UNIVERSITY OF CAPE COAST

STATISTICAL ANALYSIS OF REVENUE CONTRIBUTIONS OF SOME HIGH RISK GOODS AT TEMA PORT

ROBERT ANUM MODIN

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BY

ROBERT ANUM MODIN

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DECLARATION

Candidates Declaration

I hereby declare that this dissertation is the result of my own original work and that no part of it has been presented for another degree in this University or elsewhere.

Candidate's Signature ……………………. Date………………………

Candidate's Name: ROBERT ANUM MODIN

Supervisor's Declaration

I hereby declare that the preparation and presentation of the dissertation were supervised in accordance with the guidelines on supervision of dissertation laid down by the University of Cape Coast.

Supervisor's Signature: ………………………… Date………………….

Supervisor's Name: BISMARK K. NKANSAH

ABSTRACT

The study analyzed imports revenue contributions from six high-risk commodities obtained from the Inspection and Control Services Company at Tema port. The six items were Auto-parts, Rice, Computers and Accessories, Household Electricals, Poultry Products and Used Clothing. The data covered five years from 2004 to 2008. The objective was to obtain revenue estimates of these six items. Another objective was to provide forecasts of yearly total revenue based on the five years revenue data. In order to achieve these objectives, dummy variable regression model and trend model were used.

Initial exploration of the data revealed that the revenue contribution of the six items increased with increasing line items. It was observed that even though the line item of rice was the least in the period, it contributed the highest to revenue. The dummy variable model involved only three of the six initially selected items. These three variables, which are Auto-parts, Rice, and Household Electricals, were found to contribute significantly to the total revenue from the six items. The model explained 86 percent of variation in revenue from the three items.

Using a linear trend model, it was found that the average yearly total revenue from import was expected to increase by an amount of $8,761,463.00 each year. By this pattern, the total yearly import revenue in 2011 was expected to reach $129,600,314.00.

The findings of this study show that an outright ban on Auto-parts, Rice, and Household Electricals, would not be in the interest of revenue mobilization.

DEDICATION

To my wife Olivia

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CHAPTER ONE

INTRODUCTION

Background

Pre-shipment inspection in Ghana dates as far back as the mid-1970s. It is a system where cargo is inspected and certified at the point of exportation. It ensures that the price charged by an exporter reflects the true value of the goods. Pre-shipment inspection also prevents sub-standard goods from entering the country of an importer, and mitigates attempts to avoid the payment of custom duties. However, on the 1st April, 2000, the government of the Republic of Ghana overturned the pre-shipment inspection and introduced a process of Destination Inspection through an agreement brokered by the Ministry of Trade. Destination Inspection effectively concentrates the performance of inspections within Ghanaian territory. It is aimed at reducing the volume of physical inspection of goods and facilitating trade with the objective of establishing Ghana as the gateway to the West African sub-region (Daily Graphic, 2009).

To implement the objectives of the destination inspection, a number of inspection companies have been established. Gateway Services Limited (GSL) was the first destination inspection company to be established to do business in Ghana. GSL is a domestic subsidiary of COTECNA, a Swiss based multi-national company with expertise in international trade and security. Since then, four other destination inspection companies, namely BIVAC International, Inspection and Control Services Limited, Ghana Link Network and Webb Fontaine have joined GSL to engage in business on behalf of the Customs, Excise and Preventive Service (CEPS) and the government of Ghana.

To facilitate documentation of trade activities at the ports, all the countries of the world have been divided among these five inspection companies, and an importer is required to provide trade documents to the company handling the country where his consignment is coming from. The type and volume of goods or consignments that a particular company deals with depends on the countries that have been assigned it. Thus, for example, one company may be handling documentation of large volumes of rice whilst another provides for only a little on rice. The documents consist of Bill of Lading, Invoice, Import Declaration Form, Packing List and other supplementary documents. These documents provide among others, evidence of time of purchase of the goods, their exact description, price and terms at which they are purchased and the identity of the purchaser. Before duties can be applied to goods coming into a country, one needs to know what type of goods they are and subsequently classify and value them, since different types of goods attract different duties. In the case of Inspection and Control Services Limited which is the focus of this study, the company is assigned the following countries: countries of Western Europe (e.g. United Kingdom, Ireland, Denmark); Eastern Europe (e.g. States of the former USSR); Asia (e.g. Japan, Mongolia, Vietnam, Philippines, Iraq, Iran, Saudi Arabia, Kuwait); and the Caribbean countries (e.g. Cuba, Bahamas, Saint Vincent and the Grenadines, Trinidad and Tobago). The detailed list of the countries from where imports are under the inspection of the Inspection and Control Services Limited is given in Appendix E.

The first task of classification of goods is resolved through the use of Harmonized System Code (HS Code) established by the Brussels Declaration. The Harmonized System Code is a document which gives the list of all goods that enter international trade. The goods are arranged in a systematic order with their specific rates (Danquah, 2007). Every commodity is assigned a ten digit code denoting type of goods, such as a wooden bed, and through to the most detailed specification.

For the determination of the value, six valuation methods based on the World Trade Organization agreement are applied. The destination inspection companies then produce a Final Classification and Valuation Report (FCVR) based on classification and price verification of the consignment. The report spells out the duty obligations of the importer. This obligation comprises Import Duty, Import Value Added Tax (VAT) and National Health Insurance Levy (NHIL).

The Customs, Excise and Preventive Service administers the collection of import duty while the VAT Service collects import VAT and the National Health Insurance Levy (NHIL). The Customs, Excise and Preventive Service of Ghana dates back to the year 1839. It was then known as Department of Customs. However, in September 1986, the Customs, Excise and Preventive Service law (CEPS Law, 1986 PNDCL 144) was enacted making it an autonomous institution. Currently, it operates under the CEPS Management Law, PNDCL 330, 1993. The CEPS institution is a major source of revenue generation, collecting between 50-60% of internally generated revenue for government. It is charged with the responsibility of collecting import duty among other taxes and also to ensure protection of revenue by preventing smuggling.

The computation of import duty is based on the Cost, Insurance and Freight (CIF) value of the commodity. Import duty is tax imposed on goods imported into the country. It is charged at a rate of 5, 10 or 20 percent depending on the type and nature of the commodity.

The Value Added Tax (VAT) became operational in Ghana on 1st March 1995. However, barely three weeks after its introduction, prices of goods and services escalated. This resulted into civil and industrial strife. Confronted with increasing public discontent, the government withdrew it in June 1995. It was however, reintroduced in March 1998, but did not start until 30th December 1998. VAT is a tax on the expenses incurred by customers when they pay for goods and services, and the rate was 10 percent in 1998. In 2000, an act of parliament (Act 579) was passed which saw the amendment of the VAT rate to 12.5 percent.

The NHIL was promulgated by an act of parliament (Act 650), and introduced on 1st August, 2004. It is one of the sources of money for the National Health Insurance Fund, established to provide financial assistance to subsidize the cost of provision of healthcare services to the citizenry. It was put in place to replace the Cash-and-Carry System which undoubtedly inhibited access to healthcare for the vast majority of Ghanaians. NHIL is charged at a standard rate of 2.5%.

Currently, the three revenue agencies, CEPS, VAT and IRS have been integrated into one under the Ghana Revenue Authority (GRA). The GRA

Act, 2009 (Act 791) was passed in December 2009 to establish the GRA that will focus on functional revenue administration (GRA News, Vol 001, Edition 001 page 7).

The list of items that are imported through the Tema Port is endless. Some of the items are auto-parts, poultry, rice, generators, motorbikes, household electricals, detergents, tyres, television sets, canned fish, building materials, decorative ornaments, drinks, kitchen utensils, and biscuits. The top ten imports of Ghana in the period 2006 to 2008 are given in the Table 1.

Table 1: Top Ten Imports in 2006 – 2008 and their Revenue

HS Code	Commodity	Revenue (million $)		
		2006	2007	2008
2709	Petroleum oils	684.9	790.6	1150.2
8703	Motor cars and vehicles for transport of persons	420.7	561.9	581.3
8704	Motor cars and vehicles for transport of goods	250.0	355.6	423.7
2523	Portland cement, slag, etc.	163.4	210.5	250.4
1006	Rice	118.2	158.4	227.5
1001	Wheat and Meslin	88.1	111.7	213.0
8525	Transmission apparatus	53.8	100.9	257.3
0303	Frozen fish	108.1	138.5	103.0
3808	Insecticides, rodenticides, etc.	80.7	110.1	151.7
1701	Cane or beet sugar	79.8	115.8	95.0

Source: http://www.comtrade.un.org

Although each of these imported items generates revenue for government, there have been calls to impose a ban on the importation of goods such as auto parts, used clothing, computer and accessories, household electricals, rice and poultry products. These six commodities are the main items of study in this work. It can be seen from Table 1 that Rice and Auto-parts are among the top ten imports of Ghana. It is worth noting that according to the categorization of High-Risk Goods (HRG) by the Ghana Standards Board, each of the six items fall under electrical/electronic product, food product, vehicle spare parts, used goods, chemical and allied products. We see the HRD categorization of imports in Table 2.

Table 2: List of Broad Groupings of High Risk Goods

Number	Item	Number	Item
1	Food Products	11	Used Goods
2	Pharmaceuticals	12	Petroleum Products
3	Electrical Appliances	13	Pyrotechnic Products
4	Electrical Products, e.g. Bulbs, switches, sockets.	14	Motor Vehicle Batteries
5	Electrical cables	15	Alcoholic and Non-alcoholic Products
6	Electronic Products	16	African Textile Prints
7	LPG Cylinders and Accessories	17	Arms and Ammunitions
8	Toys	18	Machetes/Cutlass
9	Chemical and Allied Products	19	Vehicle spare parts
10	Building Materials	20	Industrial Machinery

Source: http://ghanastandards.org/destination_inspection.php

From both Tables 1 and 2, we see that almost all the top ten imports of Ghana are high-risk commodities. This justifies the strict inspection of these products before they are allowed entry into the country.

The categorization of the selected six products for this study might be a justification for the reasons that have been assigned to numerous calls for placement of embargo on such goods. The reasons assigned to such calls are mainly related to the need to protect indigenous industry, issues of human health and environmental protection (Sefa-Dedeh, 2009). It is against this background that this study is being conducted to ascertain whether or not a ban on the identified products will be in the interest of revenue mobilization.

Objectives of the Study

The main objective of this study is to analyze the revenue contributions of some high-risk goods imported at the Tema Port, and the specific objectives are:

(i) To determine the relative importance of the contribution of the selected imports to total revenue.

(ii) To determine whether there are variations in the contribution to revenue by items of the categories of goods imported over the 5-year period;

(iii) To determine whether revenue mobilization on the study items follows the same pattern over the study period;

(iv) To obtain suitable models for estimating revenues of imports with significant revenue contributions and to provide forecasts for total revenue.

Research Questions

In order to achieve the objectives outlined above, the following research questions would serve as a guide:

(i) What are the categories of items that are of the most economic importance to revenue mobilization?

(ii) Are there variations in the contribution to revenue by the selected categories of goods imported over the 5-year period?

(iii) What are the estimates of revenue from the selected imports?

(iv) What is the pattern of increase/decrease in the overall total import revenue?

Data Collection

The project makes use of secondary data. The data contains information on classification and valuation of imported goods carried out by Inspection and Control Services Limited (ICS), a destination inspection company, over a 5-year period. (The geographical areas of operation of this company can be seen in Appendix E). The lists of items that are examined by the company is endless. Six categories of items have been selected for this study, namely rice, auto-parts, household electricals, computer and accessories, poultry products and used clothing. As noted earlier, most of these items have become a prime public target for prohibition. Notable among them are rice, auto-parts, and used clothing. Some of the items that make up the auto-parts are engines, radiators and shock absorbers. Some of the items that make up the household electricals are television sets, fridges/deep freezers, DVD players, and microwaves. For auto-parts and household electricals, they have the status of either being a new product or a used one.

The data consists of revenue collected on the categories of items. The revenue is obtained in three components: Import Duty, Value Added Tax and the National Health Insurance Levy. However, these components are added to constitute the total revenue generated over the period, which is the main interest of the study. Other features of the data which are of interest are the status (used or new) of imported goods and the category of goods imported. Each category of goods comprises a number of line items per an invoice. It presupposes that twenty line items are captured in the data for say, an invoice of twenty items. Data for each year involves tens of thousands of items from several importers. For each observation, we have the importer's name, the Import Declaration Form (IDF), the product name, import duty, VAT, NHIL, the status of the item and the item category. The import duty, VAT and NHIL are all denominated in U.S. dollars.

Literature Review

In this section, we review some literature on import revenue of Ghana, in particular, and the revenue contribution of some main import commodities around Africa and the world. We look at relevant interventions for revenue mobilization and control of high-risk goods around the world.

Countries around the world are getting tough on the importation of goods they regard as high-risk goods. The seriousness which America attaches to this subject is remarkable. In an address by the Commissioner of Food and Drugs, Hamburg (2010) indicated renewed efforts of the authority to monitor imports of food and medical products at the port of entry. She said this effort would deploy a new web-based information technology system to make their monitoring system more reliable and to target high-risk shipment for further inspection. The new system, called Predictive Risk-based Evaluation for Dynamic Import Compliance Targeting (PREDICT), she said, would use a variety of assessments to rank import shipments according to risk. It would consider everything from whether a product is intrinsically risky (e.g. raw seafood) to information on previous shipment or product examination.

Apart from the Ghana Standards Board, the Ghanaian media plays a watchdog role particularly over the importation of high-risk goods. For example, the Public Agenda (Monday, May 2008) had a headline, ‘‘Standards Board Approves Deadly Gas Cylinders’’. It raised concerns about the type of Liquefied Petroleum Gas (LPG) cylinders on the Ghanaian Market. It complained that it was made of plastic and was found to be sub-standard and not fit for use in Ghana.

In order to meet the revenue expenditure demands, Ghana, like most African countries, has made a number of tax reforms. These reforms centered on removing the revenue institutions from the civil service and granting them operational autonomy with a view to improving efficiency through enhanced work and employment conditions. Two practical steps were taken in 1985. These were the establishment of the National Revenue Secretariat (NRS) and the creation of two major revenue organizations, the Customs, Excise and Preventive Service (CEPS) and the Internal Revenue Service (IRS) as autonomous institutions outside the civil service (Tekper, 1995). Most of these reforms essentially focused on tax structure rather than generating more revenue from existing tax sources (Osoro,1992). Effective revenue collection is a core element for any strategy aimed at improving economic governance.

Increasing revenue collection reduces the dependence of a state on foreign transfers. The government is able to provide and finance public goods independent of the conditionality of external donors (Lautenbacher and Witt, 2003).

A number of items have been identified by the columnist, Obosu-Mensah (2011) to attract very high duties at various points in time in Ghana. Some of these items are printing materials, drugs, manufacturing products, and used cars. According to him, in 2005, tax on drugs was as large as 25 percent. He also reports that as at January, 2011, the levy on raw materials for manufacturing was 10 percent.

Apart from oil, which all economies depend on, there are other commodities which almost all nations also appear to rely on. One of such commodities is rice. A report by Workman (2008) shows that Africa is the second largest importer of rice with import volume of 7.6 million tons, constituting 26.1 percent of global import. Asia is the largest with rice import volume of 11.9 million tons, which constitutes 41 percent of global rice import. Europe is third with volume of 3.5 million tons, which constitutes 12.2 percent of global rice import. The fourth is North and Central America (with 2.3 million tons constituting 8.1 percent). The fifth on the list is South America (with 1.1 million tons constituting 3.9 percent of global rice import). He added in his report that in Africa, Nigeria, Cote d'Ivoire, Senegal and South Africa were among the top ten rice importers in the world, with Nigeria being the world's topmost importer of rice. Nigeria's rice import which was 1.4 million tons constituted about 4.8 percent of global rice import. Furthermore, according to the Food and Agriculture Association of the United

Nations, no one country was responsible for more than 5 percent of global rice import. This indicates that almost every country of the world depends to some extent on rice. Even in Asia which farms more than 91 percent of the global rice harvest, far Eastern nations import more rice than any other continent. Workman also indicates that some countries have made effort to decrease rice import in 2004. Indonesia had the most decreasing rice importation. Again, Nigeria, Senegal and South Africa were among the top ten of countries with decreasing rice importation.

Generating more revenue and achieving a country's revenue target largely depends on reliable revenue forecast, and this forms the basis for the budget process. In Ghana, the process of setting revenue targets involves the revenue agencies, operating through the Revenue Agencies Governing Board (RAGB), now the Ghana Revenue Authority (GRA), and the Ministry of Finance and Economic Planning (MOFEP). Revenue targets are set during the fourth quarter for the ensuing year. Based on past trends, collections up to the end of the third quarter and the general economic environment, the GRA makes proposals to the MOFEP on targets for the following year. The MOFEP puts up a counter proposal using variables which it might not disclose to the GRA at that time. There is usually a negotiation between the GRA and MOFEP and although the GRA plays a lead role in setting the targets, the MOFEP has the ultimate authority in determining the final targets for the revenue authority. However, Armah (2003) contend that despite the all too often celebrations by revenue collecting agencies that they have achieved their revenue targets, questions have been raised on whether the revenue targets reflect the nation's macro-economic framework. He described as flawed the revenue setting mechanism not because the method is necessarily poor, but because the forecasting mechanism is poor.

There is therefore the need for a paradigm shift from the use of any form of judgmental forecasting technique to a more formal and scientific approach. Different techniques are employed in forecasting revenue figures. This study, however examines the use of multiple linear regression to make a revenue forecast.

Outline of Dissertation

The dissertation is in five chapters under the following headings: Introduction, Review of Methods, Preliminary Analysis, Further Analysis and Summary, Discussions and Conclusions.

Chapter One deals with the background of the study of revenue generation at the Tema Port, the objectives of the study, the questions the research seeks to answer, data collection methods, literature review and outline of the dissertation.

Chapter Two is devoted to reviewing of relevant methods that are employed in the analysis of the data. It also explains the main statistical tools used for the analysis.

In Chapter Three, exploratory data analysis was performed on the collected data to investigate and observe emerging patterns and trends. This is meant to assist in determining the main methods to use in the further analysis. It also employed the use of descriptive statistics (graphs and charts) to display facts.

In Chapter Four, we discuss further analysis carried out on the data. In this chapter, inferential statistics such as multiple linear regression, analysis of variance (ANOVA) and trend estimation are used to answer the research questions.

The final chapter of the dissertation summarizes all the major findings and discusses them in accordance with the objectives of the study, and conclusions are then derived.

CHAPTER TWO

REVIEW OF METHODS

This chapter reviews the theory of the main techniques that are relevant to the study. Basically, the methods of multiple linear regression with dummy variables and trend analysis are reviewed. Other methods such as the analysis of variance and hypothesis testing are also discussed.

Multiple Linear Regression

Multiple Linear Regression involves a single dependent variable and two or more independent variables. Suppose the dependent variable is Y and the independent variables are X_1, X_2,…,X_k. Then the multiple linear regression model is

$$E(Y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k$$

where β_0 is constant or intercept, and β_1,…, β_k are the regression coefficients which must be estimated from the sample data. Manually computing for the least squares estimate, especially in cases of more than two predictor variables can be tedious and time consuming. For this reason, most regression analyses are performed using appropriate software such as MINITAB, SAS and SPSS.

Let us consider a case in which there are two independent variables, so that

$$E(Y) = a + b_1 X_1 + b_2 X_2$$

where b_1 and b_2 are a partial regression coefficients and b_1 represents the expected change in Y when X_1 is changed by one unit but X_2 is held constant or otherwise controlled, and b_2 represents the expected change in Y for a unit change in X_2 when X_1 is held constant. Beta coefficients are the partial coefficients obtained when all the variables (Y, X_1, X_2) have been standardized to a mean of 0 and a variance of 1 before estimating the regression equation.

The beta value is a measure of how strongly each predictor variable influences the criterion variable. The beta is measured in units of standard deviation. For example, a beta of 2.5 indicates that a change of one standard deviation in the predictor variable will result in a change of 2.5 standard deviations in the criterion variable. Thus the higher the beta value, the greater the impact of the predictor variable on the criterion variable. When you have more than one predictor variable, you cannot compare the contribution of each predictor variable by simply comparing the correlation coefficients. The beta regression coefficient is computed to allow you to make such comparisons and to assess the strength of the relationship between each predictor variable to the criterion variable.

Coefficient of determination, R^2, is associated with multiple linear regression, and it is the proportion of the total variation in the response variable Y that is explained by the predictor variables X_1, X_2, .., X_k. The coefficient of determination is given by

$$R^2 = \frac{S_{yy} - SS_E}{S_{yy}}$$

where

$$S_{yy} = \sum_{i=1}^{n} y_i^{\,2} - \frac{\left(\sum_{i=1}^{n} y_i\right)^2}{n}$$

and

$$SS_E = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$

By definition, R^2 lies between 0 and 1 or between 0% and 100%. A high value of R^2 indicates a reliable regression equation for prediction. If the predictor variables are mutually uncorrelated, then it can be shown that

$$R^2 = r_{YX_1}^2 + r_{YX_2}^2 + \cdots + r_{YX_k}^2$$

On the other hand, if the predictor variables are correlated or collinear, then the contributions of the X_i s to the variation in Y is such that

$$R^2 < r_{YX_1}^2 + r_{YX_2}^2 + \cdots + r_{YX_k}^2$$

In essence, it is a measure of how good the prediction of a response variable we can make by knowing the predictor variables. However, R^2 tends to somewhat overestimate the success of the model when applied to the real world, so an adjusted R^2 value is calculated which takes into account the number of variables in the model and the number of observations a model is based on.

The Use of Dummy Variables in Regression Analysis

A dummy variable is a numerical variable used in regression analysis to represent subgroups of the sample in a study. In research design, a dummy variable is often used to distinguish different treatment groups. In the simplest case, we would use a 0-1 dummy variable where an observation is given a value of 0 if they are in the control group or a 1 if they are in the treated group. Dummy variables are useful because they enable us to use a single regression equation to represent multiple groups. This means that we do not need to write out separate equation models for each subgroup. The dummy variables act like 'switches' that turn various parameters on and off in an equation. Another advantage of a 0-1 dummy-coded variable is that even though it is a nominal-level variable it can be treated statistically like an interval-level variable.

Suppose data on Y and X_j $(j = 1, 2, \dots, k)$, are obtained from q different sources, then by introducing variables $(Z_1, Z_2, \dots, Z_{k-1})$, where

$$Z_i = \begin{cases} 1, & \text{if from source } S_i \\ 0, & \text{otherwise} \end{cases}$$

We can write a single equation rather than k different equations to model the effect of the k sources on the dependent variable, Y. The variable Z_i is called a dummy variable. With reference to this study, examples of dummy variables include the following:

$$C1 = \begin{cases} 1, & \text{if imported item is rice} \\ 0, & \text{otherwise} \end{cases}$$

$$C2 = \begin{cases} 1, & \text{if imported item is household electrical} \\ 0, & \text{otherwise} \end{cases}$$

The variable $C1$ indicates a nominal variable describing the qualitative independent variable representing the category of the item, rice. The variable $C2$ describes the category of the item called ‘household electrical’. Since in this study (Chapter Four) there are three imported items under study, the other one being auto-parts, we define two dummy variables for the category of the imported item. Another example of dummy variable that will be encountered in this study is defined as

$$S = \begin{cases} 1, & \text{if imported item is new} \\ 0, & \text{otherwise} \end{cases}$$

The variable S indicates the status of the imported item as either ‘‘new’’ or not new. Since the usage status of imported items in this study is either new or used, it is enough to define only S for this qualitative variable called status.

There are a number of points that need to be considered in determining a regression model that involve dummy variables. These points are been listed as follows:

1. The number of dummy variables necessary to represent a single attribute variable is equal to the number of levels (categories) in that variable minus one (i.e. $k-1)$.
2. For a given attribute variable, none of the dummy variables constructed can be redundant. That is, one dummy variable cannot be a constant multiple or a simple linear relation of another.
3. The interaction of two attribute variables is represented by a third dummy variable which is simply the product of the two individual dummy variables.

Interpretation of Dummy Variable Model

The interpretation based on regression model involving dummy variables can best be explained in the context of an example. We use the scenario that we will encounter in this study to illustrate how interpretations can be given on the basis of a dummy variable model.

In order to model the effect of the category of an imported item on its contribution to revenue generation, we will define two sets of dummy variables denoted by $C1$ and $C2$ as one set and the other by Status (or S). The definitions of these variables are given in the previous section. The regression model of the total revenue (Y) in terms of these variables is of the form

$$Y = \beta_0 + \beta_1 S + \beta_2 C1 + \beta_3 C2 + \varepsilon \qquad (1)$$

where ε is an error term. By the definitions of the dummy variables, since the model does not include a dummy variable for Auto-parts, the Auto-parts category is then set as the reference category. That is, interpretations based on the model will be with reference to the auto-parts category.

This model (and the definitions of the dummy variables) has a number of implications. For example, for new Auto-parts, the mean revenue is given as

$$\begin{aligned} Y_{na} &= \beta_0 + \beta_1(1) + \beta_2(0) + \beta_3(0) \\ &= \beta_0 + \beta_1 \end{aligned}$$

Similarly, used Auto-parts will yield average revenue (Y_{uc}) of β_0. Thus, the average total revenue contribution from Auto-parts will be the sum

$$Y_{na} + Y_{ua} = 2\beta_0 + \beta_1. \qquad (2)$$

The difference between revenue from new and used Auto-parts gives β_1, which is the coefficient of S.

For Rice, the only usage status it can assume is ‘new’ since used rice is not meaningful. Thus, the average revenue from rice (Y_R) will be equal to

$$\begin{aligned} Y_R &= \beta_0 + \beta_1(1) + \beta_2(1) + \beta_3(0) \\ &= \beta_0 + \beta_1 + \beta_2 \qquad (3) \end{aligned}$$

For new Household Electricals, the mean revenue is given as

$$\begin{aligned} Y_{nh} &= \beta_0 + \beta_1(1) + \beta_2(0) + \beta_3(1) \\ &= \beta_0 + \beta_1 + \beta_3 \qquad (4) \end{aligned}$$

Similarly, used Household Electricals will yield an average revenue (Y_{ul}) of

$$Y_{uh} = \beta_0 \tag{5}$$

Thus, the average total revenue contribution from Household Electricals will be the sum

$$Y_{nh} + Y_{uh} = 2\beta_0 + \beta_1 + \beta_3. \tag{6}$$

We have already noted that β_C is the amount of revenue from used Auto-parts which is also the same as the amount of revenue from used Household Electricals. We have also seen that β_1 is the difference between revenue from new and used Auto-parts. Now, when we subtract Equation (2) from Equation (6) we obtain β_3. Thus, the coefficient of *C*2 is the amount by which revenue from Household Electricals exceeds (or falls short) that of Auto-parts, depending on the sign of β_{Ξ}. From the Equations above, the representation of β_2 alone is not meaningful. However, when we subtract Equation (2) from Equation (3) we obtain a combination of parameters $\beta_2 - \beta_0$, which is interpretable. This difference gives the amount by which revenue obtained from Rice exceeds (or falls short) that of Auto-parts, depending on the sign of the difference. Given the estimates of the quantities, β_C, β_1, β_{Ξ}, $\beta_2 - \beta_0$, and their standard errors, we can obtain a $(100-\alpha)\%$ confidence interval for these quantities.

Analysis of Variance (ANOVA)

One-Way ANOVA has been chosen to determine the variations that exist in the contribution to revenue by the category of items imported over the study period.

ANOVA is defined as a technique whereby the total variation present in a data set can be partitioned into several components. Associated with each of these components is a specified source of variation so that in the analysis it would be possible to ascertain the magnitude of the contribution of each of the sources of the total variation.

The model for the One-Way ANOVA is

$$x_{ij} = \mu + (\mu_j - \mu) + (x_{ij} - \mu_j),$$

where μ is the overall mean;

$(\mu_j - \mu)$ is the effect due to treatment j; and

$(x_{ij} - \mu_j)$ is the random error term within treatment groups.

In One-Way ANOVA, the total sum of squares can be partitioned into two separate sources of variability; one due to variability among treatments (between groups) and one due to random fluctuations (within groups). In mathematical terms, the total sum of squares can be partitioned into;

$$SS_T = \sum_{i=1}^{n_j} \sum_{j=1}^{t} (x_{ij} - \overline{x}_{..})^2 \quad \text{Total sum of squares}$$

$$SS_{Tr} = \sum_{j=1}^{t} n_j (\overline{x}_{.j} - \overline{x}_{..})^2 \quad \text{Treatment sum of squares}$$

$$SS_E = \sum_{i=1}^{n_j} \sum_{j=1}^{t} (x_{ij} - \overline{x}_{.j})^2 \quad \text{Error sum of squares}$$

Therefore, the total sum of squares is decomposed as

$$SS_T = SS_{Tr} + SS_E$$

It can be shown that computational formulas for SS_T and SS_{Tr} are

$$SS_T = \sum_{i=1}^{n_j} \sum_{j=1}^{t} {x_{ij}}^2 - \frac{T_{..}^2}{n}$$

$$SS_{Tr} = \sum_{j=1}^{t} \frac{T_{.j}^2}{n_j} - \frac{T_{..}^2}{n}$$

The residual sum of squares *SSE* is then obtained as

$$SS_E = SS_T - SS_{Tr}$$

The results of the One-Way ANOVA can be summarized in an ANOVA table as shown in Table 3.

Table 3: The One-Way ANOVA Table

Source of Variation	Degrees of Freedom (df)	Sum of Squares (SS)	Mean Sum of Squares (MS)	F-ratio
Treatment (between groups)	$t - 1$	SS_{Tr}	$MS_{Tr} = \frac{SS_{Tr}}{(t-1)}$	$\frac{MS_{Tr}}{MS_E}$
Error (within groups)	$n - t$	SS_E	$MS_{E=} \frac{SS_E}{(n-t)}$	
Total	$n - 1$	SS_T		

Tests of Significance of Regression Coefficients

The overall ability of a set of predictor variables (or all the predictor variables) to explain the variation in the response variable can be tested simultaneously. Let the coefficient of regression be denoted by the $\beta's$

$H_o : \beta_1 = \beta_2 = \cdots = \beta_k = 0$

H_1: At least one coefficient is not equal to 0.

The test statistic, F, is given by

$$F = \frac{[SS_E(Reduced\ Model) - SS_E(Full\ Model)]/(k-g)}{SS_E(Full\ Model)/(n-k-1)},$$

where k is the number of predictor variables, n the number of observations and $(k-g)$ is the number of coefficients equated to 0 in the null hypothesis. The statistic F has an F-distribution with degrees of freedom $(k-g)$ and $(n-k-1)$.

Test Statistic

A statistic is calculated from the sample. To begin with, we assume that the hypothesis about the population parameter is true. We compare the value of the statistic with the hypothetical value of the parameter. If the difference between them is small, the hypothesis is accepted, and if the difference between them is large, the hypothesis is rejected. A statistic on which the decision can be based whether to accept or reject a hypothesis is called test statistic. It is important to remember that a test statistic does not prove the hypothesis to be correct but it furnishes us with evidence against the null hypothesis.

The test statistic for one-way analysis of variance is given by

$$F = \frac{MS_{Tr}}{MS_E}$$

where MS_{Tr} is the mean square treatment of the sample; and MS_E is mean square error of the sample.

Fisher's Procedure for Multiple Comparison

Fisher's procedure called *least significant difference* (LSD) is used to make pair-wise comparisons among a set of *t populations*. The procedure is summarized in the following steps.

Step 1

For specified level of significance, calculate the LSD for all pairs (i, j) and compare μ_i to μ_j using the formula

$$LSD = t_{\alpha/2} \times \sqrt{MSE\left(\frac{1}{n_i} + \frac{1}{n_j}\right)} \quad ,$$

where, n_i and n_j are the respective sample size from populations i and j and $t\alpha_{/2}$ has a t distribution with $n - t$ degrees of freedom.

Step 2

Calculate $\left|\overline{X}_i - \overline{X}_j\right|$ for all possible pairs of sample means and compare the values of their corresponding LSD. If the $\left|\overline{X}_i - \overline{X}_j\right| > LSD$, declare that the corresponding population means μ_i and μ_j are different.

Correlation Analysis

To determine whether there is any relationship between the revenue contributions of the seven selected items, we make use of the correlation analysis.

Correlation is a statistical technique used to measure the strength or degree of relationship existing between two variables. When only two variables are involved, we speak of simple correlation.

To study the relationship, we use the co-efficient of correlation denoted by r. There are several types of correlation coefficients. These are Pearson Product Moment Correlation Coefficient, Rank Correlation Coefficient and Kendall Correlation Coefficient. However, Pearson Product Moment Correlation Coefficient denoted by r would be used. The r is computed as

$$r = \frac{n\sum XY - \left(\sum X\right)\left(\sum Y\right)}{\sqrt{\left[n\sum X^2 - \left(\sum X\right)^2\right]\left[n\sum Y^2 - \left(\sum Y\right)^2\right]}} ,$$

where n is the number of data pairs. The correlation coefficient r assumes any value on the scale from -1 to 1 inclusive. If $r = \pm 1$, there is a perfect relationship between the two variables and if $r = 0$, there is absolutely no relationship between the two variables. If there is a strong positive linear relationship between the variables, the value of r will be close to +1. If there is a strong negative linear relationship between the variables, the value of r will be close to -1. If there is no linear relationship between the variables or only a weak relationship exists between the variables, the value of r will be close to 0.

By this technique, we will be able to establish the relationship existing between the two variables mentioned earlier.

Trend Estimation

Time series technique is used to study or determine the trend of revenue mobilized over the study period. Time series is a set of observations taken at specific times, usually at equal intervals. In time series, we analyze the past behaviour of variables in order to predict their future behaviour (forecasting). Time series graphs consist of points that are connected with straight lines and contain at least one of the following components, namely;

(i) Trend

(ii) Seasonal variations

(iii) Cyclical variation

(iv) Irregular or random variations.

For the purpose of this research, it is only relevant to provide a review of Linear Trend estimation because, as will be seen in Chapter Four, plots of revenue mobilized over the study period appear to have a linear trend. Several procedures can be used for trend estimation, however, the least squares method would be used in order to fit an appropriate model for the period under study. The fitted model would help us study the behaviour of revenue in order to make future forecasts.

Least Squares Method for Trend Estimation

The straight line trend model is of the form

$$y_t = \beta_0 + \beta_1 t + \varepsilon_t \quad , \qquad (7)$$

where

y_t is the value of the time series in period *t*.

$\beta_0 + \beta_1 t$ is the linear trend in time *t*; and

ε_t is the error term in time period *t*.

The model says that the time series y_t, can be represented by an average level that changes over time according to the linear equation, combined with random fluctuations (represented by the error term ε_t) which causes y_t to deviate from the average level.

By using the least squares equations:

$$\sum y = n\beta_0 + \beta_1 \sum t$$
$$\sum yt = \beta_0 \sum t + \beta_1 \sum t^2$$

where *n* is the number of time period, we can obtain the estimates for the parameters in the model.

There are two main types of linear trends: firstly, No trend, which is modeled as $y_t = \beta_0$. This implies that there is no long-run growth or decline in the time series over time; and secondly, Linear trend, which is modeled as in Equation (7). This implies that there is a straight line long-run growth (if the slope $\beta_1 > 0$) or decline (if $\beta_1 < 0$) over time.

Detailed treatment of these methods can be found in standard texts such as Johnson and Wichern (2002), Bowerman and O'Connell (1997), Sharma (1996).

CHAPTER THREE

PRELIMINARY ANALYSIS

In order to choose the main method for the analysis of this data, we first explore the data. This will assist in identifying some basic characteristics demonstrated by the variables in the study. To do the exploration, we make use of routine techniques such as charts and correlation analysis. The statistical software packages used for the analysis were SPSS and Minitab.

Revenue Distribution

Figure 1 shows a line graph of the distribution of the three revenue components over the study period. The relative sizes of the three components are

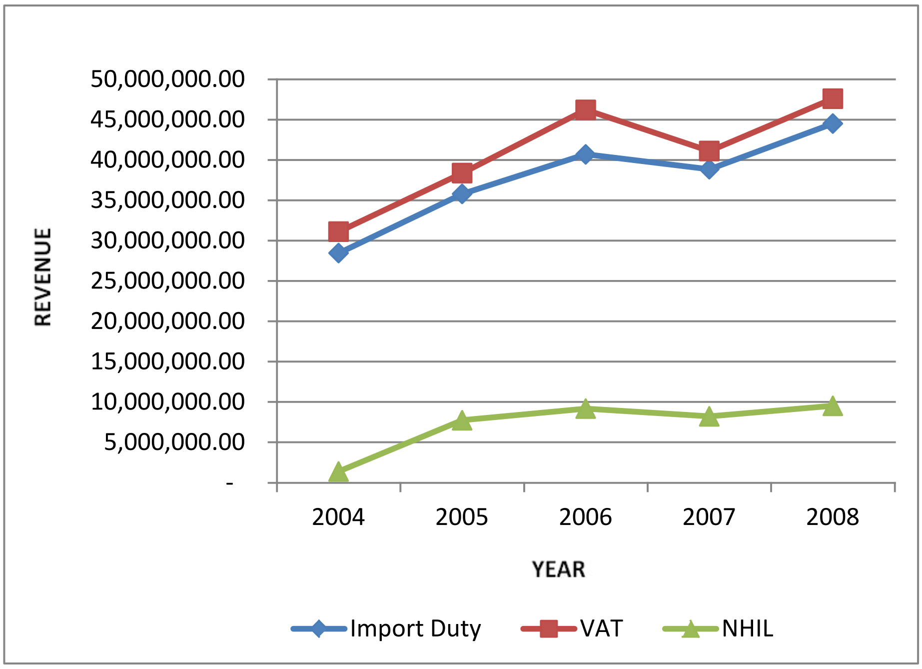

Figure 1: Revenue of Three Components over the Study Period

as a result of the percentages of tax charged for each of them. As noted in the introductory chapter, the import duty attracts 10 percent tax, VAT attracts 12.5 percent, whilst NHIL attracts 2.5 percent. From Figure 1, it is observed that there is a consistent increase in Import Duty and VAT over the period of 2004 to 2006. There was a slight dip in all three components in 2007 followed by a rise in 2008. The smallest amount of revenue for the period under study was recorded in 2004. NHIL for 2004 was particularly low. This is because the policy implementation for its collection started during the last quarter of the year. Thus, in reality, the NHIL revenue over the entire period has been stable, unlike those of Import and VAT that show discernible increasing pattern. For each year, the VAT collected was the highest, followed by the Import Duty, then the NHIL. For five years running, we observe that the revenue for NHIL has been below \$10,000,000.00. For the Import revenue, it has been between \$25,500,000.00 and \$45,000,000.00. The VAT revenue has also been between \$30,000,000.00 and \$45,500,000.00.

In Figure 2, we have the line graph of the total revenue over the study period which is the sum of the three revenue components in Figure 1. We see from Figure 2 that there was a steady trend in the series of total revenue over the study period. It appears that the trend is more likely to be a linear one rather than curvilinear. Even though there appears to be a rapid increase in total revenue from 2004 to 2005, the extent of increase (or decrease) afterwards is less sharp. We also see that the slight dips in the three revenue components in 2007 observed in Figure 1 has cumulatively resulted in a significant drop in total revenue in that year. It is obvious from the figure that the revenue in 2007 is a complete departure from the trend of total revenue in

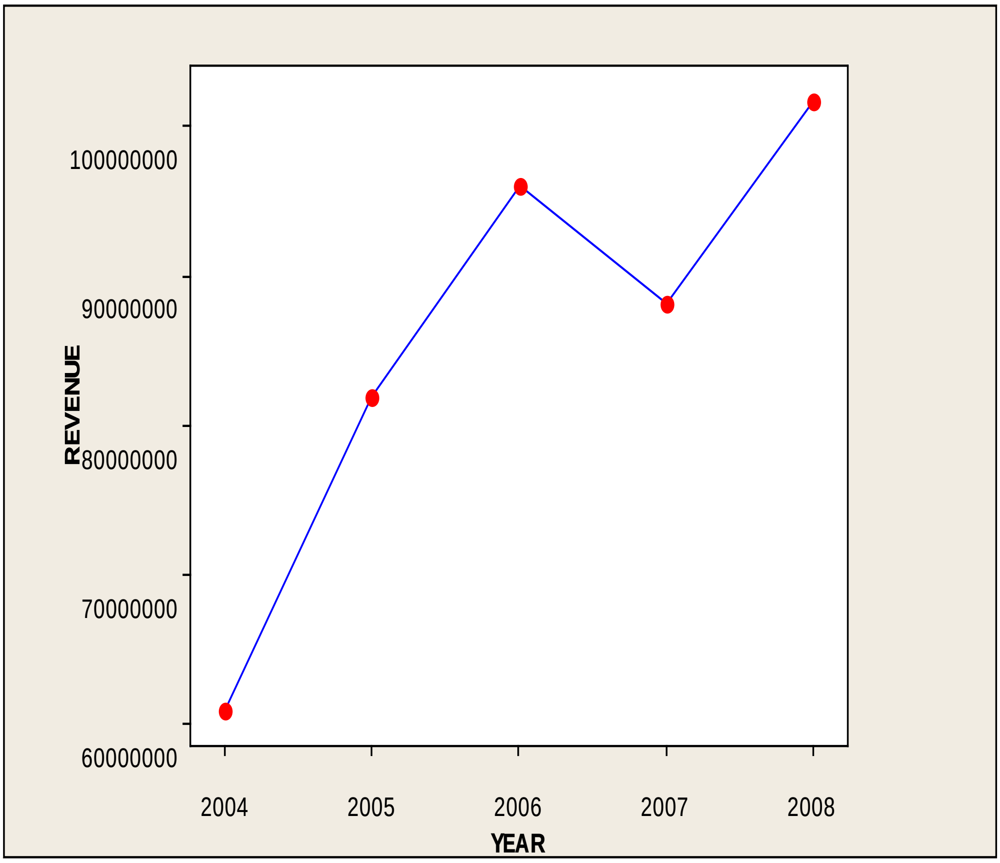

Figure 2: Distribution of Total Revenue over the Study Period

the period. It is obvious that the fluctuation in that year constitutes a shortfall in the revenue expectation for the year.

The Distribution of Usage Status of the Study Items

Figure 3 is a chart showing the distribution of the status of usage of the seven items selected for study. The status of an item is either 'new' or 'used'. As indicated in the introductory chapter, of the six items, four are imported as new or used. These items are the Auto-parts, Household Electricals, Computer and Accessories and Used Clothing. A number of observations can be made from Figure 3. We see from the figure that the total number of line items that are new and those that are used have been stable from year to year. We see that

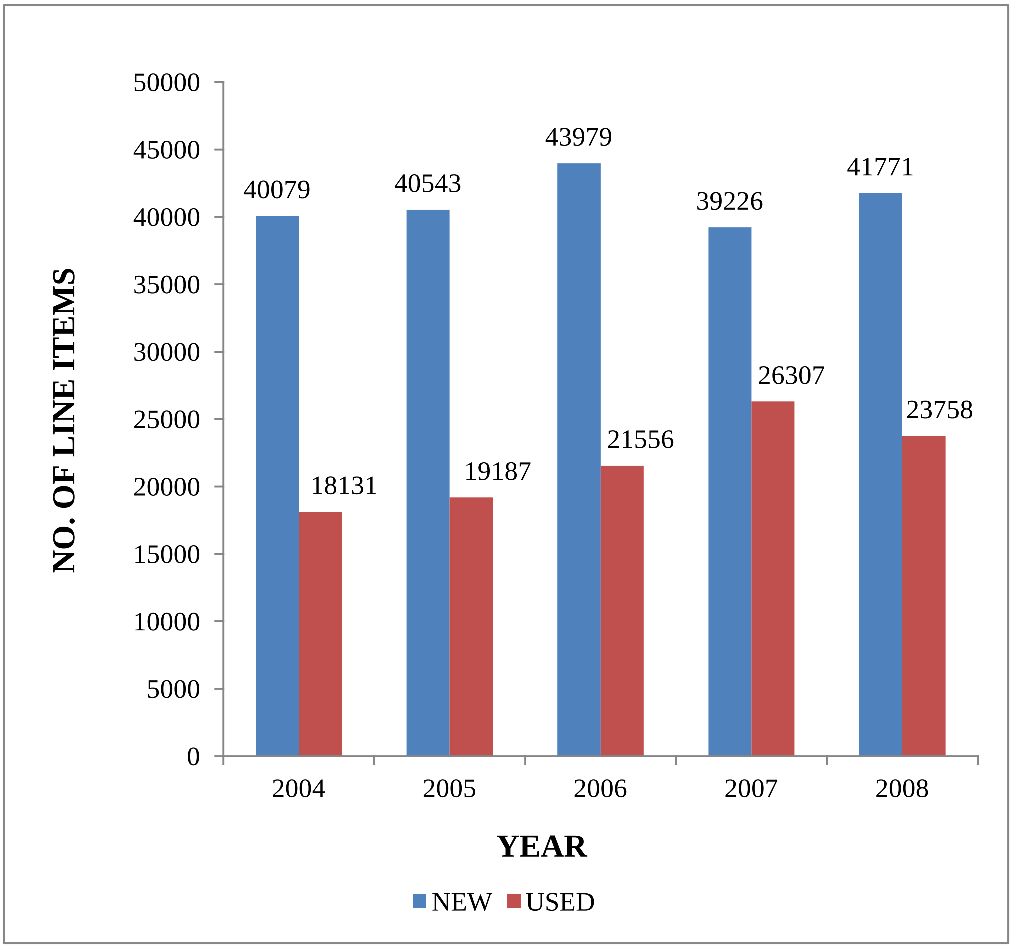

Figure 3: Distribution of Status of Study Items within the Period

the new items, which are more than the used each year, number just about 40,000 each year. The highest number (43,979) of the new items was observed in 2006, whist the lowest number (39,226) was in 2007. On the other hand, the used items number just about 20,000 each year. The highest number (26,307) of the used items was observed in 2007, whilst the lowest number (18,131) was in 2004. In the same year (2007) in which the number of new items were lowest, the number of used items was highest. With the exception of 2007, we see that the number of used items is just about half of the number of new items.

The percentages of line items in all of the five years of study have been given in Figure 4. We see from the figure that the distribution of the line items

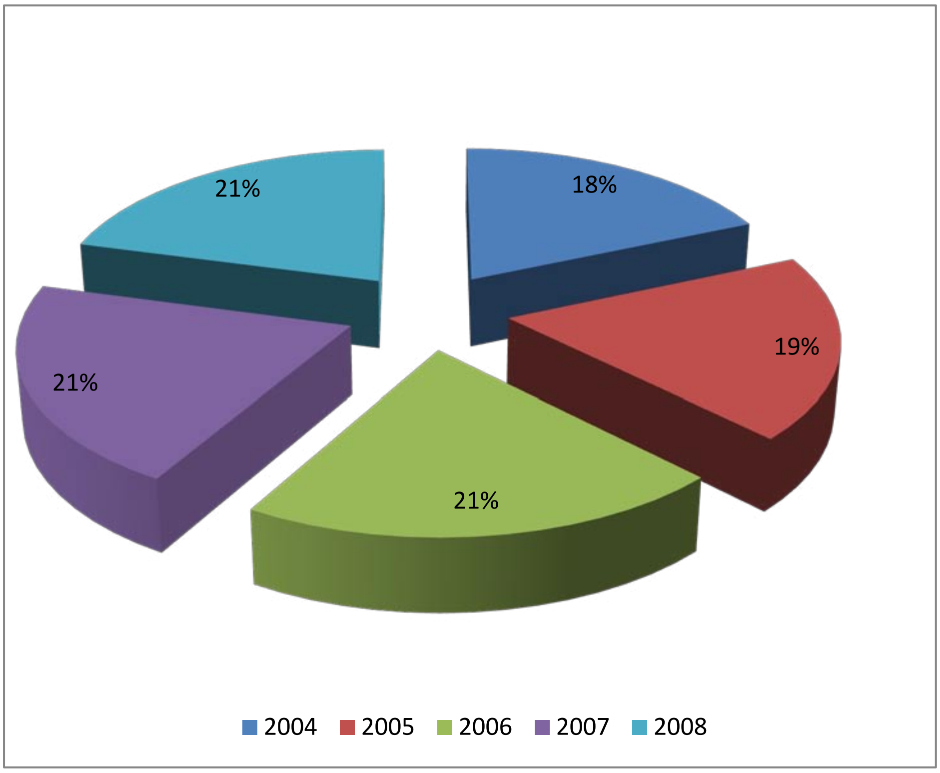

Figure 4: Percentage Distribution of Line Items

inspected by Inspection and Control Services Limited has been fairly constant for all the years. In particular, the numbers of new and used item together were the same in three years running from 2006 to 2008. There were, however, marginal drops in the number of line items in 2005 and 2006.

Revenue Contribution by each of the Study Items

We now examine the contribution of each of the six items in this study to the total revenue in each year in the study period. In Table 4, we have the number

Table 4: Revenue Contribution of the Study Items

Year	Category	Percentage	Number of

		Revenue	Line Items
2004	Auto-parts	34.04	20,988
	Computer & Accessories	1.02	714
	Household Electricals	16.48	6,301
	Poultry Products	2.24	69
	Rice	43.57	69
	Used Clothing	2.64	442
2005	Auto-parts	34.79	22,769
	Computer & Accessories	0.88	872
	Household Electricals	13.42	6,347
	Poultry Products	7.51	277
	Rice	42.44	76
	Used Clothing	0.95	473
2006	Auto-parts	30.35	17,902
	Computer & Accessories	3.18	1693
	Household Electricals	22.07	10,025
	Poultry Products	4.41	131
	Rice	36.87	76
	Used Clothing	3.13	646
2007	Auto-parts	34.31	18,554
	Computer & Accessories	2.14	1,700
	Household Electricals	17.24	11,595
	Poultry Products	1.03	53
	Rice	41.76	99
	Used Clothing	3.52	722

Table 4 continued

Year	Category	Percentage Revenue	Number of Line Items
2008	Auto-parts	27.60	17,881
	Computer & Accessories	1.50	1,391
	Household Electricals	17.78	10,915
	Poultry Products	2.41	81
	Rice	46.72	92
	Used Clothing	3.99	761

of line items of each of the six items and their revenue contribution as a percentage of the total revenue generated by the six items.

From Table 4, it can be seen that the percentage of revenue contributed by rice is consistently higher than the percentage contribution of any of the other five items. The percentage revenues are 43.57, 42.44, 36.87, 41.76 and 46.72 percent in 2004, 2005, 2006, 2007 and 2008 respectively. At the same time we see that the number of line items for rice is among the lowest throughout the period. In fact, the number of line items for rice is the least in 2004 to 2006, and it is the second lowest in 2007 and 2008. That is, the number of imports of rice that was inspected by the Inspection and Control Services Limited within the period was very small within the period.

However, its contribution to revenue is the most significant. The percentage to revenue and the number of line items of rice have been highlighted in the table for emphasis.

The next highest revenue-contributing item in the period is the auto-parts. The percentage revenue from this category of items is consistently the second highest throughout the period, ranging between 27.60 and 34.79. In contrast to rice, it can be seen that the number of line items of auto-parts is the highest throughout the period. Unlike rice, it appears that the margin of revenue contribution by auto-parts is in direct relationship with the number of its line items. Thus, the more auto-parts imported, the higher its percentage contribution to revenue.

Following auto-parts in revenue contribution is household electricals, the third highest revenue-contributing item in the period. The percentage revenue from this category of items is consistently the third highest throughout the period, ranging between 13.42 and 22.07. The number of line items of household electricals is the second highest after auto-parts throughout the period. Like auto-parts, it appears that the margin of revenue contribution by household electricals is in direct relationship with the number of its line items. Thus, the more household electricals imported, the higher its percentage contribution to revenue.

The percentage contribution of the other three items, computer and accessories, poultry products and used clothing, together contribute less than 10 percent of the total revenue. In particular, even though the number of line items of computer and accessories is the third highest each year, its percentage contribution is among the lowest. It is seen that the lowest percentage revenue was made by computer and accessories and was recorded in 2005.

To aid a more vivid illustration of the relationship among the revenue contributions of the six items, the values in Table 2 have been illustrated in Figure 5. The figure shows the actual revenue on the importation of each of the six items in each of the five years in the study period.

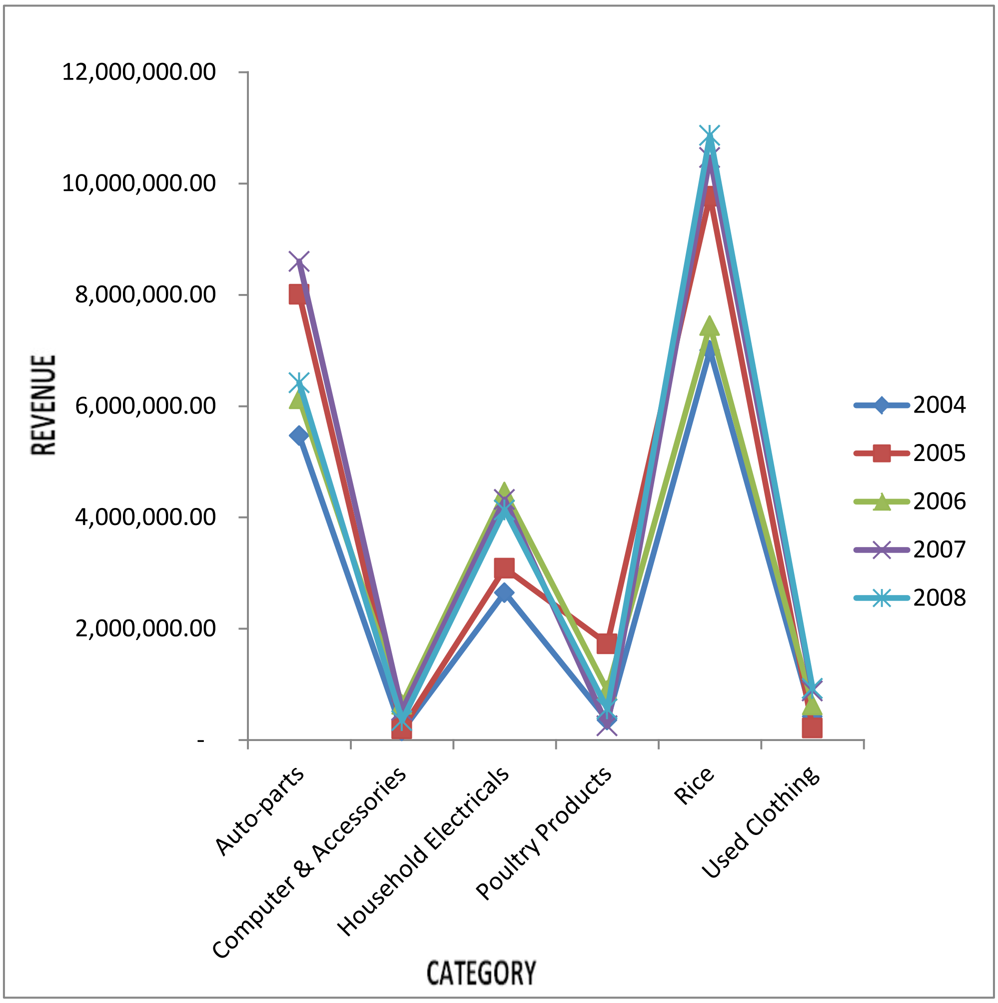

Figure 5: Trend of revenue contribution by each of the study items within the study period

We see from Figure 5 that computer and accessories, used clothing and poultry product recorded negligible revenue values. The actual revenue from rice import has been between $6,500,000.00 and $11,000,000.00. The revenue from auto-parts has been greater than $5,500,000.00 but less than $9,000,000.00. The contribution of household electricals has been greater than $2,500,000.00 but less than $5,000,000.00. The revenue contributions of the other three items have generally been less than $1,000,000.00.

Test for Multicollinearity

When the predictor variables in a regression model are correlated, multicollinearity is said to exist among the predictor variables. Multicollinearity is also described as a phenomenon in which an unacceptably high level of inter-correlation exists among independent variables, such that the effect of the variables cannot be separated.

In the above sections, we have seen that three of the six items under study, rice, auto-parts, and household electricals contributed substantially to the total revenue. The other three, computer and accessories, poultry products and used clothing did not contribute much to revenue. It was also realized that for auto-parts and household electricals, the larger the size of the line items, the larger the revenue contribution. In this section, we examine further the relationship between revenue contribution of rice, auto-parts, and household electricals and their line items in correlation analysis. Since the contributions of computer accessories, poultry products and used clothing are not significant, we drop them in this section.

Table 5 is the correlation matrix of revenue contributions of the three highly contributing items and their line items. Of particular interest is to examine the relationship between the items and their number of line items.

Table 5: Correlation Matrix

	Auto-parts	Household Electricals	Rice	Line Item
Auto-parts	1.000			
Household Electricals	0.254	1.000		
Rice	0.693	0.376	1.000	
Line Item	0.941	0.450	0.855	1.000

It can be observed from Table 5 that the highest correlation (of 0.941) is recorded between auto-parts and line item. This means that the higher the number of line items of auto-parts received at the port, the greater its revenue contribution. On the other hand, if number of line items of auto-parts is small, its revenue will be small. The high correlation coefficient suggests that to obtain high revenue from auto-parts, more of it needs to be imported. The second highest correlation coefficient (0.855) is between line item and rice. Thus, the relationship between the line item and rice is similar to that between line item and auto-parts.

The smallest correlation coefficient (0.254) is observed between household electricals and auto-parts. The low correlation value suggests that those who import auto-parts tend to import household electricals though this tendency is to a little extent. A similar relationship can be seen between household electricals and rice.

The correlation coefficient between auto-parts and rice is also quite high (0.693). This value suggests that to a large extent, those who import auto-parts tend to import rice also in the same consignment of goods.

Examination of Data for Normality Assumptions

We conclude this chapter by examining data to determine the extent to which the normality assumptions have been met. This would enable us make decisions of the use of techniques that require these assumptions in the next chapter. For example, it is assumed in multiple regression that the residuals (predicted minus observed values) are distributed normally. Even though most tests are quite robust with regard to violations of this assumption, it is always a good idea to review the distributions of major variables of interest before drawing final conclusions.

Normal probability plots are usually produced in order to inspect the distribution of the residual values. In this section, we make use of the normal probability plots and residual plots to examine the normality assumption and the homoscedasticity assumption. The response variable from which the residuals were obtained is the revenue on the imported items.

Figure 6 is the normal probability plot of the residual observations in revenue against the corresponding percentages.

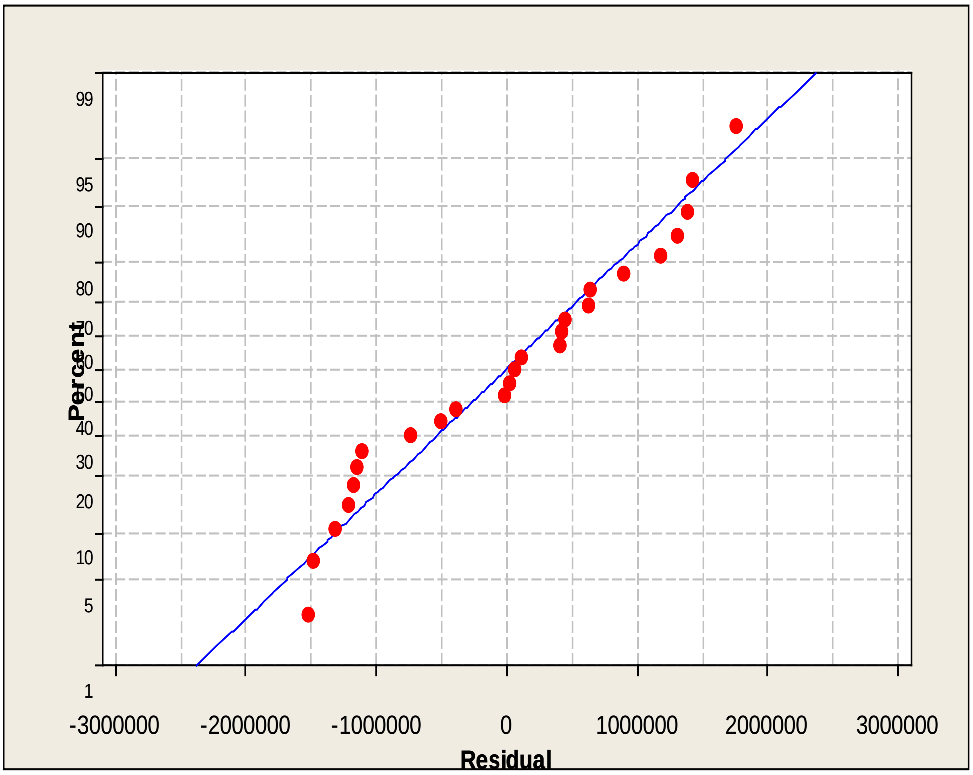

Figure 6: Normal probability plot of residuals

The normal plots of the residuals in Figure 5 shows the points are close to a diagonal line. This suggests that the residuals are normally distributed, and shows no evidence of serious departures from the model. The normality assumption is thus satisfied.

Test for homoscedasticity

Homoscedasticity refers to the assumption that the dependent variable exhibits similar amounts of variance across the range of values for an independent variable. Homoscedasticity is also known as the Constant Variance Assumption.

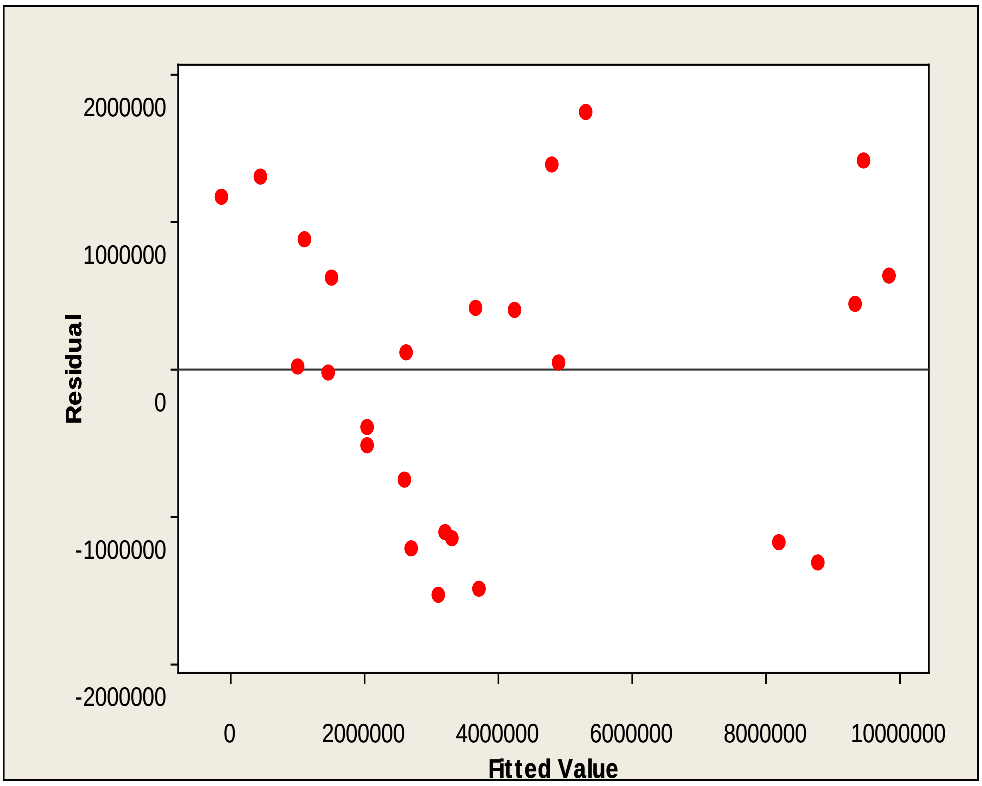

Figure 7: Plot of Residual against Fitted Value

In testing this assumption, residuals are plotted against fitted values as shown in Figure 7. The nature of the spread around zero indicates that the homoscedasticity assumption has been satisfied.

Summary of Preliminary Results

In this chapter, we have used routine statistical methods such the charts, tables and correlation analysis to examine the revenue data on six selected imported items that are inspected by the Inspection and Control Services Limited at the Tema port. These items are auto-parts, rice, household electricals, computer and accessories, poultry products and used clothing.

The analysis has shown that rice contributes the highest revenue to the total revenue from the six items studied. This is followed by auto-parts, and then by household electricals. The preliminary study has further shown that the revenue contribution of these three items increased by increasing the line items. It was observed that even though the line item of rice was the least in the period, it contributed the highest to revenue. The auto-parts recorded number of line items that were much higher than any other item. However, its revenue contribution was only second to that of rice.

Three of the study items, computer and accessories, poultry products and used clothing contributed revenue amounts that were negligible. The three together contributed less than 10 percent of total revenue from the six items. In particular, the revenue contribution of computer and accessories was the least (0.88 percent, and recorded in 2005) even though its line item was the third highest throughout the period.

It has also come to light that the numbers of new and used items have been generally stable over the period. In general, the amount of line items for used goods is almost half the number of line items for the new items. The only exception was observed in 2007 which recorded the lowest number of line items for new goods but the highest number of line items for used goods over the entire study period.

The analysis of the time series of total revenue over the study period reveals that there is a linear trend. Thus, the total revenue from the imports is expected to be on the increase in subsequent years. Two of the three components of the total revenue, the Import duty and the VAT have shown similar linear patterns over the period. The NHIL component, however, has been stable over the period.

The analysis of the tests for Normality, Multicollinearity and Homoscedasticity suggested that the assumptions for the use of multiple linear regression technique have been met.

CHAPTER FOUR

FURTHER ANALYSIS

This chapter deals with further analysis of the data. In this chapter, revenue mobilized over the study period is further analyzed using multiple regression, analysis of variance, correlation analysis and trend estimation. The choice of these techniques is informed by the results in the preliminary analysis. In that analysis, it would be recalled that four variables (items) emerged as having significant influence on revenue generation. These variables are rice, auto-parts, household electricals and the line items of these goods. It came to light that revenue contribution of these three items increased by increasing their line items. Another important observation was that even though rice had the smallest and a negligible number of line items, it contributed the most to total revenue. These findings justify the use of regression analysis in this chapter.

Another study that produced an important result was the trend analysis. In that study, we realized that there was a linear trend in the series of revenue from the imports. It is therefore expected that by using a trend analysis in this chapter, we would be able to make some forecasts for the revenue generation from the study items.

Multiple Regression Analysis

In determining the independent variables that should either be banned or retained depending on their contribution to revenue, the status of the goods which is either new or used were defined as 1 for new and 0 for used. The item category which consisted of rice, household electricals and auto-parts were also described with dummy variables. We defined these dummy variables in Chapter Two. It was indicated that since the item category has three levels, two dummies ($C1$ and $C2$) could be defined as follows:

$$C1 = \begin{cases} 1, & \text{if rice} \\ 0, & \text{otherwise} \end{cases} \quad \text{and} \quad C2 = \begin{cases} 1, & \text{if household electricals} \\ 0, & \text{otherwise} \end{cases}$$

Thus the regression model involving the revenue, status of the item and the categories of the item makes use of the auto-parts as the reference category. Table 6 gives a partial MINITAB output of the parameter estimates for the regression model for revenue. It also gives the results of significance test of the estimates.

Table 6: Regression Coefficients

	Unstandardized Coefficient		Standardized Coefficient		
Model	B	Std Error	Beta	t	Sig.
(Constant)	2.365	487450.503		4.851	0.000
Status	2.199	562859.359	0.350	3.906	0.001
C1	4.549	744592.943	0.592	6.110	0.000
C2	-1.598	562859.359	-0.255	-2.840	0.010

From Table 6, we write the regression model as

$$Revenue = 2.365 + 2.199Status + 4.549C1 - 1.598C2$$

It must be pointed out that in this model, the status of rice is always taken to be one since rice can only have a designation as being new. Another point of note is that the regression coefficients are all significant. We observe from the table again, that the standard errors associated with estimates of the parameters are extremely high. This is because the data on revenue involves several thousands of line items which involve varying sizes of revenue. These revenue figures range from units of dollars to millions of dollars. The high standard errors are therefore not surprising.

Interpretation of Regression Coefficients

A guide to the interpretation of regression coefficients of regression model involving dummy variables have been reviewed in Chapter Two. From that chapter, we see that we can obtain the constant (2.365) only when the item in question is Auto-parts, which are used items. Since this variable is the reference variable, the values of $C1$, $C2$ and status are all zero. Therefore, over the period, we estimate that used auto-parts alone would generate about $2.365million. However, if the auto-parts are new, then the revenue over the period is expected to be $4.564 million ($2.365 + $2.199). Thus, the new Auto-parts generate higher revenue than the used Auto-parts by an amount of $2,199,000.00. Together, the new and the used Auto-parts alone are expected to generate about $6.929 million. This value actually lies within the range of revenue contributions from auto-parts within the five-year period. It would be recalled that in the previous chapter, the range of revenue from auto-parts was observed to be greater than $5,500,000.00 but less than $9,000,000.00.

From the definitions of the dummy variables above, the revenue contribution from rice can be obtained from the model by simply putting $C1 = 1$. Since rice cannot be a used product, its status is always new, and hence $Status = 1$. The values of the other variable, $C2 = 0$. Therefore, over the period, we estimate that rice import alone is expected to generate about $9.113million (i.e. $\$2.365 + \$2.199 + \$4.549$). As expected, this value is not too far from the range of revenue contribution from rice which was observed to be between $6,500,000.00 and $11,000,000.00.

Again, from the definitions of the dummy variables above, the revenue contribution from household electricals can be obtained from the model by simply assigning the appropriate value for $C2$. The values of the other variables are also selected accordingly. Therefore, by putting $C2 = 1$ and $Status = 1$, we estimate that over the period, import of new household electricals alone is expected to generate about $2.966million (i.e. $\$2.365 + 2.199 - \$1.598$). However, if the household electricals are used items, then the revenue over the period is expected to be $2.365million. Like Auto-parts, we observe that the new Household Electricals generate higher revenue than the used ones, and this difference is $601,000.00. Thus, the total contribution of new and used Household Electricals together is expected to be $5.331million. Again, as expected, this value lies close to the range of revenue contribution from Household Electricals which was observed in the previous chapter to be between $2,500,000.00 and $5,000,000.00.

Therefore, based on the five-year import revenue, we summarize the revenue estimates of the imports of the three products in Table 7. It also shows the observed range of import revenue over the five-year period. The observed revenue limits have been rounded to make it comparable to the estimated figures.

Table 7: Estimates of Total Revenue from Three Imports

Item	Revenue Estimates ($)	Observed Range of Revenue ($)
Rice	9,113,000	6,500,000 – 11,000,000
Auto-parts	6,929,000	5,500,000 – 9,000,000
Household Electricals	5,331,000	2,500,000 – 5,000,000

Table 7 shows that on the average, the import revenue from rice is about $2,000,000.00 more than that from auto-parts, whilst import revenue from auto-parts in turn is some $1,500,000.00 more than that of Household Electricals.

Test of Significance of the Regression Model

As can be seen from Table 6, the individual independent variables in the model are significant at 5 percent level of significance. We now assess the overall significance of the dummy variable model by assessing the joint significance of the dependence of the revenue on Status, *C*1 and *C*2. The hypotheses of interest are

$$H_o : \beta_1 = \beta_2 = \beta_3 = 0$$

H_1: At least of the coefficients is not equal to zero.

The results of the analysis of variance are given in Table 8.

Table 8: Results of Analysis of Variance

Model	Sum of Squares	Degrees of Freedom	Mean Square	F	Sig.
Regression	203.20	3	67.730	42.769	0.000
Residual	33.27	21	1.584		
Total	236.47	24			

From Table 8, since the *p*-value is much less than 0.05, the test is highly significant. We therefore reject H_0. This implies that at 5 percent level of significance, there exists enough evidence to conclude that at least one of the predictors is useful for predicting revenue, therefore the model is statistically significant. From the table, we obtain the coefficient of multiple determination to be 0.859. This means that about 86 percent of variation in revenue is explained by the usage status and the category of the imported item. In addition, we infer that the correlation between the observed revenue and the estimated revenue based on the model is as high as 0.927. Hence, the regression model appears to be very useful for predicting import revenue.

Variations Among the Revenue Contributions from the Study Items

The contributions to revenue among the variable items imported over the period appear to vary. To determine the extent of differences in revenue contribution of these items, we perform analysis of variance to test whether significant differences exist among them. If significant differences exist, we will use Fisher's Multiple Comparison Test to establish the item or items that that on the average are significantly different.

To establish whether significant differences exist in all the items, we test the following hypotheses:

H_o: There are no significant differences in revenue among the items

H_1: There are significant differences in revenue among the items

The results of the test of analysis of variance are given in Table 9.

Table 9: Results of Test of Differences Among Three Main Imports

Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Sig.
Between Groups	7.325	2	3.663	19.823	0.000
Within Groups	2.217	12	1.848		
Total	9.543	14			

From Table 9, the test is highly significant since p –value is almost equal to zero. Therefore, we reject the null hypothesis and conclude that there are significant differences in revenue contribution among the items.

To determine whether these differences are significant and the item that contribute most to revenue over the study period, Fisher's Multiple Comparison Test was employed. The results of the test of least significant differences are given in Table 10.

Table 10: Results of Multiple Comparison (LSD)

Category (*i*)	Category (*j*)	Mean Difference (*i*-*j*)	Std. Error	Sig.	95% CI Lower Bound	Upper Bound
Rice	Auto-parts	2.1847	8.5969	0.026	3.4286	4.0579
	Household	5.3814	8.5969	0.000	3.5084	7.2546
Auto-parts	Rice	-2.1847	8.5969	0.026	-4.0579	-3.1164
	Household	3.1967	8.5969	0.003	1.3236	5.0698
Household	Rice	-5.3814	8.5969	0.000	-7.2546	-3.5084
	Auto-parts	-3.1967	8.5969	0.003	-5.0698	-1.3236

From Table 10, all the pair-wise combinations: that is Rice and Auto-parts; Rice and Household Electricals; and Auto-parts and Household Electricals all exhibited significant differences. The highest difference exists between Rice and Household Electricals (*p*-values are almost equal to zero and are highlighted).

The results correspond to the actual mean revenue contributions of the three items. The mean revenue from Rice, Auto-parts and Household Electricals are respectively \$9,112,725.364, \$6,927,968.150 and \$3,731,243.810. This implies that in terms of revenue contributions, Rice > Auto-parts > Household Electricals. Hence, it can be said that for the study period, rice was the imported commodity that contributed highest to revenue ($9,112,725.364).

Trend Model Estimation of Total Import Revenue over the Study Period

A plot of total import revenue against time (Year) for each of the five years under study is shown in Figure 8. This figure is the same as the graph in Figure 2, but with straight line fitted. The straight line model emerged as the best model associated with the smallest forecasting error. As was observed in Figure 2 in the previous chapter, the trend was the only component that could be used to characterize the revenue series. In this section, our objective here is to use the model to obtain a forecast for the revenue in the next three years. From the MINITAB output, the trend model for the series is given as

$$y_t = 59508610 + 8761463t$$

where y_t is the revenue at time t, and t is the time (year), where $t = 1$ represents 2004, $t = 2$ represents 2005, and so on. The revenue figures are measured in millions of dollars.

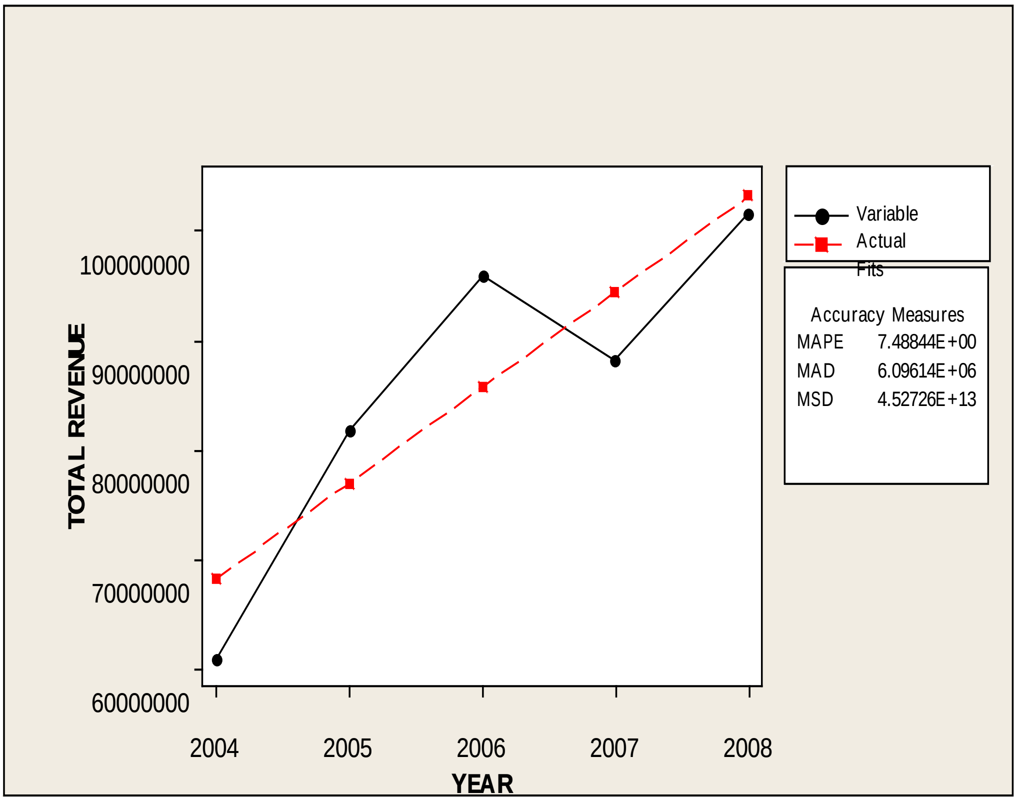

Figure 8: Trend analysis plot for total revenue

The high coefficient of t in the model confirms the time dependence of the import revenue. Thus, it is expected that the average import revenue will be increasing with time at a very fast rate.

Using the model, we provide forecasts for the next three years in Table 11 shown.

Table 11: Yearly Total Import Revenue Forecasts for Three Years

Year	*t*	Yearly Revenue Forecast ($)
2008	5	103,315,925
2009	6	112,077,388
2010	7	120,838,851
2011	8	129,600,314

The forecast revenue figures in Table 11 show that the average yearly total revenue from import is expected to increase by $8,761,463.00 each year to an amount of $129,600,314.00 in 2011. We observe, in particular, that the forecast value for 2008 is close to $100,000,000.00. The actual revenue for 2008 was $101,671,104.65.

Summary of Further Analysis

In this chapter, we have made use of the technique of multiple regression analysis involving dummy variables to analyze further the revenue data on Rice, Auto-parts and Household Electricals. These three import commodities are found to make substantial revenue contribution among the initial six items selected for this study. We have also used times series analysis to provide forecasts for yearly total revenue from the five-year period under study.

In the regression analysis, we obtained dummy variable model that included the usage status of the item and the category of the item. Each of the variables was found to significantly influence revenue. The entire model explained 86 percent of variation in revenue. It has come to light that Rice has the highest average revenue estimate of about $9,113,000.00. This is followed by Auto-parts with an estimate of $6,929,000.00. The revenue estimate of Household Electricals is the least of the three with an amount of $5,331,000.00. The differences among these three values are found to be statistically significant. It has also come to light that new Auto-parts accrue more revenue than the used Auto-parts. The same is true for Household Electricals.

The time series analysis of the yearly total import revenue reveals that a linear trend model appropriately characterizes the series. From the linear trend model, we see that the average yearly total revenue from import is expected to increase by an amount of $8,761,463.00 each year to a yearly total amount of $129,600,314.00 in 2011.

CHAPTER FIVE

SUMMARY, DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

In this chapter, we provide the summary of the dissertation which will consist mainly of the procedures that have been followed in the analysis of the import revenue data as well as the main findings that were summarized at the end of the two previous chapters. We will then discuss some of the findings that have emerged from the study. Based on the results of the study we will draw conclusions and provide relevant recommendations.

Summary

This study sought to determine suitable models that could be used to determine revenue estimates from imports commodities that have substantial revenue contribution and to provide yearly total import revenue forecasts. Six imports commodities that are regarded as high risk goods were selected from several thousands of goods along with their revenues generated over five years, from 2004 to 2008. The six items were Auto-parts, Rice, Computer and Accessories, Household Electricals, Poultry Products and Used Clothing. The revenue data were obtained from Inspection and Control Services Limited. This company is one of the five inspection companies who are mandated to inspect and to provide documentation of imported goods at the Tema port on behalf of Customs, Excise and Preventive Service (CEPS) and the government of Ghana. The data was provided in the three revenue components, namely, the Import Duty, VAT and NHIL.

Preliminary analyses in Chapter Three made use of routine exploratory methods such as a study of the correlation matrix of the study items, charts and tables. In that chapter, we examined the revenues of the six selected imports. The analysis showed that Rice contributes the highest revenue to the total revenue from the six items studied. This was followed by Auto-parts, and then by Household Electricals. It was also revealed that the revenue contribution of the six items increased by increasing their line items. It was observed that even though the line item of rice was the least in the period, it contributed the highest to revenue. Auto-parts recorded number of line items that were much higher than any other item. However, its revenue contribution was only second to that of Rice.

Three of the study items, computer and accessories, poultry products and used clothing contributed revenue amounts that were negligible. The three together contributed less than 10 percent of total revenue from the six items. The revenue contribution of computers and accessories, in particular, was the least (0.88 percent, and recorded in 2005) even though its line item was the third highest throughout the period.

It has also come to light that the numbers of new and used items have been generally stable over the period. In general, the amount of line items for used goods was almost half the number of line items for the new items. The only exception was observed in 2007 which recorded the lowest number of line items for new goods but the highest number of line items for used goods over the entire study period.

The analysis of the time series of yearly total import revenue over the study period revealed that there was a straight-line trend. Thus, the total revenue from the imports was expected to be on the increase in subsequent years. Two of the three components of total revenue, Import Duty and VAT showed similar linear patterns over the period. The NHIL component, however, was stable over the period.

The results of the preliminary analysis suggested that multiple regression involving dummy variables and linear trend models could be used to further analyze the data. Thus, in Chapter Four, we made use of dummy variable regression model to analyze revenue data on Rice, Auto-parts and Household Electricals. These three import commodities were found to make substantial revenue contributions among the initial six items selected for this study. We also used times series analysis to provide forecasts for yearly total revenue from the five-year period under study.

The dummy variable model included the usage status of the item and the category of the item. Each of the dummy variables was found to significantly influence revenue. The model explained 86 percent of variation in revenue from the three items. It was found out that Rice had the highest average revenue estimate of about $9,113,000.00. This was followed by Auto-parts with an estimate of $6,929,000.00. The revenue estimate of Household Electricals was the least of the three with an amount of $5,331,000.00. The differences among these three values were found to be statistically significant. Another observation was that new Auto-parts contributed more revenue than the used Auto-parts. The same observation was made for Household Electricals.

The time series analysis of the yearly total import revenue showed that a linear trend model was suitable to characterize the series. From the linear trend model, we saw that the average yearly total revenue from import was expected to increase by an amount of $8,761,463.00 each year. By this pattern, the total yearly import revenue in 2011 was expected to reach $129,600,314.00.

Discussion

A number of results obtained in this study need some amount of discussion. These discussions will focus on issues that are concerned with the volume of import over the study period and the contribution of the importation of Rice in particular to total import revenue. Another issue worth discussing is the association of the number of line items of the six identified imports with revenue generation.

The study has shown the relevance of the importation of Rice on the mobilization of revenue at the Tema port. Even though there is intense effort to increase local Rice production, it appears the importation of foreign Rice is indispensable. The findings of this study, however, present a way to create a balance between Rice importation and local production. It has been observed in this study that even with very few line items of Rice, we stand a good chance of realizing substantial amount of revenue. Thus, to encourage the production and consumption of local Rice, more duties could be imposed on Rice import. Such action would only increase prices of imported Rice but is not likely to reduce the volume of its import since the purchasing power of those who have been patronizing it may not necessarily dwindle. Thus, even with high duties, resulting in high revenue generation, the importation of Rice would not be completely discouraged. After all, as indicated in the literature review, we are a part of a continent that is the second largest importer of Rice.

Another issue for discussion is the stability in the volumes of both new and used imports from all the six items examined. This shows that the volume is not increasing even though revenue is on the increase. This phenomenon is a departure from what is in literature. In Chapter One, we observed that Osoro (1992) had noted that most of the tax reforms essentially focused on tax structure rather than generating more revenue from existing tax sources. Clearly, we see from this study that with the same volume of imports, more revenue is being generated.

Findings from analysis of variance indicate that variations exist in the contribution to revenue by the items of the categories of goods imported over the 5-year period. Multiple comparison tests revealed that the contribution to revenue by rice is much more substantial than that of the rest of the categories of items imported over the period. However, revenue contributions from the other two items, Auto-parts and Household Electricals, cannot be ignored. We noted that the revenue from the new items were higher than the used items. This suggests that to reduce the risk of these high-risk goods, we can encourage the importation of more new items instead of the used. However, since the revenue contributions of these items were directly linked to the number of their line items, it could be inferred that the revenue from the new items were higher simply as a result of their larger numbers than the used. It is therefore not clear whether used import attract higher duties than the new. Since there appears to be a policy on the quota of new and used imports (the number of line items of used items were almost half that of the new throughout the period), there should be a similar policy on the duties these items attract. This will make the country be seen to be getting tough on high-risk goods as we have noted some countries do in the literature.

Finally, the consideration of a ban on the items studied in this work should be treated with a lot of care. This is because all of these bring in some substantial amount of revenue. It appears from this study that items such as used clothing, computer and accessories and poultry products are the items that we can comfortably dispense with. Even with these items, other measures of risk reduction such as intensification of monitoring systems may be a better option rather than outright ban.

Conclusions and Recommendations

The study analyzed imports revenue from commodities that have substantial revenue contributions from six selected commodities that are regarded as high-risk goods. The six items were Auto-parts, Rice, Computer and Accessories, Household Electricals, Poultry Products and Used Clothing. Data that covered five years, from 2004 to 2008, were obtained from Inspection and Control Services Limited, an import inspection company. The data contained Import Duty, VAT and NHIL revenues of several thousands of line items that covered numerous imports commodities. The objective was to obtain revenue estimates of six items. Another objective was to provide forecasts of yearly total revenue based on the five years revenue data. In order to achieve these objectives, dummy variable regression model and trend model were used.

Initial exploration of the data revealed that the revenue contribution of the six items increased with increasing line items. It was observed that even though the line item of rice was the least in the period, it contributed the highest to revenue. The Auto-parts recorded number of line items that was much higher than any other item. However, its revenue contribution was only second to that of Rice. Three of the study items, computer and accessories, poultry products and used clothing contributed revenue amounts that were negligible. The three together contributed less than 10 percent of total revenue from the six items.

The dummy variable model involved only three of the six initially selected items. These three variables, which are Auto-parts, Rice, and Household Electricals, were found to contribute significantly to the total revenue from the six items. The model explained 86 percent of variation in revenue from the three items. From the model, Rice had the highest average revenue estimate of about $9,113,000.00. This was followed by Auto-parts with an estimate of $6,929,000.00. The revenue estimate for Household Electricals was the least of the three with an amount of $5,331,000.00. The differences among these three values were found to be statistically significant. It also came to light, that new Auto-parts and new Household Electricals contributed more revenue than their used items.

Using the linear trend model, it was found that the average yearly total revenue from import was expected to increase by an amount of $8,761,463.00 each year. By this pattern, the total yearly import revenue in 2011 was expected to reach $129,600,314.00.

The findings of this study, shows that three high-risk goods, Auto-parts, Rice, and Household Electricals, are important contributors to import revenue. As a result, a ban on these items could lead to substantial loss in revenue generation. Instead, the number of their line items could be increased whilst at the same time we find ways of minimizing its negative impact on the local economy. On Rice, for example, more duties could be imposed whilst local production is encouraged. This is because, it has come to light that a few line items of Rice would still yield the desired revenue. In the case of Auto-parts and Household Electricals, more of their new items could be imported whilst discouraging their used items. The importation of used clothing, poultry products and computer and accessories, however, could be controlled since their revenue contribution is negligible.

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APPENDIX A

Actual Revenue and Line Items of the Study Items

Year	Category	Revenue($)	Percentage Revenue	Line items
2004	Auto-parts	5,472,316.95	8.97	20988
	Computer & Accessories	164,507.73	0.27	714
	Household Electricals	2,649,313.89	4.34	6301
	Poultry Products	360,476.82	0.59	69
	Rice	7,005,092.81	11.48	69
	Used Clothing	424,998.38	0.70	442
	Other	44,927,556.87	73.65	29627
	Total	61,004,263.44	100	58210
2005	Auto-parts	8,011,472.99	9.78	22769
	Computer & Accessories	203,503.42	0.25	872
	Household Electricals	3,089,386.32	3.77	6347
	Poultry Products	1,730,330.15	2.11	277
	Rice	9,773,211.54	11.93	76
	Used Clothing	217,726.55	0.27	473
	Other	58,918,152.01	71.90	28916
	Total	81,943,782.98	100.00	59,730

Appendix A Continued

Year	Category	Revenue($)	Percentage Revenue	Number of Line items
2006	**Auto-parts**	6,132,671.16	6.38	17902
	Computer & Accessories	641,942.32	0.67	1693
	Household Electricals	4,458,942.93	4.64	10025
	Poultry Products	891,020.37	0.93	131
	Rice	7,449,280.07	7.75	76
	Used Clothing	631,591.39	0.66	646
	Other	75,915,665.27	78.98	35062
	Total	96,121,113.50	100.00	65,535
2007	**Auto-parts**	8,601,846.61	9.75	18554
	Computer & Accessories	536,928.28	0.61	1700
	Household Electricals	4,323,314.42	4.90	11595
	Poultry Products	257,363.92	0.29	53
	Rice	10,468,893.81	11.87	99
	Used Clothing	883,314.77	1.00	722
	Other	63,153,069.17	71.58	32810
	Total	88,224,730.99	100.00	65,533

Appendix A Continued

Year	**Category**	**Revenue($)**	**Percentage Revenue**	**Number of Line items**
2008	**Auto-parts**	6,421,533.04	6.32	17881
	Computer & Accessories	349,618.64	0.34	1391
	Household Electricals	4,135,261.49	4.07	10915
	Poultry Products	560,092.53	0.55	81
	Rice	10,867,148.59	10.69	92
	Used Clothing	928,711.69	0.91	761
	Other	78,408,738.66	77.12	34408
	Total	101,671,104.65	100.00	65,529

APPENDIX B

Revenue of Three Main Imports

Year	Category	Revenue($)
2004	New Auto-parts	4,053,801.69
	Used Auto-parts	1,418,515.27
	New Household Electricals	1,639,957.34
	Used Household Electricals	1,009,356.54
	Rice	7,005,092.81
2005	New Auto-parts	6,172,195.16
	Used Auto-parts	1,839,277.83
	New Household Electricals	2,077,811.83
	Used Household Electricals	1,011,574.50
	Rice	9,773,211.54
2006	New Auto-parts	4,622,793.85
	Used Auto-parts	1,509,877.31
	New Household Electricals	2,733,452.36
	Used Household Electricals	1,725,490.57
	Rice	7,449,280.07
2007	New Auto-parts	7,043,287.63
	Used Auto-parts	1,558,558.99
	New Household Electricals	2,203,179.20
	Used Household Electricals	2,120,135.22
	Rice	10,468,893.81

Appendix B Continued

Year	**Category**	**Revenue($)**
2008	New Auto-parts	4,947,249.01
	Used Auto-parts	1,474,284.03
	New Household Electricals	2,147,528.74
	Used Household Electricals	1,987,732.75
	Rice	10,867,148.59

APPENDIX C

Countries Under the inspection of the Inspection and Control Services Company

Number	Import Country	No	Import Country
	Western Europe		**Asia**
1	United Kingdom	1	Japan
2	Ireland	2	Mongolia
3	Denmark	3	Taiwan, province of
4	Portugal	4	Hong Kong
		5	Vietnam
	Eastern Europe	6	Lao People's Democratic Republic
	States of former USSR	7	Cambodia
		8	Philippines
		9	Brunei
		10	Malaysia
		11	Singapore
		12	Indonesia
		13	Burma
		14	Bangladesh
		15	Bhutan
		16	Nepal
		17	Sri Lanka
		18	Pakistan
		19	Afghanistan
		20	Iran
		21	Iraq
		22	Syrian Arab Republic
		23	Lebanon
		24	Israel
		25	Jordan
		26	Saudi Arabia
		27	Kuwait

Appendix C Continued

Number	Import Country **(The Caribbean)**
1	Cuba
2	Bahamas
3	Dominican Republic
4	Haiti
5	Jamaica
6	Puerto Rico
7	St Christopher and Nevis
8	Antigua and Barbados
9	Guadeloupe
10	Dominica
11	Martinique's
12	Aruba
13	Netherlands Antilles
14	Saint Vincent and the Grenadines
15	St Lucia
16	Barbados
17	Grenada
18	Trinidad and Tobago
19	Other Caribbean States