A DEMAND ANALYSIS FOR CEMENT IN NIGERIA

by

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ABSTRACT

This study was motivated by the fact that although there are several works on the supply of cement in Nigeria, the demand aspect has not been examined in detail and quantitatively. This study attempts to estimate the price and income elasticities of demand for both imported cement and for aggregate demand for cement in Nigeria. It also attempts to assess the impact of custom tariff on imported cement and appraise the import substitution effects of the domestic manufacturing of cement in Nigeria. And finally, the thesis attempts to show the trend of cement consumption in Nigeria between 1948 - 66, the annual rate of growth of consumption during this period as well as the future time path of this rate of growth.

The market analysis in chapter two deals with the supply and demand determinants and the pricing policies of the firms. The market structure is also analyzed and the results of the carefully managed government foreign policy in respect of importation of cement.

An appropriate model is postulated in chapter three to grapple with the problem of the demand equations. The theoretical framework is also discussed in this chapter.

Chapter four is devoted to the discussion of the results of the estimated demand equations. The least squares method is used to estimate the parameters of the equations. From the results it is concluded that cement is price inelastic; both aggregate and imported cement exhibit low and shifting price elasticity. Aggregate demand for cement is "income" elastic. The income elasticity for imported cement is however low, this is a sign of increasing import substitution. The impact of tariff on imported cement is somewhat low when measured in terms of elasticity.

The trend of cement consumption during the reference period shows that cement consumption has been growing at a decreasing rate. The rate of growth tends to about 2% with time though the level of consumption grows infinitely large with time.

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CHAPTER I

Introduction

Cement constitutes a key material in the construction industry. It has extensive applications in the building of roads, bridges, dams, commercial and residential houses and a host of other uses in the construction sector. It forms also an important raw material in the manufacturing of asbestos cement, cement blocks, pipes and other precast products. And because cement is used in one form or the other in almost all sectors of an economy, its level of consumption at any given time is highly sensitive to the state of economic activity. This point is easily visualised by considering the use of cement in building of farm houses and stretches of concrete ground for drying farm products, to the building of the gigantic Kainji dam as well as the second Lagos bridge. Hence a deeper understanding of the nature of demand for cement in any economy, requires a knowledge of the country's economy particularly the construction activity.

It has been observed that there is a close association between consumption of cement and the level of development in an economy[1]. A country's per capita cement consumption is therefore often adopted in measuring the real disparities in cement consumption level among

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1. United Nations, Economic Commission for Africa: Prospects for the Cement Industry in West Africa. Note by the Secretariat. Conference on Industrial Coordination in West Africa, E/CN/INR/75, 1964, p. 2.

countries. It is considered a useful device for revealing gaps in consumption not only among developing countries but also between the developed countries on one side and the developing countries on the other[1]. Unfortunately nothing specific or definitive can be given about the country's population, since there was no comprehensive count before 1952/53 census, while the 1963 comprehensive count raised controversial issues. Neither count could be said to be accurate: the first is generally considered as essentially under-estimated while the second is said to be inflated[2]. By 1952/53 census, the country's population was put at 31 million. The 1963 census put it at 55.7 million. From the various studies carried out, Nigeria's population has been said to be growing at the rate of 2.8%[3].

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1. United Nations, Economic and Social Council, Economic Commission for Africa: A Development Programme for the West Africa Cement Industry, E/CN14/INR/117, August 1966. p. 6.

2. Aluko, S.A.: "How Many Nigerians? An Analysis of Nigeria's Population Problems, 1901-63". Journal of Modern African Studies, 3.3 (1965) pp. 371-391.

3. There are conflicting views both on the population figures of Nigeria as well as the rate of growth. Some studies have however put the country's rate of growth at 2.8%, viz: Okonjo, C. 'A Preliminary Medium Estimate of the 1962 Mid-Year Population' The Population of Tropical Africa J.C. Caldwell and C. Okonjo, eds. 1968, p. 82. Nigerian Institute of Social and Economic Research, University of Ibadan. Physical Planning Research Programme: Interim Report No. 1 March 1969, p. 14.

If the 1963 census figures are taken as point of reference, and given a 'healthy' rate of growth of the G.D.P., the population could provide an effective demand and a dependable internal market for consumers and producer's goods under economic growth. The extent to which this can be attained will depend upon the growth of the major productive sectors of the economy.

The Nigerian economy, until recently, has relied preponderantly upon her agricultural sector. Though the dependence has been considerably reduced by the discovery of petroleum in Nigeria. As recent as 1965, agriculture including livestock, fishing and forestry still accounted for 63% of the Gross Domestic Product of Nigeria, while 70% of her foreign exchange came from this sector alone[1]. The growth of foreign exchange earning from crude oil between 1964 and 1966 indicates that the relative proportion of foreign exchange contributed by the agricultural sector will decline rapidly during the next decade.

The empirical findings that could be drawn from the input-output analysis of the Nigerian economy 1959-60 by N.G. Carter show that the Nigerian agricultural sector has a very weak linkage with the other sectors of the economy[2]. They thus confirm Albert O. Hirchman's

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1. Nigeria, Federal Office of Statistics: Annual Abstract of Statistics, 1967 Lagos, 1967, p. 137.

2. Carter, Nicholas G.: An Input-Output Analysis of the Nigerian Economy 1959-60, Massachusetts Institute of Technology, Massachusetts, 1963. pp. 124-126.

predictions of forward and backward linkages of primary production[1]. Nevertheless the indirect influence of agriculture is far reaching on the Nigerian economy. The sector had provided a lot of savings, both private and public, in the past. Much of this has gone into construction activity which is the principal determinant of level of cement consumption. The fact that the Nigerian agriculture is not highly mechanised reduces the amount of cement used on farm lands and farm houses. But further development of the sector and increasing economic well-being of the farmers will induce increasing consumption of cement through building of concrete houses both on the farms and in the country's towns and villages. This will also contribute to provide a large market for the growing manufacturing sector of the economy, thus strengthening the link between the agricultural sector and the manufacturing sector.

The Nigerian manufacturing sector can be considered as scattered small islands in a vast agrarian landscape. The sector contributes just a small proportion of the Gross Domestic Product. The sector's contribution of £96.4 million in 1965 constituted only 6.3% of the G.D.P. and it was the highest proportion so far recorded (See Table 1.1 in the Appendix). With the structural changes that have been occurring within the economy since the beginning of this decade, the

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1. Hirchman, Albert O.: The Strategy of Economic Development, Yale University Press, Yale, 1958, p. 109.

industrial sector is increasingly becoming the factor that makes the Nigerian economy tick[1].

Owing to lack of adequate data, the degrees of inter-dependence among the industries cannot be accurately measured. A rough picture of the inter-dependence of a few of the industries is shown in Table 1.2 in the Appendix. It is worthwhile to note here that cement and ceramics have high backward linkage with the economy.

It has been observed that on the world spectrum of manufacturing activities, the Nigerian plants are relatively labour intensive[2]. Given the existing situation in which a considerable amount of intermediate input is processed, Capital-Output ratio will be inferior to Fixed Asset - Value Added ratio. The latter removes the exaggeration that can result from the use of intermediate inputs. A comparison of the two ratios are given in the Appendix, Table 1.3. An important point to note here however is that increasing capital formation has a considerable influence on the level of cement consumption. Each addition to capital asset requires one form of construction activity or the other. Since the beginning of this decade for instance, mining has been assuming increasingly larger and larger proportion both in

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1. Aboyade, O.: The Development Process, Paper read at the Conference on National Reconstruction and Development in Nigeria, 1969, p. 23.

2. Helleiner, G.K.: Peasant Agriculture, Government and Economic Growth in Nigeria, R.P. Irwin, Inc. Homewood, Illinois, 1966, p. 330.

its contribution to the Gross Domestic Product as well as its proportion within the aggregate capital formation. This has in turn influenced both the level of cement consumption and the kinds of cement consumed in Nigeria. It is by the virtue of the use in the oil drilling centres that the oil-well cement is used in the country. It can be concluded therefore that the level and rate of growth of an economy has a considerable influence on the level of aggregate demand, whether for final consumer goods or for inter-mediate goods.

B. The Problem

Nigeria is still in the process of searching for a springboard for economic development. To develop economically means to increase continuously the output per unit of capital investment. The end is the increase in national income while the means is the efficient utilisation of the national resources and the increase in the capital per man. Construction activities - building of roads, bridges, dams, ports, residential and industrial houses form the major aspects of Capital formation. It is in this connection that cement constitutes a very important material for development strategy. While there exist some works on Nigeria cement industry and supply of cement into Nigeria cement market, the demand side of the market has been wholly neglected. Among the few existing works on the industry as well as

the supply side of the cement market are Ugoh's two articles[1].

The first article is devoted to the Nigerian Cement Company (NigerCem). Ugoh traced the history of the company from the time it was formed in 1954 to 1963 when the company has operated for six years. He analysed the capital structure with respect to ownership. He discussed also the method of cement production at the company's factory site, Nkalagu. He assessed the profits made by the company from the time of its inception 1957 December to 1963. The article embraces the factory's business performance, the effects of its production on the domestic market and its future prospect given the presence of a second integrated plant in the country. An integrated cement plant can be defined as a plant that is responsible for mining its basic raw material, limestone, burning it at clinkering temperature and grinding the resulting clinker into cement. This is to differentiate such factories from those that are engaged in the production of cement from the clinker stage. Ugoh concluded that the Nigerian Cement Company was enjoying a period of monopoly especially in the Eastern part of the country. This gave the company the opportunity to make large profits. This he thought could not continue into the distant future when the company would be faced with competition with other factories and internal problems like labour unrest.

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1. (a) Ugoh, S.U.: "The Nigerian Cement Company" The Nigerian Journal of Economic and Social Studies, Vol. 6, No. 1, 1964. pp. 72-91.

   (b) Ugoh, S.U.: "The Nigerian Cement Industry" The Nigerian Journal of Economic and Social Studies, Vol. 8, No. 1, March 1966. pp. 97-111.

In his second article,[1] Ugoh examined the performance of the existing cement factories up to 1965. He compared the labour productivity in the two major integrated plants (the Nigerian Cement Company Ltd. and the West African Cement Company) with labour productivity in the cement industries in the United States, USSR, and Japan. He examined also the market structure and the factories' general pricing policy. He rationalised the use of small-sized rotary kilns which facilitates flexibility in production level as compared with large-sized rotary kilns. He discussed briefly the effects of domestic production of cement on the country's balance of payment. Unforeseen circumstances have invalidated some of Ugoh's forecasts about production figures. His forecast of growth of excess capacity in the cement industry has not come true. He lamented the absence of co-ordination in the establishment and location of factories that has resulted in gross misallocations and waste of resources. He considered that this lack of co-ordination was very serious especially in the cement industry in which he concluded that some of the inefficient plants would be forced to close down unless they are subsidised or construction industry grows at a faster rate than ever.

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1. Ugoh, S.U.: "The Nigerian Cement Industry" The Nigerian Journal of Economic and Social Studies, Vol. 8, No. 1, March 1966. pp. 97-111.

Apart from Ugoh's two articles, Bellmann is currently writing on the Nigerian Cement Industry.[1] Bellmann attempts to evaluate the performance of the Nigerian Cement Industry within the context of a developing economy. He intends to examine the availability of the cement basic raw materials, their locations and to assess the economics of the location of existing cement factories.

Among other industries he considered, Sokolski[2] gave a catalogue of the existing cement factories under market oriented industries. He started with the earliest clinker grinding plant at Port Harcourt, "NEMCO". And in passing, he mentioned each Nigerian Cement plant's production capacity, capital structure and location in relation to individual plant's market and raw materials.

There is one feature common to all the works reviewed above: they lay emphasis on the supply side of the cement market. This thesis sets out to examine the demand aspect of the Nigerian Cement Market. The problem can be divided into three:

(i) The first problem consists of the analysis of the market structure upon which a theoretical model could be built for quantitative analysis of demand for cement in the country.

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1. Bellmann, T.: Cement-Industry in Nigeria as a developing country Ph.D. thesis to be submitted by December 1969.

2. Sokolski, Alan: The Establishment of Manufacturing in Nigeria Fredrick A. Praeger, Publishers, New York, 1965, pp. 244-248.

(ii) The second is two-fold: (a) the estimation of the demand function for imported cement; (b) the estimation of the aggregate demand for cement in Nigeria.

(iii) And lastly an examination of the long-run trend of the aggregate cement consumption between 1948-66.

C. Objectives of the Study

The main objective of this thesis is to add to the existing scanty knowledge of the Nigerian cement market. In particular the thesis sets out to achieve the following objectives:

(i) To highlight the market structure of cement in Nigeria.

(ii) To estimate the price and income elasticities of demand for both imported cement and of aggregate demand for cement i.e. imported and locally manufactured.

(iii) To appraise the import substitution effects of domestic manufacturing of cement in Nigeria.

(iv) And finally to show the consumption trend of cement in Nigeria and the rate of growth of consumption during our reference period and the future trend.

D. Plan of the Study

In the remaining part of this thesis Chapter two deals with the structure of the Nigerian Cement Market. The supply of cement to the domestic market through importation and domestic production will be

examined. The form of the Nigerian market and the pricing policy of the cement manufacturing firms will also be examined. Finally attempts will be made in this chapter to highlight some of the factors determining the level of domestic demand for cement.

Chapter three discusses the theoretical background for estimating demand equations, the properties or the restrictions that are usually imposed on demand equation whether in a complete system or in a subsystem. We shall examine in this chapter the various problems of single equation model particularly with regards to a demand equation model. We shall also try to justify our use of the least square method. This chapter will end by enumerating the sources of our data.

Chapter four sets out to achieve the objectives we enumerate in section C above. The long-run consumption trend of cement will be determined. The estimation of the parameters of the demand equations will be followed by a few comments on our empirical findings. In the last chapter we shall give a brief resume of the major findings in the previous chapters. We shall also assess the monetary and non-monetary implications of expanding the industry.

Finally suggestions will be made on the possibilities of further studies on the Nigerian cement market.

Chapter II

The Market for Cement in Nigeria

A. The Nigerian Cement Industry

Even though there are numerous kinds of cement, our thought is always on the ordinary portland cement once cement is mentioned without a specification of the kind. The ordinary portland cement may be defined in the British standard as a product obtained "by intimately mixing together calcarceous and argillaceous or other silica alumina, and iron oxide-bearing materials, burning them at a clinkering temperature and grinding the resulting clinker".[1] This ordinary portland cement constitutes by far the largest proportion of cement used throughout the world.[2] A full list of the existing different kinds of cement is beyond the scope of this dissertation.[3] At present only very few of other kinds of cement are currently being used in Nigeria. About 114 tons of Low Heat cement was used in the construction of the Kainji dam, the oil companies are using some quantity of oil-well cement, and the white cement is used to a small extent. Albeit, all

1. Lea, F.M. & Desch, C.H. The Chemistry of Cement and Concrete. Edward Arnold (Publishers) Ltd. London, 1956, p. 14.
2. Taylor, H.F.W.: The Chemistry of Cements, Academic Press Inc. (London) Ltd., London 1964, p. 4.
3. For comprehensive list of the different kinds of cement see Lea, F.M. & Desch, C.H. op-cit. pp. 14-19.

the cement factories in the country manufacture the ordinary portland cement.

In 1966, there were six cement factories operating in the country and in addition three plants were under construction. These plants are grouped into three for the purpose of discussion: the old integrated plants, the newly planned integrated plants and the clinker plants.

A.1 The Economics of Location of a Cement Factory

One salient over-riding feature about the location of cement is that it is transport-oriented.[1] The economics of cement production at any given plant site depends upon the quantity and quality of the basic raw material especially limestone with respect to location, and the capacity of the natural market to absorb the output. Natural market here means the market within a short radius of the factory say about three hundred miles in case of the Nigerian situation with the attendant transport difficulties. Heavy transport is incurred either by transferring the bulky raw materials to a distant factory site or by transferring the low-valued finished product to markets.[2] One over-riding point about the economics of cement production is therefore the reduction of transport cost to the minimum possible.

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1. Loescher, S.M.: Imperfect Collusion in the Cement Industry. Havard University Press, 1959. p. 44.

2. Loescher, S.M. Ibd.

A.2 The Old Integrated Plants

In terms of output and supply of cement into the Nigerian cement market within the period covered only Nkalagu and Ewekoro plants really count. The former is owned by the Nigerian Cement Company and the latter by the West African Portland Cement Company. By 1956 import of cement had risen to 368,000 tons,[1] and this quantity is more than enough to encourage installation of one or two moderately scaled cement plants. After the futility of earlier attempts[2] to induce foreign investor to establish a cement plant, the Nigerian governments decided to establish one at Nkalagu in partnership with a Danish firm, F.L. Smidth and its British Associate Tunnel Portland Cement Company. These two companies accounted for just 10.72% of the equity share while the Nigerian government accounted for 68.56%. The Nigerian Development Corporation took 10.72%; the remaining 10% went to private individual Nigerians. The Nigerian Cement Company was incorporated in 1954. Production of cement actually started at Nkalagu in December 1957. The factory enjoys the advantage of high quality limestone. Coal is found near the factory site. The 200-mile distance between the coast and the factory site affords the factory a partial protection against imported cement. Its location near a railway station gives the additional

1. Federal Office of Statistics: Nigeria Trade Summary. Government Printer, Lagos, 1954.

2. Kilby, Peter: Industrialisation in an Open Economy: Nigeria 1945 - 1966, Cambridge University Press, 1969, p. 101.

advantage of sending cement by rail to some parts of the North and South. Starting with one kiln in 1957 and a capacity of about 100,000 tons per annum, by 1967, the number of kilns has increased to four and actual production has risen to 500,000 tons per annum. This first integrated cement factory was so successful that between 1959 and 1966 the average rate of return on equity was 28% and on equity and reserve 20%.[1]

With the establishment of Nkalagu Cement Company, the British Combine Associated Cement Manufacturers were faced with losing one of their overseas growing markets. They had been responsible for exporting a considerable amount of Nigerian imported cement up to 1957. The West African Cement Company was therefore formed in 1957, after the discovery of limestone at Ewekoro near Abeokuta. Production actually began in 1961.

The Ewekoro factory is located in the midst of a rich and growing cement market. The present Western and Lagos States have been responsible for consuming over half of the Nigerian aggregate cement consumption.[2] Between 79% and 89% of the factory's output was sold in this area between 1964 and 1968.[3] Though just a distance of about

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1. Kilby, Peter (1969) op.cit. p. 106.

2. Ministry of Trade and Industry, Northern Regional Govt: The Industrial Potentialities of Northern Nigeria, Govt. Printer, Kaduna, 1963, p. 123.

3. Filled questionnaire by the Sales Department of the West African Cement Company.

one hundred miles from the coast, and to some extent as a result of the protectionist policy, the plant has stood fairly successfully the competition of low-priced imported cement. The location of the factory offers an opportunity of conveniently transporting cement to the North. This advantage is very important. The railway transport facility was fully utilised between 1964 and 1966 when the company obtained a contract to supply cement to the company building the Kainji Dam. The West African Portland Cement Company has been expanding rapidly. Its output grew gradually from 76,000 tons in 1961, to 379,000 tons in 1965 and 466,000 tons in 1968.

From the foregoing discussion on the two major integrated plants, it is clear that they have supplied a considerable proportion of the total supply of cement into the Nigerian market. Table 2.1 shows the proportion that the plants jointly supplied into the market.

Since there were no other integrated plants producing prior to 1967, the two factories were responsible for the output under integrated plants in Table 2.1. The proportion ranged between about 90% and 100% during the period 1958-66.

A.3 The New Integrated Plants

Construction work started between 1964 and 1965 on three integrated plants. These are referred to as the new integrated plants. The Kalambaina Cement Company of Northern Nigeria Limited was the first to start cement production. The company's financial

Table 2.1

Nigeria: Cement Output of Domestic Producers.

Year	Output of the integrated plants '000 tons	Output of the Clinker Mills '000 tons	Total Domestic Production '000 tons	Percentage supplied by the integrated plants
1958	112	-	112	100.0
1959	122	-	122	100.0
1960	158	7	165	95.8
1961	301	81	332	90.6
1962	423	57	480	88.1
1963	486	17	533	91.2
1964	602	115	717	84.0
1965	837	149	986	84.9
1966	844	98	942	89.6

Source: (a) Federal Office of Statistics: Files on Industrial Production.

(b) Filled questionnaire from cement manufacturers.

structure is made up of £3 million supplied by the former Northern Nigerian government and a loan of £2.8 million from Forrostaal A.G., A German Company.[1]

The Kalambaina cement plant is located near Sokoto, close to the north-west boundary of Nigeria with the Republics of Niger and Dahomey. The plant is linked with the country only by land route. It is not on the railway line like Ewekoro or Nkalagu. Gausau, a distance of about one hundred and thirty miles, is the nearest railway station. To overcome this difficulty, the company built a depot at this place for the purpose of transporting cement to Kaduna, Kano and Zaria by rail. These three towns are the highest cement consuming centres in the North.

The factory's capacity is about 100,000 tons per annum. This target has never been reached since the beginning of operation in May 1967. The original kiln ordered was found unsuitable for the local conditions, another was therefore ordered to replace the first one. This substituted kiln was however found to be ill-adapted to the other components of the plants. This has tended often to affect both the quality and quantity of cement produced. The plant produced 43,000 tons in 1967 and 40,000 tons in 1968.[2] From the point of view of economics

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1. Sokolski, Allan: The Establishment of Manufacturing in Nigeria. op.cit., p. 213.
2. The figures were obtained from the questionnaire filled by the company.

of production, this output is small. Cement production is one in which average cost decreases rapidly with increasing scale of production until the optimum size is attained. The average capacity in many countries is about 500,000 - 600,000 tons per annum. New plants in some countries are producing between two - three million tons per annum.[1]

With a capacity of 100,000 tons per annum and with the company's output of less than this, it will be expected that the company will not be confronted with any difficulty in disposing of that output. Its annual output so far is just about 20% of the aggregate cement consumption in the North. The Northern States cannot, however, be regarded as the factory's natural market. The 'North' is a vast area. Transport cost from Kalambaina site and competition from the southernly situated factories make this impossible even if the plant can produce enough output to meet the demand. It has been estimated that the cost per ton at Nkalagu was £4:15s. in 1965;[2] it was £6:10s. per ton at Ewekoro in 1966[3] while it was about £12:10s. per ton at Kalambaina in 1967.[4] Though the cost per ton at Kalambaina is expected to fall when the

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1. United Nations. Economic and Social Council. Economic Commission for Africa: A Development Programme for the West African Cement Industry, Niamey, 10-22 Oct., 1966, pp. 47-48.

2. Kilby, Peter: Industrialisation in an Open Economy: Nigeria 1945 - 1966. Cambridge University Press, 1969, p. 104.

3. Estimates from the company's 1966 Balance Sheet.

4. Estimates from the company's 1967 Balance Sheet.

factory expands to an optimum size; but since transport cost from Ewekoro site to Kaduna, for instance, is about £5 per ton, the factory cannot avoid fierce competition from the south. This situation makes the prospect of earning much profit seems gloomy. Perhaps the possibility of export to Nigerian neighbouring countries may enable the company to escape the difficulties of competition with the southerly based larger factories.

This possibility of export seems to nullify the criticism levelled against the plant's location that it is uneconomic.[1] Although this is justified within the context of the Nigerian cement market, the same may not, however, hold when the two Nigerian neighbouring countries, Republics of Dahomey and Niger, are taken into consideration. If increased efficiency can be achieved thus resulting in considerable lowering of cost per unit, it may be possible to extend the factory's natural market to these countries. Nigeria exported 5,623 tons of cement to these countries in 1963. Some 2,880 tons was also exported in 1965.[2] The absence of growth in the export of cement to these countries may be due to the establishment of a cement plant

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1. Kilby, Peter: op.cit., p. 108.
   Aboyade, O: "Location and Development Policy". The Nigerian Journal of Economic and Social Studies, Vol. 10, No. 3, 1968, p. 190.

2. Federal Office of Statistics: Nigerian Trade Summary 1960 - 1968. Govt. Printer, Lagos.

in Niger in 1966,[1] as well as the civil war that has forced two of the country's cement plants to stop production.

The second of the recently installed integrated plants is Calabar Cement Factory. The mill was also supplied by a German firm, the Coutinho Caro Company. Its capacity is 100,000 tons per annum. It appears that the establishment of a second plant in the south-eastern part of the country and at a coastal area cannot be justified from the point of view of demand situation in 1964. The size and location of Calabar Cement plant expose it to competition of imported cement. This competition can be very dangerous at times when cement is dumped in the country. Ewekoro plant with its size and distance from the coast had to close down for two months in 1962 because of low priced Polish Cement.

The third plant, Okpilla Cement plant, is located in the Mid-West. The mill is also supplied by the Continho Caro. Kilby considered that the location is viable.[2] Moreover, the possibility of supplying Clinker to Koko clinker plant has been envisaged. Albeit, owing to some technical and managerial problems, the plant has not started operation, though its erection has been completed over two years ago.

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1. United Nations. Economic and Social Council. Economic Commission for Africa. op.cit., p. 46.

2. Kilby, P.: op.cit., p. 108.

A.4 The Clinker Plants

Apart from the establishment of the five integrated cement plants discussed above, there are several clinker grinding plants in existence at one time or the other. Reference has been made to the Nigerian Engineering and Manufacturing Company. Its history dated as far back as 1957, operating continually between that time and 1964. The addition of a fourth kiln at Nkalagu and the consequent lowering of ex-factory price[1] forced 'NEMCO' to close down in 1964. Both the Lagos Cement Works and Koko Cement Plant (Mid-West) were erected in 1964. Also the Anglo Canadian Cement Company started production of cement from Clinker in Lagos in 1963. The company later transferred to the production of pre-cast products.

All these clinker plants have common features: they merely process imported materials. Therefore they have no backward linkage with the economy. Their impact on employment is very slight. From Table 2.1, the proportion of their output ranged between 4% and 16% of the total domestic supply during the period 1960-66.

B. Cement Supply through Importation

Before 1957, all the quantity of cement consumed in Nigeria was imported. Discussion of this source of supply can conveniently be divided into three: the period 1946 - 1954 which was the

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1. Kilby, Peter: op.cit., p. 107.

post-world-war I era, the period 1955 to 1960 which was a period of ever increasing volume of import of cement, and the period 1961 to 1966 which was one of increasing import substitution.

Import of cement was very small during the post second world war period. Volume of import slowly increased between 1946 and 1954. Table 2.2 shows the small quantity of about 96,000 tons in 1946 increasing to over 368,000 tons in 1954. It was also a period of carefully managed commercial policy that favoured importation of cement from Britain. Even in 1955 when Nigeria started to import cement from Belgium, Luxemburg, Western and Eastern Germany, etc., the annual volume of import from these countries was small. Between 1955 and 1960, Nigeria imported 2.42 million tons of cement.[1] About 79% of this actually came from British cement manufacturers while the remaining 21% was shared among the other countries. As it will be shown below, the lion share of export of cement to Nigeria was taken by Britain because of political ties. Other reasons may be language difficulty, currency exchange problems and ignorance of some cement importers as to the existence of lower prices per ton in other countries.

The year 1960 was significant for two reasons. It gave a signal to the end of increasing volume of importation. It also threw open

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1. Federal Office of Statistics: Nigerian Trade Summary 1955 - 1960. Govt. Printer, Lagos.

the gates of other cement markets. What became important were relative low prices and ease of importation. This is not surprising for two reasons: Nigeria became independent in 1960 and could demonstrate this by widening her world market. The cement industry in Nigeria has started to make some impact on the cement market, this necessitates importing from countries that sell at relatively lower prices.

The period 1961-66 was therefore one of shopping for cement all over the world. Nigeria was importing cement from Federal Republic of Germany, Eastern Germany, U.S.S.R., Brazil, Norway, Egypt, Poland, etc. Polish cement was popular in Nigeria between 1963-64. It appeared as if Polish cement was being dumped into the country. At a time when Ewekoro was selling at £10:10s. per ton (ex-factory price) import of Polish cement was £5:12s. per ton (c.i.f.). Indeed Ewekoro was forced to close down for two months in 1963. During this year, 37% of the total cement import of Nigeria came from Poland.[1] The share of Britain declined from 79% to 27.7% during this period (1961-66). By 1963, the domestic supply of cement has considerably improved and the government came to the aid of the industry by raising the custom duty to £5 or 66⅔ ad valorem (whichever is higher).[2]

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1. Federal Office of Statistics: Nigerian Trade Summary. Govt. Printer, Lagos, 1963. (Percentage calculated from import figures.

2. Federal Republic of Nigeria: Annual Volume of the Laws of the Republic of Nigeria, 1964. Vol. 5. Lagos, Federal Ministry of Information, Printing Division, 1965.

Figure 2.1

The Supply of Cement into the Nigerian Cement Market: 1950-66

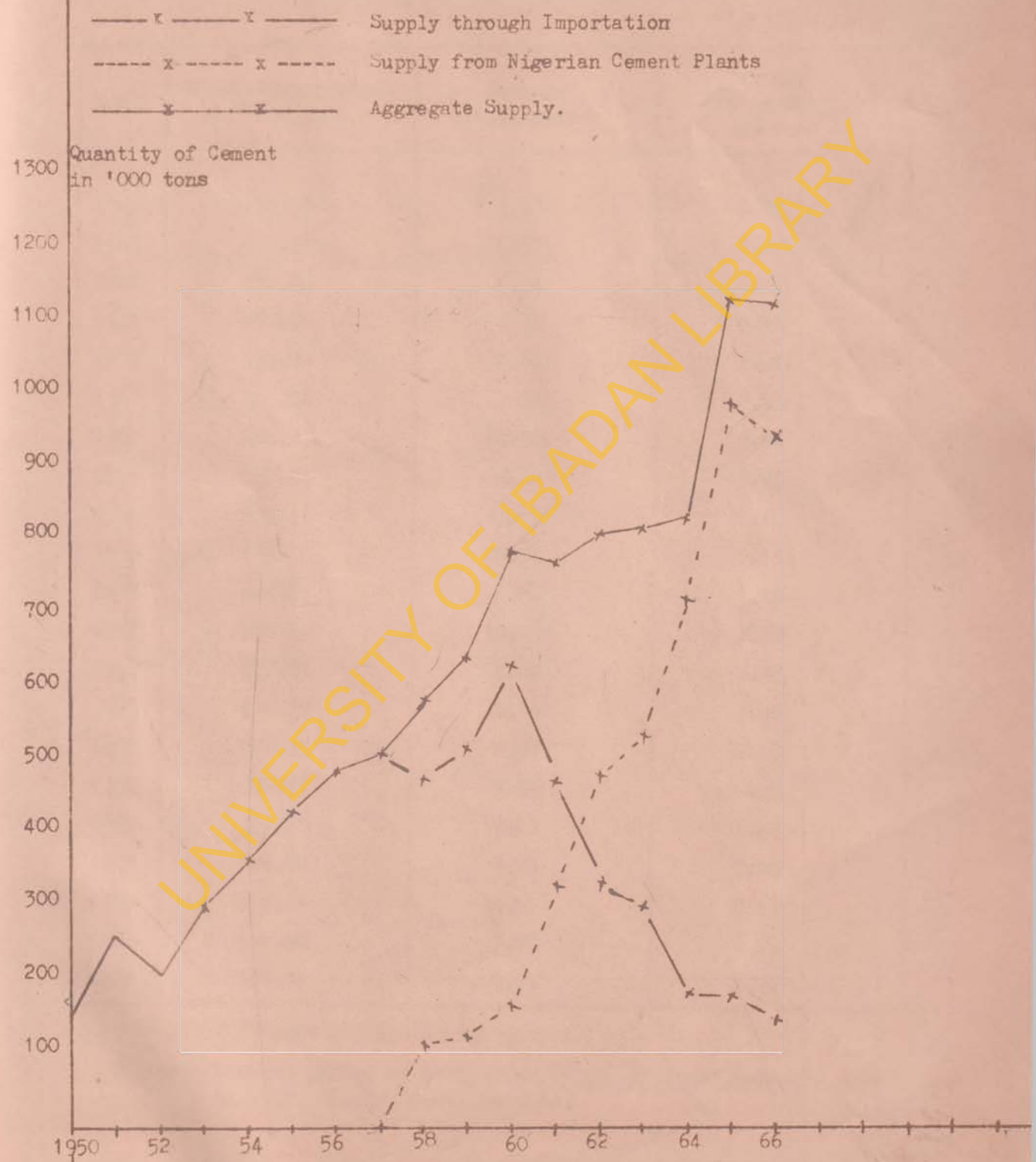

Table 2.2

Nigeria's Import of Cement: 1946-66

Year	Quantity imported in '000 tons	Average c.i.f. price*	Average Custom duty per ton
		£	£
1946	95.99	4.95	0.89
1947	107.31	5.97	0.88
1948	131.66	6.34	0.99
1949	161.96	6.30	0.93
1950	153.86	7.14	1.00
1951	261.06	9.82	0.95
1952	205.17	10.90	0.94
1953	297.44	9.24	0.97
1954	368.11	7.21	1.16
1955	435.10	8.54	1.40
1956	488.57	8.82	1.40
1957	510.24	9.09	1.39
1958	477.12	8.60	1.37
1959	516.19	8.58	1.40
1960	626.49	8.57	1.42
1961	476.91	7.68	1.40
1962	334.88	7.06	1.47
1963	300.22	6.76	2.00
1964	178.11	6.87	5.15
1965	171.49	7.71	4.75
1966	151.00	8.61	4.71

* (Values are in current prices.)

Source: Federal Office of Statistics, Nigerian Trade Summary, 1946 to 1966. Lagos, Govt. Printer.

It can be concluded, therefore, that although the period of 1961-66 was one of importing cement from countries selling at lower prices, it was also one during which domestic production was increasing rapidly. By 1966, 85% of the country's supply of cement came from the Nigerian cement factories. Figure 2.1 shows the relative movement of consumption of cement, of import of cement, and of domestic production. Imposition of heavy duty was necessary to protect the domestic factories from the strain and stress that can result from dumping of cement by large-scale producing factories. Between 1957 and 1966, Nigeria spent £30.5 million in importing cement, and over 3.7 million tons were imported. But this constituted just 46% of the aggregate consumption of cement during the period. Even though Nigeria spent large sums for importation of cement producing plants, some raw materials, and for paying expatriate workers, a lot of foreign exchange has been saved during this period.

Our main concern here has been importation of cement as a source of supply. From Table 2.2, it is clear that this is a dwindling source. But since there are other kinds of cement like Low Heat Cement, Oil-well Cement (used by the petroleum drilling companies), etc. used to a small extent in Nigeria, importation of these kinds will continue. This is inescapable since all the cement factories in the country manufacture the ordinary portland cement.

The carefully managed commercial policy in the sense that importation of cement is much reduced and the fewness of the cement manufacturing plants in Nigeria tends to make the industry oligopolistic. It is a hybrid of real cost advantage and institutionally enforced oligopoly.[1]

By the end of 1965 for which relevant data are available, the Nigerian cement industry has absorbed over £N11.4 million as expenses on fixed asset. During this year therewere also about 2,400 employed in the industry. About 2,000 are semi-skilled and unskilled workers.[2] The Ewekoro and Nkalagu factories accounted for over 80% of the domestically supplied cement. These two factories seem to be better placed in terms of location, transport facilities and natural market demand capacity. Each of the newly established integrated plant is expected to produce about 100,000 tons per annum. Regional rivalry, encouragement by sales promoters of cement plant manufacturers, and to some extent, the profit made by the existing firms play a considerable role in establishing the new plants. It is too early to discuss the profitability prospect of these factories, however. But they will

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1. Fellner, William: Competition Among the Few Oligopoly and Similar Market Structures. Reprinted from Economic Classics, New York, 1960, p. 44.

2. Federal Office of Statistics: Industrial Survey Nigeria 1964 and 1965. Lagos, Nigeria.

prevent the older plants from sliping into inefficiency and from relying on quasi-monopolistic advantage, an inevitable result of supply being in the hands of two or three firms.

Before the civil war in 1967, Nigeria was able to supply well over 90% of her cement need; it will be incorrect though to assert that the 1,100,000 tons was the country's demand at that time since there is a high degree of probability that there existed unsatisfied demand at this specified year.[1] The high tariff wall, the requirement of an import licence before importation of cement could be made and the resulting high prices of cement are reasons to believe that consumption could have been higher than the 1,137,000 tons level of 1966 if these conditions were absent.

Because of the high cost of transport compared with the ex-factory price in the foreign manufacturing plants, and because of the falling cost per unit with increase in the scale of production, the cement industry is a clear case of a infant industry. Kilby admitted this and put the increase in price as a result of transport cost at 70% of the ex-factory price in the exporting countries.[2] This gives cement firms an enormous comparative advantage as an import replacing industry.

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1. Kilby, Peter, op.cit., p. 109.

2. Kilby, Peter: op.cit., p. 100.

C. The Market Structure

As explained earlier, there were only a handful of cement producers in the country as late as 1967. Only three of them are fully integrated plants while the remaining plants were merely clinker grinding plants. The integrated plants were responsible for over 80% of the domestic output. The second important source to the market is through importation: but the proportion of this has dwindled steadily from 99.2% in 1957 to mere 13.3% in 1966 as a result of carefully manipulated protectionist policy. We therefore have an oligopolistic market - a market for just a few, with product differentiation through selling under brand names. One remark about product differentiation in respect of cement seems in order. To be sure, cement is one of the most standardized commodities; it is virtually a homogeneous commodity once a standard is laid down and adhered to. It can, however, be easily differentiated either through the use of brand names or by slight alteration in its quality. Here is an appeal to the public for instance: "Elephant cement complies fully with international standard for the ordinary portland cement - and does in fact exceed them by a wide margin".[1] This advertisement differentiates "Elephant Cement" from other brands in the country; moreover, it claims superiority over ordinary specification. This tends to build imperfection in the

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1. West Africa, No. 2711, May 17, 1969.

cement market; the fewness creates a situation of oligopoly in the suppliers' market.

Fellner[1] enumerated three broad conditions which can lead to the growth of oligopoly in an industry. First is the existence of real cost advantage of large scale production which lowers cost per unit. This implies the existence of profitable relationship between sales cost and revenue. Such sales cost will include selling cost in form of advertisement and inducement given to middlemen. The second is the existence of few big firms that can employ short-run financial strength to destroy small competitors and prevent new entrants, the objective being to enjoy oligopsony power. In the third instance, "atomistic groups" get organised in such quasi-oligopolistic fashion that agreement is enforced by an outside agency; such agency may be government or other producers that supply raw materials or sales outlets.

The Nigerian cement industry complies with the first condition. Cement making involves heavy capital outlay which cannot be easily financed in developing countries. It is interesting to note here that all the integrated companies are financed by the old regional governments and foreign cement plant manufacturers. Private shares in these companies do not assume any considerable proportion. Only the Nigerian Cement Company derives a sizable part of its capital from private

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1. Fellner, William: op.cit., p. 44.

ordinary share and this came as a result[1] of the large profits made by the company. Moreover, there abounds in the cement industry real cost advantage in large scale production. Looking for wider market outside the plants natural market which may involve supporting transport cost by basing-point policy or delivered price policy, will involve additional selling cost. This is, however, outweighed by the real cost advantage derived from increasing the scale of production until the minimum marginal cost possible is attained and therefore the minimum average cost and consequently maximum profit.

What is the effect of government intervention through commercial policy? What effect has the positive excess demand situation arising from the fact that the domestic firms cannot fully supply the demand, and the fact that there is import restriction? The fewness of the domestic firms and the restriction of import tends to breed a hybrid of real-cost oligopoly and government imposed oligopolistic situation. The effect of the commercial policy is diminution of output and increase in price. And this is essentially what happens in monopoly and oligopoly markets. Profit is maximised either by raising price and allowing quantity demanded to be fixed by the market forces or by doing the converse.

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1. Ugoh, S.U.: "The Nigerian Cement Company". Nigerian Journal of Economic and Social Studies, Vol. 6, No. 1, p. 74.

D. The Pricing Policy and Marketing Strategy:

The Nigerian cement industry is still in its infancy: this makes complex pricing policy unnecessary. The existing firms rarely sell outside their natural markets. It appears that the long experience about the stable cement prices cannot be disturbed until some of the existing factories expand and require additional markets outside their natural markets. There is also an upper limit to which the price of cement can be raised in this country, war period apart with its uncertainty and speculation. If, for instance, businessmen are sure to make profits by importing in spite of the high custom duty, they would do so, and the existing factories would lose part of their markets. It would appear, therefore, that there are upper and lower bounds within which the firms can operate as regards price fixing. The lower bound is set by the amount of custom duty and average c.i.f. price and, of course, port charges and transport cost while the upper is naturally set by the profit motive of the firms (the mark-up). In this connection, it is proper to state that it is incorrect to assert that it was "NigerCem" that set the price level of cement in the old Eastern Region.[1] What really happened was that the company gave some profit margin to the distributors to win the market from imported cement.

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1. Ugoh, S.U. op.cit., p. 83.

Moreover, the Nigerian cement market is completely devoid of the complexities of "basing point" or "delivered price" agreements. With the exception of two cement firms (the Kalambaina Cement Company and Nigeria Cement Company) which built depots at a few strategic places for the purposes of reducing their respective middlemen's transport costs and inconveniences, the Nigerian cement firms do not subsidise middlemen in respect of transportation to distant places. With continuing expansion, this cannot be avoided. There will be instances when a factory may need to win a contract to supply cement to distant markets in the sense of being outside the factory's natural market. Cement industry demand is characterised by spatial fluctuation as well as temporal fluctuation. Aggresive commercial policy requires smoothing out this fluctuation by complex and flexible pricing policy.

Arising from the situation discussed above, there is a phenomenon in Nigeria, of gradually rising price from the South to the North, since all the cement factories, except the Kalambaina cement, are situated in the south. This situation arises due to lack of any incentive to give financial support to distributors in distant markets. The Kalambaina cement factory has not been in a strong position to reverse this situation. Table 2.3 below is a rough average prices of a ton of cement in a few tons between 1958 and 1966. It is a rough estimate because the quantities sold in each town are not known and hence the average is unweighted. All that could be said is that a considerable amount (about half of the aggregate cement consumption) is taken up in the Western and Lagos States. The six Northern States consumes just about a quarter.

Table 2.3

Rough Average Prices of Cement Per Ton in a Few Selected Towns, 1958-66

£'s per ton.

Date	Ibadan	Lagos	Port-Harcourt	Onitsha	Kano
1958	13.75	12.25	11.96	12.97	17.4
1959	12.66	12.50	11.66	12.47	17.6
1960	13.12	13.50	11.98	11.75	16.45
1961	13.16	13.50	11.91	11.75	16.48
1962	12.23	12.83	12.12	12.05	16.20
1963	11.72	11.50	11.47	10.20	16.35
1964	12.05	11.50	10.20	10.30	16.20
1965	11.81	13.00	11.70	11.15	16.07
1966	12.33	12.04	12.61	11.04	16.54

Source: Federal Ministry of Trade and Industry. Files on monthly trade report for West, East and North - 1957 to 1966.

E. The Determinants of Demand for Cement

The determinants of demand for cement are always classified into two: the level of construction work in a country and the competitive position of cement relative to structural steel, mansory and other substitutes.[1] In the Nigerian context, only the first determinant is important. On the other hand, there is at present the use of bricks and mud in residential houses which compete with cement. Similarly, stones are used in many construction jobs, though these cannot be used without the adhesive function of cement. The two, bricks and stones tend to complement cement at times while they can compete with it occasionally. Petroleum asphalt and tar are mostly used in paving the Nigerian roads, but in a few instances cement is used. It was used to pave the Mokwa-Kainji Road before being covered again by a mixture of tar and sand. It is right to say that the amount of cement used in the highways is limited to the quantity used for constructing bridges, street, gutters and harbours. This quantity is further determined by technological factors required to produce the necessary concrete strength. The aggregate demand for cement is therefore determined by the amount of construction work which is also dependent, to a large extent, on national political objectives and social welfare policy.

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1. Spencer, Clark, Hognet, Business and Economic Forecasting, New York, R.D. Irwin, Inc., 1961.

The rate of construction work in Nigeria since the early 1950's has been phenomenal. Residential buildings have taken up the largest share of the construction work. As Professor Aboyade noted, "within the construction itself, the largest component comes from residential buildings constituting about 60 % of construction activity, and about thirty per cent of the gross capital formation".[1] Although this fell in the following years, in 1966 it still constituted more than 25%, as shown in Table 2.4 below. Within the decade of 1957-66 itself the amount spent on building (and mostly residential building) grew from £N30.7 million to £N52, an increase of about 6.6% per annum. It has been asserted and perhaps without much exaggeration that a study of construction industry in Nigeria is a study of half the whole field of fixed capital accumulation in this country. The statement can be recast that a study of aggregative demand for cement in Nigeria is a study of the development of construction industry, from the use of mud and burnt bricks to that of concrete.

Building continues to dominate the construction industry; nor is it building of all sorts, it is the construction of residential houses. While we are not concerned here about efficiency in resource use, it is pertinent to point out that this has a far-reaching effect on the price elasticity of demand for cement. It is generally believed that price elasticity for cement is low both in the very short-run and even in the fairly long-run. One reason why cement is price inelastic is

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1. O. Aboyade, Foundations of African Economy. New York, Praeger, p. 121.

Table 2.4

Construction Sector and the Gross Capital Formation

1957 - 1966

Year	Building and Civil Engineering			Total Gross Fixed Capital Formation	Building & Civil Engineering as a % of GFCF
	Building £'m	Civil £'m	Total £'m		
1957	30.7	23.1	53.8	99.3	54.2
1958	35.6	23.6	59.2	109.2	54.2
1959	44.8	29.0	73.8	122.8	60.1
1960	44.7	27.6	72.3	129.1	56.0
1961	42.8	27.1	69.9	152.5	45.8
1962	46.8	29.6	76.4	159.8	47.8
1963	47.6	33.0	80.6	177.8	45.3
1964	48.2	31.1	79.3	195.0	40.7
1965	50.6	42.3	92.9	234.1	39.7
1966	52.0	46.6	98.6	242.6	40.6

Source: Federal Office of Statistics: Economic Indicators, Vol. 5, No. 5, May 1969.

that engineers are not always committed to change technical designs within a short time, so that a small reduction in the price of cement will not induce any change in the specification of the design and raw materials already drawn up. There is also inertia on the part of engineers in altering the customary construction methods.

To what extent is the Nigerian construction industry affected by these factors? The fact that about 50% of the construction work is not awarded on contract to contractors and engineers means that the influence of these factors are considerably minimised. A difference of one pound per ton can alter the quantity purchased by individuals who prefer to employ technicians and labour and to supply them with materials. In this case, the cement content in any piece of work can be influenced by changes in the price of cement. Sand, stone and burnt bricks are therefore effective substitutes even in the Western part of the country where the highest proportion of construction work has been going on since the past two decades. In some cases, cement is used for flooring and plastering of the wall. In some, it is used for the foundation of the building; and in yet another group, cement is not used at all. Under these circumstances, cement could be price elastic, depending upon the weight of these factors.
Apart from the level of construction work in the country, the level of price of cement can influence the level of consumption of cement. But we shall expect a very close positive association between cement consumption and construction activity.

Another important factor influencing cement consumption is cement inter-industry relationship. It is generally agreed that cement has a weak forward linkage. Since the past few years, asbestos, water pipes and other pressed products are being manufactured in the country. These products have increased the level of cement consumption, though the influence has not been considerable. The quantity taken up by the leading Asbestos Cement Product has been 15,000 tons on average between 1965 and 1968, and there are only a few of them.

It is generally claimed that there is a close association between per capita income and consumption of cement. With our paucity of data, it is difficult to make a categorical statement; both figures on population and national income are rough. Reliable inferences are therefore difficult to obtain. This drawback of lack of reliable population figures is noted by participants of the sub-regional meeting on Economic Cooperation in West Africa.[1] Table 2.5 gives the series of per capita consumption of cement and per capita income between 1950-66. These series give a coefficient of determination of less than 2%. This is an indication of absence of association. Though as mentioned above much importance cannot be attached to this result. The most populous part of the country though not in terms of population

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1. United Nations. Economic and Social Council, Economic Commission for Africa (E/C14/INR/117): op.cit., p. 39.

Table 2.5

Nigeria: Per Capita Consumption of Cement and Per Capita Income[1]

Year	Per Capita Consumption in lbs	Per Capita Income in £N
1950	11.20	20.60
1951	17.22	21.69
1952	13.44	22.09
1953	17.92	22.10
1954	22.40	23.22
1955	24.64	23.32
1956	26.88	22.25
1957	29.12	23.67
1958	26.88	24.75
1959	33.60	25.89
1960	40.32	28.50
1961	40.32	27.80
1962	38.08	28.27
1963	38.08	29.74
1964	38.08	29.64
1965	49.28	30.35
1966	49.28	30.23

Sources: Federal Office of Statistics: Economic Indicators, Vol. 5, No. 5, May, 1969. Lagos, Nigeria.

1. 1952 and 1963 census figures are synthesized to obtain the rough estimates of population figures, 1948 - 1966.
See Olusanya, P.O. Social Economic Aspects of Rural Urban Migration in Western Nigeria. Appendix B.

density has been the least cement consuming area. The whole of six northern states has over half of the country's population, yet they consume just about 20% of the aggregate cement consumption.[1] The high level of cement consumption in the West is influenced by culture, taste as well as economic prosperity.[2] It is doubtful whether increase per capita per se can go a long way to explain increasing rate of demand for cement. Other explanatory variables have to be looked for.

In sum, while there are many factors that influence the consumption of cement and therefore the demand, the most important of these factors is the state of construction activity. It may be incorrect to state a priori that cement will not be responsive to price as in the developed countries. The conditions existing in those countries are either non-existent or passive in many developing countries. In addition, substitutes such as mud, burnt bricks, etc. which are ineffective substitutes in developed countries are effective in Nigeria. With increasing efficiency in the industry and consequent lowering of prices, there will be a great stimulation in the consumption of cement.

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1. Ministry of Trade and Industry, Northern Regional Government: Industrial Potentialities of Northern Nigeria op.cit. p. 123.

2. O. Aboyade: op.cit., p. 122.

CHAPTER III

THEORETICAL BACKGROUND AND METHODOLOGY

A. THE THEORY OF DEMAND

The classical theory of demand, despite modifications and reformulations by several economists, is still subject to significant gaps which prevent a marriage of the theoretical construct and the empirical analysis. As a result of these gaps, tests of empirical implications of the theory have been largely unsuccessful. Although this study is not concerned with discussing the weak links between theory and empiricism, an attempt is made in this chapter to discuss the theory in so far as it enables us to find a suitable empirical (ex-post) demand function for analysing the relation for a producers' good, cement, in Nigeria. In other words, the theoretical constructs presented will be those that help us to find some mathematical formulations which will prove to be a useful predictive tool.

The theory of consumer behaviour is rooted in the concept of ordinal utility. The demand function must be single-valued and to each set of prices and income, there

corresponds a unique set of goods. It must be homogeneous in degree zero: that is a change in income and prices in the same proportion leaves quantities demanded unchanged, ceteris paribus.

The consumer has to choose such a bundle of commodities, Σx_i, (x_i is the i^{th} commodity and p_i, the corresponding price) in such proportions that each commodity maximizes his utility under his budget constraint. Or as stated by Samuelson,

> "The utility analysis rests on fundamental assumption that the individual confronted with given prices and confined to a given total expenditure selects the combination of goods which is highest on his preference scale.[1]"

The quantity of each commodity thus selected is a function of all prices and income.

$$\begin{aligned} x_1 &= f_1(p_1, p_2, \ldots p_n, M) \\ x_2 &= f_2(p_1, p_2, \ldots p_n, M) \\ &\ldots\ldots\ldots\ldots \qquad \ldots\ldots\ldots \quad (1) \\ x_n &= f_n(p_1, p_2, \ldots p_n, M) \end{aligned}$$

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1. Sammuelson, Paul, Foundations of Economic Analysis, Havard University Press, 1961, pp. 97 - 98.

$x_1, x_2, \ldots, x_n$ are the quantities of commodities demanded, and $p_1, p_2, \ldots, p_n$ are the respective prices; M denotes the income at the disposal of the consumer. The problem of utility maximization is one of constrained maximum, because p_i and M are given.

$$U = F[\Phi(x_1, x_2, \ldots, x_n)] \quad \ldots\ldots\ldots (2)$$

U denotes the utility derived from the commodities $x_1, x_2, \ldots, x_n$, and Φ is a utility index, subject to the constraint.

$$\Sigma x_i p_i = M; \quad \ldots\ldots\ldots (3)$$

that is, total expenditure sums up to income.

This can be regarded as an appropriate starting point for analyzing the commodities from which utility is derivable directly[1]. It appears that economic theorists have neglected the area of demand for produced inputs or intermediate goods. This area has not received much attention

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1. Some studies have been carried on this line, for instance, Court, R.N.: "Utility Maximisation and Demand for New Zealand meat", Econometrica, Vol. 35, Nos. 3 - 4, 1967, pp. 424 - 446.

from empirical investigators[1]. The point to note here is that we need to go beyond the theory of utility as the basis for our empirical work.

In cases of primary inputs such as labour, land and capital, their demand depends upon their marginal products within the profit maximization context. The case for produced input is not, however, so easily settled. But it would appear that since these commodities do not give utility directly, they need be classified with primary inputs, though with some qualifications. We have to think in terms of each produced input's relative importance in the industry (or industries) in which it is consumed. The demand will be influenced by the relative proportion of the cost of any input to the total cost of the finished product, the nature of demand for the finished product, the characteristic of the supply of any input, and the extent to which other inputs can be substituted. In any case, for a produced input which constitutes a high cost ratio to total cost of the finished product, there will

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1. Fisher, F.M.: A Priori Information and Time Series Analysis, North-Holland Publishing Company, Amsterdam, 1966, p. 93.

be a strong desire to substitute other inputs in case of an increase in the price, if such a substitute exists. The degree of substitutability may be determined by what is technologically feasible.

It should be noted that what is relevant in case of demand for produced input is profit maximization rather than utility maximization which is the main objective in the usual consumer theory of demand. Although, a business unit may have other motives, but profit maximization is one of the paramount objectives. In the case where produced input is involved, profit maximization will depend, essentially, on optimum input mix and minimization of cost for a given output.

We assume that the j^{th} firm's production function (keeping other factors other than inputs constant) is

$$y_j = f_j(x_1, x_2, \ldots x_n) \quad \ldots\ldots\ldots (4)$$

where y_j is the j^{th} firm's output, using $x_1, x_2, \ldots x_n$ as inputs. These inputs are both primary and produced. The combination of inputs is chosen to attain an optimum mix which will minimize cost of producing a given output, subject to technological feasibilities. If we denote profit by Π, unit

price of finished product by p', and by p_i the price of the i^{th} input, the profit of the j^{th} firm is

$$\Pi_j = p'f_j(x_1, x_2, \ldots, x_n) - p_1x_1 - p_2x_2 - \ldots - p_nx_n \quad \ldots\ldots\ldots (5)$$

Setting the partial derivatives of the profit function with respect to the inputs equal to zero, we have

$$\begin{aligned} p'f'_j(x_1, x_2, \ldots, x_n) - p_1 &= 0 \\ p'f'_j(x_1, x_2, \ldots, x_n) - p_2 &= 0 \\ \ldots\ldots\ldots\ldots\ldots\ldots & \quad \ldots\ldots\ldots (6) \\ p'f'_j(x_1, x_2, \ldots, x_n) - p_n &= 0 \end{aligned}$$

where $\frac{\partial \Pi_j}{\partial x_i} = p'f'_j(x_1, x_2, \ldots, x_n) - p_i$ Solving the system of equations in Equation 6 for the x's will give the demand function for the j^{th} firm for the various inputs as:

$$\begin{aligned} X_{j1} &= X_{j1}(p_1, p_2, \ldots, p_n, p') \\ X_{j2} &= X_{j2}(p_1, p_2, \ldots, p_n, p') \\ \ldots\ldots\ldots\ldots\ldots\ldots & \quad \ldots\ldots\ldots (7) \\ X_{jn} &= X_{jn}(p_1, p_2, \ldots, p_n, p') \end{aligned}$$

The demand for the i^{th} input like any other input depends upon p_i, the price of itself, the unit prices of other inputs that are used with it in the production of the j^{th} firm's output, and the unit price of the finished product. The demand for a produced input like a primary input is a derived demand: it is indirectly derived from the demand for the product for which it is employed to produce. If the unit prices of all other inputs are held constant, the j^{th} firm's demand for the i^{th} input is

$$X_i^d = X_i^d(p_i) \qquad \ldots\ldots\ldots (8)$$

If there are m firms within the economy using the i^{th} input, the total demand for the i^{th} input is the summation of the individual firm's demand[1].

$$Q^d = \sum_{j=1}^{m} X_j^d(p_j) \qquad \ldots\ldots\ldots (9)$$

$$j = 1, 2, \ldots m$$

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1. Henderson and Quandt: Micro-economic Theory, McGraw-Hill Book Company, Inc., London, 1958, pp. 107 - 109.

In the present exercise, cement, being a produced input, its aggregate demand in Nigeria is a summation of individual demand of all cement users in the economy.

B. REVIEW OF SOME PREVIOUS STUDIES ON DEMAND FOR PRODUCERS' GOODS.

Inumerable work abounds on empirical demand for agricultural products. There are also many on other consumer goods, both durable and non-durable. The existing works on demand for producers' goods number just a few. Here, an attempt will be made to review three of them. Two of these are attempts to derive demand equations, while the third is on methodology of forecasting demand for a producer's good.

The demand for a producer's good is a derived demand and in this area there are always greater and more diverse problems to solve. Whitman's work[1] remains a classic in this area of empirical demand analysis. Whitman considered the following six different formulations:-

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1. Whitman, R.H.: "The Statistical Law of Demand for a Producer's Good as Illustrated by the Demand for Steel", Econometrics, Vol. 4, 1936.

$$(a) \quad X = b_o + b_1 p + b_2 t$$

$$(b) \quad X = b_o + b_1 p + b \frac{dP}{2dt}$$

$$(c) \quad X_t = b_o + b_1 p_t + \int_{-\infty}^{\infty} \Phi(t - \tau) p_t \, d\tau$$

$$(d) \quad X_t = b_o + b_1 p_t + \Sigma_k b_k^p (t - kr) \qquad \ldots\ldots\ldots (10)$$

$$(e) \quad X_t = b_o + b_1 p_t + b_2 \frac{dP}{dt} + \Sigma_k b_k p(t - kr)$$

$$(k = 2, 3, 4, \ldots\ldots k)$$

$$(f) \quad X = b_o + b_1 p + b_2 \frac{dP}{dt} + b_3 I + b_4 t$$

where X denotes quantity demanded;

p = price;

t = time;

$\frac{dP}{dt}$ = rate of change of price with respect to time;

I = index of industrial production.

$b_o, b_1, b_2 \ldots\ldots b_k$ are parameters to be estimated.

Constraints on the parameters are $b_o > 0$;

$b_1 < 0$;

$b_2, b_3, \ldots\ldots, b_k$

are not constrained, they are all parameters referring either to previous prices or rate of change of previous prices.

He referred to equation 10(a) as a formulation often used to estimate demand functions of agricultural products. This gave him a shifting result that prevents making any specific statement about the demand parameters. He then turned to equations 10(b to e), which are almost the same.

These equations [10(b) to 10(e)] grew from the works of Evans[1] and Roos[2]. They are basically built on the concept that the quantity demanded at any given time depends on the current price, the rate of change for price with respect to time, and the previous levels of price. Equation 10(b) includes the influence of $\frac{dP}{dt}$, that is the rate of change of price with respect to time; Equation 10(c) considers the influence of the previous prices, time going infinitely back; 10(d) is the discrete form of 10(c); 10(e) is a hybrid of 10(b) and 10(d). As was clear from the empirical work, while the inclusion of the term $\frac{dP}{dt}$ seems reasonable, the concept that

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1. Evans, G.C.: "The Dynamics of Monopoly", American Mathematical Monthly, Vol. 31, No. 2, February, 1929, p. 77.

2. Roos, C.F.: "Dynamical Theory of Economics", Journal of Political Economy, Vol. 35, 1929, pp. 632 - 656.

quantity demanded at any given time depends on previous price levels is questionable in some markets. The term $\frac{dP}{dt}$ is necessary in markets where gambling and speculation abound. This can be a common phenomenon in many dealers' markets. The influence of previous prices, especially when far into the past, would probably have a negligible effect. And lagged adjustment function, relevant to agricultural products is concerned with the supply function. Only equation 10(e) gave a somewhat plausible result. Whitman discovered that there are some important variables excluded.

He later incorporated the Index of U.S. Industrial Production into the analysis. This serves as a measure of income. He obtained a much improved result. The resulting equation is given below.

$$X = 1.49 - 1.27P + 6.27\frac{dP}{dt} + 4.64\bar{I} - 0.03t \quad \ldots\ldots\ldots (11)$$
$$(0.23) \quad (0.94) \quad (0.35) \quad (0.17).$$

$$R^2 = 0.85.$$

The standard errors are put in the parentheses. The positive and significant coefficient of $\frac{dP}{dt}$ confirms existence of speculation in the steel market (United States) during the time of observation (1921 - 1930). Whitman tackled cleverly

the problem of estimating the demand equation for steel. He got his signs right, though it is not easy to determine the price and income elasticities from the equation.

For the purpose of estimating the parameters, especially as set out in theory of demand, Fisher's work[1], is by far the best available, in respect of estimating demand for a producer's good. He considered a model[2] of long-run economic behaviour under decision making costs and presented the result of psychological experiment designed to test the hypothesis that it is possible to construct fairly simple circumstances involving costs of decision review under which decision makers pay more attention to "turning points" years. Attention is centred on his method of analysing demand for aluminium ingot[3]. After analysing the form of market and tackling the problem of 'identification', Fisher proceeds to estimate the demand function for Aluminium Ingot. The Quantity demanded

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1. Fisher, F.M.: A Priori Information and Time Series Analysis, Essays in Economic Theory and Measurement. North-Holland Publishing Company, Amsterdam, 1966.
2. Fisher, op. cit., Chapters 2 and 3.
3. Fisher, op. cit., Chapter 5.

was regarded naturally as the dependent variable thus following Marshallian demand model as against Walras. He then used "the list price of 99%+ pure virgin ingot"; this choice was made on the ground that this is the only price series that is readily available for the years covered. The Bureau of Labour Statistics Wholesale Price Index (1926 = 100) for metal and metal production was used as price deflator. The Federal Reserve Index Durable Manufacturing Production (1947-49 = 100) was used as a measure of Income Variable. Using the first differences of the natural logarithms, Fisher adopted the least square regression to estimate the parameters. The logarithmic function was adopted because of easy estimation of the elasticities and because of the a priori reason to suppose that any time trend in aluminium ingot is roughly exponential. The demonstration effect of aluminium used is assumed to be roughly proportional to the amount of aluminium currently being used. Denoting aluminium output in year t by Q_t, the real price of aluminium in year t by p_t, and the Federal Reserve Index of Durables in year t by Y_t, Fisher obtained the following equation:

$$\Delta \log Q_t = \underset{}{0.0542} + \underset{(0.124)}{0.755}\ \Delta \log Y_t - \underset{(0.426)}{0.024}\ \Delta \log p_t \quad \ldots\ldots\ldots (12)$$

$$R^2 = 0.744$$

Since the coefficient of Y_t or income elasticity is significantly different from 1, Fisher considers the result suspect.

He then made allowance for stockpiling during those years in which it occurred, and eliminated the observations for a few abnormal years, abnormal in the sense that demand exceeded supply. This was necessary because, there is no way to correct the resulting parameter shift. These corrections considerably improved his result.

$$\Delta \log Q_t = 0.0325 + \underset{(0.161)}{0.950}\ \Delta \log Y_t - \underset{(0.608)}{0.428}\ \Delta \log p_t \quad \ldots\ldots\ldots (13)$$

$$R^2 = 0.904.$$

Both the price and income elasticities fall within his expected respective magnitudes. Fisher then proceeds to estimate the long-run elasticities on the basis of the above result. Fisher's demand function for aluminium ingot is certainly one of the genius attempts to estimate demand for a producer's good.

Another noteworthy work in respect of demand for a producer's good is that given by Spencer and others[1]. In this

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1. Spencer, M.H.; Clark, C.H. & Hoquet, P.W.: Business and Economic Forecasting: An Econometric Approach, Richard R. Irwin, Inc., Homewood, Illinios, 1961, Chapter 9.

work, attempts have been made to relate the independent variables that wield considerable influence on the amount of each construction material demanded at any given time. One of the materials considered is Portland Cement. The important determinants of demand for Portland Cement has been construction activity and the competitive position of cement relative to substitutes, such as structural steel, mansory and other substitutes.

The construction sector is divided into three broad categories: using the following notations:

P = Producer's plant,

H = Highway Construction, and

A = All other.

Weights are then attached to each one according to its relative contribution to aggregate consumption for the years 1947 - 49. He arrived at this formula for constructing the end-use index, E.

$$E = 0.195P + 0.165H + 0.640A \quad \ldots\ldots\ldots (14)$$

He chose the series of "Portland Cement Shipments" as a measure of demand, D. Both D and E then standardised on comparable

basis by their respective standard deviations. An "unexplained variation" variable measured as the ratio of actual shipments and shipments expected on the basis of the regression performed on end-use and cement shipment index. He came to the conclusion that there is a close association between the consumption of cement and the construction activity, E or end-use, and the shipment of cement, D. Combining the two variables, he concluded that:

$$D = \frac{E}{s_E} f(t) s_S \cdot \qquad \ldots\ldots\ldots (15)$$

where D = Demand for Portland Cement measured by shipments,

E = End-use,

s_E = Standard deviation of End-use index,

s_S = Standard deviation of Portland Cement shipments,

f(t) = Net growth or time trend.

Spencer and his team were primarily concerned with forecasting sales; they therefore ignored the estimation of parameters such as income and price elasticities. This method is not sufficient for estimating the demand function for cement. Nevertheless, it highlights some of the important determinants of demand for cement.

In sum, Fisher has demonstrated that the demand paramaters of a producer's good are capable of being estimated under the conditions of oligopoly. It is obviously an improvement over Whitman's work. Spencer's methodology is useful where there are sufficient data on the break-down of consumption of a given producer's good within an economy. Unfortunately, such data are not always available in the developing countries.

C. MODEL SPECIFICATION AND METHODOLOGY

Formulation of any mathematical function requires the choice of suitable variables specified in an appropriate relationship. In addition to this requirement, specification of demand function needs to take into consideration, the theoretical restrictions like expected theoretical magnitude of coefficients of income, price, etc. In this exercise we attempt to estimate two different demand functions: one for the demand for import of cement and the other for the aggregate demand for cement.

For the purpose of estimating the demand for import of cement into the country, we postulate the function here:

$$X = f(P, Y, K, T, U) \qquad \ldots\ldots\ldots (16)$$

where X = quantity of cement imported into the country;

P = the average import price of cement per ton measured as the average value of a ton of cement;

Y = the country's control of foreign exchange, measured as the value of the country's export, minus a change in the foreign exchange reserve;

K = a trade restriction variable measured as the amount of custom tariff imposed on a ton of cement at any given time;

T = a trend-dummy variable, as a measure of changes in "taste", culture and industrial production of cement at home;

U = a disturbance term assumed to have $E(u) = 0$;

$$E(uu') = \sigma^2$$

The variable T requires some explanation. It is not, strictly speaking, a trend factor: it is more or less a dummy variable. The trend factor is here defined to take into consideration the effect of production. Importation of cement increased in cyclical manner until it reached its peak in 1960 and thenceforth fell gradually to about the 1948 level in 1966. T is therefore defined as:

$$T_i = H_i - 2S_i \quad \ldots\ldots\ldots (17)$$

where $H_i = i - 1947$;

$i = 1948, 1949, \ldots\ldots\ldots$;

$$S_i = \begin{cases} 0 & \text{for } i \leq 1957; \\ i - 1957 & \text{for } i > 1957. \end{cases}$$

H is a trend variable having its origin in 1947.

S is another trend variable having its origin in 1957, the year manufacturing of cement began in Nigeria.

S_i variables have a cumulatively double effect on the growth of the volume of import of cement. It stops the normal growth of import and it reduces the already attained level. The net effect of the two conflicting factors is denoted by T_i at time i.

Reference has been made to the shortcomings in the theoretical formulation of demand analysis, especially as regards the non-economic and/or non-quantifiable factors that have overwhelming influence on the pattern of demand for most commodities. The introduction of trend factor in the independent variables

is one of the common methods of circumventing this problem. Another method is the transformation of the raw data or the use of the first differences of the logarithms of the data in running regression for determining the parameters. Fisher uses the latter method effectively in his demand analysis for Aluminium Ingot[1]. This is a device for removing trend effect as well as serial correlation. Fisher is opposed to inclusion of trend as a variable in demand analysis on the ground that the coefficient of T (trend factor) is meaningless in economics[2]. But Fisher's reason could have been sound only if the current theorising about consumers' behaviour is not badly out-balanced from the point of view of applications[3]. Import duty is an important explanatory variable. The imposition of custom duty on imported cement could be said to be mainly for the purpose of earning revenue to the government. But since 1963, the objective has changed to one of protecting the domestic industries, including the Nigerian cement industry. It is

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1. Fisher, F.M.: op. cit., pp. 93 - 117.

2. Fisher, F.M.: op. cit., p. 25.

3. Stone, Richard: The Measurement of Consumers' Expenditure and Behaviour in the United Kingdom 1920 - 1938, p. 270.

important that custom tariff on cement is incorporated into the body of the independent variables that determine the quantity of cement imported into the country at any given time.

For the purpose of estimating the aggregate demand equation, it is postulated that the aggregate demand for cement; X, is:

$$X = f(p', Y', t, \epsilon_t) \qquad \ldots\ldots\ldots (18)$$

where X is the quantity of cement demanded in thousands of tons,

Y' is the index of construction activity in Nigeria used here as a measure of income in respect of demand for cement,

t is the trend factor.

It is doubtful whether the inclusion of trend factor is necessary. We feel that it may lead to the problem of multicollinearity or it may increase serial correlation into the equation. It is felt that the use of the value of construction activity is enough to subsume the trend factor. We shall therefore include trend factor as a variable in one of the equations and exclude it in the others. t is defined here as:

$$t_i = (1.02026)^i \qquad \ldots\ldots\ldots (19)$$

where i = 0,1,2, ... n

It has been observed that the consumption of cement is growing at a rate of 2.03% exponentially. This growth path is therefore chosen on the ground that it approximates the trend of consumption to a large extent.

ϵ_t = random disturbance term which is a catch-all for all other factors excluded from the explanatory variable and it is assumed to have $E(\epsilon_t) = 0$ and $E(\epsilon\epsilon') = \sigma^2$.

The data used in the study for the estimation of the demand equation for import of cement are given in Table 3.1. We have used the series between 1948 and 1966 on the ground of avoiding the effects of parameter shifts. We cannot assume any absence of parameter shift during the period of the Second World War. The country was engulfed in a civil war since 1967 and we have excluded 1967 and 1968 on this ground. Any economic investigation is at most a large subset of the complete set of equations describing man's social behaviour. Parameters of our subset are variables of a larger set. The argument that all will be well in econometrics if long time series are available is invalid[1].

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1. Fisher, F.M.: op. cit., p. 5.

TABLE 3.1

Import of Cement, Average Import Price, Disposable Income (measured as the value of Nigeria's export plus net decrease in the Foreign Exchange Balance), Custom Tariff and the Trend Factor: 1948 - 1966.

YEAR	Import of Cement in '000 Tons	Average c.i.f. Price Per Ton £	Value of Nigeria's Export Plus net decrease in Foreign Exchange Reserves £'m	Average Tariff Per Ton £	Trend Factor
1948	131,66	6.34	22.9	0.99	1
1949	161,96	6.30	63.2	0.93	2
1950	153.86	7.14	84.8	1.00	3
1951	261.06	9.82	83.8	0.95	4
1952	205.17	10.90	106.8	0.94	5
1953	297.44	9.24	77.3	0.97	6
1954	368.11	7.21	109.2	1.16	7
1955	425.10	8.54	110.4	1.40	8
1956	488.57	8.82	139.0	1.40	9
1957	510.24	9.09	137.5	1.39	10
1958	477.12	8.60	162.3	1.37	9
1959	516.19	8.58	151.1	1.40	8
1960	626.49	8.57	193.0	1.42	7
1961	476.91	7.68	191.4	1.40	6
1962	334.88	7.06	195.4	1.47	5
1963	300.22	6.76	229.8	2.00	4
1964	178.11	6.87	227.2	5.15	3
1965	171.49	7.71	251.4	4.75	2
1966	151.00	8.61	286.5	4.71	1

TABLE 3.2

Consumption of Cement, Value of Construction Activity, and Adjusted Average Ex-post and Ex-factory Prices, 1950 - 1966.

YEAR	Consumption of Cement in '000 Tons	Adjusted Average Ex-post and Ex-factory Price Per Ton	Value of Construction Activities £'m	Trend Factor
1950	153.86	10.98	20.3	1.000
1951	261.04	13.88	25.4	1.020
1952	205.17	15.26	19.4	1.041
1953	297.07	12.47	25.9	1.062
1954	365.11	10.72	37.8	1.083
1955	424.84	10.74	38.3	1.105
1956	487.82	10.26	36.5	1.127
1957	509.49	10.48	43.0	1.151
1958	486.68	11.07	35.3	1.175
1959	634.49	10.91	47.0	1.198
1960	790.15	11.08	55.4	1.222
1961	832.22	10.79	57.9	1.247
1962	807.90	9.69	57.5	1.272
1963	814.49	9.62	66.0	1.298
1964	827.20	10.29	65.0	1.324
1965	1131.36	10.61	80.0	1.351
1966	1132.39	10.54	81.3	1.378

In case of the series for estimating the aggregate demand equation, 1950 was chosen as the starting point because this was the farthest back we can go in respect of data on construction activities. We have a similar reason for terminating the series at 1966 to avoid the complications of the war period.

Annual observations are used to estimate the regression coefficients. In estimating the demand function for cement in general, we perform a regression analysis on quantity of cement consumed, value of construction activities and on weighted ex-factory, ex-port average prices. Weights cannot be assigned accurately to the available wholesale prices, as there are no data on the amount of cement consumed in each town every year. A recourse was therefore made to sales at factories and deliveries at the Nigerian ports. Strictly speaking, this is the dealer's demand curve for cement; the delivery at the port and the sales at the factory constitute the purchase of the cement dealers. This is not wholly true: there are many big firms in the construction industry that purchase their cement directly from the cement factories either within the country or abroad. Besides, it has been found that when data at this stage of the market are collected

at fairly long intervals, they approximate the demand at the final consumer level[1]. Both the data of quantity and the corresponding price refer to the same link of the market chain the dealer stage or the middlemen stage of the market. This is also true at each place of collecting the data.

As has been argued above, income is only remotely related to the quantity of cement consumed. Instead, a more appropriate variable, the value of construction activity in the country is used. Prices and the index of construction activity are deflated by the same deflator[2] with which the value of construction activity is deflated. Current figures of prices and income are used in estimating import demand equations. Common suitable deflators are not available. The current figures are therefore used; it is hoped that this will not affect the result. It has been suggested that the use of deflators can even distort demand equations, as shown below:

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1. Working, E.J.: "What Do Statistical Demand Curves Show?", Quarterly Journal of Economics, Vol. I, No. 4, 1926 - 27.

2. Deflator which is derived by dividing GDP at current price by GDP at constant prices - a kind of Paasche Price Index Number.

> "The implication of proportionality between the deflator and variable adjusted often is not warranted. Actually the procedure may introduce distortions and spuriousness into the relations which are to be described by analysis[1]."

In the use of the index of the construction activity, the trend factor is considered to have been subsumed.

Aggregated data are used throughout and it is assumed that aggregation has little or no significant effect on the estimated parameters, as discussed under the theoretical restrictions upon demand equations. Linear formulations in logarithm and semi-logarithm are used throughout. It is recognized that there are some functions that may give better fit. Two reasons dictate the choice - simplicity and theoretical plausibility - following Carl Christ:

> "An economic equation should be simple enough so that its meaning can be understood; (and) if the immediate objective is to make a decision about a real economic problem, for instance, to decide on the selling price of a good or to choose a fiscal policy, then the equation used should be consistent with the relevant parts of the well established theory[2]."

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1. Foytik, Jerry: "Characteristics of Demand for California Plums", HILGARDIA (A Journal of Agricultural Science published by California Agricultural Research Station), Vol. 20, April, 1951, p. 420.
2. Christ, Carl F.: Econometric Models and Methods, John Wiley and Sons, 1967, p. 5.

Linear logarithmic functions facilitate estimation of the elasticities and conform with the theoretical properties underlying the "true" functions in the complete system, especially the additivity property.

The problem of single equation model is that with which we are generally confronted when a model containing several equations is required but we decide to use a single-equation-model - a case in which some of the explanatory variables of the single equation are themselves endogenous variables. This is common for an industrial commodity and is more difficult to solve and harder to circumvent than in the case of agricultural products. It is generally easy to deal with agricultural products because of the exogeneous factors that make the determination of quantity supplied independent of the prevailing price. Similar opportunity does not present itself in cases of goods produced in most other market structures.

On the other hand, a close examination of market behaviour of some industrial products reveals some features that facilitate estimation of demand parameters. Such commodities are those supplied to the market outside perfectly competitive conditions. Under perfect competition the market demand curve is given and cannot be influenced to any signi-

ficant extent by individual producers. What an individual producer does is to maximize his profit by equating his marginal cost to the already determined market price. On the other hand, monopolists and oligopolists are thereoti-cally assumed to maximize profit by equating marginal cost to marginal revenue. If this condition holds in reality, "the demand curves for their products could not be estima-ted by least square regression unless there are reasons to suppose that their marginal cost curves shifted greatly relative to their demand curves.[1]" The equality between marginal cost and marginal revenue assumes that profit maximization is the sole objective of any monopolist or oligopolist. It has been observed that firms maximize other things besides profit. There are standards within each economic entity which the business units are expected to maintain. These standards may contradict the desire to maximize profit. Profit maximization should therefore be qualified. Economic activities are influenced by other objectives different from economic advantage which compete rather than complement economic advantage. Secondly, "profit maximization; the specification of this condition does not

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1. F.M. Fisher: op. cit., p. 95.

mean that it is always fulfilled". Decisions are always based on past experiences; subjectivity cannot be ruled out. Given a certain experience different decisions will be drawn from it by different individuals, all of which cannot be correct. In most cases the marginal cost is not known and so a considerable number of business decisions, are always taken under uncertainty.[1]

In addition to the two qualifications, there is the familiar rigidity observable in business world contrasting with the frequent shocks and disturbances that even conflict with previously formulated business decisions. Decisions are not always reversed as a result of intermitent disturbances. Businessmen usually wait until they are convinced that a more or less permanent change has occurred. Business forecasting appears to be solely focused on identifying secular rather than the temporary cyclical turns[2]. Decision makers are interested in stability of price when they deal

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1. Fellner, William: Competition Among the Few: Oligopoly and Similar Market Structures, New York, Augustus Kelley, 1960, (Reprints from Economic Classics), p. 145.
2. Fisher, F.M.: op. cit., Chapter 2.

with monopoly and oligopoly markets: they place premium on "quiet life"[1]. Frequent changes in prices and other policies concerning the public have the tendency of compromising with the long-run business interest. Speculation usually develops when there are frequent changes in prices for instance, in the lower stages of the market before the consumer stage. But big business units prefer to hold buffer stocks upon which reliance can be placed at periods of high level sales.

The net outcome is fairly rigid prices and more variable volume of sales. It is on the basis of this that demand functions are capable of being estimated by the least squares regression. As has been analyzed in Chapter Two, cement is supplied under oligopoly conditions in the country. Prices have been fairly stable at the factories and changes have not been frequently made. The fear of the public opinion and governmental policy have forced each producer to acquiesce in the existing price level for fairly long periods until a turn is definitely identified.

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1. J.R. Hicks: "Annual Survey of Economic Theory: The Theory of Monopoly," Econometrica, 3, January, 1935, p. 8.

Fisher's caution must be taken into consideration[1]. He notes that secret price concession and excessive price rigidity may invalidate the possibility of estimation by least squares regression because secret price concession falsify price-quantity data and excessive price rigidity precludes the availability of adequate observations. Such conditions do not operate at the demand "point" considered in this study. Other problems exist, however. There are problems of errors in the variables, of multicollinearity and of the assumptions in respect of the disturbance term. Any of these can affect the magnitudes of the parameters. Some of these are actually examined in Chapter Four.

SOURCES OF DATA AND LIMITATIONS

A considerable proportion of the data used in this thesis is drawn from government and semi-government publications. In some cases where the published data is not sufficient for our needs, we have collected data directly from factories and commercial firms.

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1. Fisher, F.M.: op. cit., p. 95.

For data on volumes of imports and their respective c.i.f. values, we have relied on data published monthly[1]. Each monthly data are cumulated for quantities and values from January to December to get annual data. For the purpose of obtaining custom tariff, we have used annual data. The source[2] contains annual compilation of the monthly summaries with additional information as to the origin, destination, and duty on each commodity. The discontinuity of the Trade Reports after 1960 left a gap that was filled by other publications[3].

In respect of the output figures of the cement industry, we have used the Economic Indicators[4]. This publication was also used for figures of index of construction activity in Nigeria. The Industrial Survey[5] has been of great advantage

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1. Federal Office of Statistics: Nigerian Trade Summary, 19.... - 1968.

2. F.O.S.: Trade Reports, 1946 - 1960.

3a Federal Ministry of Commerce and Industry, Lagos: Handbook of Commerce and Industry, 1st edition, 1952 to 5th edition, 1962.

3b Federal Ministry of Information, Lagos: The Nigerian Trade Journal.

4. F.O.S.: Economic Indicators, Vol. 1, 1964 - Vol. 4, 1968.

5. F.O.S.: Industrial Survey of Nigeria, 1962/63, 1963/64, 1964/65, 1966.

in supplying figures of aggregate employment, aggregate output, capital invested, etc. in respect of each industry. There is, however, the drawback caused by lumping of industries together when there are not as many as five plants in an industry.

For the purpose of obtaining figures on changes in the country's foreign exchange balances, we have relied on the Central Bank publication[1]. This is not, however, adequate, since the data does not go as far back as 1948, the year we started our observations. We have therefore supplemented it by Onitiri's work[2].

We have used the price figures compiled by the Federal Ministry of Trade and Industry[3] in respect of price movement of cement in some important towns in Nigeria. Unfortunately, the price series do not include any information about the volume of sales at each of these towns; this reduces greatly the use to which the series can be put.

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1. The Central Bank of Nigeria: Economic and Financial Review, Vol. 1, 1963 - Vol. 4, 1968.

2. Onitiri, H.M.A.: Nigeria Balance of Payments and Economic Policy, 1946 - 1960. Ph.D. Thesis submitted to the University of London, 1963. p. 196.

3. Federal Ministry of Trade and Industry: Files on Monthly Trade Report on West, North, East.

Some of the limitations of the data from the above sources have been mentioned. Perhaps the greatest drawback is that there are no records of quantities of cement consumed in each region or each important town. The aggregate figures on cement consumption cannot be broken down into private and public sectors, and into commercial and residential buildings. Such a breakdown could have helped our analysis.

Figures of costs and revenue of individual domestic cement factories are not available. This makes a more thorough analysis of the Nigerian cement industry difficult. It is, however, considered that the available data will enable us to obtain reliable results in the next chapter.

CHAPTER IV

THE EMPIRICAL DEMAND FUNCTIONS FOR CEMENT IN NIGERIA

A. DEMAND FOR IMPORTED CEMENT

Attention is given to the short-run reactions of demand with respect to changes in price of cement, changes in the level of custom tariff, and changes in the value of Nigeria's export value which is used here as a measure of income. Before giving our expectations about the magnitudes of the estimated parameters, the demand equations estimated are given below.

$$\text{Log } X = 4.9195 - \underset{(0.0342)}{0.0309P} - \underset{(0.0528)}{0.1558K} + \underset{(0.0009)}{0.0035Y} + \underset{(0.0178)}{0.1456T} \quad \ldots\ldots\ldots (20)$$

$$R^2 = 0.9226; \; d^+ = 1.10$$

$$\text{Log } X = 4.4510 - \underset{(0.4292)}{0.2247 \log P} - \underset{(0.2219)}{0.08004 \log K} + \underset{(0.1963)}{0.1701 \log Y} + \underset{(0.1289)}{0.6128 \log T} \quad \ldots\ldots\ldots (21)$$

$$R^2 = 0.8238; \; d^+ = 1.18$$

The variables are as defined above in chapter 3. R^2 is the coefficient of determination while d^+ is the calculated Durbin-Watson statistic for the purpose of testing the degree of serial correlation in the equations.

Before discussing our findings as shown by equations (20) and (21), it is necessary to say something about the expected values of the parameters, in the light of theory. It must be emphasised, however, that while this can highlight the reasonableness of our result, it cannot be a sufficient condition for either accepting or rejecting them. As has been noted by many writers, the gap between theoretical demand curves and statistical demand curves might never be completely bridged[1]. Reasonableness here is therefore intended to mean close approximation to a priori expectations.

For a commodity like cement, theory requires the coefficient of price to be negative. This holds whether it is imported cement or not. We have no a priori information about the magnitude of the coefficient of "income". This

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1. Stigler, G.J.: "The Limitations of Statistical Demand Curves", American Statistical Association Journal, Vol. 34, 1939, p. 481.

depends upon the kind of growth that has been taking place in the country. Following Johnson's terminologies, growth may be pro-trade, neutral, or anti-trade[1]. This kind of growth is determined by a country's consumption pattern, foreign trade policy and kind of growth. Nigeria is a case of incomplete specialisation since some quantity of cement is being manufactured within the country. Growth is neutral if an increase in the national income leads to a proportional increase in the demand for imported cement. Growth is anti-trade if income elasticity of demand is less than 1, pro-trade if it is more than 1. Therefore, the coefficient of income can assume any magnitude. It can be less or greater than zero. Theory requires an inverse relationship between change in quantity demanded and change in the level of custom tariff, assuming that importers bear part or the whole tariff. The coefficient of tariff is therefore expected to be less than zero. The coefficient of trend can assume any value, depending upon the trend variable. It can be concluded therefore that all the parameters of the equa-

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1. Johnson, H.G.: Money, Trade and Economic Growth, (Survey Lectures in Economic Theory), George Allen and Unwin, Ltd., London, 1962, pp. 75 - 98.

tions are correctly signed. The proportion of variability explained out of the total variability is also high enough to justify statistical inferences from either of the two equations. Both equations, however, suffer from some degree of serial correlation since the Durbin-Watson statistic falls within the indeterminate region for both equations. Discussion is centred on equation (20) on the ground of its higher coefficient of determination. Moreover, all the parameters in equation (20), except the coefficient of price, are statistically significant. In the case of equation (21), only the coefficient of T is statistically significant.

Equation (20) can be recast as:

$$X = e^{(4.9195 - 0.03P - 0.16K + 0.0035Y + 0.15T)} \quad \ldots\ldots\ldots (22)$$

For the purpose of estimating the elasticity in respect of the variables, their mean values are used.

Denote income elasticity by η_y

$$\eta_y = \frac{\partial \bar{X}}{\partial \bar{Y}} \cdot \frac{\bar{Y}}{\bar{X}}$$

Applying this to equation (22) above, we have $0.004\bar{Y}$ as the value of income elasticity. This gives 0.52 substituting the mean value of Y.

The growth of import of cement has been less than the growth of income. This means that growth has been anti-trade-biased. The result has not been due to decreasing consumption in respect of the commodity: consumption has been rising. The fact is that the increased consumption of cement is increasingly being met from domestic production. This is in harmony with the findings of Professor Vielrose who used the concept of import substitution. His findings in respect of cement is that import substitution ratio declined gradually from 0.56 in 1961 to 0.16 in 1967[1]. This reveals the rate at which import of cement is being substituted for in the country.

Though the coefficient of price is correctly signed, it is not significant. With -0.031 and a standard error of 0.034, there are extreme cases in which a rise or fall in price may not have any influence on the quantity of cement imported, other factors being held constant. If we denote price elasticity by η_p

$$\eta_p = \frac{\partial \bar{X}}{d\bar{P}} \cdot \frac{\bar{P}}{\bar{X}}$$

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1. Vielrose, Egon: "Import and Export Substitution in Nigeria", Nigerian Journal of Economic and Social Studies, Vol. 10, No. 2, July 1968, pp. 183 - 190.

From equation (22) stated above, $\eta_p = 0.031P$. When the mean value of price is substituted, this gives -0.25. It can be concluded therefore that price elasticity of demand for import is both low and shifting.

The effect of custom tariff can be similarly measured in terms of elasticity. Define elasticity of custom tariff by η_π

$$\eta_\pi = \frac{\partial X}{\partial K} \cdot \frac{\bar{K}}{\bar{X}}$$

$$= \frac{\partial}{\partial K}(4.9195 - 0.03P - 0.16K + 0.004Y + 0.15K).\frac{\bar{K}}{\bar{X}}$$

$$= -0.16\bar{K}$$

If we substitute, $\bar{K}$, the mean value of K, we have -0.33 as custom tariff elasticity. An increase of one per cent in the level of custom tariff will lead to about one-third per cent decrease in the level of import of cement, other influencing factors remaining unaltered. The T factor - the "catch all" for the effects of trend domestic production of cement - is equally important.

The value of T depends upon the growing production of cement at home and the year in question - (see the definition of T in Chapter 3). The production of cement at home is growing at such a rate that the increase in domestic demand is being met from this source rather than from importation.

In sum, the important variables determining the quantity of cement into Nigeria at any given time are, K, (the custom tariff effect) and T (the trend variable that measures the effects of trend of consumption and the increasing production of cement at home). By the criteria of rationality, goodness of fit of our function, reasonableness of signs with respect to economic theory, and the size of parameters, we have one good demand equation for import of cement.

B. THE AGGREGATE DEMAND FOR CEMENT

Theory requires price elasticity in respect of cement to be negative in spite of the nature of the commodity. We hold this as a necessary, but not a sufficient condition for the correctness of our demand equation. However, since the demand for cement is a derived demand we expect low price elasticity. In case of changes in the price of cement the

extent of substitutability is given by the technological condition governing a piece of construction activity. The cement-sand ratio may vary greatly depending upon the importance these would-be owners of houses place on concrete type of buildings. This ratio will tend to about a constant value as more and more construction work is given to reputable building contractors who have long-run interest in the construction industry, and will therefore stick to generally accepted cement-sand ratio. At present, the use of cement in building residential houses is an innovation in most Nigerian villages. While concrete walls and floors are becoming the accepted norm in towns and cities, the cement content varies also from one residential house to another.

Moreover, the amount of cement used in public construction work will not be price elastic. It appears that marginal changes in price of cement will not influence significantly the cement content of highways, dams, streets, public buildings. This factor reduces price elasticity of cement. A low price elasticity is therefore expected.

If the cement cost is proportional to the aggregate construction output throughout the period of our observation we can on the basis of that expect unitary income elasticity since income is defined as the index of construction within the economy. It has been noted that cement input constituted

about 12½% of the total gross output of concrete-type buildings in 1956 - 58[1].

If this 1:8 cement output-ratio is constant in all forms of construction we would have expected unitary income elasticity. This ratio varies, however, almost from year to year. The ratio ranged between 12.4% in 1954 and 23% in 1957 during the period 1948 - 66. We expect the "income" elasticity to be about unity. The results of the aggregate demand functions for cement are presented below, equations 23 to 26.

$$\underset{(0.5863)\ (0.0431)\ (0.0032)}{\text{Log } X = 5.4187 - 0.0383P' + 0.0269Y'} \quad \ldots\ldots\ldots (23)$$

$$R^2 = 0.91;\ d^+ = 1.13$$

$$\underset{(1.5709)\ (0.0385)\ (0.0097)\ (1.5659)}{\text{Log } X = 2.2263 - 0.0321P' + 0.0069Y' + 3.3731t} \quad \ldots\ldots\ldots (24)$$

$$R^2 = 0.93;\ d^+ = 0.89$$

$$\underset{(1.1279)\ (0.3538)\ (0.094)}{\text{Log } X = 0.0434 + 0.4396\ \log P' + 1.372\ \log Y'} \quad \ldots\ldots\ldots (25)$$

$$R^2 = 0.96;\ d^+ = 1.55$$

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1. Aboyade, O.: (1966), Foundations of an African Economy, op. cit., p. 79.

$$X = -3422.89 + 503.40 \log P' + 749.75 \log Y' \quad \ldots\ldots\ldots (26)$$
$$(664.11) \quad (208.29) \qquad (55.35)$$

$R^2 = 0.95$; $d^+ = 1.41$

Equations (23) and (24) conform with our theoretical expectations while equations (25) and (26) do not. Though these two equations, (25 and 26), are superior in terms of proportion of variability of quantity explained, they do not make any sense in terms of economic theory. Theory requires the coefficient of price to be negative unless the commodity under consideration is an ostentations good. This wrong sign of the functions can therefore be attributed to wrong model specification[1]. Equations (23) and (24) are correctly signed: their respective coefficient of determination is about the same. The difference between the two is the inclusion of a trend factor in equation (24). It appears that the use of construction activity as a measure of income precludes the effect of a trend factor. At least, it is clear that both cannot be incorporated without being faced with the

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1. Morgan, D.J. and Corleft, W.J.: "The Influence of Price in International Trade: A Study in Method", Journal of Royal Statistical Society, Vols. 113 - 114, 1950/51, pp. 307 - 358.

problem of serial correlation and multicollinearity. Equation (24) is rejected by null hypothesis at 95% level of confidence while equation (23) falls within the indeterminate region. Besides, the coefficient of "income" variable comes up with statistically insignificant result. Attention will therefore be focussed on equation (23); the influence of trend will be examined in greater detail in the next section. Unfortunately, both results of equations (24) and (34) cannot be synthesized even if we assume that other variables in equation (24) except trend are constant. This is because equation (24) is slightly different from equation (34): the former is an exponential function; the latter is a modified exponential function - an exponential function plus a constant term.

For the purpose of estimating the income and price elasticities, equation (23) can be recast as:

$$X = e^{(5.4187 - 0.038P' + 0.0268Y')} \quad \ldots\ldots\ldots (27)$$

Income elasticity is denoted by

$$\eta_{y1} = \frac{\partial \bar{X}}{\partial \bar{Y}} \cdot \frac{\bar{Y}'}{\bar{X}'}$$

and similarly price elasticity is denoted by

$$\mu_{p'} = \frac{\partial \bar{X}}{\partial \bar{P}} \cdot \frac{\bar{P}'}{\bar{X}}$$

$\bar{X}$, $\bar{Y}$ and $\bar{P}$ are used because the mean value of the variables are used.

Applying our definition income elasticity to equation (26) we obtain a term $0.0269\bar{Y}'$, the value of this 1.24, we substitute for $\bar{Y}'$ and applying a t-test[1] to the value, we found that it is not significantly different from 1. This agrees with our expectation that income elasticity will be about unity given proportionality ratio of cement input-construction activity. As this proportion becomes constant over time, income elasticity tends to one. Since the quantity of cement used is not perfectly proportional to the index of construction activity over the period, the income elasticity of 1.24 is as good as we can expect.

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1. $\eta = b\bar{Y}$, $\quad Var(\eta) = \bar{Y}^2 \, Var(b)$

$$S.E(\eta) = \sqrt{\bar{Y}^2 \, Var(b)}$$

$$= \bar{Y} \text{ S.E. of } b$$

$$t = \frac{\eta - E(\eta)}{\text{S.E. of } \eta}$$

Test: $H_0 : \eta = 1$ against $H_1 : \eta > 1$

From equation (23), the value of price elasticity is -0.43. The value of -0.43 does not differ from our expectation. It has been observed that cement is price inelastic[1]. The coefficient of price is, however, not statistically significant. One of the reasons for this is the relative stability of cement price in Nigeria and throughout the world during our period of observation. This is an outcome of quasi-monopolistic and oligopolistic price regidity which enable us to estimate the demand equation by the least squares method. Fisher too was confronted with similar situation in his estimation of short-run demand equation for aluminium ingot.[2]

This result is also plausible if it is remembered that short-run adjustments are difficult to make in the construction industry. Reference has been made to technological specifications which construction engineers do not frequently change. Also construction plans may not be altered as a result of marginal changes in the level of price of cement.

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1. Loescher, S.M.: Imperfect Collusion in the Cement Industry, op. cit., p. 78.

2. Fisher, F.M.: A Priori Information and Time Series Analysis, op. cit., p. 109.

C. THE LONG-RUN CONSUMPTION TREND OF CEMENT IN NIGERIA

Among other reasons, a study of the consumption trend of cement is important for two main reasons. The consumption trend needs to be considered alongside with the expansion of the domestic cement industry. This is necessary if the country's scarce resources are to be efficiently allocated. It is also useful for restricting import of cement to the minimum necessary for filling the gap between domestic production and consumption of cement. It also has the advantage of highlighting the rate at which expansion can take place in the cement industry to avoid excess capacity, a feature too common in the industry in most developed countries.

In this exercise, therefore, an attempt is made to fit a curve into the time series of cement consumption, and on the basis of that forecast the level of consumption in the immediate future. Economic time series form the bulk of the material upon which quantitative investigation can be carried out. The behaviour analyzed takes place over time; and forecasts of the behaviour are predictions of future time series. Nevertheless, time series are the outcome of many factors. There are the secular trend, the periodic movement, and the erratic movement generated by random shocks. There

are other influencing variables that will come into play. In case of cement consumption with which we are presently concerned, its trend may be the outcome of population growth, income growth, the growth of cement industry within the country, or increasingly larger and larger control of foreign currency which gives the country increasing power to import capital goods and produced inputs. As a result, capital formation is further increased: this also increases the consumption of cement. Trend is the outcome of interaction of several variables. This outcome can be analyzed into several components: the seasonal variation, the cyclical variation, and the trend value. Seasonal variations appear in time series when data are collected weekly or monthly but do not appear when they are collected annually. The data used here are annual series and are therefore not affected by seasonal variations. We are left therefore with the trend, cyclical, and random disturbance components.

In the present exercise we are concerned with the secular trend or the general long-term movement or trend of cement consumption and the cyclical movement about the trend. The logarithmic and semi-logarithmic functions were first tried to grapple with the problem but neither was found appropriate.

A difference equation of the first order gives a reasonable fit, however. We postulate a model of the form

$$Y_t = \beta Y_{t-1} + \alpha + u_t \quad \ldots\ldots\ldots (28)$$

where Y_t denotes the quantity of cement consumed at year t, and Y_{t-1} the quantity consumed in year t-1; where $E(u_t = 0$, $E(uu^1) = \sigma^2$, and α and β constants.

This model gives a better fit and it is more plausible. There is always a level of construction work to be carried out both in the private and public sectors. New construction activity such as building on new roads, residential and commercial houses can be regarded as addition to the level needed for repair in construction industry. The level of cement consumed in a given year can therefore be said to have a definite relationship with the previous levels of consumption. We have a dynamic model in the above model because it contains terms corresponding to different periods of time. It is also a modified exponential function. The solution is given by

$$Y_t = k\beta^t + \gamma \quad \ldots\ldots\ldots (29)$$

There are 19 observations: consumption of cement is in thousands of tons between 1948 - 1966, both years inclusive. The least squares method is employed to estimate the values of the parameters of the difference equation. We have

$$Y_t = (1.02026)Y_{t-1} + 45.405 \quad \ldots\ldots\ldots (30)$$

According to the rules of solving difference equations, the constant term in the solution is given by

$$\gamma = \frac{\alpha}{1-\beta} = \frac{45.405}{1-1.02026} = -2240.894 = -2241 \quad \ldots\ldots\ldots (31)$$

To estimate β in the solution of difference equation, we place the restriction that the sum of the estimated values is equal to the sums of the values estimated. That is

$$\Sigma\hat{Y}_i = \Sigma Y_i.$$

$\hat{Y}$ denotes estimated value, while Y denotes values observed.

$$\begin{aligned}\Sigma Y &= K + \gamma + K\beta + \gamma \cdots + K\beta^{n-1} + \gamma \\ &= K(1 + \beta + \beta^2 + \cdots + \beta^{n-1}) + n\gamma \\ &= K\frac{1-\beta^n}{1-\beta} + n\gamma \quad \ldots\ldots\ldots (32)\end{aligned}$$

$(n = 19)$

Hence

$$K = \{\Sigma\hat{Y} - \eta r\}\frac{1-\beta}{1-\beta^n} \qquad \ldots\ldots\ldots (33)$$

From our observations $K = \{104411 - 19(2240.894)\}\frac{0.02026}{0.4639} = 2321.$

Equation (34) is our final equation.

$$Y_t = 2321(1.02026)^t - 2241 \qquad \ldots\ldots\ldots (34)$$

Table 4.1 shows the observed values of consumption of cement between 1948 to 1966 as well as the estimated values. The estimated values for 1967 - 75 constitute the forecasts of consumption of cement on the basis of our observations, 1948 - 66. The civil war that engulfed the country between 1967 - 69 has undoubtedly affected our results in respect of forecasts of the consumption values: the best we can make of a difficult situation is to treat the war period as bringing lags into the exponent to the tune of the number of years during which the war lasts. This is sensible only under the assumption of absence of parameter shift. If this device does not work, then there must have been parameter shifts and a change in the pattern of consumption of cement.

TABLE 4.1

Forecast Values of Consumption of Cement 1948 - 75
And The Observed Values 1948 - 68

YEAR	Observed Value '000 tons	Estimated Value '000 tons	YEAR	Observed Value '000 tons	Estimated Value '000 tons
1948	131	80	1963	817	895
1949	162	127	1964	831	958
1950	154	175	1965	1133	1023
1951	261	224	1966	1139	1089
1952	205	274	1967	856*	1157
1953	297	325	1968	655*	1212
1954	366	377	1969		1296
1955	425	430	1970		1367
1956	488	484	1971		1440
1957	509	539	1972		1515
1958	587	595	1973		1591
1959	634	653	1974		1668
1960	790	712	1975		1746
1961	832	771			
1962	811	832			

*Figures are not corrected nor do they include consumption for the three Eastern states.

In some publications, attempts have been made to forecast consumption of cement in Nigeria. Almost invariably, they have used constant growth to project the consumption of cement in the country[1]. It is therefore useful to find the time path of the rate of change of our function. We assume that there is no parameter shift:

$$Y_t = K\beta^t + \gamma$$

$$\frac{Y_{t+1} - Y_t}{Y_t} = \frac{K\beta^t(\beta) + \gamma - K\beta^t - \gamma}{K\beta^t + \gamma}$$

$$= \frac{K\beta^t(\beta - 1)}{K\beta^t + \gamma}$$

$$= \frac{\beta - 1}{1 + \frac{\gamma}{K\beta^t}}$$

$\gamma < 0$, $K > 0$, $\beta > 0$.

$$\lim_{t \to \infty} \frac{\gamma}{K\beta^t} \to 0; \quad \therefore \lim_{t \to \infty} 1 + \frac{\gamma}{K\beta^t} = 1$$

$$\lim_{t \to \infty} \frac{\beta - 1}{1 + \frac{\gamma}{K\beta^t}} = \beta - 1$$

$$= 0.02026$$

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1. N. Nig. Govt: Min. of Trade & Industry: The Industrial Potentialities of Northern Nigeria, op. cit., p. 124.
   Ugoh, S.U.: "The Nigerian Cement Industry", NJESS, Vol. 8, No. 1, p. 110.

By modified exponention form the rate of growth of consumption of cement decreases at the initial stages as t tends to infinity. Consumption of cement increased from 1948 to 1949 by 25% and decreased gradually from that height to just 2.7% in 1966. With this function and assuming there is no parameter shift, growth of cement consumption tends to 0.0203% with time. The behaviour of this function in equation (34) is depicted graphically in figure 4.1.

Figure 4.2 shows the behaviour of the deviations from the trend line between 1948 and 1966. It is noted in chapter two that cement consumption is susceptible to both spatial and temporal fluctuations. When the fluctuations between 1948 and 1966 are considered, there seems to be no cyclical movement. We therefore hold that there is no regular cycle in the consumption of cement in Nigeria during the period of our observation, though it must be admitted that the series of observation is not long enough for this result to be conclusive.

The period of 1967 up to date (1969) is one of civil war. The rate of construction activity has been slowed down in the country[1]. This can be regarded as part of the

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1. See consumption figures for 1967 and 1968 in Table 4.1

fluctuations about the trend of cement consumption. It is expected that the end of the civil war will have a give a signal for a period of construction boom. The demaged roads and towns have to be rebuilt; similarly the destroyed residential and commercial houses will have to be repaired. All this involves increased level of consumption.

Figure 4.1

Observed Values of Cement Consumption and the Fitted Trend Line

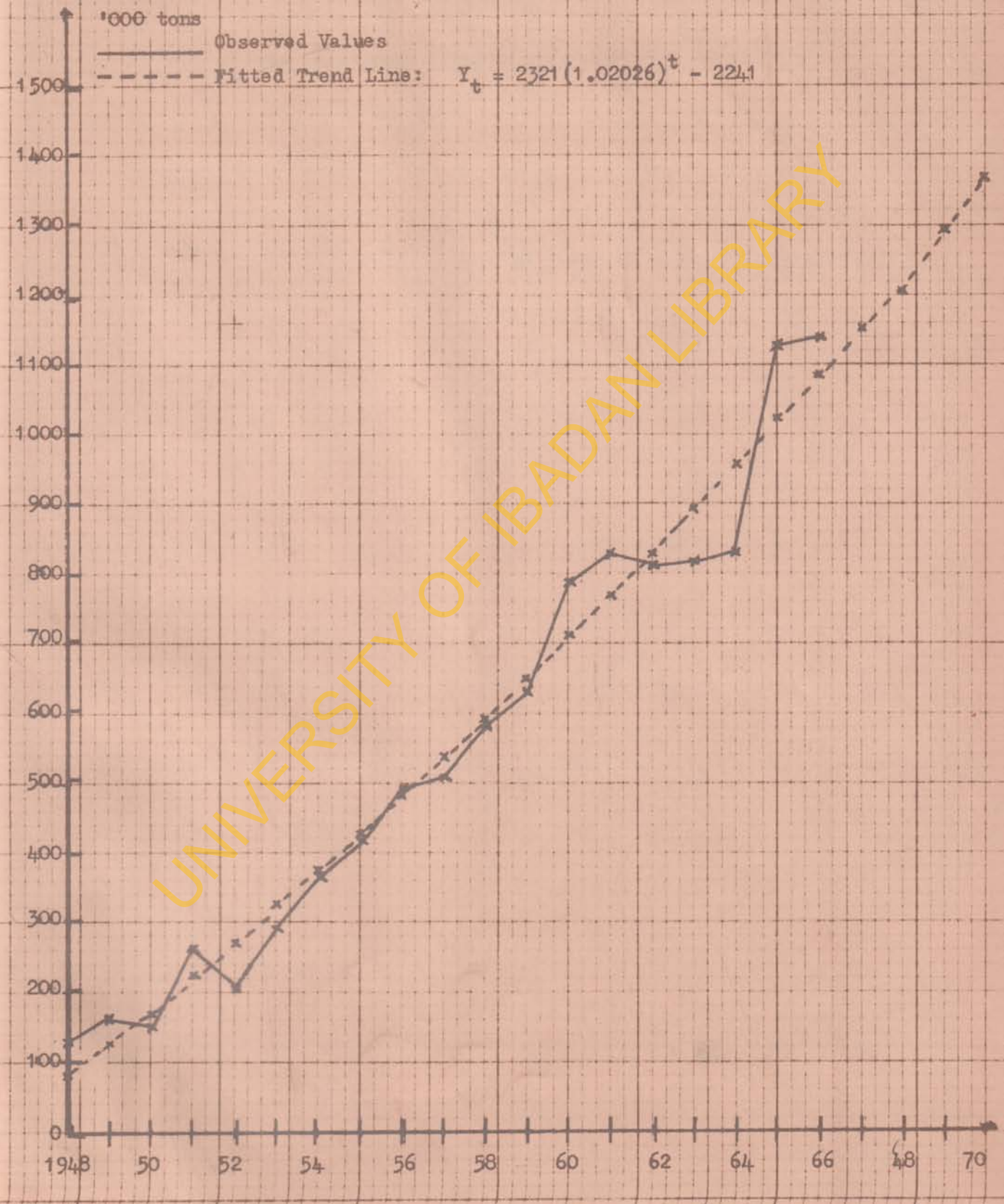
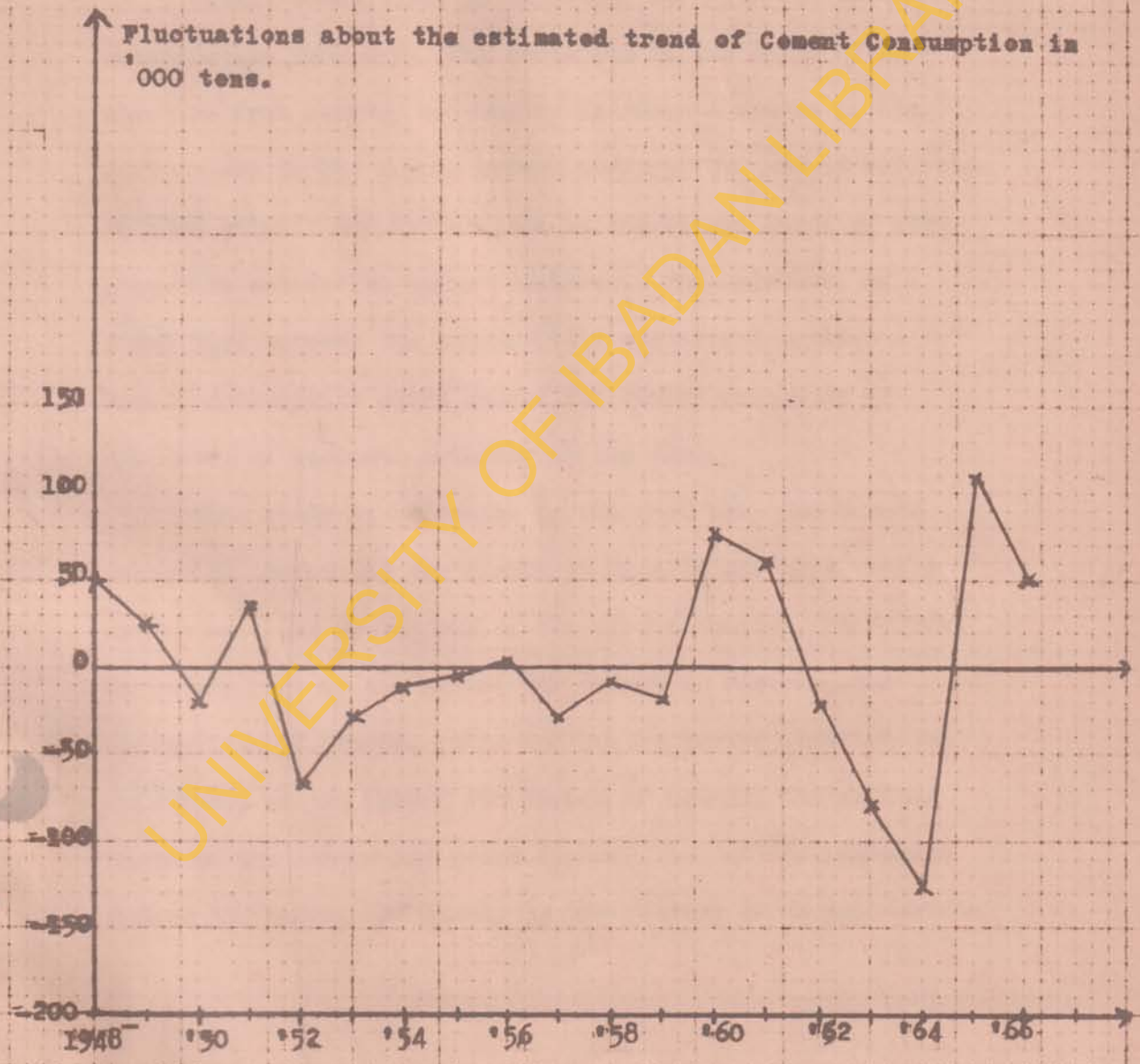


FIGURE 4.2

Fluctuations in Annual Consumption of Cement in Nigeria

1948 - 1966



CHAPTER V

SUMMARY AND CONCLUSION

A. SUMMARY OF FINDINGS AND POLICY IMPLICATIONS

Cement constitutes an important raw material in the construction industry. The variation in the level of consumption from country to country is often measures as the differences in per capita cement consumption, and it reflects to some extent, the differences in degree and level of construction activities among countries. The existence of a close link between the construction sector and aggregate cement consumption makes demand for cement sensitive to the level of economic activity at any time.

This study is motivated by the fact that the demand aspect of the market for cement in Nigeria has been wholly neglected. The objectives of the thesis consist, therefore, in an analysis of the market for cement in Nigeria, the estimations of income, price and custom tariff elasticities in respect of the demand for import of cement; the estimations of the income and price elasticities of the aggregate demand for cement and lastly in the fitting of an appropriate

mathematical function to the behaviour of the long-run trend of consumption of cement. Our findings are summarized in the succeeding paragraphs.

The supply of cement in Nigeria between 1946 and 1966 can be divided into two: the period 1946-60 and the period 1961-66. In the first period, imported cement dominated the market scene. The level of import reached a peak in 1960 and declined gradually afterwards. Cement was, however, imported from a few countries. The bulk of importation came from the British Associated Portland Cement Manufacturers. This was mainly due to the government policy which preferred trading with United Kingdom as Nigeria was then a colony of that country. Other countries exporting cement to Nigeria at one time or the other were Belgium, Luxemburg, Western and Eastern Germany. Import of cement from United Kingdom represented 79%, while import of cement from these remaining countries represented 21% during 1955-60 period.

The second period can be regarded as dominated by the domestically manufactured cement. This was partly the result of government restrictive policy and partly, the result of increasing outputs of the domestic cement plants.

By 1963, the tariff duty on import of cement was almost prohibitive: but was necessary, however, to protect the domestic factories from being driven out of business by the low-priced Polish cement.

The growth of the Nigerian cement industry does not change the market structure, however. The market remains oligopolistic throughout the period. The influence of brand name is not significant since cement is virtually a homogeneous commodity. Prices were fairly stable during the period of our observation. The Nigerian cement industry thus exhibits the familiar feature of monopoly or close knit oligopoly within which commodity price is of pre-determined nature.

An important national advantage of the expansion of the industry is however the saving of foreign exchange. Ugoh estimated that £3.5 million was saved in 1963 through production of cement in Nigeria. The output of the domestic cement plants has been growing since then. Increasing foreign exchange is therefore being saved.

For the purpose of fitting a function to the trend of cement consumption in Nigeria equation (34) has been found appropriate:

$$Y_t = 2321(1.02026)^t - 2241.$$

The average rate of growth during our period of reference is higher than this value. Between 1948 and 1966, consumption grew at a compound rate of about 12.5%. The value for the average rate of growth gives a somewhat misleading picture, however. The percentage change was as high as 25% in 1948 - 49; by 1966 this has gradually declined to 2.7% from the equation of the trend curve, this rate of growth tends to a constant value of 2.03% with time.

The compound rate of growth of about 12.5% reflects, in part, the growth of construction activity in Nigeria during this period. This main determinant of consumption is the level of construction activity. Within the Nigerian context, cement has to compete with other inferior raw materials such as burnt bricks, mud and sand, rather than structural steel and masonry as in the developed countries. With increasing expansion of the industry in Nigeria a substantial lowering of price is bound to occur as it has occurred in the developed countries. This will lead to increased consumption of cement, other things being equal.

Cement consumption exhibited much temporal fluctuation during the period of our observation. This is an evidence to show that cement consumption pattern does not diverge much from that of the developed countries where much temporal

fluctuation has been observed. Nigeria cement consumption fluctuation is devoid of any regular cycle, however.

The demand function for import of cement is given by equation (20) which is given below:

$$\text{Log } X = 4.9195 - \underset{(0.0342)}{0.0309P} - \underset{(0.0528)}{0.1558K} + \underset{(0.0009)}{0.0035Y}$$

$$+ \underset{(0.0178)}{0.1456T}$$

$$R^2 = 0.92$$

The overall demand for import of cement has been anti-trade-biased. The increasing level of consumption of cement has ~~been~~ increasingly continued to be met from the output of the domestic factories. Demand for import of cement is price inelastic. During our period of observation the average magnitude of price elasticity is -0.25. An increase of one per cent in the level of price will lead to a decrease of about $\frac{1}{4}$ of 1% in quantity demanded, other things being equal. Similarly, there is a negative association between the level of demand and that of import duty. An increase of 1% in the level of custom tariff will lead to about a decrease of $\frac{1}{3}$% in the level of import of cement. For the purpose of policy application, the government can employ this relationship to

change the import of cement to a required level. To reduce import of cement by 5% it will be necessary to raise the level of custom tariff by about 15%. Other influencing factors are assumed unaltered, and the explanatory variables are assumed to take their respective mean values.

It can be concluded therefore, that given the expected level of cement consumption in a given period and the expected output of domestic cement plants, import duty can be adjusted on the above basis to induce the minimum level required to fill the gap between domestic production and consumption of cement. From the trend of consumption, the expected level of cement consumption in the immediate future can be easily estimated.

The aggregate demand equation for cement is given by equation (23) repeated below:

$$\underset{(0.5863)\ (0.0431)\quad (0.0032)}{\text{Log } X = 5.4187 - 0.0383P' + 0.0269Y'}$$

$$R^2 = 0.91$$

From the aggregate demand function for cement, it is evident that cement is price inelastic. This conforms with the situation in the developed countries. The demand is,

however, income elastic. It is found more appropriate to relate cement demand to the value of construction activity rather than aggregate income. "Income" elasticity is 1.24. An increase of 1% in the level of construction activity will lead to about 1.24% increase in the level of cement consumption. From this it can be deduced that the other inferior raw materials, such as mud, burnt bricks, wood, are giving way to cement. The cement input - construction activity ratio may tend to be in proportion as time goes on and the 1.24% income elasticity This proportion tends to be perfect as the cement construction activity ratio becomes fixed or technologically given.

B. SUGGESTIONS FOR FURTHER STUDIES

For the purpose of obtaining further information on the supply of cement into the country, the study of the industry's production function will be a useful exercise.

This study is essentially on wholesale demand. A full-scale econometric model of cement in Nigeria is needed.

It will also be a useful exercise to study the price margins. This is Retail Price minus Wholesale Price. An analysis of this margin can highlight the profit made by the retailers.

Prices of cement increase from South to North. The apparent reason for this phenomenon is that the major sources of supply are in the South and transport costs have to be added to profit margins when cement is sold in the North. Other reasons may have accounted for the relatively high prices in the North. Improving efficiency of interstate distribution will, therefore be a useful exercise.

APPENDIX I

Table 1.1

Nigeria: Relationship between GDP and Manufacturing Sector

Year	GDP £N million	Manufacturing £N million	% of Manufacturing in the GDP
1958/59	630	40.5	4.4
1959/60	642	46.9	4.8
1960/61	708.8	54.0	4.8
1961/62	728.3	61.4	5.2
1962/63	804.8	75.9	5.8
1963/64	837.5	78.9	5.6
1964/65	839.0	82.4	5.7
1965/66	845.9	96.4	6.3
1966/67	892.2	98.0	6.1

Source: Federal Office of Statistics, Gross Domestic Product of Nigeria 1958/59 - 1966/67, Govt. Printer, Lagos, Nigeria, August 1968.

Table 1.2

The Degree of Dependence of Selected Manufacturing Industries on Imported Inputs

Industry	Domestic Intermediate Inputs	Imported Intermediate Inputs
Groundnut Oil	75%	3.7%
Textile (Large)	46.6%	5.1%
Leather tanning	50.2%	1.7%
Tile and Concrete	53.0%	8.2%
Butter	96.9%	0.1%
Cement and Ceramics	35.1%	7.8%

Source: Helleiner, G.K., Peasant Agriculture, Government and Economic Growth in Nigeria, op.cit., p. 329.

Table 1.3

Comparison Between Capital Output Ratio and Fixed Asset - Value Added Ratio in Selected Manufacturing Industries in Nigeria

Industries	Value Added as a ratio of Fixed Asset (from 1965/66 figures)	Capital Output Ratio
Miscellaneous Food Prep.	0.73	0.26
Beer Brewing	0.82	1.62
Textiles	0.58	1.40
Footwear	0.61	1.80
Sawmilling	0.64	1.07
Printing	0.44	0.84
Rubber Product	0.55	1.27
Vegetable Oil milling	1.07	4.83
Miscellaneous Ch. Prod.	0.48	1.07
Cement	0.42	0.77
Metal Products	0.99	2.76
Motor Vehicle Repairs	1.44	6.92

Source: Federal Office of Statistics, Industrial Survey, Nigeria 1965/66, Lagos, Nigeria.

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