

**DETERMINANTS OF COMPUTER PRICES: A CASE OF  
SELECTED RETAIL OUTLETS IN NAIROBI**

**BY**

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AND MANAGEMENT OF THE UNIVERSITY OF NAIROBI**

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## DECLARATION

This research project report is my original work and has not been presented for any award in any other University

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Signature

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**L50/65931/2010**

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Date

This research project report has been submitted for examination with my approval as a University Supervisor

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## **DEDICATION**

I dedicate this research proposal to my parents, Shadrack Jorim Wamari Musandu and Mother Selyna Musandu.

## **ACKNOWLEDGMENT**

I wish to acknowledge the supervision and prompt responses from my supervisor Dr. Raphael Nyonje - was very helpful. At the same time I am grateful to my lectures at the University of Nairobi for all that I have been able to learn so from them and share with them. To the good librarians at the Jomo Kenyatta Memorial Library, who have been very helpful in assisting to retrieve materials whenever they are required, I extend a special thanks. To my classmates, for the insights encouragement and guidance ó all of which have enriched my life and learning at the University, I am truly grateful.

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## **ABBREVIATIONS AND ACRONYMS**

AMD ó Advanced Micro Devices

BPO ó Business Process Outsourcing

Gb ó Giga bytes

ICT ó Information and Communication Technology

Mb ó Mega bytes

RAM ó Random Access Memory

ROM ó Read Only Memory

## ABSTRACT

This report highlights the procedure and findings of a research carried out to establish the relationship between computer prices and some of their selected attributes. The survey was carried out in the Nairobi central business district. Respondents in 73 out of the targeted 103 outlets responded positively to a descriptive survey providing information which was analyzed to give rise to the survey's findings. While computers have been manufactured for decades, in various shapes and sizes, some attributes have endured. This study examined how a computer's brand, the brand of its processor, as well selected specifications, and the kind of computer affected its price. It is most likely that computers will continue to develop, but will retain the long established attributes examined in this study. Currently, concerted efforts are being made to reduce the cost computers either for competitive and social reasons. There are many initiatives aimed at availing computers to more and more people and the planned laptop per child program for public schools in Kenya is just one such initiative. In an established industry such as the global computer industry, developments often come about through continuous improvement leading to better quality products over the years ó prices tend to drop while the capacity of products continues to be enhanced. The findings of this research demonstrate the areas that can be targeted through industry research and investment to make the most significant gains ó in terms of lowering computer prices. The research showed the size of the hard-disk to be an important component of price. Regression models showed that about 25% of the computers price could be explained by the size of the hard disk. The aspect of branding has also turned out some significant findings ó in terms of the brand of the computer itself, and the brand of its processor. Both were found to have significant bearing on the price of the computer.

# CHAPTER ONE

## INTRODUCTION

### 1.1 Background to the Study

Product Design is an integral part of Project Planning, Design and Implementation. The design of technological goods usually takes place in project settings ó this applies to vehicles, airplanes, phones or computers to name but a few. Not much has been published in the area of how attributes of computers influence their prices. However, computers today are a global product (Zakaria, 2008). Processors manufactured in the USA power models across the world ó as far as Taiwan, India, Hong-Kong, Europe or Japan. Software is increasingly manufactured in Asia ó with India taking a lead. Assembly is increasingly done in Asia ó in China or in Taiwan. Therefore, it is not easy to discuss how the actual hardware and software costs vary across the world ó especially due to the limited published researches in this area.

Due to rapid technological developments and competition, such products must be designed, produced and marketed within reasonable time. Eventually, due to obsolescence of the product, the project cycle comes to an end. The products of interest in this particular research were computers. This study took the form of an evaluation of existing products ó with a view to informing future product development or new project cycles. Trade-off analysis is an important component of product design. Breakthrough innovations in the automobile industry have come about as a result of trade-off analysis (Liker, 2004). The Toyota Prius for instance came about partly due to detailed analysis of design trade-offs of existing vehicles.

These studies involved analyzing a wide range of existing cars to come up with general observations about their common properties. Toyota investigated how vehicle weight affect fuel consumption, how engine capacity affected fuel consumption and speed and on. It was therefore possible to determine what the optimum specifications for the breakthrough vehicle would be. Design trade-offs are equally important in computer design ó the area of interest in this study (Funk, 2005). This study seeks to carry out trade-off analysis implicitly by examining computer attributes. The study was carried out in Nairobi with an effort to informing global value chains. Today, many computers are designed in the USA or Japan, then manufactured in Taiwan (Kawakami, 2008) and may be sold in the USA, Kenya, India or China. Therefore, an evaluation

carried out in the Kenyan market fits perfectly in the globalized project cycle and is useful for the purpose of helping to clarify the issue of "Determinants of Computer Prices". There are many reasons why computers were selected as the item of interest in this research. For Kenya, like many other developing countries, the growing role of ICT in the economy is evident.

Kenya's Vision 2030, recognizes the potential of the country to benefit from Business Process Outsourcing (BPO), just like developing countries in Asia are doing. Today, India is recognized for the largest Software Industry in the world – one of the reasons why India's Economy is growing at a rate only comparable to that of China. A lot of job opportunities in BPO, are readily done on computers and they include marketing, transcription, translation and software development. Kenya's vision is not idealistic. The growth of the mobile phone sector, and the relatively skilled manpower, have ensured that Kenya has become a global champion in the development of innovative mobile phone applications – including the renowned mobile phone money transfer such as MPESA.

To strengthen Kenya's position and give it a greater comparative advantage in this area, the affordable and widespread acquisition of computer hardware is critical. Two obstacles with regard to hardware affordability include the fact that the country remains relatively poor in the foreseeable future. Therefore the relatively low per capita incomes make it unlikely that the majority of the population may own computers.

At the same time, computers are normally imported into the country – meaning that they compete with other import items for the limited foreign exchange – further reducing the Gross Domestic Product (GDP), and increasing the trade deficit. Despite these, the government, well aware of the benefits of computers, continues to zero-rate them as a further measure of ensuring access. Most recently, a laptop for every school child has been proposed as a key initiative in the education sector.

This study sought to demystify computer production and value addition by examining how costs accumulate into the production process and what else determines the market value of a computer. The broad goal can be achieved by examining computer prices with a view to paving way for further research. Such researches should be valuable to those who wish to assemble computers

locally, those involved in computer retail business, and those who are involved in computer design projects such as the ones that seek to produce the \$ 100 laptop for mass circulation worldwide.

While there are many brands and models of computer, they have some common attributes that are often used to evaluate them on purchase. One such attribute is related to memory or the Random Access Memory (or RAM). It is a fact that the greater the size of the RAM, the greater the processing power and stability of the computer. A computer with more RAM is less likely to hang. At the same time, as computer software develops over the years, they tend to place greater demands on RAM. Therefore, having more RAM is good for a computer.

A second performance related measure is the speed of the processor. When RAM is held constant, a computer with greater processor speed will perform faster or is more capable of handling complex multiple operations. A third performance related measure is that of the size of the hard disk or secondary memory. This determines the storage capacity of the computer. It can also determine processing speed or capacity because when RAM is constrained, the computer may use part of the hard-disk as RAM or which is possible when there is adequate space or the hard-disk is not full.

The above performance related measures are described in this research collectively as "specifications" because they relate to industry standards that can be described purely on scientific or technical terms. There are also other measures that are aesthetic or perception related. The first is the brand of the computer itself. The specifications may be uniform but brand may influence the cost, demand, consumption, or prestige of a computer. Some brands may come to be known as reliable, or have better after sales service, or even be associated positively due to clever advertising or marketing.

The other brand related attribute is that of the processor. Whereas the processor, like the computer is marketed in terms of its speed, it is also branded. Many of the processors in the Kenyan market are either made by Intel Corporation or AMD. Intel brands its processors variously, generating variants such as Duo Core, Pentium, Celeron, and Atom. Processor

branding is not necessarily performance related, for not all Celeron processors for instance run at the same speed. Still the brand of the processor has a cost and perceptual implication on the customer ó which may generate interesting analysis in this study.

Finally, this study would have been incomplete without an analysis fo the kind of computer ó in terms of whether it is a desktop, or laptop or notebook. Previously, a laptop would cost so much more than a desktop but laptop prices have dropped over the years. The effect occasioned by of type of computer would be so great that any attempt to model or analyze without regard to it would lead to large regression and other errors.

## **1.2 Statement of the Problem**

This study sought to investigate the determinants of computer prices in selected outlets in Nairobi, Kenya. The viability of a project in the market place is determined by production costs among other factors. The issues of cost and prices determine how firms succeed or fail or how products compete against each other. In relation to the stated objectives, it is evident that computer prices tend to be related with specifications but this relationship has not been modeled and published so that information on the various markets is not readily available.

From brand theory, it is known that the brand of a product may be the biggest determinant of price (Duncan, 2007). However, information on how this affects computer prices, if at all is not readily available. These are the problems that the study sought to unravel. Likewise, from the literature study carried out it is clear that such knowledge gaps exist for both the computer-brand or processor brand.

The problem at hand in this case is of global nature ó it is not confined to Kenya alone. In attempting to understand how brand and specifications and other attributes affect computer prices, their production costs and by extension their demand, the overall question of how greater efficiency and higher quality as well as customer satisfaction can be attained, all have to be addressed. Computer manufacture and retail is a very dynamic and delicate field. Small differences in product characteristics or prices result in the rise and fall of blue-chip and start-ups

alike. There was an IBM era and an Apple era. Compaq gave way to HP and Dell (Scott, 2009). The cycle is endless.

For any single firm having some information on how to develop products that are relevant for the markets is essential. Any such decision will need huge investment as product design and development is a costly venture. This study sought to "create" more science in the area of computer pricing. It is aimed at ensuring that managers make better judgments by understanding how or what exactly results in customer satisfaction in a given market. Do they pay more for brands or specific qualities, and if so, which ones? If brand influences price ó independent of specification, then managers would invest a little more in branding than hardware (Duncan, 2007). If specifications by themselves drive prices, then manufactures will be able to predict how much each attribute affects market price ó enabling them to make or design the product accordingly. This should address the current problem of unavailability of a framework to ease cost benefit analysis when designing computers.

### **1.3 The Purpose of the Study**

The purpose of the study was to investigate the determinants of computer prices in selected retail outlets within Nairobi city.

### **1.4 Objectives**

The objectives of this study were as follows:

1. To examine the extent to which specifications influence the price of computers in Kenya
2. To investigate how processor types (usually displayed on the computer) and processor brand influence the computer price
3. To establish the how the brand of the computer influences its price
4. To determine the effect of the type of computer such as laptop, desktop, or notebook on computer prices.

### **1.5 Research Questions**

This study was aimed at answering the following questions:

- 1 To what extent does a computer's specification influence its price?
- 2 How does processor type influence the price of the computer?



- 3 How does brand relate to computer price?
- 4 How do computer types such as laptop, desktop or notebook compare affect their prices?

### **1.6 Significance of the Study**

Understanding how computer characteristics relate to price is essential for product design. It helps answer questions about viability and sustainability of a computer project. This is of primary importance for project planning. Due to competition, products are often designed with a view to being viable at a given prices and attaining some technological breakthroughs in a sustainable manner. This study is intended to give insights to computer designers or those doing business in computers.

With regard to processors for instance, the decision to include a processor in a computer as opposed to another would greatly be aided by insights provided in this study. The manufacturer may know what it costs to buy the various processors from Intel or AMD but the clear picture of how the different choices resonate among buyers can better be established by surveying retail outlets. Apart from product design, there is a lot to be learnt by people doing business in computers. A decision to introduce a new brand into a market ó say a Turkish or Taiwanese brand should be carried out with a clear understanding of how brand dynamics work in the marketplace. What value would be attributed to a new brand on account of specifications or on account of its processor type ó attributes which tend to be standardized. And what is the likely disadvantage due brand loyalty of existing brands and at what price is this likely to be overcome.

### **1.7 Delimitation of the Study**

This study proposed to examine a few selected retail outlets in the Central Business District of Nairobi City. For control purposes, wholesale outlets were not examined. For the same reason, the study did not cover suppliers or supply or contract prices ó whose prices are often at variance with market prices for a number of reasons. The preferred retail outlets were those that have several model and brands of computers on sale. Another important criteria was that the selected outlets will be those where the prices of computers are displayed readily as opposed to those where one has to ask to be told what costs how much ó for it is likely that an interview situation may very easily alter the price that is stated by the retailer.

The variables of interest were the computer processor speed, memory size, and hard-disk space, processor type ó which includes manufacturer and at times brand ó such as Intel Celeron as opposed to Intel Atom or a not Intel Processor such as AMD. There were many other attributes and accessories that affect price. They include battery life, accessories such as web-camera, DVD player, the presence (or absence) of various software, and so on. The variables of interest did not include these.

### **1.8 Limitation of the Study**

One major challenge was the unwillingness to cooperate by some of the retailers of interest. This was overcome by either moving to a different store, or collecting the information as a shopper ó since these are usually readily displayed.

### **1.9 Assumptions of the Study**

One assumption that has been made is that the respondents gave factual information. It was also assumed prior to the study that the variables to be analyzed by regression bear some linear relationship.

### **1.10 Definition of Significant Terms**

**Brand:** This refers to the corporate identity of the manufacturer. For example if a manufacturer such as Hewllet Packard sells computers named and labeled HP, then HP is the computer's brand.

**Computer Processor:** This is the component of the computer that executes instructions including arithmetic and logic operations.

**Processor Brand:** Computer Processors usually have brand names reflecting the manufacturer and the product as well. These are usually displayed on computer. An "Intel Pentium" processor reflects both the Intel corporate brand, and the Pentium product brand

**Specifications:** These are the general industry standards that are used to measure the capabilities and capacities of all computers ó regardless of manufacturer or brand.

**Type of Computer:** There are many ways that computers can be categorized. In this case, Type of Computer refers to the packaging or size of the product ó whether it is a laptop, notebook, or personal computer.

## **1.11 Summary**

The study sought to enhance overall understanding of computer costs. This kind of analysis will be extremely helpful in assisting projects such as the envisioned \$ 100 laptop.

Understanding how various fixed and variable costs contribute to computer prices would greatly assist in product development and computer project management.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

Over the years, various studies have been done with regard to computer attributes and how they influence purchase decisions or product costs. It is generally acknowledged that Brand, Specifications, Processor Type and Type of Computer are some important determinants. A literature review was carried out and some of the findings are listed below.

#### **2.2 The Relationship between Specifications and Cost of Computer**

A study in Marketing Research was carried out to determine the most important laptop attributes for students in Franklin Pierce University (Melville, Matula, Pinney, & Pelletier, 2010). Many other studies on related issues have been carried out prior to or after this study. Specifications are an important area of computer quality for consumers. Computers are normally advertised in terms of their processor speed, memory capacity (or RAM), Hard-disk size and other attributes.

The study at Franklin Pierce focused mainly on laptop features. Not much was analyzed about preferences in terms of processor type or specifications such as speed. The aspect of brand was analyzed where Apple was the favored brand followed by Dell and HP. These findings are not relevant to Kenya to the extent that the Apple brand has an insignificant market share, while the overall trend could be different. No analysis was done to determine how brand affects costs of computers ó specifications held constant.

Elsewhere, the aspect of specification or attributes was studied implicitly and it was found that lack of choice or identical alternatives to choose from tend to hasten the speed at which purchase decisions are made (Gunasti, & Ros, 2008). This study did not deal with the issue of how specifications affect price ó a key determinant of purchase. A similar study on "No-choice option" was carried out earlier and published in the Journal of Consumer Research by Ravi Dhar (Dhar, 1997).

The aspect of customer preferences in relation to details such as specifications was researched and published in the *Journal of Marketing Science*. This study mainly analyses whether user utility is satisfied by needs being met or whether the specifications (or design variables) such as memory, processor type, or performance specifications such as price, weight, speed or RAM. It was found that design parameters fitted well with experienced users while for novices, needs based parameters such as portability, affordability, displaying density, or viewing distance were more primary considerations (Randal, Terwiesch, & Ulrich, 2007).

While the above study proves that people consider needs and attributes when making purchases, it does not analyze the issue of how these contribute or influence to product cost – the main object of this study. The issue of design trade-off was analyzed and found to result in new product classes or dominant designs in a particular class (Funk, 2005). Frank did not examine, the aspect of trade-offs and brands - in relation to cost – which is of primary interest in this study (Determinants of Computer Prices).

The aspect of “performance metrics” or quality measures of computer attributes is discussed in detail in “Technology Acceleration” (See-To, & Westland, 2003). There is the general recognition that specifications such as RAM & Processor Speed, as well as attributes such as brand, do affect price. However, the focus of this particular research is to analyze and model the way attributes develop over years, and not how they affect price at any given place or time.

The issue of electronic prices – and therefore those of computers is discussed in “Information Systems Research” in the article “Using Transaction Prices to Re-examine Price Dispersion in Electronic Markets” (Ghose, Yao, 2010). The drivers of interest here include product cost, order cycle, time, own price, and transaction quality. These are all important but it is the intention of this particular research project to determine what particularly drives product cost – with reference to computers.

### **2.3 The Effect of Brand on Price**

Several studies have been done on the issue of computer brands. Many of them seek to determine the influence of computer brands or branding on consumer preferences. This particular research

seeks to study brand in relation to prices. The price of a commodity tends to be related to brand and therefore consumer preference among other factors. The loyalty towards a particular brand may be due to a number of reasons.

A computer's brand may be directly tied to qualitative aspects such as specifications, type of computer and processor type. This study seeks to analyze the relationship between brand and price in two ways – one is at the level of empirical or descriptive observation – where we may discover that brand bears, or does not bear any relationship with price. The other level of analysis or interest is whether the observed price variances due to brand (if any) are purely due to perceptual factors such as brand image or they are tied to other attributes.

The relationship between brand and quality (or technological advancement) is studied in: "The Impact of Competition on Technology Adoption: An Apples-to-PCs analysis" (Copeland, Shapiro, 2011). Here brand is examined in terms of Apples versus the rest (or PCs). The mentioned study acknowledges the different rates of technology adoption by various manufacturers. This study finds that market structure, and competition in particular does influence the adoption of technology as well as the rate of increase of innovations. This study does not however seek to analyze the issue of brand and price – whether there are variances in price due to different brands and if there are dependent or independent specifications, type or processor type.

In 2006, the study: "The Mixed Effects of Brand Innovativeness and Consumer Innovativeness on Attitude Towards the Brand" was published. The Hypotheses of the study revolved around whether consumers (novelty seekers and risk takers) and non-innovative consumers (risk averse and nostalgic) tended to be influenced differently with respect to brand image due to greater or lesser innovativeness. A year later, , a study on: "The Effect of Brand Equity on Consumer Buying Behavior In the Laptop Market of China", was carried out using both primary and secondary data (Liu, 2007). The four components of Brand Equity namely, Brand Awareness, Perceived Quality, Brand Association, and Brand Loyalty were examined. Various results were obtained and it was observed that both brand image and brand loyalty had medium positive correlation coefficients – 0.461 and 0.409 for brand image and brand loyalty respectively. In the

above mentioned study, there was an attempt to examine the effect of customer behavior in relation to quality as far as brands are concerned. However, this was merely described as quality and not analyzed in terms of specific attributes such as processor type, clock speed or memory size.

More recently, a study was carried out on: "Turkish Consumers Risk Perception Towards Global Computer Brands" (Apaydin & Koskal, 2011). This was yet another attempt to study the effect of brand on consumers. It was observed that global brands had competitive advantage of local ones due to increased brand equity. This study was carried out only in the Turkish market. It also did not examine the issue of brand in relation to price. Did the global brands cost more and by how much? And once again the perceived quality was not analyzed in terms of well known attributes which include memory size, processor speed, and processor type among others.

Beyond computers, a study was carried out in India under the title: "How do Consumers Evaluate Brand Extensions – Research Findings from India" (Thamaraiselvan, & Raja, 2008). There were several research hypotheses. India is a unique market because there are many international or foreign firms that have teamed up with local companies. The international ones comprise of "parent brands" which team up with local brands to form "brand extensions". The above study did find that there is a relationship between perceived quality and brand image or reputation. In Bangladesh, a 2006 study did examine the effect of Brand Name, Product Quality, Price Sensitivity, Promotion and Willingness to Buy in the context of Personal Computer Peripherals Industry in Bangladesh (Istiaque, 2006).

It was found that all the above variables significantly correlated with the willingness to buy. Brand name was found to have a positive correlation coefficient of 0.54 at a confidence interval of 90% since brand name is a significant factor for consumers' willingness to buy PC peripherals, the study recommends that: "Firms selling PC peripherals should develop a reasonable brand affiliation among consumers to increase sales". The Bangladesh study did tackle the aspects of brand and product quality but once again, product quality is described in subjective terms and not through specifics as "Determinants of Computer Prices" proposes.



Again the aspects of specifications, processor type, and type of computer are not covered in the Bangladesh study. Instead, emphasis is placed on peripherals or devices such as printers.

The aspect of brand was also researched and published by the title: "The Mixed Effects of Brand Innovativeness and Consumer Innovativeness towards the Brand". The problem at hand was to determine how the pursuit of innovation by a firm, and the consumer behavior influenced attitude towards the brand (Ouellet, 2006). There were two hypotheses in this study. The first examined how or whether consumer innovativeness influenced brand innovativeness. Highly innovative consumers were those who were highly responsive and adoptive of the latest technology while the less innovative were those who were risk averse or even nostalgic of what they were already familiar with. This study found that some consumers favored innovative brands while others did not.

The above study tackled the issue of brands and innovation. However, it did not tackle the areas of interest in this study: To explain if there is a relationship between brand price and whether that relationship is based on perception or image factors or it is due to the other price determinants explored in this study. Today, a lot of manufacture of PCs and Netbooks is outsourced by leading firms to manufacturers in Asia. Taiwan stands out as a leading destination of manufacture. Several iconic firms - from the USA, Japan, and elsewhere, outsource their products for manufacture in Taiwan (Kawakami, 2008). This trend is likely to continue due to the observed growth (Kawakami, 2007).

The growing practice of outsourcing of manufacture means that branding is now the focus of corporations in the USA and elsewhere (Dedrick, & Kramer, 2007). The aspect of globalization and value chains has been discussed in several researches including: "Who captures value in global innovation? The case of Apple's iPod" (Linden, Kramer, & Dedrick, 2007). The study shows Apple as a winner in capturing the largest share of value with predominantly American employees and Shareholders reaping the benefits or despite the fact that the iPod is manufactured in China. This general pattern is replicated elsewhere in the computer industry.

The above study shows that much of the value in computing devices maybe not be in the manufacture of hardware itself, there is still a lot of work to be done with regard to understanding how the particulars of a computing device affects its overall price ó which is analyzed in depth in chapter 4 of this research publication in the context of Kenyan retail outlets.

## **2.4 The Influence of Processor Brand on Cost of a Computer**

A number of researches have been carried out in the recent years on the computer processor brands and types. Previous researches help us understand the importance of the processor on the computer and therefore customer satisfaction. They help us to understand how processor quality and brand contribute to the value and therefore the price of the computer.

The research published under the title: "Faster, Smaller, Cheaper: An Hedonic Analysis of PDAs". This study acknowledges that prices are positively related to processor performance, RAM memory, Permanent Storage Capacity, and Batter Life (Chwelos, Bernd, & Cockburn, 2004). The above study touches on important aspects of this study (Determinants of Computer Prices). It remains to be seen what findings would be obtained in the Kenyan market. In addition, it remains to be seen whether brand as a factor is dependent or independent of the well known performance measures indicated above.

The type of computer processor affects power consumption as well. It is a established that a Duo Core processor consumes more power than an Atom processor with the same clock speed ó despite the fact that both are Intel Processors. Therefore, as far as electricity consumption is concerned, processor type may be a quality consideration since it affects other favorable qualities such as long battery life. The article: "Low-Power Microcontroller Core" analyses issues related to energy efficiency and performance of a processor (Eriksen, 2009).

The recognition of the processor type as a quality component touches on what this study (Determinants of Computer Prices) seeks to investigate: "The effect of Microprocessor type on price of the computer ó particularly in the Kenyan Market. Given that AMD and Intel are two leading manufacturers of processors, the article: Does AMD Spur Intel to Innovate More?"(Goettler, & Gordon, 2010) is useful in analyzing the effects of competition between the

two firms on the prices of their processors. It is therefore interesting to observe whether and how processors as a component affect the price of computers in the Kenyan market ó one of the objectives of this study (Determinants of Computer Prices). These effects are very likely not because of processor cost variations but the perceptual effects due to processor branding.

A 2008 study on the “Effect of Superstar Software on Hardware Sales in System Markets” was carried out, and did show that some popular modern software spur or increase system requirements ó and therefore the demand for faster processor (Binken, & Stremersch, 2008). From a hardware perspective, the above research explains why there is a continuous demand for the faster systems ó a known fact. How this demand translates to price differences is one of the objects of this study (Determinants of Computer Prices).

## **2.5 The Relationship Between Type of Computer and Cost**

Computers come in many shapes and sizes. Some of the most popular include the personal computer, Laptop, Notebook, Netbook, Personal Computer, and Tablet Computer ó all of which fall within the scope of this research. Since the focal point of this research is price, the study of the various types of computer is mainly due to how they determine price ó since factors such as brand, memory, size, processor type, and speed tend to remain the same.

Type to some extent dictates screen size. A Notebook will have a smaller screen than a Laptop or PC. In 2001, a study showed that screen size and resolution as well as display rate had substantive effect on test-performance (Bridgemand, Lennon, & Jackenthal, 2001). The above study is strictly confined to test scores, but points to areas that may influence user preferences or demand.

User satisfaction preferences were also studied with reference to Laptop and Tablet PCs (Ozok, Benson, Chakarborty, & Norcio, 2005 ). It was found that tablets were preferred for portability ó but not for day to day computing needs. This study was again limited to preference ó not price. That tablets were not preferred for day to day use may explain the findings of another study: “A Bitter Pill to Swallow: The Rise and Fall of the Tablet Computer” (Atkinson, 2008). These

findings may impact on the demand for and therefore price of tablet computers ó which were launched at comparatively higher prices.

Other studies have been done with a view to comparing the various computers. In 2008, a study was published on the ergonomics of computer use ó the effects on posture and muscle use. Differences were found with regard to desktop computer, laptop computer, tablet computer and paper. A lot remains to be understood on the effects of tablets in particular (Straker, Coleman, Maslen, Burges-Limerk, & Pollock, 2008).

Differences were also found in the way Netbooks and Tablet PCs impacted on face-to-face collaborative learning (Alvarer, Brown, Nussbaum, 2012). While both of the above studies compare the effects of computers on learners or students, the issue of relative cost, which remains of interest is not addressed. A lot of research remains to be done on t4he impact of mobility ó in value terms. This aspect is partly examined in: òValuing Mobile Computing: A Preliminary Price Index for PDAsö (Chwelos, Berndt, Cockburn, 2003).

This study was a òfirst stepö towards understanding the economics or benefits of mobilityö. The study does acknowledge hat a lot remains to be done in understanding the economic benefits of increased mobility. Clearly, mobility adds value to the computer user. However, the study did not examine the comparative differentials in hardware price. Finally in 2010, òPurchase Intentionö was studied (Chen, 2010). This study focuses on the notebook computer ó examining its main selling points or attraction. Convenience and compatibility were the principal selling points. Once again the aspect of price was not examined.

## **2.6 Theoretical Framework**

This research was carried out in the context of a number of theories. They touch on parameters such as of costs, prices, and perception. They are listed and explained as below.

### **Gordon Moore's 'Laws'**

This theory is based on an observation that was made by Gordon Moore of Intel Corporation in 1965 (See-To, & Westland, 2003). This law governs the growth of computing performance and has appeared to hold over the years. While it was developed when transistors were used in processors, the trends have remained even with changes in technology. He states that the number of transistors in a processor, and therefore the capacity of processors would double every two years and that the cost per unit of processing power would come down.

### **Cost of Production Theory**

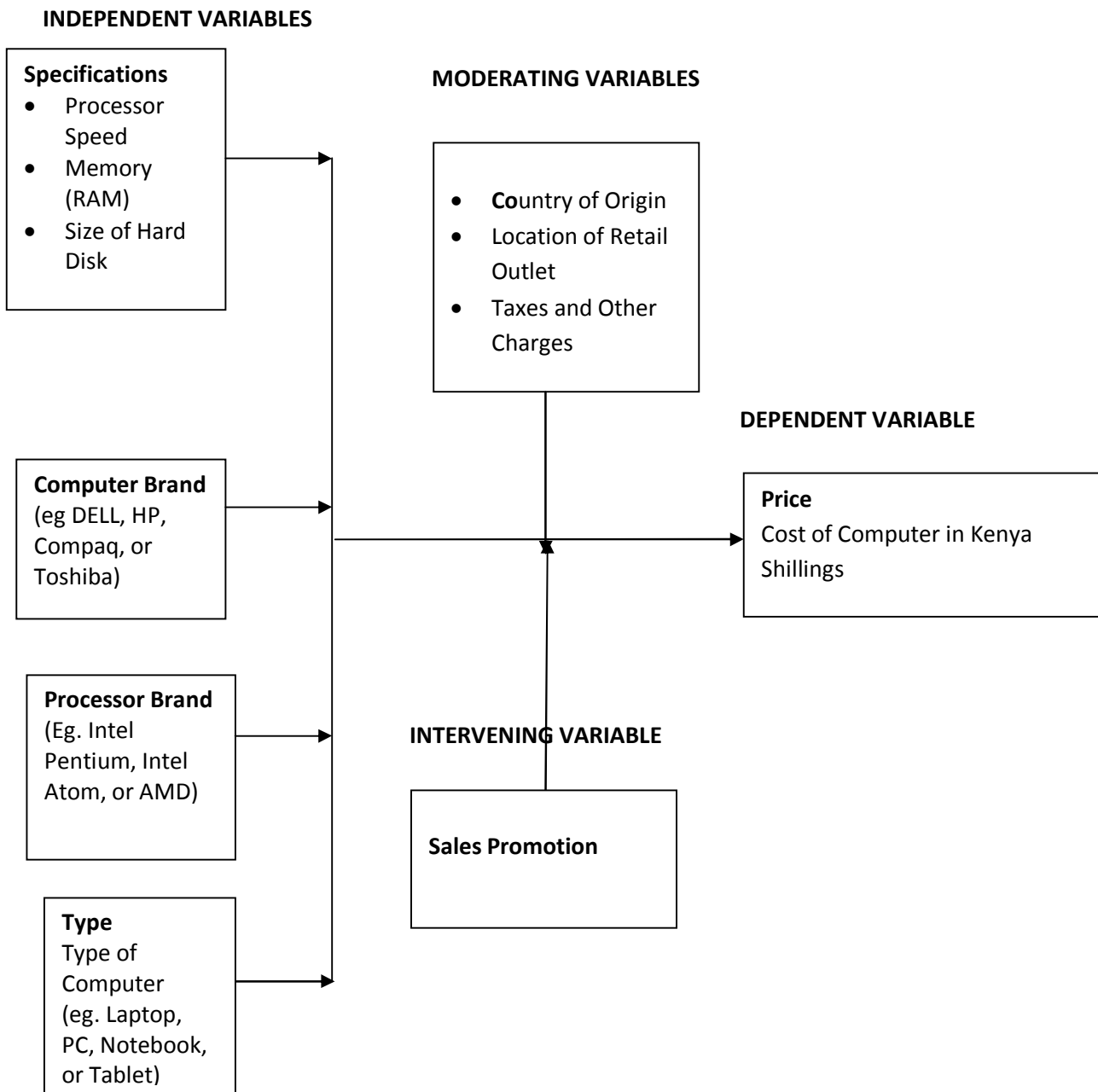
This theory states that the price of an object is related to the total cost of the resources that are used to make it (Byner, & Stone, 1981). The theory explains why the computer process are partly examined in relation to the capacity of components as this determines the price.

### **Theory of Aggregate Supply and Demand**

This theory explains that where there is a great demand for a commodity, it is possible to produce at a lower cost per unit (Byner, & Stone, 1981). In relation to computers has been observed that as the consumption has gone up over the years, the prices per unit have generally continued to fall even with technological and other improvements. As new models emerge, they may initially be costly as they have not been produced in sufficient quantities and this may lead to a higher price for computers with the latest specifications or features.

## **2.7 Conceptual Framework**

There are a number of variables of interest in this study. The dependent variable is price of the computer and what the consumer pays for the product. The independent variables are specifications, brand, processor type, and type of computer.



**Independent Variables:** Specifications, Computer Brand, Processor Brand, Type of Computer

**Dependent Variable:** Price of Computer

**Moderating Variables:** Country of Origin, Country of Retail, Taxes and others

**Intervening Variable:** Sales Promotion

# **CHAPTER THREE**

## **RESEARCH METHODOLOGY**

### **3.1 Introduction**

The purpose of this chapter is to outline the methodology of the study. It describes the research design, the target population, the sampling procedure, the sample, validity and reliability of research instruments, data collection and data analysis. The proposed methods of data analysis are outlined. The nature of variables is also analyzed.

### **3.2 Research Design**

The design of this study falls under the quantitative research paradigms. The design is that of a descriptive survey. This design enabled both preliminary and exploratory analysis to be carried out effectively (Saunders, Lewis, & Thornhill, 2009). The numerical and descriptive data collected was used to make various inferences in relation to the objectives and research questions of the study. The descriptive survey design was selected because it enabled various outlets to be surveyed and meaningful generalization to be made. At the same time much of the data collected was numerical or categorical meaning that meaningful statistics or summaries could be derived with relative ease.

### **3.3 Target Population**

The yellow pages online directory lists 263 companies in Kenya under the category of "Computer Hardware and Maintenance" (Yellow Pages, 2012). Out of the 263, there are about 103 that fall in the CBD. These comprised the target population. It is from this target population that outlets were selected to comprise the sample from which the study was done.

### **3.4 Sampling Size and Sampling Procedure**

The study was carried out by attempting to enumerate the entire target population. Respondents were interviewed from the various sampling units, which in this case will be the retail outlets.

### **3.4.1 Sample Size**

The total number of outlets to be targeted was 103 and enumeration of all these units would have constituted a census. However it was only possible to get responses from respondents in 73 outlets.

### **3.4.2 Sampling Procedure**

Since a census involving the listed outlets was carried out, they were selected from the "Yellow Pages" directory cited above. Only those within the Central Business District will be surveyed. On closer examination, most of them were located along particular streets such as Kimathi Street, Biashara Street and Moi Avenue. For logistical reasons, the enumeration will therefore use a street-to-street motion by initially targeting those areas where the outlets are concentrated. At the same time, some outlets are located in particular buildings in substantial numbers and example is Shell and B.P. house. These ones will be surveyed building by building. Those that are isolated will be targeted individually.

Since not all the outlets in the CBD are in the yellow pages directory, this exercise cannot be said to be a census in the proper sense, but a census of the listed outlets. Moreover, there are always new businesses and some of the older ones close down. At the same time there are identical business selling identical items, but they have opted not to list in the Yellow Pages Directory. The sampling design is therefore that of simple random sampling since it randomizes the selection of outlets.

### **3.5 Data Collection Instrument**

Data was collected by asking questions where clarifications are necessary. The information was used to fill the questionnaire. The questionnaire was the primary data collection instrument. It has 3 sections: A, B, and C. It contains a total of 13 Questions involving both numeric and categorical data. Some questions require responses involving up to 8 variables.

Section A was answered by all shop owners. It explained if they really sold computers. In the event that they sell hardware such as printers, or simply maintain computers, the rest of the survey will not be administered. Those who sell laptops and notebooks responded to section B.



These comprised the larger number of computer retailers. Section C was responded to by those who also sold tablet computers.

### **3.5.1 Pilot Testing of the Instrument**

The instrument was tested in four outlets ó with small number of computers. It was examined for validity and reliability. The time taken to administer it and the challenges of administering it and any necessary preparations were noted to ensure smooth implementation of the survey thereafter. The instrument was tested in 3 of the retail outlets in Nairobi Central Business District, and the data obtained will be added to the rest of the survey data.

### **3.5.2 Validity of the Instrument**

A valid instrument measures what it is intended to. It is not always that instruments contain what is exactly to be measured. For example an instrument may measure salary ó when it actually is geared towards income. Clearly, the two are not the same. In the case of the survey instrument, its validity was measured by checking what it measured against what it was intended to. It was pilot tested. To determine validity, triangulation was used where different data collection methods were used to collect the same data. In this case, both questions to the respondents and observation were used. If it is found to for instance measure õbrandö when it was geared at doing so, then the correlation coefficient was calculated and in this case found to be õoneö ó making us conclude that the instrument is valid.

### **3.5.3 Reliability of the Instrument**

The test re-test method was used to determine the reliability of the instrument ó that is if it gave the same results when administered by different people on the same respondent. Here some outlet, say a super-market such as Nakumatt that sells computers was selected and two different people used to administer the instrument. The results were compared and a reliability co-efficient of 0.9 indicated that the instrument was reliable.

### **3.6 Data Collection Procedure**

The data was collected at the targeted stores, by making introductions and then asking questions and recording the responses on individual questionnaires. These were later recorded into a table and entered into an excel sheet.

### **3.7 Method of Data Analysis**

After collecting the data and filling the checklist or database, the information was input into a computer for manipulation using Excel or SPSS software. This resulted in a number of descriptive and inferential statistics. There were regressions carried out on the research question regarding specifications. Likewise, analysis was done to establish whether various categories such as computer brand resulted in significant differences in prices. Whether these observed price differences were due to the specified attribute such as brands or independent of any other attributes was tested by Chi-square tests for independence give meaningful information

To address the research question relating to specification several regression models will carried out ó attempting to relate memory size, processor speed and hard disk space with price. A multiple regression will be done and the efficiencies of the various models determined and explained. To address the research question related to brand, it would be possible to get the average (mean) price for each brand and compare them. This can be done descriptively, if we take the selected outlets as populations. By assuming that the sampled units are a random sample drawn from a normally distributed population, SPSS was used to carry out Independent Samples t-test. The same techniques used to analyze the influence of brand applied to the research questions regarding processor type and type of computer.

### **3.8 Operational Definition of Variables**

All the variables in this study gave rise to objective measurements. Methods need not be devised for measuring them as this has already been done by the manufacturers. The details of the measures are outlined in the following table.

Table 3:1 Operationalization of Variables

<b>VARIABLE</b>	<b>VARIABLE INDICATORS</b>	<b>MEASUREMENT</b>	<b>MEASUREMENT SCALE</b>	<b>TYPE OF ANALYSIS</b>
<b><i>INDEPENDENT VARIABLES</i></b>				
Specifications	Processor Speed	Gigahertz	Numeric	Regression
	Memory Size (Ram)	Megabytes	Numeric	Regression
	Size of Hard Disk	Gigabytes	Numeric	Regression
Computer Brand	Manufacturer, Logo	Corporate Identity	Nominal	Frequency Table, T-test
Processor Brand	Architecture of processor	Corporate or Identity, Identity and the series	Nominal	Frequency Table, T-Test
Type of Computer	Structure and size of hardware	Size of the computer	Nominal	Frequency Table
<b><i>DEPENDENT VARIABLE</i></b>				
Price	Retail Price	Price in Kenya Shillings	Numeric	Regression

## **CHAPTER FOUR**

### **DATA ANALYSIS, INTERPRETATION AND PRESENTATION OF FINDINGS**

#### **4.1 Introduction**

This chapter carries out analysis in relation to the themes of the research ó which have been derived from the research questions. It seeks to answer the principal questions relating to computers with regard to their specifications in terms of processor speed, memory size and hard-disk size; their processor types; their brands; and in terms of their types as notebooks, laptops, desktops, or tablets.

#### **4.2. Response Rate**

The 73 respondents were interviewed at 73 retail outlets spread across the Nairobi city center. Since the census farm constituted 103 respondents, this was 71% of the targeted figure. They were retailers or sales persons who agreed to participate in the survey as requested. All the respondents are categorized as one group of persons without regard to their roles or gender. For all those interviewed, the questionnaires were filled and retained by the interviewers.

##### **4.2.1 Responses on Types of Computer**

The responses resulted in the collection of data on computers. The attributes of a total of 353 computers were collected. As a result of the various questions asked, the data helped to create a database comprising of data from 225 laptop computers, 61 desktop computers, 46 notebook computers, and 21 tablet computers. This was so because not all the stores had all the items of interest. One shop would have no tablets for instance while another would have no notebook. In addition, more of the questions were concerned with laptops than say tablets. As a result, this summary is not an indication of the frequency of occurrence of the various kinds of computers. This data is summarized in Table 4.1.

Table 4:1 *Classification of Computer by “Type”*

Type of Computer	Frequency	Percentage
Desktop	61	17.3
Laptop	225	63.7
Notebook	46	13
Tablet	21	5.9
Total	353	100

#### **4.2.2 Computer Brands Encountered in the Survey**

There are many brands of computers being retailed in Nairobi. While the survey did not seek to target any particular brands, it so happens that the computers discussed in terms of the attributes or categories above, can be classified in terms of their brands ó usually the brand-name or corporate name of the respective manufacturers. A total of 12 brands were encountered. The number of computers by brand is summarized in table 4.2. The most popular brand was HP which accounted for a total of 155 units or computers. Acer, Dell, Samsung, and Toshiba also had a substantive market share. Only two Sony computers were encountered during the survey.

Table 4:2 *Classification of Computers by Brand*

Brand	Frequency	Percentage
Acer	42	11.9
Asus	2	0.6
Compaq	7	2
Dell	30	8.5
HP	155	43.9
Intex	1	0.3
Lenovo	2	0.6
Mac	18	5.1
Mecer	6	1.7
Samsung	44	12.5
Sony	2	0.6
Toshiba	44	12.5
Total	353	100

#### **4.2.3 Classification of Computers According to their Processors**

The processor is the part of the computer that does the calculations, processing, gives instructions as to what is to be stored, retrieved, displayed, or transmitted among other operations. The kind of processor that a computer has is an important consideration in many respects (Binken, & Stremersch, 2008). The cost of production theory mentioned in the theoretical framework of this research states that the cost of production influences price. The other aspect of processor is the brand. There are two principal brands of processors contained in the computers being retailed in Nairobi. They are made by Intel and Advanced Micro Devices (AMD) corporations respectively. Intel has the bigger market share and computers often display

labels stating the kinds of processors that they contain. In terms of processors, the market shares for the two firms were found to be 86.1% for Intel and 13.9% for AMD.

Table 4:3 *Classification of Computers by Processor Brand*

Type of Processor	Frequency	Percentage
Intel	285	86.1
AMD	46	13.9
Total	331	100

#### **4.3 The Effect of Selected Computer Specifications on their Retail Prices**

This research sought to answer among other questions, how much some computer specifications influence their retail prices. The variables of interest here were the processor speed in Gigahertz, Memory size in Megabytes, and the size of the Hard Disk ó also in Megabytes. Since all these variables are numeric, the relationship can be investigated through regression analysis ó where cost or retail price is the dependent variable (or ðyö) and the various specifications treated as independent variables (or ðxö). There are many kinds of regression, however, simple linear regression models were attempted for the different specification variables and then a multiple regression was done in an attempt to model the combined effect.

### 4.3.1 The Effect of Processor Speed on a Computer's Cost

Using the data collected from all the computers, it was found that the processor speed ó cost relationship can be modeled into a linear equation with the following coefficients.

Table 4:4 *Regression Model for the effect of Speed on Retail Price*

Component	Value
Constant	44,353
Speed (Coefficient)	1,895
R	0.113
R Square	0.013

These coefficients would generate an equation of the form  $y = 1,896x + 44,354$  (usually said to be in the form  $y = a + bx$ , implying that  $y = 44.354 + 1,896b$ ). This model is however not an efficient model since the value of  $\tilde{r}$  is 0.143. For a linear regression model to be considered efficient, the value of  $\tilde{r}$  should be 0.5 or above. Since the value of  $\tilde{r}$  is much lower than 0.5 this means that the model is not an efficient one. In other words, there is a weak linear correlation between computer speed and cost when attempting to generalize for all computers in the market. On the other hand  $\tilde{r}$  squared (or  $\tilde{r}^{2\delta}$ ) has as value of 0.013. This means that only 0.13% of the variation in price can be explained by the linear relationship between processor speed and price. The aspect of speed creates a weak prediction index.

### 4.3.2 The Effect of Memory Size on Retail Price

One of the objectives in this study was to investigate how the size of a computer's memory influences its cost. It is a reasonable proposition that larger memory chips would cost more and therefore add to the overall price of the computer. In addition, when people seek to buy computers, they often go for the higher capabilities such as larger memory whenever they are able to chose ó a trend that would push up the prices of computers with larger memory.



The data collected was analyzed through regression analysis to generate a second linear regression model relating memory size to retail price (or cost). The data relating memory size to retail price results in a linear regression model showing a positive relationship between memory size and greater retail cost. In other words when the memory size increases, there is the expectation that retail price will increase correspondingly. The regression coefficients are summarized in Table 6.

Table 4: 5 Regression Model for the Effect of Memory Size on Retail Price

Component	Value
Constant	47,791.359
Memory Size/RAM (Coefficient)	292.797
R	0.143
R Square	0.020

The above equation would generate a linear equation of the form:

$y = 293x + 47,791$ . The value of  $\tilde{r}$  is 0.143. Like the previous model, the efficiency of this model is low. Likewise,  $\tilde{r}^2$  takes on the value of 0.020, which means that only about 2% of the variation in price can be explained by the linear relationship between  $x$  and  $y$ -giving us another weak index. This suggests that there can be many other factors affecting the retail price or perhaps the model might not be as linear as envisaged. It could for example be better modeled into a curvilinear relationship. More analysis should be carried out and other research questions set and tackled.

### 4.3.3 The Effect of Hard Disk size on Retail Price

A regression analysis was carried out to assess the effect of a computer's hard disk size on its retail price. The components of the model are summarized in Table 4.6.

Table 4:6 *The Effect of a Computer's Hard-Disk Size on its Retail Price*

Component	Value
Constant	21,742.352
Hard Disk Size (Coefficient)	70.135
R	0.501
R Square	0.251

The above coefficients generate a liner regression model:

$$y = 70.135x + 21,742$$

From this equation, it is clear that the larger the size of the hard-disk, the greater the cost of the computer. The value of  $\tilde{r}$  is 0.501. Since this is greater than 0.5, the regression model relating the size of the hard-disk to the price of the computer is more efficient than the other two and can in its own right be classified as having met the threshold for an efficient model. The value of  $\tilde{r}^2$  is 0.251. This means that 25% of the variation in price can be explained in terms of the linear relationship between x and y.

#### 4.3.4 The Combined Effect of Speed, Memory Size, and Hard-Disk Size on a Computer's Retail Price

To investigate the effect of a computers speed, memory size and hard-disk size on its retail price, it is necessary to generate a multiple regression model ó one in which there are several independent variables. By analyzing the data with SPSS, the following regression coefficients were obtained:

Table 4:7 *The combined effect of Hard Disk Size, Processor Speed, and Memory Size on a Computer's Retail Price*

Coefficient	Value
Constant	17,478.960

Hard Disk (Coefficient)	70.46
Speed (Coefficient)	1,260.933
RAM (Coefficient)	182.754
R	0.526
R Square	0.251

The above regression model is a little more complex than the previous three. However, it is still a linear regression model. It generates the regression line of the form:

$y = x_1 + x_2 + x_3 + c$  where  $x_1$ ,  $x_2$ , and  $x_3$  are the variables memory size, speed and hard disk size respectively. The regression line is therefore of the form:

$$y = 183x_1 + 1260x_2 + 70.5x_3 + 17,478.96$$

The value of  $r$  for this model is 0.526. This means that the model is an efficient one. From this model, it is clear that the memory size, the speed and hard-disk size all contribute positively to the retail price of a computer. However, from the previous regression models, it can be deduced that the hard disk is the principal contributor to price since adding the other variables into the equation do not change the values of  $r$  and  $r^2$  significantly. The value of  $r^2$  remains at 0.251 which means that only 25% of the variation in price can be explained by the linear equation between the  $x$ s and  $y$ . The importance of this model is that it provides some guidance on how a computer designer may predict the retail price of a model or compare the expected retail prices of different proposed models even before they are developed. He or she may control the above specifications in order to come up with a computer design that can compete favorably in the market.

#### 4.4 The Effect of Processor Type on a Computer's Retail Price

The processors in this research were examined in terms of the manufacturer's brands of Intel and AMD. As pointed out in the earlier findings, there were more Intel Processors than AMD processors in the sample of the ratio being 86:14.

To examine whether the processor brands used in the computers were related to their retail prices, a test was carried out for equality of means using the independent samples t-test. The means for the two categories were found to be as follows:

Table 4:8 *The Difference in Retail Price due to Processor Type*

Processor Brand	Frequency	Mean	Std. Dev.
Intel	283	51,175.44	30,931.883
AMD	46	35,119.57	14,501.412

From the data, the average price of computers with Intel processors was Kshs 51,175.44 while the average price for those with AMD processors was 35,119.57. In terms of magnitude, this is a significant difference. Since the computers examined in reality are just a sample of the entire population that are on retail in Nairobi, the following questions can further be asked:

- a) How significant was this result?
- b) How confident are we than another survey that ends up picking different sampling units from the ones that were selected would end up giving a similar, and not opposite result?

To answer these questions it is important to examine the level of confidence. The results from SPSS give a level of significance of 0.001. This falls in the critical region of the 95% confidence level which is at 0.025 for a two-tailed test - if the null hypothesis had been that the means were equal. Since alpha falls within the critical region, Null hypothesis is rejected. It is therefore safe to conclude that the population means from which the two samples were obtained are not equal. The lesson here is that in the market, using AMD processors results in producing fairly lower cost computers by a substantive margin.

#### **4.5 The Influence of Brand on Retail Price**

The sample of computers was analyzed with respect to brand to determine how retail price varied with regard to brand. The means and standard deviation were calculated and summarized in

Table 4:9 *The Difference in Computer Retail Prices due to Brand*

BRAND	Mean	Frequency	Std. Deviation
HP	49401.4074	162	27176.10114
Dell	38431.0345	29	28518.70443
Toshiba	57443.1591	44	30197.38664
Samsung	47586.1591	44	33753.83508
Mecer	45400.0000	5	30615.35562
Acer	31091.4048	42	11854.71981
Mac	82111.1111	18	33258.15051
Asus	38250.0000	2	12374.36867
SONY	84997.5000	2	7067.53228
10	35000.0000	2	.00000
11	53000.0000	1	.
Total	48772.5128	351	29343.74755

From the above table, the Apple or Mac brand together with SONY stood out as the most expensive in the sample. Their prices averaged Kshs. 82,111 and Kshs. 84,997 respectively. The least costly computer brand was Acer with a retail price of Kshs 31,091 per computer. The standard deviation for Acer was also relatively low, indicating that the computer prices are consistently low for this brand.

The brand attribute is a complex one since it is influenced by many factors including perception. People may prefer an item of a given brand over another even when there is no qualitative difference between the two. Advertising may for instance make some people pay more for a brand even then the product being sold is of lower quality. At the same time, the consumer may

prefer a given brand because it is associated or displays preferred qualities. Likewise, what a manufacturer charges for a brand many related to production cost, which may further be related to aggregate supply and demand among other price theories. Many questions could therefore be asked with regard to the prices differences that have been reflected due to brand. Are the different average prices observed for the various brands independent of other attributes such as processor brands?

#### 4.6 The Effect of Computer Types on their Retail Prices

The computers in the sample were also analyzed with regard to their types ó to determine what differences result in retail prices due to the different categories of computer. To answer the corresponding research question, a descriptive statistics analysis was done to compare the means of the different categories with respect to the computer types. The average prices were found to be as follows for the sampled computers.

Table 4:10: *The Effect of Type of Computer on Retail Prices*

Type of Computer	Mean (Cost)	Number	Std. Deviation
Laptop	54783.8437	224	32128.73628
Notebook	34434.5652	46	17697.07012
Desktop	35359.5833	60	17385.18189
Tablet	60105.1579	19	14353.28049
Not sated	4.0000	2	.00000
Total		351	

The tablet computers were the highest priced with a mean price of Kshs 60,105. The corresponding standard deviation was 14,353 ó the lowest despite the greater magnitude of price. This shows that the high price for tablet computers is rather consistent. At the same time,

Notebooks and Laptops were found to be the least costly with an average price of Kshs 34,435 and Kshs 35,360 respectively.



## CHAPTER FIVE

### SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Introduction

This chapter discusses the summarized findings, conclusions, and recommendations that have been derived from the analysis of responses or data collected from the respondents. The summary of findings is made with respect to objectives of the survey or the areas that were probed via the research questions. In addition, the chapter highlights various areas that need to be researched further.

#### 5.8 Summary of findings

The first objective of the study was to examine how computer specifications influence their prices. The study showed that the most important specification in this regard was the size of the hard disk in terms of its storage capacity, usually measured in gigabytes. On average, this constituted about one quarter, or 25% of the computer. At the same time it was established that the other specifications, namely memory size or processor speed had little impact on the overall price of the computer ó both components accounting for less than 5% of the overall price. These findings demonstrate that any effort to manufacture or procure a computer with a larger hard-disk, tended to result in higher prices than were occasioned by increases in the other specifications.

From the analysis carried on data relating to the first objective, it may appear that processors are not important determinants of price. While this was true in terms of their clock-speeds, analysis of the brand aspect of the computer demonstrated a significant influence. Computers fitted with Intel processors sold for a significantly higher price than those with AMD processors ó the difference in price was large ó about Kshs. 15,000/= on average. This particular aspect demonstrates the importance of branding in a production or retail process. While the regression analysis showed that the processors themselves explain only about 1.3% of the retail price, significantly higher prices were related to computers with Intel Processors compared to those with AMD processors. Clearly, the brand of the processor itself (whether Intel or AMD) was a most important determinant. The question might therefore be asked: ðWhy would the brand of a

relatively inexpensive component explain such a large price variation? The answer might be found in the success of the "Intel Inside" campaign – reputed to be one of the most successful component branding initiatives (Jones, 2002).

From the point of view of computer pricing in Nairobi, these observations prove a number of things. First, Intel restricts access of its branded components. This restriction apparently works against manufactures of low cost computers because Intel may be concerned that some other shortcomings of these computers may create a negative association with its branded components. Secondly, it is also possible that the Intel stickers on the computers enable retailers sell their products for a higher margin. Either or both of these two dynamics explain why Intel brand appears to have a relationship with higher-end computers. Finally, Intel does not only manufacture processors but also circuits, systems software and other computer components – whose prices may affect the computers overall price.

The data was analyzed to establish the relationship between a computer's brand and its price. A significant price variation was established for brands ranging from Kshs. 31,091 for Acer and Kshs. 84,998 for Sony. The most sampled brand was HP – with a total of 162 out of the 351 computers in the researched sample. This should imply that HP has the largest market share. It is noteworthy that there are many brands whose computers sold at a lower price than those of HP, but they appeared to have only a small fraction of HP's projected market share – going by the sampled units. This observation points to some customer loyalty towards HP in the current market.

Likewise, while the price of a SONY computer at Kshs. 84,998/= was not much higher than that of the Macs at Kshs. 82,111/=, significantly more Macs than Sonys were sampled. There were 18 Macs compared to only 2 Sony computers. Despite the higher price of these brands, the Macs still had a substantive niche market.

The study found that the average price of a notebook computer was almost as much as that of a desktop – at Kshs. 34,435/= and Kshs. 35,360/= respectively. Tablet computers had the highest average price at Kshs. 60,105/=. The average price of a laptop was Kshs.54,784/=.

### 5.3 Discussion of Findings

The survey found that while there are many brands models of computer with different features, it is possible to observe certain trends which may be used for purposes such as forecasting, project design and budgeting. A number of models for predicting retail prices were possible to develop. Over the years, observations have been made on the relationship between computer attributes ó their performance and their prices. The study of these has resulted in the most famous law in the area of information technology ó the Gordon Moore Laws (Jones, 2002). As indicated in the theoretical framework, many other researches have been carried out in the context of Moore's Laws (See-To, Westland, 2003).

The significance of the relationship between the increase in computer processor speeds, and the fall in their prices has been emphasized by many. Bill Gates stresses the continued importance of these trends on the computer hardware and software development in the coming years (Gates, 1995). It has also been suggested that in the current era of globalization social, political and economic development all over the world will be driven by Moore's Law. At this point it might be useful to restate that the law states that the computing power of silicon chips (processors) will double every 18 to 24 months, while their prices will have (Friedman, 1999).

This study sought to establish the relationship between important aspects of computer microchips and the prices of computers in Nairobi. While relationship has been found to be positive, it has been found to influence an insignificant percentage of the overall computer prices. Similar observations were made with regard to the relationship between computer prices and their memory.

The other aspect of the study revolved around the relationship between computer prices and the sizes of their hard disk. Just like in the case of Moore's Laws, it has been observed that advances in compression technology mean that the amount of data that can be stored per square inch of memory has increased by 60% every year since 1991. Meanwhile the cost of that storage has fall from \$5.00 per Megabyte to 5 cents increasing the power and accessibility of computers every day (Friedman, 1999). It is in the context of this observation that the analysis of computer had

disk space and the price of computers was carried out. As a result, it has been observed that computer price increases with memory and the size of the hard disk explains 25% of the price of the computer.

The importance of this finding to computer designers is that they may need to consider to what level they need to control the size of the hard-disk, if the objective is to produce a low cost computer. At the same time, those in procurement of computers need to beware of just how much they may end up increasing their expenditure by overstating the hard-disk sizes, especially when this particular component does not meet the customer's most important need. It may therefore be wise to trade-off hard-disk size for another desired computer characteristic.

The relationship between how the nature of the processor influences the price of the computer was also explored. This is particularly important in the context of one of the most successful product component campaigns – the 'Intel inside' campaign (Jones, 2002). This campaign drew the awareness of consumers to the brand of the processor. It was therefore important to explore to what extent this influenced the price of the computer. It was found that computers with Intel processors cost significantly more than those that had AMD processors.

The relationship between brand and price was also explored. Macintosh and Sony computers were found to be the most expensive at an average of over Kshs. 80,000 a piece and popular brands Dell, Asus and Acer were found to average less than Kshs. 40,000 a piece. This tells us that in addition to computer specifications and components, there is a very significant variation due to the brand of the computer itself.

Finally, the relationship between computer types and their prices were explored. Tablets were found to cost more than 60,000 a piece while desktops and notebooks were found to cost significantly less at an average of about Kshs. 35,000 and Kshs. 34,000 respectively. Of the many different specifications, hard-disk size was found to be the most reliable determinant of price. The memory size and processor speed were also useful in generating models, but further research is necessary to investigate what other variables or classification can be introduced to improve the efficiency of the models.

## **5.4 Conclusions**

The findings of this survey show that there are a number of factors that determine the prices of computers. While the market has many computers made by many different manufacturers, it is evident that there are some properties that define what a computer costs. These can be modeled to provide a basis for optimization of future designs. The information from the many computers that are already on sale in Nairobi tell us what determines the prices of computers in this market and to what extent.

Various regression models were developed showing how the various specifications determine price. These can be improved to lead to more important models. Since the other computer characteristics such as type of computer have proved to also determine price, it is possible to develop more efficient models by developing models for each of the sub-populations or types of computers. There are many important features of computers that were not factored into the survey ó such as the kind of software they had. These are also price determinants.

It was found that the different brands of computers had different average prices by substantive margins. This could be due to a number of factors since brand is a complex component of a product. It was found for instance that there is some relationship between brand and type of processor. Further analysis can be done to determine what else besides production or component costs lead to the price variations that have been observed due to the various brands.

## **5.5 Recommendations**

One of the recommendations for this survey is that there needs to be further research to refine the determinants further. In addition, the data should be analyzed further to determine what role the pre-installed software play in determining retail price. There needs to be some effort in taking the same research data and correcting it by taking into consideration the effect of many determinants that were not surveyed. It will also be very helpful to come up with a single model for forecasting that can be used to determine the price of a computer in Nairobi by including a wide number of determinants into a single model.

More importantly, the findings of this research highlight potential areas for investment in the computer industry. Out of the hardware components that were researched, it is evident that the hard-disk offers the best potential for improvements that would lead to significant price variation. Likewise, the variation in computer price due to the brand of the computer itself, or its processor, illustrate that branding initiatives may turn out to be more worthwhile investments than might appear from a casual observation.

### **5.6 Suggestions for Further Research**

Further researches can be carried out to determine the effect that the various features of computers that were not surveyed have on their retail prices. These include the presence or absence of features such as webcams (or in built cameras) and pre-installed software among others. Further research should be carried out on the area of specifications do determine what else contributes to the retail price. Regression models could be developed to include factors such as the screen size  $\phi$  which is usually measured in inches. With a number of additional factors, it will be possible to come up with even more accurate regression models.

The issue of brand needs to be investigated further. This can be done by comparing some popular brands in pairs or small groups to determine what accounts for their different prices or what makes their products cost almost the same. Armed with such information, it will be possible to help designers of computer products avoid unnecessary over heads that will make their products less competitive. It should be found out how much brand is really a determinant or whether price differences observed due to brand are simply evidence of say one brand using higher specifications or is related to a more costly type of product such as a tablet. This kind of analysis has already been initiated through the cross tabulation that sought to shed some light on the issue of computer processors in relation to brand. More such analysis needs to be done to establish the underlying causes of price differentials.

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## APPENDIX 1: QUESTIONNAIRE

### Introductory Remarks:

Hello! I am Thomas Owiti Musandu, and am carrying out a research at the University of Nairobi to establish what factors determine the cost of a computer and by how much. To achieve this objective, I require some data from retail outlets such as yours.

I will therefore be very grateful if you assist me with some information that will help me complete this survey. Could I proceed or do you have any questions?

### Section A: Questions about the Nature of Business

1. Do you sell Computers? Yes          No
2. What is the Nature of your Business?  
Computer Maintenance  
Sale of Hardware/Accessories other than Computers

---

### Section B: Questions about Laptops and Notebook Computers

1. What brand of computers is the most popular with your customers? (Brand in terms of HP, DELL, Toshiba, Acer etc.) \_\_\_\_\_
2. How many brands do you have in stock? \_\_\_\_\_
3. Do you have any laptops? And if so, which of them is the most popular?
4. Kindly supply the following details for the laptop mentioned in 3

Item No.	Computer Brand	Model	Speed (GHz)	RAM (GB)

Hard Disk size (GB)	Type of Computer	Cost In Kshs	Pre-Installed Software

5. Which is the most expensive laptop? \_\_\_\_\_
6. Which is the least expensive laptop? \_\_\_\_\_

7. Kindly supply the following details for the most expensive laptop and least expensive laptops:

Item No.	Computer Brand	Model	Speed (GHz)	RAM (GB)

Hard Disk size (GB)	Type of Computer	Cost In Kshs	Pre-Installed Software

8. Do you sell any Notebook Computers? Yes No

9. If Yes kindly supply the following details for the most popular Notebook Computer?

Item No.	Computer Brand	Model	Speed (GHz)	RAM (GB)

Hard Disk size (GB)	Type of Computer	Cost In Kshs	Pre-Installed Software

---

### Section C: Questions about Personal Computers and Tablet Computes

1. Do you sell any Personal Computers? Yes No

2. If Yes kindly supply the following details for the most popular PC?

Item No.	Computer Brand	Model	Speed (GHz)	RAM (GB)

Hard Disk size (GB)	Type of Computer	Cost In Kshs	Pre-Installed Software

3. Do you sell any Tablet Computers?    Yes            No
4. If "Yes" kindly supply the following details for the most popular Tablet Computer?

<b>Item No.</b>	<b>Computer Brand</b>	<b>Model</b>	<b>Speed (GHz)</b>	<b>RAM (GB)</b>

<b>Hard Disk size (GB)</b>	<b>Type of Computer</b>	<b>Cost In Kshs</b>	<b>Pre-Installed Software</b>

## APPENDIX 2: RESEARCH AUTHORIZATION

REPUBLIC OF KENYA



### NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Telephone: 254-020-2213471, 2241349, 254-020-2673550  
Mobile: 0713 788 787, 0735 404 245  
Fax: 254-020-2213215  
When replying please quote  
secretary@ncst.go.ke

P.O. Box 30623-00100  
NAIROBI-KENYA  
Website: www.ncst.go.ke

Our Ref: **NCST/RCD/14/013/1063**

Date: **17<sup>th</sup> June 2013**

Thomas Owiti Musandu  
University of Nairobi  
P.O Box 30197-00100  
Nairobi.

#### RE: RESEARCH AUTHORIZATION

Following your application dated **11<sup>th</sup> June, 2013** for authority to carry out research on "*Determinants of computer prices: A case of selected retail outlets in Nairobi.*" I am pleased to inform you that you have been authorized to undertake research in **Nairobi County** for a period ending **31<sup>st</sup> July, 2013.**

You are advised to report to **the County Commissioner and County Director of Education, Nairobi County** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

  
**DR. M. K. RUGUTT, PhD, HSC.**  
**DEPUTY COUNCIL SECRETARY**

Copy to:  
The County Commissioner  
The County Director of Education  
Nairobi County.

*"The National Council for Science and Technology is Committed to the Promotion of Science and Technology for National Development".*

### APPENDIX 3: RESEARCH PERMIT

PAGE 2 PAGE 3

**Research Permit No. NCST/RCD/14/013/1063**

**THIS IS TO CERTIFY THAT:**


**Prof./Dr./Mr./Mrs./Miss/Institution**  
**Thomas Owiti Musandu**  
**of (Address) University of Nairobi**  
**P.O Box 30197-00100, Nairobi**  
**has been permitted to conduct research in**

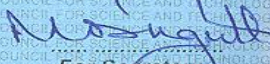
**Location**  
**District**  
**Nairobi**  
**County**

**on the topic: Determinants of computer prices: A case of selected retail outlets in Nairobi.**

**for a period ending: 31<sup>st</sup> July, 2013.**

**Date of issue** 17<sup>th</sup> June, 2013  
**Fee received** KSh. 1000

  
*Thomas Owiti Musandu*  
**Applicant's Signature**

  
**For Secretary**  
**National Council for**  
**Science & Technology**