production of final goods, a more appropriate variable for capturing the level of economic activity in the industrial production. Nevertheless, it was impossible to obtain the required series due to the paucity of data on industrial production and, as a proxy, we used real G.D.P.

Additionally, as some raw materials were produced locally over a period of analysis, a problem existed in obtaining the price index for the domestic component of the relative price variable. Faced with such a problem, we again resorted to the use of a proxy for domestic prices and in this case use was made of the All Item Consumer Price Index.

The estimated equations that were obtained by applying both the linear and log-linear functional forms to be aggregated and per capita data are presented below.

16a
$$Mraw^* = 2586.984 - \underset{(83.850)}{343.696} \frac{(P_{raw})}{(P_h)} + \underset{(.037)}{.270} \frac{(Y)}{(P_h)} + \underset{(3816.496)}{6459.133} (D)$$

$R^2 = .974$ S.E. 3221.867 D.W. = 2.215

16a[1]
$$Mraw = 16571.445 - \underset{(70.686)}{294.923} \frac{(P^m_{raw})}{(P_h)} + \underset{(.039)}{.255} \frac{(Y)}{(P_h)}$$

$R^2 = .867$ S.E. = 4672 D.W. = 1.788

16b
$$\log Mraw^* = 2.460 - \underset{(.240)}{.891} \log \frac{(P^m_{raw})}{(P_h)} + \underset{(.160)}{1.007} \log \frac{(Y)}{(P_h)} + \underset{(.51)}{.108} (D)$$

$R^2 = .957$ S.E. = .104 D.W. = 1.694

$$\log Mraw = .778 - \underset{(.188)}{.867} \log \frac{(P^m_{raw})}{(P_h)} + \underset{(.206)}{1.249} \log \frac{(Y)}{(P_h)}$$

$R^2 = .853$ S.E. = .171 D.W. = 1.354

16.16a
$$\frac{(Mraw)^*}{(N)} = 111.026 - \underset{(.353)}{1.482} \frac{(P^m_{raw})}{(Ph)} + \underset{(.042)}{.272} \frac{(Y)^0}{(Ph)} + \underset{(15.891)}{25.038} (D)$$

R2 = .969 S.E. = 13.662 D.W. = 2.069

16.16a[1]
$$\frac{(Mraw)}{(N)} = 68.090 - \underset{(.292)}{1.280} \frac{(P^m_{raw})}{(P_h)} + \underset{(.045)}{.265} \frac{(Y)^0}{(P_h)}$$

R2 = .848 S.E. = 19.462 D.W. = 1.694

16.16b $\log \frac{(Mraw)}{(N)} = 3.001 - \underset{(.133)}{.708} \log \frac{(P^m_{raw})}{(P_h)} + \underset{(.198)}{.744} \log \frac{(Y)^0}{(P_h)}$

$+ \underset{(.415)}{.772} (D)$

$R2 = .934$ S.E. $= .114$ D.W. $= .813$

16.16b1 $\log \frac{(Mraw)^*}{(N)} = 6.070 - \underset{(.355)}{1.259} \log \frac{(P^m_{raw})}{(P_h)} + \underset{(.067)}{.678} \log \frac{(Y)^0}{(P_h)}$

$R2 = .960$ S.E. $= .061$ D.W. $= 1.403$

As indicated by the results given above all of the estimated parameters had the correct signs and were statistically significant at the 2 per cent or more level. It can also be observed that unlike the case of consumer goods imports, the inclusion of the dummy variable in the estimated equations led to significant improvements in the fit of both functional forms.

Using our general criteria, we selected equations (16a), (16b), (16.16a), (16.16b1) as being the best variants of the import demand equation for raw materials. Overall these four equations show that our choice of explanatory variables was quite adequate for they were able to explain over 95 per cent of the variations in raw material imports.

As Table A2 shows, the price elasticity varies from between —0.884 to —1.259 per cent depending on the functional form, type of data and combination of explanatory variable. To some extent, these results are surprising, for given the Barbados heavy dependence on foreign source of raw materials we expected much lower values. Nevertheless, these values do indicate that there is marginal room for substitution between domestically produced and imported raw materials.

The activity elasticities obtained confirmed our aprori expectations as to their signs and magnitudes. The above unity values support the view which is generally held that in a developing economy such as Barbados any increase in the level of industrial production leads to a corresponding increase in raw material imports.

Import Demand Equations for Functional Group: Agricultural and Other Raw Materials

In as much as Barbados is mainly an agricultural based economy, it is expected that agricultural raw materials such as fertilizers and pêsticides would form major components of raw material imports. Evidently, this was the case over our period of analysis, for the available figures indicate that agricultural raw material imports represented over

52.67 per cent of total raw material imports, approximately 15.30 per cent of all imports. Of this form of imports, fertilisers formed the bulk, that is 50 per cent closely followed by seeds.

Utilising the quantum of farm raw materials as the dependent variables and relative prices and real G.D.P. as the activity variable, we applied both the linear and log-linear models to aggregate data. In addition to preceding models no subject was extended to per capita data to test the effect of population growth as well as the inclusion of a dummy variable in the equation undertaken in order to examine the effect of the devaluation of the pound sterling in 1967. The estimated equations we obtained are given below:

$$\underline{17a}\ Mfarm = 28809 - \underset{(23.535)}{316.102}\ \frac{(P^m_{farm})}{(P_h)} + \underset{(.014)}{.123}\ \frac{(Y)}{(P_h)} + \underset{(1108.761)}{2423.788}\ (D)$$

$R^2 = .981$ S.E. = 1144.239 D.W. = 1.651

$$\underline{17a^1}\ Mfarm = -5586.344 - \underset{(32.746)}{73.654}\ \frac{(P^m_{farm})}{(P_h)} + \underset{(.021)}{.158}\ \frac{(Y)}{(P_h)}$$

$R^2 = .928$ S.E. = 2852.911 D.W. = 1.578

$$\underline{17b}\ \log \underline{Mfarm} = 4.922 - \underset{(.126)}{1.229}\ \log \frac{(P^m_{farm})}{(P_h)} + .872 \log \frac{(Y)}{(P_h)} + \underset{(.073)}{.164}\ (D)$$

$R^2 = .963$ S.E. = .082 D.W. = 1.395

$$\underline{17b^1}\ \log Mfarm = -15.585 - \underset{(.235)}{.297}\ \log \frac{(P^m_{farm})}{(P_h)} + \underset{(.221)}{2.194}\ \log \frac{(Y)}{(P_h)}$$

R^2 S.E. = .225 D.W. = 1.652

$$17.17a\ \frac{(Mfarm)}{(N)} = 125.105 - \underset{(.098)}{1.383}\ \frac{(P^m_{farm})}{(P_h)} + \underset{(.016)}{.125}\ \frac{(Y)^0}{(P_h)} + \underset{(4.512)}{9.425}\ (D)$$

$R^2 = .980$ S.E. = 4.690 D.W. = 1.431

$$\underline{1717a^1}\ \underline{(Mfarm)} = -48.670 - \underset{(.164)}{.212}\ \frac{(P^m_{farm})}{(P_h)} + \underset{(.028)}{.192}\ \frac{(Y)^0}{(P_h)}$$

$R^2 = .905$ S.E. = 14.203 D.W. = 1.601

$$\underline{17.17b}\ \log \frac{(Mfarm)}{(N)} = -11.593 - \underset{(.333)}{0.811} \log \frac{(P^m_{farm})}{(P_h)} + \underset{(.355)}{2.449} \log \frac{(Y)^0}{(P_h)} + \underset{(.290)}{.126}\ (D)$$

$R^2 = .930$ S.E. = .278 D.W. = 1.266

$$\underline{1717b^1}\ \log \frac{(Mfarm)}{(N)} = 3.084 - \underset{(.223)}{1.339} \log \frac{(P^m_{farm})}{(P_h)} + \underset{(.136)}{.980} \log \frac{(Y)^0}{(P_h)}$$

$R^2 = .893$ S.E. = .104 D.W. = .358

Our results indicate that both the functional forms chosen and the combination of explanatory variables fit the data quite adequately. In this context, no less than 89 per cent of the variation in agricultural raw material imports was explained by the combination of explanatory variables.

Furthermore, the signs of the estimated parameters conformed to economic theory in all equations. On the basis of R^2, standard errors and D.W. statistic, we chose equations (16a), (16b), (16.16a), (16.16b) as the best fitting equations, when aggregate and per capita data respectively, were utilised. On Table A2, it can be observed that the activity elasticity extends from .946 to .980 depending on the combination of explanatory variables and the functional form utilised.

These results were not unsuspected given the emphasis which the Barbadian Government had placed on import replacement in recent years. In so far as the price elasticities are concerned the values were all above unity, thus indicating that not only had Barbadian consumers been price sensitive but, in addition, they showed that substantial economies were obtained with an increase in the domestic production of agricultural raw materials. It is also important to note that most of the variation in this form of imports can be attributed to price changes as the magnitude of the price coefficients exceeded the corresponding values of the activity variable, national income.

Import Demand Equations for Functional Group: Industrial Fuels

This group represents one of the most important forms of imports coming into Barbados and consists mainly of petroleum products such as aviation fuel and kerosene. Over the period, 1954—1970, its importance can be gauged from the fact that it represented over 27.43 per cent of raw material imports in value and in terms of importance was second only to food. In so far as the demand equations were concerned, the dependent variable was obtained in the usual way, that is, by dividing the price index into the total value of industrial fuel imports. The explanatory variables that were used in the demand equations however, posed some problems. In this respect the completion of the oil refinery in Barbados in 1968 meant that allowances ought to have been made in the relative variable for domestic production. Inasmuch as this was not done in the exercise, it meant that the estimated parameters for relative price may be inflated upwards.

Similarly, problems also exist in the activity variable, for since the industrial fuel that was imported was destined for the industrial sector as raw materials inputs levels of industrial production would have been the appropriate activity variable. Notwithstanding this apparent shortcoming in the estimation of the demand function, we felt that real G.D.P. serves as an ideal proxy for industrial production because to a large extent it mirrors the industrial growth of the economy.

Utilising the preceding variables, in addition to the dummy variable discussed previously, we estimated the following equations:

$$\underline{18a}\ Mfif = -\ 6175.578 - \underset{(36.480)}{26.494}\ \frac{(P^{m}_{fif})}{(P_h)} + \underset{(.023)}{.127}\ \frac{(Y)}{(P_h)} + \underset{(2714.064)}{5844.211}\ D$$

$$R^2 = .947 \quad S.E. = 2541.812 \quad D.W. = 2.078$$

$$\underline{18a1}\ Mfif = 12517.516 - \underset{(23.084)}{131.534}\ \frac{(P^{m}_{fif})}{(P_h)} + \underset{(.006)}{.044}\ \frac{(Y)}{(P_h)}$$

$$R^2 = .899 \quad S.E. = 863.400 \quad D.W. = 1.958$$

$$\underline{18b}\ \log Mfif = -\ 14.816 - \underset{-(.0517)}{.102}\ \log \frac{(P^{m}_{fif})}{(P_h)} + \underset{(.254)}{2.053}\ \log \frac{(Y)}{(P_h)} + \underset{(.236)}{.259}\ (D)$$

$$R^2 = .954 \quad S.E. = .223 \quad D.W. = 1.530$$

$$\underline{18b}\ \log Mfif = 10.627 - \underset{(.475)}{1.083} \log \frac{(P^{m}_{fif})}{(P_h)} + \underset{(.098)}{.258} \log \frac{(Y)}{(P_h)}$$

$R^2 = .586$ S.E. $= .205$ D.W. $= 1.495$

$$\underline{18.18a}\ \frac{(Mfif)}{(N)} = - 48.960 - \underset{(.208)}{.146} \frac{(P^{m}_{fif})}{(P_h)} + \underset{(.036)}{.181} \frac{(Y)^0}{(P_h)} + \underset{(15.272}{8.166} (D)$$

$R^2 = .908$ S.E. $= 14.580$ D.W. 1.514

$$\underline{18.18b}\ \frac{M_{fif}}{(N)} = 37.660 - \underset{(.070)}{.460} \frac{(P^{m}_{fif})}{(P_h)} + \underset{(.006)}{.054} \frac{(Y)^0}{(P_h)}$$

$R^2 = .925$ S.E. $= 2.857$ D.W. $= 1.615$

$$\log \frac{(M_{fif})}{(N)} = 3.587 - \underset{(.242)}{1.069} \log \frac{(P^{m}_{fif})}{(P_h)} + \underset{(.183)}{.707} \log \frac{(Y)^0}{(P_h)} + \underset{(.089)}{.179} (D)$$

$R^2 = .920$ S.E. $= .094$ D.W. $= 1.394$

$$\underline{18.18b^1}\ \log \frac{(M_{fif})}{(N)} = 4.665 - \underset{(.328)}{.752} \log \frac{(P^{m}_{fif})}{(P_h)} + \underset{(.233)}{.363} \log \frac{(Y)^0}{(P_h)}$$

$R^2 = .568$ S.E. $= .222$ D.W. $= 1.594$

As the results show, the devaluation of the pound sterling in 1967 seemed to have influenced Barbados import demand for industrial fuels. However, such influence does not seem to have been strong, for the estimated parameters were small, though statistically significant. With respect to the estimated parameters for the other explanatory variables, these were all theoretically correct although in the case of both linear and log-linear models the coefficients of the relative price variable were not statistically significant.

On the basis of R^2, standard errors and D.W. statistics, the best equations for industrial fuels were the following: (18a), (18b), ($18.18a^1$) and ($18.18b^1$). As these equations clearly show, the activity elasticity was well above unity which indicates a proportional relationship between imported fuels and the level of economic growth of the Barbadian economy. This result is of course not too surprising bearing in mind the limited size of the Barbados oil refinery.

With regard to the price elasticities, it will be observed that these are well below unity with corresponding small standard errors in the case of the log-linear models. Overall, the price elasticities range between .102 and —1.069 depending upon the combination of explanatory variables and type of data utilised. The negative sign of the relative price coefficient means that an increase in the relative price of industrial fuel imports will, *ceteris paribus*, reduce the demand for fuel.

Finally, it is interesting to note that most of the explanation of industrial fuel imports was due to the activity variable, real G.D.P.

Imports Demand Equations for Functional Group: Industrial Chemicals

Imports of industrial chemicals represented nearly 19.89 per cent of raw material imports over the period of analysis. The bulk of imported industrial chemicals consisted of fertilisers. Nevertheless a small but not unimportant quantity of industrial chemical imports consisted of cosmetics. In order to derive the dependent variable, we aggregated the physical quantity of the components indicated above at current prices and divided the whole series by the relevant import price index based on 1965 prices. Like all the other sections of this exercise, the level of domestic prices was represented by the All Item Consumer Price Index. Because Barbados is in the early stages of industrialisation, the domestic chemical industry is rather underdeveloped thus, we expect marginal substitutability between imported and domestically produced chemicals.

To measure the effect of domestic economic activity on chemical imports, real G.D.P. was used as the activity variable. The import demand equations for industrial chemicals were fitted to aggregate and per capita data using the two functional forms. The estimated equations are presented below:

$$\underline{19a}\ Mfic = 9865.566 - \underset{(18.610)}{117.823}\ \frac{(P^m_{fic})}{(P_h)} + \underset{(.005)}{.053}\ \frac{(Y)}{(P_h)} + \underset{(.101)}{.315}\ (D)$$

$$R^2 = .944 \quad S.E. = 676.520 \quad D.W. = 1.879$$

$$\underline{19a^1}\ Mfic = 11084 - \underset{(30.175)}{41.078}\ \frac{(P^m_{fic})}{(P_h)} + \underset{(.006)}{.007}\ \frac{(Y)}{(P_h)}$$

$$R^2 = .437 \quad S.E. = 1992.867 \quad D.W. = 1.750$$

$$\underline{19b}\ \log Mfic = 10.254 - \underset{(.337)}{.683} \log \frac{(P^{m}_{fic})}{(P_h)} + \underset{(.074)}{.131} \log \frac{(Y)}{(P_h)} + \underset{(.098)}{.405}\ (D)$$

$R^2 = .847$ S.E. = .140 D.W. = .698

$$\underline{19b^1}\ \log Mfic = 8.152 - \underset{(.305)}{.542} \log \frac{(P^{m}_{fic})}{(P_h)} + \underset{(.133)}{.278} \log \frac{(Y)}{(P_h)}$$

$R^2 = .567$ S.E. = .211 D.W. = 1.401

$$\underline{19.19a}\ \frac{Mfic}{(N)} = 37.598 - \underset{(.078)}{.390} \frac{(P^{m}_{fic})}{(P_h)} + \underset{(.009)}{.042} \frac{(Y)^0}{(P_h)} + \underset{(2.684)}{4.506}\ (D)$$

$R^2 = .939$ S.E. = 2.688 D.W. = 1.487

$$\underline{19.19a^1}\ \frac{(Mfic)}{(N)} = 47.969 - \underset{(.126)}{.276} \frac{(P^{m}_{fic})}{(P_h)} + \underset{(.015)}{,025} \frac{(Y)^0}{(P_h)}$$

$R^2 = .575$ S.E. = 8.352 D.W. = 1.717

$$\underline{19.19b}\ \log \frac{(Mfic)}{(N)} = 6.635 - \underset{(.278)}{.699} \log \frac{(P^{m}_{fic})}{(P_h)} + \underset{(.247)}{.005} \log \frac{(Y)^0}{(P_h)} + \underset{(.150)}{.369}\ (D)$$

$R^2 = .733$ S.E. = .190 D.W. = 1.404

$$\underline{19.19b^1}\ \log \frac{(Mfic)}{(N)} = -3.025 - \underset{(.337)}{1.520} \log \frac{(P^{m}_{fic})}{(P_h)} + \underset{(.334)}{1.939} \log \frac{(Y)^0}{(P_h)}$$

$R^2 = -857$ S.E. = .294 D.W. = − 2.076

As can be seen from the above equations, all of the estimated coefficients had the expected signs, and in most cases were statistically significant. The only exception being equation 19.19b where the activity variable, although having the correct sign, was statistically significant.

The significant improvement in R^2, when the dummy variable was included in the estimated equation, clearly indicated that the devaluation of the pound sterling in 1967 had an impact upon Barbados imports of industrial chemicals. In addition, if we compare both log-linear and linear functional forms it would seem that the latter formulation gives a better fit to the sample of data than the former.

On the basis of R^2, standard errors and D.W. statistics, we chose equations (19a), (19b), ($19.19a^1$), $19.19b^1$) as being the best fitting variants of Barbados imports demand equations for industrial fuels. The estimated values of activity elasticities in Table A2 indicate very little variation in the magnitudes of these elasticities. It is also quite noticeable that in both models activity elasticities are in the neighbourhood of unity.

These values are not too surprising given the development of chemical industries in Barbados. In other words, the results given above clearly indicate a technological relationship between imported raw chemical inputs and the growth of the domestic chemical industry. The magnitude of the price elasticity ranges from —1.195 to —1.520 depending upon the functional form and type of data utilised.

Two explanations come readily to hand for the high values of the price elasticities. Firstly, as was indicated earlier, Barbados did make some progress in its industrialisation programme (albeit marginal) and one of the most important areas of industrial activity was in the manufacture of chemical products, especially pesticides for the sugar industry and in pharmaceutical products. Consequently, there existed a high margin of substitutability between home produced and imported chemical products. Secondly, the Barbadian consumer did not have a preference for imported chemical products; hence it was not considered as a necessity.

Import Demand Equations for the Functional Group: Capital Goods

The share of capital imports in total imports averaged a little over 22.93 per cent during the period, 1954—1970. Of this category of imports, the major share was in the form of machinery, with construction materials and transport equipment taking the second and third place respectively.

As Barbados can be identified as being in the lower end of the spectrum of underdeveloped economies, she has to rely to a large extent on capital imports both for the renewal of old machinery and for the expansion of her capital stock. In other words, this means that there was minimal competition between home produced and imported capital goods within Barbados over the period of analysis. In so far as the variables used in the various estimating equations were concerned, the dependent variable represented physical quantities, while the relative price was the ration of import prices to the All Item Consumer Price Index.

The import demand functions for capital goods were then fitted to aggregate and per capita data. The results thus obtained are presented below:

20a $Mcap = 24140.141 - \underset{(47.675)}{241.884} \frac{(P^m_{cap})}{(P_h)} + \underset{(.034)}{.153} \frac{(Y)}{(P_h)} + \underset{(2691.006)}{11981.887} (D)$

$R^2 = .950$ S.E. = 3051.341 D.W. = 0.829

20a[1] $Mcap^* = 35637.453 - \underset{(91.399)}{301.094} \frac{(P^m_{cap})}{(P_h)} + \underset{(.011)}{.130} \frac{(Y)}{(P_h)}$

$R^2 = .970$ S.E. = 1465.713 D.W. = 1.487

20b $\log Mcap = 3.830 - \underset{(.130)}{.714} \log \frac{(P^m_{cap})}{(P_h)} + \underset{(.173)}{.795} \log \frac{(Y)}{(P_h)} + \underset{(.156)}{.403} (D)$

$R^2 = .942$ S.E. = .114 D.W. = .850

20b[1] $\log Mcap^* = 7.247 - \underset{(.215)}{1.244} \log \frac{(P^m_{cap})}{(P_h)} + \underset{(.062)}{.722} \log \frac{(Y)}{(P_h)}$

$R^2 = .968$ S.E. = .063 D.W. = 1.400

20.20a $Mcap = 105.473 - \underset{(.204)}{1.055} \frac{(P^m_{cap})}{(P_h)} + \underset{(.039)}{.153} \frac{(Y)^0}{(P_h)} + \underset{(11.227)}{48.948} (D)$

$R^2 = .941$ S.E. = 12.871 D.W. = 0.866

20.20a[1] $\frac{(Mcap)^*}{(N)} = 159.602 - \underset{(.380)}{1.322} \frac{(P^m_{cap})}{(P_h)} + \underset{(.012)}{.123} \frac{(Y)^0}{(P_h)}$

$R^2 = .962$ S.E. = 6.043 D.W. = 1.511

$$\underline{20.20b}\ \log \frac{(Mcap)^*}{(N)} = 6.104 - \underset{(.454)}{1.268} \log \frac{(P^m{}_{cap})}{(P_h)} + \underset{(.080)}{.679} \log \frac{(Y)}{(P_h)}$$

$$- \underset{(.061)}{.002}\ (D)$$

$R^2 = .960 \quad S.E. = .063 \quad D.W. = 1.612$

$$\underline{20.20b^1}\ \log \frac{(Mcap)}{(N)} = -2.632 + \underset{(.041)}{.045} \log \frac{(P^m{}_{cap})}{(P_h)} + \underset{(.211)}{.690} \log \frac{(Y)^0}{(P_h)}$$

$R^2 = .651 \quad S.E. = .210 \quad D.W. = 2.612$

From our results above, it can be seen that the coefficients of determination were on the whole fairly high, varying from .651 to 970 depending upon the combination of explanatory variables, type of data and functional form. The estimated parameters had the correct signs and with the exception of the dummy variable parameter in equation (20.20b) were statistically significant at the 5 per cent level or more.

It can be observed, however, that the incidence of serial correlation was particularly high when the dummy variables were included in the estimated equations. The fact that the exclusion of the above variable led to an improvement in the value of the Durbin-Watson statistic signals mis-specification of the above models. The relatively low standard errors of the activity variable clearly indicate that this variable is doing all the work in the estimated equations.

Utilising the criteria of R^2 standard errors and D.W. statistic, equations ($20a^1$), (20b), $12.12a^1$) and ($12.12b^1$) were selected as the best fitting equations. As we expected, the activity elasticities were low (varying from .722 to .725). Since capital goods imports are used by the industrial sector for the production of critical components in the manufacturing process, they cannot be considered as being luxuries; thus a below unity activity elasticity seems reasonable. Taking the relative price elasticities at their face value, their sizes clearly indicate that there are quite important substitution possibilities between imported and home produced capital goods.

Import Demand Equations for the Functional Group: Construction Materials

As we indicated in Chapter One in the Barbadian industrial base was relatively small over the period of analysis and thus great reliance was placed on crude material imports. In this respect, construction material imports represented over 33.34 per cent of capital goods imports and nearly 7.65 per cent of total imports over the period 1954—1970.

While this form of import consisted of heterogeneous group of commodities, it is still possible to identify some of its major components. Thus, the bulk of construction material imports consisted of iron and steel building materials, but a slightly less proportion consisted of items such as wood, tractors and road building equipment.

Since precise definitions have been given in Appendix 2 of both the data and variables utilised in the study, we shall not go into a detailed discussion of these at this point. Nevertheless, a few comments on the deflation of the import price index for construction material seem appropriate. In this context, it is important to note that in our analysis the consumer price index was used as a proxy for the price of domestically produced as well as important construction materials.

The assumption underlying this usage was that the price of domestically produced construction materials was crudely linked to the price of other consumer goods. In other words, the view was held that the behaviour of the price index of construction material was similar to the behaviour of the All Item Consumer Price Index.

By applying both the linear and log-linear functional forms to aggregate and per capita yearly observations for the period 1954—1970, we obtained the results given below:

21a $$Mfcn = \underset{}{11112.281} - \underset{(18.099)}{42.784} \left(\frac{P^m_{fcm}}{P_h}\right) + \underset{(.008)}{.004} \left(\frac{Y}{P_h}\right) + \underset{(774.681)}{3944.506}\ (D)$$

$$R^2 = .854 \quad S.E. = 1195.147 \quad D.W. = .641$$

21a[1] $$Mfcm^* = 2510.559 - \underset{(15.699)}{82.243} \left(\frac{P^m_{fcm}}{P_h}\right) + \underset{(.008)}{.056} \left(\frac{Y}{P_h}\right)$$

$$R^2 = .908 \quad S.E. = 1056.722 \quad D.W. = 1.755$$

21b $$\log Mfcm = 9.707 - \underset{(.218)}{.556} \log \left(\frac{P^m_{fcm}}{P_h}\right) + \underset{(.095)}{.146} \log \left(\frac{Y}{P_h}\right) + \underset{(.097)}{.405}\ (D)$$

$$R^2 = .844 \quad S.E. = .143 \quad D.W. = 1.005$$

$$\underline{21b^1} \log Mfcm^* = -6.275 - \underset{(.314)}{1.430} \log \frac{(P^m_{fcm})}{(P_h)} + \underset{(.276)}{1.744} \log \frac{(Y)}{(P_h)}$$

$R^2 = .872$ S.E. = .075 D.W. = 1.899

$$\underline{21.21a}\ (Mfcm) = 60.460 - \underset{(.111)}{.267} \frac{(P^m_{fcm})}{(P_h)} - \underset{(.018)}{.002} \frac{(Y)^0}{(P_h)} + \underset{(6.172)}{14.176} (D)$$

$R^2 = .724$ S.E. = 7.310 D.W. = 1.410

$$\underline{21.21a^1}\ \frac{(Mfcm)^*}{(N)} = 8.617 - \underset{(.077)}{.379} \frac{(P^m_{fcm})}{(P_h)} + \underset{(.010)}{.066} \frac{(Y)}{(P_h)}$$

$R^2 = .886$ S.E. = 5.182 D.W. = 2.111

$$\underline{21.21b^1} \log \frac{(Mfcm)}{(N)} = -.510 - \underset{(.393)}{.968} \log \frac{(P^m_{fcm})}{(P_h)} + \underset{(.470)}{1.148} \log \frac{(Y)}{(P_h)} + \underset{(.270)}{.585} (D)$$

$R^2 = .897$ S.E. = .261 D.W. = .964

Notice that all of the relative price coefficients had the correct signs and were statistically significant at the 5 per cent or more level. This tendency was also evident in the case of the parameters of the dummy variable(D). However, the results obtained for the relative price parameters deviated to some extent from this trend. In this respect, it can be observed that two of the estimated equations (21a) and ($21.21b^1$) had small and statiscally insignificant relative price coefficients. Furthermore, in the latter equation given above, the price coefficient had a theoretically incorrect sign. The miniscule Durbin-Watson statistic in equations (21a), (21b) and ($21.21b^1$) clearly indicates that these equations were mis-specified. Such mis-specification probably arises from the fact that over the period of analysis the extremely high rate of increase in Barbados crude material imports reflects, in part, the large expenditure undertaken by firms under Government's incentive legislation. Since the influence of such legislation was not represented in the estimating equations by a separate variable, its effects were incorrectly attributed to changes in relative prices, real disposable income and the devaluation of the pound sterling in 1967.

Notwithstanding the above shortcomings, all of the equations explain the data well, with R^2 varying from .724 to .908. On the basis of our general criteria of R^2, standard error and D.W. statistic we chose equations ($21a^1$), (21b), and ($21.21b^1$) as the best representatives of the import demand equation of crude materials.

The less than unity value of the relative price elasticity given on Table A2 clearly shows that crude material imports were treated as a necessity by Barbados consumers. On the other hand, the greater than unity activity elasticity indicates that crude material imports varied directly with the level of economic activity within the Barbadian economy. The relatively low value of the standard error of the activity coefficient, as compared to that of the price coefficient, indicates that changes in the level of economic activity were mainly responsible for changes in Barbados crude material imports.

Import Demand Equations for the Functional Group: Transport Equipment

Transport equipment both for private and official use was one of the most important components of Barbados capital imports over the period 1954—1970. In 1954, this group of imports represented over 10—41 per cent of capital imports in terms of value. However, by 1970 the figure rose by nearly 4.00 per cent 14.23 per cent. The bulk of transport equipment consisted of motor cars (50.31 per cent), trucks and buses (37.24 per cent). Turning to the variables utilised in the various equations, it can be noted that the relative prices, real G.D.P. and dummy variable play the same role in the import demand for transport equipment as in the other commodity groups.

Thus the variable, Pm fte/Pd, indicates changes in the relation between Barbados prices and price of competing imports. Here too, the All Item Consumer Price Index has been used as a proxy for domestic prices. The effect of the level of domestic economic activity on the import demand for transport equipment is gauged by the variable, real G.D.P. Finally, in order to capture the effect of the devaluation of the pound sterling in 1967, the dummy variable (D) was introduced in the various import demand equations.

Applying both the linear and log-linear functional forms to the aggregated and per capita data we obtain the following results:

$$\underline{22a}\ Mfte = 2916.164 - \underset{(17.267)}{52.399} \frac{(P^{m}_{fte})}{(P_h)} + \underset{(.011)}{.033} \frac{(Y)}{(P_h)} + \underset{(992.483)}{2637.198}\ (D)$$

$R^2 = .941$ S.E. = 882.781 D.W. = .910

$$\underline{22a^1}\ \ Mfte^* = 5329.465 - \underset{(33.092)}{114.807}\ \frac{(P^{m}_{fte})}{(P_h)} + \underset{(.023)}{.128}\ \frac{(Y)}{(P_h)}$$

$R^2 = .831$ S.E. = 2243.610 D.W. = 1.282

$$\underline{22b}\ \ \log Mfte = - 1.897 - \underset{(.385)}{1.023}\ \log \frac{(P^{m}_{fte})}{(P_h)} + \underset{(.411)}{1.218}\ \log \frac{(Y)}{(P_h)}$$

$$+ \underset{(.266)}{.441}\ (D)$$

$R^2 = .895$ S.E. = .259 D. = 750

$$\underline{22b^1}\ \ \log Mfte = - 3.830 - \underset{(.342)}{.763}\ \log \frac{(P^{m}_{fte})}{(P_h)} + \underset{(.222)}{1.408}\ \log \frac{(Y)}{(P_h)}$$

$R^2 = .861$ S.E. = .158 D.W. = .914

$$\underline{22.22a}\ \ \frac{(Mfte)}{(N)} = 13.032 - \underset{(.076)}{.193}\ \frac{(P^{m}_{fte})}{(P_h)} + \underset{(.013)}{.028}\ \frac{(Y)^0}{(P_h)}$$

$$+ \underset{(4.292)}{15.715}\ (D)$$

$R^2 = .945$ S.E. = 3.774 D.W. = 1.338

$$\underline{22.22a1}\ \ \frac{(mfte)}{(N)} = 21.472 - \underset{(.151)}{.447}\ \frac{P^{m}_{fte}}{(P_h)} + \underset{(.029)}{.125}\ \frac{(Y)^0}{(P_h)}$$

$R^2 = .759$ S.E. = 10.449 D.W. = .855

$$22.22b\ \ \log \frac{(Mfte)}{(N)} = .572 - \underset{(.143)}{.620}\ \log \frac{(P^{m}_{fte})}{(P_h)} + \underset{(.264)}{.958}\ \log \frac{(Y)^0}{(P_h)}$$

$$+ \underset{(.111)}{.331}\ (D)$$

$R^2 = .892$ S.E. = .137 D.W. = 1.297

$$\underline{22.22b^1}\ \ \log \frac{(Mfte)^*}{(N)} = 8.949 - \underset{(1.111)}{1.712}\ \log \frac{(P^{m}_{fte})}{(P_h)} + \underset{(.198)}{.792}\ \log \frac{(Y)^0}{(P_h)}$$

$R^2 = .870$ S.E. = .150 D.W. = 1.528

Our results indicate that the devaluation of the pound had a profound effect on Barbados consumers' demand for imported transport equipment. This is clearly shown by the high and statistically significant parameters of the dummy variable. That relative prices and the level of economic activity also played an important role in Barbados import demand for this group of commodity is indicated by the theoretically correct signs, as well as the statistical significance of the estimated parameters of the preceding variables. All of the equations were quite satisfactory with R^2 varying from .759 to .945. Estimates of the relative price, real G.D.P. and dummy variable coefficients show that they all had the correct signs and were statistically significant. It can be seen, however, that in almost all of the estimated equations the residuals were auto-correlated. This is confirmed by the Durbin-Watson statistic which varied from .750 in equation (22b), to 1.528 in equation (22.22b), indicating definite auto-correlation.

Nevertheless, in order to provide some consistency with our previous analysis we utilised our criteria of R^2, standard errors and Durbin-Watson statistic and selected equations (22b) and ($22.22b^1$) as being the best representatives of Barbados import demand equations for transport equipment. From these equations the elasticities given in Table A2 were obtained. The above unity values of the relative price elasticity coefficients indicate that some complementarity exists between home produced and imported transport equipment.

Seeing that Barbados did not produce transport equipment at home over the period of analysis, this result is hard ot interpret. A possible explanation however, is the fact that extensive repairs of transport vehicles were undertaken in Barbados; hence what our result probably indicates is that any increase in the price of imported transport equipment led to a corresponding shift to the second-hand market for such equipment. The activity elasticities which varied from .966 to 1.068 was not too surprising, given the highly developed nature of Barbados mass transportation system.

Import Demand Equations for Functional Group: Machinery

Imports of machinery represented one of the major components of total imports over the period, 1954—1970. In value terms they represented approximately 11.73 per cent of total imports and 51.15 per cent of capital imports respectively. To some extent, the high incidence of machinery imports is a clear indication of the underdeveloped nature of the Barbadian economy. Nevertheless, it also indicates that an attempt has been made by Barbadians to change the economic base of their economy from one which has been primarily agricultural to that of a mixed economy.

To investigate the underlying relationship between machinery imports, relative price, real G.D.P. and sterling devaluation in 1967, the least squares procedure was applied to the sample of data covering the period

1954—1970. Equations (21a) to (21.21b[1]) represent estimates for the two functional forms viz. linear and log-linear.

As can be observed from the results obtained, in almost all of the equations, not only had the coefficients of the explanatory variables the expected signs but in the majority of cases they were significantly different from zero. The only exception to this general rule was equation (21.21b) where the coefficient of the price variable, although having the correct sign, was statistically insignificant.

$$\underline{23a}\ Mfm = 8690.461 - \underset{(28.373)}{96.946}\ \frac{(P^{m}_{fm})}{(P_h)} + \underset{(.025)}{.087}\ \frac{(Y)}{(P_h)} + \underset{1642.720}{4395.410}\ (D)$$

R^2 = .895 S.E. = 1869.705 D.W. = 1.207

$$\underline{23a^1}\ Mfm = 173829.063 - \underset{(1336.500)}{1595.498}\ \frac{(P_{fm})}{(P_h)} + \underset{(.154)}{.702}\ \frac{(Y)}{(P_h)}$$

R^2 = .882 S.E. = 17020.027 D.W. = 1.506

$$\underline{23b}\ Mfm = -\ .276 - \underset{(.139)}{.669}\ \log \frac{(P^{m}_{fm})}{(P_h)} + \underset{(.229)}{1.068}\ \log \frac{(Y)}{(P_h)} + \underset{(.109)}{.281}\ (D)$$

R^2 = .911 S.E. = .133 D.W. = .461

$$\underline{23b^1}\ \log Mfm = .872 - \underset{(1.065)}{1.295}\ \log \frac{(P^{m}_{mfm})}{(P_h)} + \underset{(.169)}{.732}\ \log \frac{(Y)}{(P_h)}$$

R^2 = .872 S.E. = .144 D.W. = 1.772

$$\underline{23.23a}\ Mfm = 41.860 - \underset{(.120)}{.369}\ \frac{(P^{m}_{fm})}{(P_h)} + \underset{(.028)}{.072}\ \frac{(Y)^0}{(P_h)} + \underset{(6.987)}{22.368}\ (D)$$

R^2 = .894 S.E. = 8.109 D.W. = 1.049

$$23.23a^{1}\quad \frac{(Mfm)}{(N)} = 839.774 - \underset{(5.532)}{7.965}\ \frac{(P^{m}_{fm})}{(P_h)} + \underset{(.172)}{.719}\ \frac{(Y)^{0}}{(P_h)}$$

$R^2 = .884 \quad S.E. = 69.787 \quad D.W. = 1.245$

$$23.23b^{1}\quad \log \frac{(Mfm)}{(N)} = 1.047 = \underset{(1.480)}{.525} \log \frac{(P^{m}_{fm})}{(P_h)} + \underset{(.181)}{.738} \log \frac{(Y)^{0}}{(P_h)} + \underset{(.068)}{.322}\ (D)$$

$R^2 = .904 \quad S.E. = .135 \quad D.W. = 2.075$

$$21.21b^{1}\quad \log \frac{(Mfm)}{(N)} = 3.280 - \underset{(.176)}{1.119} \log \frac{(P^{m}_{fm})}{(P_h)} + \underset{(.147)}{.994} \log \frac{(Y)^{0}}{(P_h)}$$

$R^2 = .892 \quad S.E. = .115 \quad D.W. = 2.093$

Thus in each equation except 23.23b the three variables seemed to have contributed significantly to the explanation of machinery imports; however, the activity variable (real G.D.P.) explains a greater proportion of the variation of this form of imports. On the basis of R^2, standard errors, and D.W. statistics, equations (23a), (23b), (21.21a) and (21.21b) were chosen as being ideal representatives of the component of Barbados aggregate and per capita imports respectively.

The relative prices and activity elasticities derived from the latter set of equations are given in Table A2. The price elasticities were well below unity, especially when per capita data was utilised. These small values clearly highlight the fact that there has been little if any, substitution between home produced and imported machinery and further indicate that despite the rapid economic development of the Barbadian economy it is still technologically dependent on metropolitan economies.

Correspondingly, the high values of the activity elasticities indicate that a direct relationship existed between the rapid rate of growth of the Barbadian economy and the rate of growth of this category of import.

CHAPTER FIVE

SUMMARY AND CONCLUSIONS

While this study had as its major objective the provision of conditional estimates of Barbados demand for various categories of imports, an examination of import trends was also undertaken. But is must be noted that the study had a number of shortcomings, the most important being the lack of relevant data series and the omission of the estimated parameters in the case of the different variants of the dynamic model.

In so far as the lack of data was concerned, the unavailability of data on wholesale prices as well as the level of industrial production inhibited a much more profound analysis of the relationship between the level of industrial activity and imports.

Correspondingly, the inadequacy of the computer facilities at our disposal forced us to confine our analysis to the different variants of the static model, and evidently such an analysis does not facilitate an examination of both the long and short run impact of prices and/or income increases on imports.

Notwithstanding the apparent shortcomings of the study, we feel that it was of some importance in that it revealed the following:

(a) that the trend in Barbados imports had shifted, quite noticeably, from the sterling area to the dollar area;

(b) That, when imports from metropolitan economies are excluded from total imports, there had been a significant growth in Barbados imports from the larger territories in the Caribbean viz

Guyana, Jamaica and Trinidad and Tobago in the post-1967 era.

However, it has also been shown that there was a relative decline in Barbados imports from the smaller territories of the Windward and Leeward Islands over the same period.

(c) That the proportional share of food imports in total imports had not risen dramatically over the period 1954—1970. More importantly, however, was the fact that this category shifted downwards within the functional group, consumer goods.

(d) That, whatever increases in food imports occured over our period of analysis can, in the main, be attributed to a decline in peasant food crop farming as well as to an increase in population.

(e) That most of the commodities imported into Barbados since 1954 were responsive to changes in relative prices and the level of of domestic economic activity.

But the empirical results also indicated that, as of 1970, the devaluation of the pound sterling in 1967 had a negligible effect on the importation of many commodities, particularly consumer goods.

Although in the present study the argument was developed and substantiated with evidence that Barbados import demand depended upon relative prices, real G.D.P. and, to a lesser extent, the devaluation of sterling in 1967, the findings suggest broader implications. In other words, from a theoretical point of view, it would seem that there is a need for an extension of the import demand functions so as to incorporate some of the peculiar characteristics of a developing economy such as Barbados.

Given the structure of social classes as well as the relative openess of the Barbadian economy, we feel that factors such as the maldistribution of income as well as the actual and expected rates of inflation may affect Barbados import and demand and furthermore, such effects may be far-reaching in so far as overall economic policy is concerned.

Before concluding the paper, it is appropriate for us to make a few comments on the preceding factors. To begin with, the inclusion of an income distribution variable can be rationalised on two grounds. Firstly, it is well recognised that the structural transformation of an under-developed economy such as Barbados is likely to lead to a redistribution of income in favour of profit earners and other sections of the population engaged in economic activity in the emerging corporate sectors. The most likely consequence of such redistribution of incomes , given the taste and preference of Caribbean people in general and Barbadians in particular, will be an increase in imported goods and services from North America and Britain. Secondly, the changing distribution of income may be manifested in an extremely rapid rate of urbanisation. Hence, by a priori reasoning, the share of the various SITC sections, as well as functional groups of imports, can be expected to differ between the more developed (urbanised) sectors of the economy and the less developed agricultural sectors. As a consequence of such shifts in import shares, the import/demand elasticities adjusted for special geographical areas may have different implications for our analysis.

An additional factor which is directly connected to the first is the fact that the rate of imports may differ significantly between upper and lower income households. One may very well ask what would be the effect on Barbados demand for imports, given an increase in the degree of income inequality. On the one hand it can be argued that, from the standpoint of having greater wealth, the import demand of higher income families should be greater than that of the lower income families. But on the other hand, seeing that most of the lower income families within Barbados consist mainly of young children, one can very well argue that because savings are less (consumption is greater) in the early phases of the life cycle, the demand for imports by lower income households may be just as great or even higher than that of higher income (but relatively small) households. Evidently, such a problem cannot be resolved without resorting to an empirical test of the hypotheses which are inherent in the preceding discussion.

In conclusion, it would seem that the customary definition of import demand functions, as well as the interpretation of the trends in imports, is obscure unless some attempt is made to incorporate the effect of non-economic institutional factors and their movements in any import demand functions that may be specified.

APPENDIX I

TABLE A1

IMPORT DEMAND ELASTICITIES FOR COMMODITIES AGGREGATE

DATA (S. I. T. C. GROUPS)

Imports		Relative Price Elasticity	Activity Elasticity
Food			
a	Linear form	0.990	.682
b	Logarithmic form	1.195	.678
Beverages & Tobacco			
a	Linear form	1.854	.165
b	Logarithmic form	.614	.722
Crude Materials			
a	Linear form	1.854	5.850
b	Logarithmic form	.187	2.363
Mineral Fuels etc.			
a	Linear form	—	—
b	Logarithmic form	1.216	1.023
Chemicals			
a	Linear form	1.086	.956
b	Logarithmic form	.989	.815
Manufactures			
a	Linear form	.880	.729

TABLE A1 (Cont'd)

IMPORT DEMAND ELASTICITIES FOR COMMODITIES AGGREGATE DATA (S.I.T.C. GROUPS)

Imports	Relative Price Elasticity	Activity Elasticity
b Logarithmic form	.850	.684
Machinery & Transport Equipment		
a Linear form	.447	.984
b Logarithmic form	1.313	1.707
Miscellaneous Manufactures		
a Linear form	.663	1.223
b Logarithmic form	1.164	1.459

TABLE A2

IMPORT DEMAND ELASTICITIES FOR COMMODITIES AGGREGATE DATA (FUNCTIONAL GROUPS)

Imports	Relative Price Elasticity	Activity Elasticity
Consumer Goods		
a Linear form	.840	.920
Food		
a Linear form	.182	.064
b Logarithmic form	2.268	.870
Beverages		
a Linear form	2.117	.903
b Logarithmic form	—	—
Durables		
a Linear form	4.586	3.153
b Logarithmic form	1.287	.766
Non-Durables		
a Linear form	1.510	1.076
b Logarithmic form	1.356	1.088
Raw Materials		
a Linear form	.846	1.084
b Logarithmic form	.891	1.007

TABLE A2 (Cont'd)

Agricultural & Industrial Raw Materials		
a Linear form		
b Logarithmic form	.229	.872
Industrial Fuels		
a Linear form	1.997	1.087
b Logarithmic form	.683	.131
Capital Goods		
a Linear form	1.096	.725
b Logarithmic form	1.224	.722
Construction Materials		
a Linear form	1.003	.978
b Logarithmic form	1.430	1.744
Transport Equipment		
a Linear form	1.100	1.214
b Logarithmic form	1.023	1.218
Machinery		
a Linear form	.703	.966
b Logarithmic form	.669	1.068
All Commodities		
a		
b		

TABLE A3

IMPORT DEMAND ELASTICITIES FOR COMMODITIES PER CAPITA DATA (S. I. T. C. GROUPS)

Imports	Relative Price Elasticity	Activity Elasticity
Food		
a Linear form	—	—
b Logarithmic form	—	—
Beverages & Tobacco		
a Linear form	—	—
b Logarithmic form	.660	.151
Crude Materials		
a Linear form	2.318	5.684
b Logarithmic form	.489	1.886
Minerals fuels etc		
a Linear form	.953	.872
b Logarithmic form	1.135	.951
Chemicals		
a Linear form	.923	.756
b Logarithmic form	.819	.626
Manufactures		
a Linear form	1.023	.746
b Logarithmic form	1.182	1.804
Machinery & Transport Equipment		
a Linear form	.465	1.028
b Logarithmic form	1.023	1.478

TABLE A4

IMPORT DEMAND ELASTICITY FOR COMMODITIES PER CAPITA DATA (FUNCTIONAL GROUPS)

Imports	Relative Price Elasticity	Activity Elasticity
Consumer Goods		
a Linear form	—.460	.919
b Logarithmic form	—	
Food		
a Linear form	—	—
b Logarithmic form	—	—
Beverages		
a Linear form	—	—
b Logarithmic form	—1.033	1.019
Durables		
a Linear form	—3.892	3.982
b Logarithmic form		
— —		
Non-Durables		
a Linear form	—1.697	1.155
b Logarithmic form	—1.217	.830
Raw Materials		
a Linear form	—0.884	1.079
Logarithmic form	—1.259	.678

TABLE A4

IMPORT DEMAND ELASTICITY FOR COMMODITIES PER CAPITA DATA (FUNCTIONAL GROUPS)

Imports		Relative Price Elasticity	Activity Elasticity
Agricultural & Industrial Raw Materials			
a	a Linear form	—1.517	.946
b	Logarithmic form	—1.339	.980
Industrial Fuels			
a	Linear form	—1.819	.671
b	Logarithmic form	—1.069	.707
Industrial Chemicals			
a	Linear form	—1.195	.848
b	Logarithmic form	—1.520	1.939
Capital Goods			
a	Linear form	—1.164	.676
b	Logarithmic form	—	—
Construction Materials			
a	Linear form	—1.079	1.096
b	Logarithmic form	—.968	1.148
Transport Equipment			
a	Linear form	—.950	.984
b	Logarithmic form	—.620	.958

TABLE A4 (Cont'd)

IMPORT DEMAND ELASTICITY FOR COMMODITIES PER CAPITA DATA (FUNCTIONAL GROUPS)

Imports	Relative Price Elasticity	Activity Elasticity
Machinery		
a Linear form	—.369	.777
b Logarithmic form	—1.119	.994
All Commodities		
a Linear form	—.310	.235
b Logarithmic form	—.898	.673

LIST OF VARIABLES USED IN THE STUDY

Mf = Volume of imported food

Mbt = Volume of imported beverages and tobacco

Mcm = Volume of imported crude materials

Mfe = Volume of imported mineral fuels and lubricants

Mof = Volume of imported animal and vegetable oils and fats

Mch = Volume of imported chemicals

Mmf = Volume of imported manufactured goods

Mmte = Volume of imported machinery and transport equipment

Mmm = Volume of imported miscellaneous manufactures

M_{FIF} = Volume of Imported imports of functional group: **industrial fuels**

M.F.I.F. = Volume of imported imports of functional group: **industrial chemicals**

MFCM = Volume of imported imports of functional group: construction materials

MFTE = Volume of imported imports of functional group: transport equipment

MFMAC = Volume of imported imports of functional group: Machinery

MFTI = Volume of imported imports of functional group: total imports

MF Ind. Fuel = Volume of imported imports of functional group: industrial fuels

MF Ind. Chem = Volume of imported imports of functional group: industrial chemicals

MF Con. Mat. = Volume of imported imports of functional group: construction materials

MFTE = Volume of imported imports of functional group: transport equipment

MF Mach. = Volume of imported imports of functional group: machinery

MFTI = Volume of imported imports of functional group: total imports

MT = Volume of total imports

MFCg = Volume of imports of functional group: consumer goods

MFRI = Volume of imports of functional group: raw materials and intermediate goods

MFCap = Volume of imports of functional group: capital goods

Mf Food = Volume of imports of functional group: food

MF Bev = Volume of imports of functional group: Beverages

MFDur = Volume of imports of functional group: durables

MFNon Dur = Volume of imports of functional group: non durables

MFAgri = Volume of imports of functional group: Agricultural and industrial raw materials

Mt = Volume of total imports

MFCG = Volume of imports of functional group: consumer goods

MFRI = Volume of total imports of functional group: raw materials and intermediate goods

MFCAP = Volume of total imports of functional group : capital goods

MFFd = Volume of total imports of functional group: food

MFBev = Volume of total imports of functional group: Beverages

MFDur = Volume of total imports of functional group: durables

MFND = Volume of total imports of functional group: non durables

MFAI = Volume of total imports of functional group: agricultural and industrial raw materials

NI = National Income (Guyana)

ICP = Index of Consumer Prices (Guyana)

N = Total Population Guyana

PMf = Price Index of Imported Food

PMbt = Price Index of Imported beverages and tobacco

PMcm = Price Index of Imported crude materials

PMfl = Price index of imported food mineral fuels and lubricants

PMof = Price index of imported animal and vegetable oils and fats

PMch = Price index of imported chemicals

PMmf = Price index of imported manufactured goods

PMmte = Price index of imported machinery and transport equipment

PMmm = Price index of imported miscellaneous manufacturers

PMmt = Price index of imported total imports

PMfri = Imported price index of functional group: raw materials and intermediate goods

PMfcap = Imported price index of functional group: capital goods

PMf fd = Imported price index of functional group: food

PMFbev = Imported price index of functional group: beverages

PMf dur = Imported price index of functional group: durables

PMFND = Imported price index of functional group: non durables

PMfair = Imported price index of functional group: agricultural and industrial raw materials

PMfif = Imported price index of functional group: industrial fuels

PMfcm = Imported price index of functional group: construction materials

PMfte = Imported price index of functional group: transport equipment

PMfmac = Imported price index of functional group: machinery

D1 = Dummy Variable, taking the value 1 in 1967 and 0 elsewhere

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