

**ASSESSMENT OF VERTICAL PRICE TRANSMISSION IN RICE MARKETS IN  
NAIROBI CITY COUNTY, KENYA**

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**DECLARATION**

This thesis is my original work and has not been presented for award of a degree in any other university or for any other award

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**DEDICATION**

To my loving husband Cornelius and dear daughters; Clare and Collete.

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## TABLE OF CONTENTS

<b>DECLARATION</b> .....	ii
<b>DEDICATION</b> .....	iii
<b>ACKNOWLEDGEMENT</b> .....	iv
<b>LIST OF TABLES</b> .....	viii
<b>LIST OF FIGURES</b> .....	ix
<b>LIST OF APPENDICES</b> .....	x
<b>LIST OF ABBREVIATIONS AND ACRONYMS</b> .....	xi
<b>DEFINITION OF OPERATIONAL TERMS</b> .....	xiii
<b>ABSTRACT</b> .....	xiv
<b>CHAPTER ONE:</b> .....	1
<b>INTRODUCTION</b> .....	1
1.0 Background.....	1
1.1 Rice sector.....	3
1.2 Urban food marketing systems .....	5
1.3 Statement of the problem .....	6
1.4 Objectives .....	7
1.4.1 General objective .....	7
1.4.2 Specific objectives .....	8
1.5 Research hypotheses .....	8
1.6 Justification of the study .....	8
1.7 Scope of the study.....	9
1.8 Theoretical framework.....	10
1.9 Conceptual framework of vertical price transmission .....	11
<b>CHAPTER TWO</b> .....	13
<b>LITERATURE REVIEW</b> .....	13
2.0 Introduction.....	13
2.1 Market integration.....	13
2.2 Testing vertical market integration .....	14
2.2.1 Correlation analysis .....	14

2.2.2 Dynamic regression models.....	15
2.2.2.1 Ravallion (1986) model .....	15
2.2.2.2 Co-integration analysis .....	15
2.2.3 Switching regime models.....	16
2.2.3.1 Parity Bound Model (PBM).....	17
2.2.3.2 Threshold Autoregressive (TAR) model .....	17
2.3. Granger causality .....	18
2.4 Market structure and market conduct .....	19
2.5 Reviews of empirical studies .....	21
2.6 Gaps in the literature review .....	26
<b>CHAPTER THREE .....</b>	<b>28</b>
<b>RESEARCH METHODOLOGY .....</b>	<b>28</b>
3.0 Introduction.....	28
3.1 Study area.....	28
3.2 Research design .....	30
3.3 Population, sample size, and sampling design.....	31
3.4 Types, sources and collection of data .....	32
3.5 Methods of data analysis.....	33
3.5.1 Assessment of the degree of vertical market integration between wholesale and retail rice markets .....	33
3.5.2 Determination of the direction of causality between wholesale and retail rice market levels .....	39
3.5.3 Assessment of market structure and conduct of wholesale and retail rice market levels .....	40
<b>CHAPTER FOUR.....</b>	<b>42</b>
<b>RESULTS AND DISCUSSIONS .....</b>	<b>42</b>
4.0 Introduction.....	42
4.1 Descriptive statistics of wholesale and retail price series data .....	42
4.2 Determination of the order of integration of wholesale and retail rice prices .....	43
4.3 Determination of the degree of vertical market integration.....	44
4.4 Determination of the direction of causality between the wholesale and retail price ...	45

4.5 Examination of the role of market structure and conduct in vertical price transmission in rice markets in Nairobi City County.....	46
4.5.1 Descriptive statistics of socioeconomic characteristics .....	46
4.5.2 Assessment of market structure .....	50
4.5.3 Assessment of Market conduct .....	54
<b>CHAPTER FIVE .....</b>	<b>58</b>
<b>SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS .....</b>	<b>58</b>
5.0 Introduction.....	58
5.1 Summary and conclusion of findings from the determination of the degree of vertical market integration between wholesale and retail market levels .....	58
5.2 Summary and conclusion of findings from the determination of causality between wholesale and retail market levels.....	58
5.3 Summary and conclusion of findings from the examination of the role of market structure and conduct in vertical price transmission.....	59
5.4 Policy implications.....	60
5.5 Propositions for further research.....	60
<b>REFERENCES.....</b>	<b>62</b>

**LIST OF TABLES**

Table 4.1: Descriptive Statistics of retail and wholesale rice prices.....	42
Table 4.2: ADF unit root test results at levels and first differences .....	43
Table 4.3: Phillips-Perron (PP) test at levels and first differences .....	44
Table 4.4: Trace and maximum eigenvalue test results .....	45
Table 4.5: Granger Causality test results between retail and wholesale prices .....	46
Table 4.6: Cross-tabulation of gender by type of trade .....	47
Table 4.7: Cross-tabulation of age by type of trade.....	48
Table 4.8: Cross-tabulation of the level of education and type of trade .....	49
Table 4.9: Cross-tabulation of the experience by type of trade .....	50
Table 4.10: HHI for retail rice market level .....	51
Table 4.11: HHI for wholesale rice market level.....	52

**LIST OF FIGURES**

Figure 1.1: FAO food price index.....2  
Figure 1.2: Conceptual Framework .....12  
Figure 3.1 Map of study area Nairobi City County .....30  
Figure 4.1. Sources of rice purchases .....55

**LIST OF APPENDICES**

Appendix 1.1: Questionnaire for rice wholesalers and retailers .....	77
Appendix 1.2 VAR Lag Selection Criteria .....	81
Appendix 1.3: Daily wholesale and retail price series for Nairobi City County .....	82
Appendix 1.4: Research Authorization Letter .....	88
Appendix 1.5: NACOSTI Letter .....	89

**LIST OF ABBREVIATIONS AND ACRONYMNS**

AIC	Akaike Information Criteria
APT	Asymmetric Price Transmission
EAC	East African Community
EAGC	Eastern Africa Grain Council
ECM	Error Correction Model
EUCORD	European Cooperative for Rural Development
FAO	Food and Agriculture Organization
GAIN	Global Agricultural Information Network
HHI	Herfindahl Hirschman Index
HQ	Hannan Quinn information criterion
ICT	Information and Communication Technology
KNBS	Kenya National Bureau of Statistics
Ksh/kg	Kenya shillings per kilogram
LBDA	Lake Basin Development Authority
MOA	Ministry of Agriculture
MT	Metric Ton
NCPB	National Cereals and Produce Board
NEPAD	New Partnerships for Africa's Development
NGO	Non-Governmental Organization
NIB	National Irrigation Board
NRDS	National Rice Development Strategy
OLS	Ordinary Least Square
PP	Phillips Perron test
RATIN	Regional Agricultural Trade Intelligence Network
SAPs	Structural Adjustment Programs
SIC	Swarchz Information Criterion

TAR	Threshold Auto Regression
VAR	Vector Auto-regression
VECM	Vector Error Correction Model
VPT	Vertical Price Transmission

## DEFINITION OF OPERATIONAL TERMS

**Vertical price transmission-** Refers to the transfer of price changes between different market levels (between wholesale and retail rice market levels)

**Degree of vertical market integration-**Refers to the extent price changes between wholesale and retail rice market level co-move. It is indicated by the number of cointegrating vectors between wholesale and retail price series

**Market Structure-**Refers to the organisation of wholesale and retail rice market in terms of market concentration, barriers to entry and product differentiation

**Market conduct-**Refers to the techniques that rice wholesalers and retailers adopt, considering the existing market structure. They include buying, selling and transport characteristics

**Stationary series-** Refers to data whose mean and standard deviation does not change over time

**Non-stationary series-**It refers to data whose mean and standard deviation varies over time

**Unit root-** It refers to a process that has a characteristic root equal to one leading to a non-stationary process

**Order of integration-**Refers to the number of times a unit root process is differenced to become stationary.

**Wholesaler-**Refers to a rice trader who sells in large quantities from 25kg and above

**Retailer-**Refers to a rice trader who sells in smaller quantities from  $\frac{1}{4}$ kg and above

**ABSTRACT**

Sub-Saharan Africa (SSA) agricultural commodity markets have been liberalised since the 1980s through Structural Adjustment Programs (SAPs). The aim was to foster market integration and efficiency. Liberalisation of markets allows free flow of goods and services from areas with excesses to those with a deficit. But most Sub-Saharan countries, Kenya included, has associated liberalisation with failure and unsustainable food markets though agriculture is the mainstay of the economy. Price information is a conduit connecting and integrating different market locations and levels. Thus, this study assessed the degree of market integration and direction of price influence between the wholesale and retail rice market levels in Nairobi City County. Besides, the research examined the role of market structure and conduct in vertical market integration and Granger causality. The Eastern African Grain Council (EAGC) provided the weekly wholesale and retail price data from January to December of the year 2016. Data analysis was done in E-views 9. Primary data were randomly gathered from 80 rice traders in Nyamakima and Toi markets through questionnaires. The data consisted of socioeconomic aspects, market structure, and market conduct of rice wholesalers and retailers. This data was analysed using SPSS 20. Johansen cointegration method revealed the absence of cointegration between the wholesale and retail rice markets. Further, wholesale and retail prices exhibited independent Granger causality. The assessment of socioeconomic characteristics showed the dominance of female retailers. Further, most retailers were in their productive ages while most wholesalers were old. Also, wholesalers were more educated than retailers, and retailers possessed more experience than wholesalers. The assessment of market structure showed a high concentration in the wholesale market (HHI of 0.33) while the retail market had a moderate concentration (HHI 0.21). The examination of market conduct showed a majority of both wholesalers and retailers shared a similar source of rice supplies (brokers). Besides, the word of mouth provided most of the market information. The study concluded the rice market in Nairobi City County were not integrated and inefficient. It links this to the presence of market power at wholesale and retail market levels, minimal price interaction, and unreliable market information. Policies that favour a formal centralised information system can improve market integration. Adoption of Information and Communication Technologies (ICTs) can also enhance reliability of information and access to formal financial services.

## CHAPTER ONE

### INTRODUCTION

#### 1.0 Background

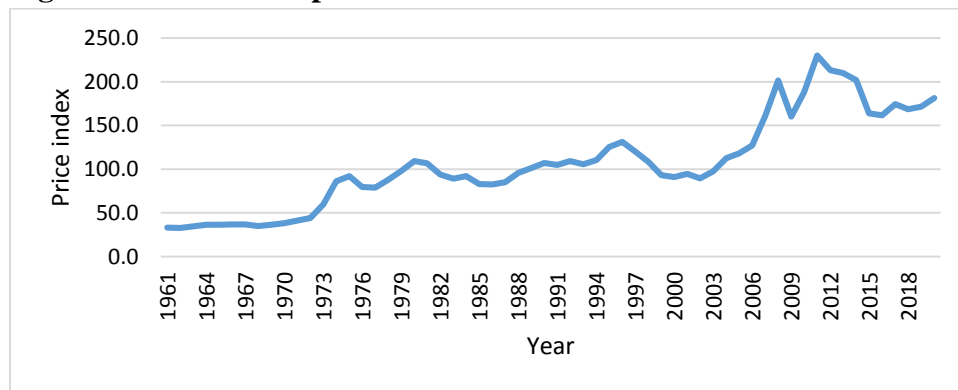
The marketing of agricultural commodities in Kenya has been liberalised since the adoption of Structural Adjustment Programs (SAPs) in the 1980s, with the facilitation of the World Bank and the International Monetary Fund (IMF) (Gitau, 2013). Liberalisation was meant to foster market integration and efficient resource allocation, increase competition, encourage the participation of the private sector, and reduce government intervention (Mtumbuka et al. 2014). Nonetheless, the influence of agricultural market liberalisation on market integration has been disputable ((Morara et al. 2010; Heidhues & Obare, 2011; Mbithe, 2012; Gitau, 2013).

The Kenyan government still has a strong voice in the acquisition, distribution, and regulation of commodity markets; especially those of staple foods, to regulate food prices and improve food security. This creates uncertainties and distorts the flow of market information which impedes optimal market integration (Sitko & Jayne, 2013). Further, the country is characterised by food scarcity, uncompetitive prices, and poor policies even though the agricultural sector is the mainstay of the economy (Morara et al. 2010).

The fluctuation of world food prices over the past years have had diverse effects on a country's economy and the functioning of commodity markets (FAO, 2015). Figure 1.1 shows world food prices reduced considerably at the beginning of the 1960s to early 2000s then increased from 2003 to 2006. From 2006 to mid-2008, there was a sharp spike. A decline followed until mid-2010 from where prices soared again and to a sharp peak in

2011 and then declined (FAO, 2019). As a result, poor households, smallholder farmers, and countries that heavily relied on imports like Kenya were the worst hit. This is because of high dependency on rain-fed agriculture and a huge budgetary allocation to food (FAO, 2015). Food prices are more likely to remain high and continue to fluctuate owing to continuous growth in population and economy, climate change, and high cost of production as oil prices remain high (FAO, 2019).

**Figure 1.1: FAO food price index**



Source: FAO, 2019

As commodity prices change over time, it generates price shocks and signals between markets and have serious policy implication to a country. The extent and direction of transfer of these price signals from one market to another is determined by the level of market integration. Markets integrate when price changes are transmitted between markets (Rosa et al. 2014). Price transmission is broadly classified as vertical price transmission and horizontal price transmission. The co-movement in the transmission of price changes between marketing levels leads to vertical market integration. On the contrary, the co-movement of price changes between different marketing locations leads to horizontal market integration (Rashid et al. 2010). The trend in price transmission is created by product characteristics and transformations and the market structures (Ahn & Lee, 2015).

Market structure and conduct have a direct impact on the level of market integration and the direction of flow in price changes (Ike, 2014). In a perfect competition market, no trader controls the market and market information is sufficient and symmetric. As a result, the pass-through of price changes is complete and quick between markets to ensure traders maximize market opportunities as soon as they occur (Areté srl, 2012). However, the presence of market power along a supply chain leads to inefficient markets characterised by uncompetitive product pricing and imbalanced distribution of profit margins (Weldesembe, 2013). Further, price changes are transmitted from where the market is concentrated to other market levels. The dominant trader has more bargaining power and is swift to pass increases in price downstream than when prices decrease (Dudová & Bečvářov, 2015).

### **1.1 Rice sector**

Rice (*Oryza sativa L.*) is the second most important staple food after maize in the East African Community (EAC) (Kilimo Trust, 2013) and comes third after maize and wheat in Kenya (Short et al. 2012). Small scale farmers grow most of the rice for commercial, human, and animal consumption on land less than 3 hectares. The National Irrigation Board (NIB) in Mwea, Bunyala, Ahero, West Kano, and South West Kano manages 78% of the total rice production (Atera et al. 2018). The Mwea irrigation schemes produce the bulk of the rice (KNBS, 2019). The other non-NIB irrigation schemes (2%), are privately managed like the Dominion Farms Limited in Nyanza. Rain-fed rice production makes up 20% of entire production (MOA, 2009). Rice is therefore key in enhancing food security and eradicating poverty in Kenya.

The annual rice consumption is about 820,000 MT but annual production is estimated at 240,000 MT (GAIN, 2019). The deficit (70.7%), is met through imports from countries like Pakistan (74%), Vietnam (9%), Thailand (4%), and India (4%) (Atera et al. 2018). Production is projected to increase by 11% per annum due to the expansion of land under rice cultivation by 8%. Besides, the government prepared the National Rice Development Strategy (NRDS) in the year 2009. The strategy aimed at enhancing food security, reducing poverty and facilitating self-sufficiency in food as per the Vision 2030 (EUCORD, 2012). Nevertheless, the national demand still surpasses local supply. This has been attributed to vagaries of weather, low development in high yielding and pest-resistant rice cultivars, poor storage facilities, poor milling facilities, and poor infrastructure (Atera et al. 2018; Kilimo Trust, 2013). Further, incidences of dumping of cheap imports in the country pose partial competition to domestic rice markets (MOA, 2009).

Aromatic rice like Pishori and non-aromatic rice like Sindano or Biryani are the two types of rice grown in Kenya. The aromatic basmati rice is the most preferred for its aroma and taste (MOA, 2009; Short et al. 2012). According to Atera et al. (2018), aromatic rice retails between Ksh 150 and Ksh 200 per kilogram while non-aromatic rice retails between Ksh 80 and Ksh 100 per kilogram. Wholesale prices from the year 2016 to 2019 fluctuated between Ksh 119 and Ksh 145 per kilogram (RATIN, 2019). The poor organization of marketing leads to the mixing of aromatic and non-aromatic rice varieties which alters market prices (MOA, 2009).

The consumption of rice has been accelerating by 12% each year compared to the intake of wheat at 4% and maize at 1% (MOA, 2009; Gitau et al. 2011). The growing population

and per capita consumption, urbanisation, and changes in dietary choices have fuelled the upsurge in consumption of rice (Atera et al. 2011). The urban market, Nairobi City County in particular, provides an enormous market for domestic rice more than other urban markets. Female traders control the market, more so at the retail level (MOA, 2009; Atera et al. 2018). This presents urban rice traders with an opportunity to earn an income and reduce poverty (Kilimo Trust, 2013). However, limited knowledge of the level of integration of rice market in urban markets exists. Further, little is known about structure and conduct of the urban rice markets.

### **1.2 Urban food marketing systems**

The rate of urbanisation is highest in Africa compared to the rest of the world (Resnick, 2017). NEPAD (2013) estimates that two in every five people live in urban areas. The growing urban population will plunge African countries like Kenya who are net importers of most staple food, into a chronic cycle of poverty and hunger. Thus, urbanisation poses a significant impact on food security, especially among the urban poor who are severely affected by spikes in world food prices like in the years 2008 and 2011 (Resnick, 2017; FAO, 2019). In Kenya, urbanisation motivates the increase in rice consumption (MOA, 2009; Kilimo Trust, 2013; Atera et al. 2018).

The urban food marketing system encompasses production, processing, packaging, distribution, retailing, and consumption. Activities in urban areas involves more purchasing than the production of food (Ericksen, 2008). The urban food markets in Kenya can be categorized as either formal or informal (Signé & Johnson, 2018; Owuor, 2017). Formal markets like supermarkets are registered with the government, hence subject to

taxation. They also guarantee the quality of commodities, and price information is public. On the contrary, informal markets like street vendors and kiosks are not registered with the local authority hence do not pay taxes. Besides, price information is not open but depends on haggling. Furthermore, the quality of goods is uncertain (Anbarci et al. 2012).

Urban areas are characterised by an increasing population in the informal settlements and middle class (Kimani-Murage et al. 2014; Resnick, 2017). Consequently, informal food markets are popular than formal food markets because they are near consumers, sell cheap products in compact units, are price elastic, and can offer credit (Romanik, 2008; Resnick, 2017; Signé & Johnson, 2018). However, products are more susceptible to inefficient quality checks. The markets contain substandard infrastructures like water supply, waste management, and electricity, which could otherwise offer an incentive for investment in equipment and quality. Further, traders are in frequent conflict with city police through impromptu crackdowns and arrests (Romanik, 2008; Resnick, 2017). Thus, it is important to test the efficacy of urban food marketing systems to improve living standards and food security among urban dwellers.

### **1.3 Statement of the problem**

Market liberalisation should allow free movement of agricultural commodities from markets with surpluses to those with shortages. But in most Sub-Saharan countries, market liberalisation has been associated with failure and unsustainable food markets (Heidhues and Obare, 2011; Mbithe, 2012; Gitau, 2013). The flows of price information connects different market levels. The efficiency in vertical price transmission determines the degree of market integration. Further, vertical price transmission shows the direction of price

flows which unveils the nature of the market structure, market conduct, and entry points of policy interventions. Hence, access to complete and precise market price information is paramount to traders in responding to price changes (Kharin, 2015; Verreth et al. 2015; Djuric et al. 2016).

Rice is the third most important staple food in Kenya. Its consumption is increasing by 12% each year, because of population growth, change in dietary inclinations, and urbanisation (Atera et al. 2018). Nairobi City County accounts for the largest rice consumption market (Kilimo Trust, 2013; Owuor, 2017). Therefore, rice consumption is vital in eliminating hunger and poverty, generation of income and improvement in standards of living (Kilimo Trust, 2013; Atera et al. 2018). However, there is a lack of knowledge on the extent of price integration and direction of price causality between different rice marketing levels, central in determining market efficacy. Further, information is scarce on how market structure and conduct of different marketing levels affect the level of price co-integration and price causality. This study sought to fill in these gaps by analysing the degree of market integration, Granger causality, and the role of market conduct and structure on vertical price transmission.

## **1.4 Objectives**

### **1.4.1 General objective**

The general objective of the study was to assess vertical price transmission in rice markets in Nairobi City County, Kenya.

### **1.4.2 Specific objectives**

The specific objectives of the study were:

1. To determine the degree of vertical market integration between wholesale and retail rice market levels in Nairobi City County
2. To determine the direction of causality between wholesale and retail market levels in Nairobi City County
3. To examine the role of market structure and market conduct in vertical price transmission in rice markets in Nairobi City County

### **1.5 Research hypotheses**

The research hypotheses for the study were:

1. The wholesale and retail market in Nairobi City County is not integrated
2. Wholesale price does not granger cause retail price in Nairobi City County
3. Market structure at wholesale and retail market levels in Nairobi City County is not competitive

### **1.6 Justification of the study**

In Kenya, rice is the third most important cereal after maize and wheat, hence crucial in the attainment of food security and generation of income (MOA, 2009). Urbanisation is one of the major drivers of increasing urban rice consumption (Atera et al. 2018). As the demand for rice increases, the rice supply chain is expected to integrate. Integration improves food security and ease fair distribution economic welfare among traders (Rashid, et al. 2010). Rice is mainly consumed in urban areas and Nairobi City County is the principal consumption market in Kenya (Kilimo Trust, 2013).

The assessment of vertical price transmission is useful in determining the degree of vertical market integration and Granger causality (Djuric et al. 2016). The direction of causality pinpoints the nature of competition and sources of inefficiencies in the rice market. This enables policymakers at the national and county government to discern the entry points of specific policy interventions to enhance market integration (Verreth et al. 2015). Besides, it assists policymakers to assess the efficacy of existing policies. The government and donors like the World Bank also benefit through better planning, resource allocation, and management of funds (MOA, 2009).

The findings inform the policies recommended to stakeholders such as the county government and traders with a view of enhancing the efficiency of the rice market. Likewise, the results add to the existing literature on the Kenyan rice market. Information on market structure and conduct helps rice wholesalers and retailers to better understand how they interact, find solutions to marketing hurdles, and improve their economic welfare.

### **1.7 Scope of the study**

The study was done in Nairobi City County and focused on rice wholesalers and retailers in Nyamakima and Toi markets. Weekly wholesale and retail price data for local rice for the period January to December 2016 was used. Weekly data captures changes in rice prices as soon as they occur. Regional Agricultural Trade Information Network (RATIN) developed by the Eastern African Grain Council (EAGC) provided the price series data. The study analysed the degree of vertical market integration and direction of Granger causality using the time series data. Questionnaires were utilized to gather information on socioeconomic characteristics, market structure, market conduct, and external factors at

wholesale and retail levels. The data were used to elucidate the findings from analysis of vertical price transmission.

### **1.8 Theoretical framework**

The basis of this study is the theory of perfect competition. According to the theory, a pure market is characterised by many small traders, full information, instant trading, ease of entry and exit, no transaction costs, and undifferentiated products. A rapid transmission of equal amounts of price increases or decreases between market levels leads to symmetry. Further, marketing costs only produce price differences (Areté srl, 2012). Arbitrage ensures similar pricing of products across market levels. Until prices equalize, trade is profitable when the price difference is adequate to cover marketing costs (Minot, 2010).

Many small traders ensure competition is high and greatest social and economic welfare, since no one controls the market. The seamless transmission of price changes between market levels is inhibited by market power (Kapeller & Puhringer, 2010; Minot, 2010). Perfect information enables a fast reaction to price changes and efficient arbitrage (Listorti, 2009). In theory, instant trading implies an instantaneous response to price signals, but lags prolonge the adjustment of price changes. If two products are homogeneous, they are perfect substitutes. They attract uniform pricing at different market levels leading to perfect price transmission and market integration. However, if the products are differentiated in terms of quality, use, or origin, they attract different pricing. Thus, adjustment to changes in price varies and cause imperfect or absence of market integration (Minot, 2010).

### **1.9 Conceptual framework of vertical price transmission**

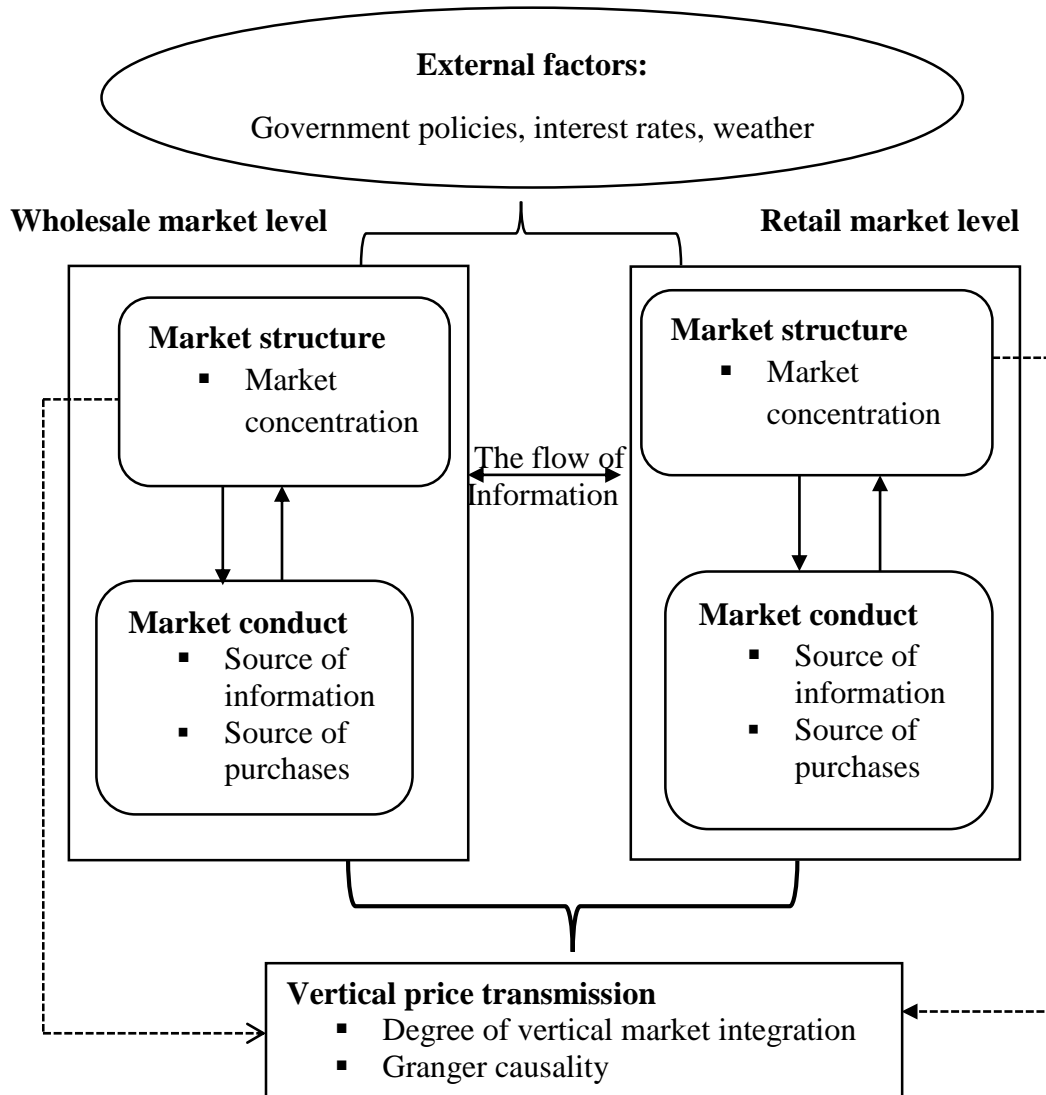
Figure 1.2 shows the relationship between variables influencing the Vertical Price Transmission (VPT). Distinct market structures and conduct at wholesale and retail market levels affect the VPT. Market structure influence market conduct and market conduct influences the market structure. Besides, market structure alone affects the VPT. The flows of market information connect wholesale and retail market levels. External factors influence the wholesale and retail market levels. Wholesalers and retailers cannot control the external factors.

In a pure competition, neither the wholesale market level nor the retail market level controls the market. Wholesale and retail market levels integrate because of smooth transmission of price changes. Concentration of either the wholesale or retail market level deters fair competition and full transfer of price signals. As a result, the transfer of price changes starts where market power is highest. The dominant trader becomes the price maker while the other takes the price (Areté srl, 2012; Ahn & Lee; 2015, Kharin, 2015).

Market structure affects market conduct which affects the degree of market integration and Granger causality (Weldesenebe, 2013). Complete and symmetric market information ensures that wholesale and retail market levels respond fast to price signals and maximise market opportunities. Inadequate information renders wholesalers and retailers unable to recognize and adjust to price changes. It results in inefficient market structures and the absence of market integration (Minot, 2010).

Trading between wholesale and retail markets leads to their prices interacting and influencing the level of market integration. Insignificant transactions between them leads

to minimal chances of price association. As a result, price fail to integrate or influence the direction causation (Mandizvidza, 2017).



**Fig 1.2: Conceptual Framework**

Source: Adapted from Weber & Henderson, (2012)

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.0 Introduction

This chapter reviews studies about vertical price transmission. First, the chapter describes the concept of price transmission and market integration. Second, it describes methods used to analyse market integration. Third, it presents the concept of Granger causality. Fourth, it gives a description of market structure and conduct. A review of empirical studies on vertical price transmission follows. Last, it discusses the gaps in the literature review.

#### 2.1 Market integration

Price transmission relates to transferring price changes from one market to another related market. Transmission elasticity measures the percentage change in the price in a market given a one percent change in price in another related market (Jena, 2016). Price transmission can be broadly classified as horizontal or vertical. Horizontal or spatial price transmission refers to price transmission between different marketing locations. Horizontal or spatial market integration is the co-movement prices in different locations. On the contrary, vertical price transmission refers to the pass-through of price changes along marketing stages. It is concerned with the direction, speed, magnitude, and nature of price transmission. Hence vertical market integration is the co-movement of price changes in different market levels (Rashid et al. 2010). Vertical price transmission is the focus of this study.

Markets integrate when price changes between markets move together. It signifies interdependence between markets. A complete transfer of price changes between markets

leads to full market integration. The absence of price transmission segments markets (Jena, 2016). Market integration is the bed-rock upon which markets become efficient. It ensures effectiveness of policies aimed at stabilization of prices and balancing regions with food surplus, food deficit, and those producing non-food cash crops (Adenegan & Bolarinwa, 2010; Varela et al. 2013). However, several factors can impede vertical market integration including product homogeneity, market power, and availability of market information (Conforti, 2004; Listorti, 2009); Minot, 2010). Markets integrate with similar pricing of undifferentiated products across different marketing levels. Further, the domination of a single or a few players inhibits the smooth flow of information reducing integration. Inadequate or incorrect information prevents prompt response to price signals necessary for integration.

## **2.2 Testing vertical market integration**

Several methods measure market integration and produce varied results. These methods include correlation analysis, dynamic regression models, and switching regime analysis (Listorti, 2009; Listorti & Esposti, 2012).

### **2.2.1 Correlation analysis**

According to Fackler & Goodwin (2001), correlation analysis is the oldest method used to measure market integration. The basis of the method is prices moving together correlate. Markets that fully integrate have a correlation coefficient equal to one while those that do not integrate have coefficient equal to zero (Minot, 2010). Correlation analysis is one of the easiest methods to use due to its simplicity and only requires price series data. Nevertheless, only two variables can be analysed at a time. Furthermore, it does not

consider the non-stationary nature of price series data. This method also assumes transmission and reaction to price changes is instant, but in reality, time elapses (Minot, 2010).

### **2.2.2 Dynamic regression models**

Dynamic regression models use the Vector Auto-Regression (VAR) model. Contemporaneous and lagged values of prices, represent price linkages between markets. Cointegration analysis and Ravallion (1986) model fall under this category (Listorti, 2009).

#### **2.2.2.1 Ravallion (1986) model**

This method assumes a central market exists from which a radial structure of price relations develops with other related markets. The central market is a point of reference for all market prices. Prices in one market are influenced by its own lagged values and contemporaneous and lagged prices of related markets (Ravallion, 1986). According to Barret (1996), the central market hypothesis does not always hold because direct trading and the flow of trade between markets in successive seasons can reverse.

#### **2.2.2.2 Co-integration analysis**

A time series cointegrates when there is a stationary linear combination of two or more non stationary variables. The variables move closer and together in the long-run though in the short-run, they could drift apart (Abu, 2015). A time series is integrated of order  $d$ ,  $I(d)$ , if it becomes stationary after being differenced  $d$  times. A stationary time series is written as  $I(0)$  and a non-stationary series is  $I(1)$  (Verreth et al. 2015).

A time series is stationary when its mean and variance remains static. If the mean and variance values keep changing over time, the series becomes non stationary. The use non

static data yields spurious regression coefficients (Minot, 2010). However, the cointegration of prices does not imply markets are efficient because cointegration analysis does not take into account transaction costs (Listorti & Esposti, 2012).

The tests for cointegration is Engle and Granger two-step procedure and Johansen cointegration test. Engle and Granger (1987) test is a pair-wise approach. In the first phase, Ordinary Least Square (OLS) of non-stationary series is formulated to estimate long-run relationship. Residuals from step one are lagged in the second stage, and tested for the order of integration and used as error correction terms in error correction models (Götz et al. 2014). Johansen's (1988) cointegration test, on the contrary, is a multivariate approach of the Dickey-Fuller test based on maximum likelihood estimation. It starts with Vector Auto-Regressive (VAR) model. The number of cointegrating vectors is determined with trace statistic and maximum eigenvalue tests (Enders, 2004) and shows the degree of market integration (Listorti & Esposti, 2012). Full market integration happens when the cointegrated vectors are equal to  $n - 1$ . Weak integration occurs when cointegration vectors are less than  $n - 1$ . The number of variables is denoted by  $n$  (Chang, 2000).

The choice of which variable is dependent or independent in Engle and Granger method may give misleading results. It requires prior knowledge of which variable is dependent or not (Vavra & Goodwin, 2005). On the contrary, all variables are considered endogenous in Johansen's approach which is adopted for the study.

### **2.2.3 Switching regime models**

These models take into account both price and transaction cost data. Markets will only integrate if the differences in price are more than their cost of marketing. The models are

the Parity Bound Model (PBM) and Threshold Autoregressive (TAR) model (Rashid et al. 2010).

### **2.2.3.1 Parity Bound Model (PBM)**

Sexton et al. (1991) came up with three switching trade regimes using price data only. The model assumes transaction costs are endogenous and trade is unidirectional. Baulch (1997) later improved this model by including transaction costs and allowing reversal and discontinuity in the flows of trade. The regimes outline parity bounds where arbitrage conditions hold or not. In the first regime, the price difference equals the transfer cost and is at the parity bound. Arbitrage and trade are efficient, and prices co-move. The second regime is within the parity bound and prices do not co-move because the differences in price is less than the transfer cost (Baulch, 1997). Further, the inefficiency is caused by excesses in trade (Sexton et al. 1991). In the third regime, the price difference is outside the parity bound. This is because profitable trade opportunities are not being exploited (Baulch, 1997) or trade is negligible (Sexton, 1991). Shortcomings for PBM stems from pair-wise analysis and requires transaction cost data (Listorti, 2009).

### **2.2.3.2 Threshold Autoregressive (TAR) model**

This is a model used to analyse non-linear time series data. The model assumes there is a neutral band, caused by transaction costs, where arbitrage is non-existent. Deviations must exceed a predetermined threshold for prices to co-move. Prices will not integrate if the deviations are below the threshold. The thresholds give a regime-switching phenomenon as is with the PBM. Thresholds could be asymmetric (Goodwin & Piggot, 2001). The

limitations of this model are; it is bivariate (Meyer, 2008) and transaction costs are the only cause of threshold effects, but other causes like structural breaks exist (Listorti, 2009).

The PBM and TAR models need information on transfer costs, a parameter difficult to measure and find (Barret & Li, 2002; Maina, 2013).

From the aforementioned discussion, correlation analysis is the simplest method to test for market integration. However, it assumes instant adjustment to price changes while in reality, lags exist are present. The switching-regime models are more robust than correlation and cointegration analysis but need data on transaction cost, difficult to measure and access (Barret & Li, 2002). Therefore, this study adopted a cointegration analysis to test market integration because it provides information on both the short-run and the long-run relationship of variables. Price data is only requirement for analysis and is available (Rashid et al. 2010; Listorti & Esposti, 2012).

### **2.3. Granger causality**

Causality stems from the fact that future occurrences cannot cause what happened in the past. If variable Y causes variable X, then the past values of Y are vital in forecasting the values of X (Granger, 1969). Y is said to Granger-cause X if its past and contemporaneous values can be used to improve the prediction of future values of X (Ike, 2014). Co-integration implies the existence of a causal relationship in at least one direction (Granger, 1988).

The direction of causality determines who the price leader is in a market and pinpoints the nature of competition (market structure) (Revoredo-Giha & Renwick, 2012). A unidirectional causality exists if Y causes X or the vice versa, but not the reverse. It shows

non-cooperative behaviour (Revoredo-Giha & Renwick, 2012) and suggests a lack of information synergy between market levels (Listorti, 2009). A bi-directional causality occurs when X causes Y or Y causes X. This implies that Y and X increase each other's predictions. It is a likely indication of collusive behaviour among market agents (Revoredo-Giha & Renwick, 2012). There is independence when no causality exists (Ike, 2014).

The Price determination theory posits that causality moves downwards starting from the farm level but empirical results have varied. For instance, Kharin (2015) found that a unidirectional causality from retail to farm prices existed along the dairy supply chain in Russia, while Zheng's (2016) study of the US pork industry established a bi-directional causality at farm-retail-wholesale prices. It is therefore important to do a Granger causality test to determine the actual direction of price flow between market levels.

#### **2.4 Market structure and market conduct**

Market Structure refers to the organisation of a market in terms of market concentration, barriers to entry or exit, and product differentiation (Martin, 2012). It is improbable that market actors along a supply chain will gain from the expected benefits of the liberalized market when the prevailing market structures are not thoroughly assessed (Arias & De Franco, 2011). The existing market structure pushes market agents to behave in a certain manner in terms of pricing strategies, promotion strategies, and innovations. This is commonly referred to as market conduct (Zeberga, 2010).

Market concentration refers to the market share a firm possesses in an industry. It shows the intensity of competition in the market. As market concentration increase, the level of market competition decreases (Naldi & Flamini, 2014). Herfindahl-Hirschman Index

(HHI) is the most commonly used as a measure of market concentration because all firms in an industry are considered and it distinguishes each firm's market share. As the HHI value increases, competition decreases and market power increases (Ukav, 2017; de Gioia, 2017; OECD, 2018). The concentration of agents is a key indicator of market power which influences the degree of integration and direction of price transmission (Goodwin & Vavra, 2009). According to Chisanga et al. (2014), high concentration impedes competitive pricing even with the prevailing low cost of production in an industry, which ultimately causes higher prices. Analogously, it determines a firm's level of bargaining power which points to where commodity price is dictated. Meyer & von Cramon-Taubadel (2004) assert market power results in inefficient markets. Furthermore, a decrease in farm price is transmitted slowly or partly to consumers compared to when prices increase. Conversely, retail prices increase faster than they decline (Peltzman, 2000).

Product differentiation refers to varying and unique attributes a product possesses that makes it appealing to the target market. A perfectly competitive market is characterised by homogeneous products. These products are similarly priced at different market levels because they are perfect substitutes. Consequently, price changes will co-move across market levels. A difference in quality attributes leads to substitution of a product for another, thereby leading to imperfect or lack of vertical price transmission and market integration (Conforti, 2004; Minot, 2010).

Barriers to entry and exit are factors that limit market participation. They could be institutional, technical, or economic factors (Zeberga, 2010). For instance, government restrictions on cross-border trade prevent pass-through of price shocks from external

markets to the domestic market. Again, the lack of efficient information systems to relay price signals between market levels leads to slow and no response to price signals. Therefore, traders are not able to take advantage of profitable market opportunities in time (Minot, 2010).

## **2.5 Reviews of empirical studies**

Several studies on price transmission in the agricultural sector have been done in the past using different methodologies. The studies have focused on particular commodities, produced specific results, and led to the generation of specific policies to enhance market integration and market efficiency. Studies on price transmission are reviewed in this section.

Ojiako et al. (2013) studied the spatial market integration and price transmission of gari markets in Nigeria. The study used weekly price data from the thirty-seventh week of 2004 to the twenty-eighth week of 2006. Cointegration analysis was utilised to assess market integration between the urban and the rural gari market. The results showed that these markets were integrated. The urban market responded faster to price shocks compared to the rural market. There was a unidirectional Granger causality from rural to urban gari market. Both this study and the present study are similar in that cointegration analysis is used to examine market integration. However, spatial integration is assessed in this study while vertical integration is the focus of the current study. Additionally, market structure and conduct was not examined but it is assessed in the present study to give possible explanations for the findings of market integration and Granger causality.

In Iran, Hosseini & Khalifehmahaleh (2013) studied the market structure and price adjustments in the tea market using annual price data from 1977 to 2011. Cointegration analysis showed a long-run relationship between on-garden and retail prices and between on-garden and wholesale prices. The error correction model affirmed the existence of price asymmetry between on-garden and retail prices and between wholesale and retail prices. However, there was a symmetry between on-garden and wholesale tea prices. Granger causality results indicated farm prices Granger caused wholesale and retail prices and wholesale prices Granger caused retail prices. The tea market structure was assessed using the Herfindahl-Hirschman Index (HHI) and concentration ratios. The results showed the presence of monopoly in tea processing plants which caused asymmetric price transmission from the farm to wholesale and to retail market levels. This study, just like the present study, examines vertical price transmission and market structure. This study used both HHI and concentration ratios to examine the market concentration, unlike the current study that only uses HHI. However, market conduct is not examined like in the current study. Furthermore, three market levels (on-garden, wholesale, and retail) are examined in this study, but the present study uses only two market levels (wholesale and retail).

Chege et al. (2014) evaluated the effect of exchange rate volatility on French bean exports from Kenya to the European Union market using monthly data from January 1990 to December 2011. The objective of the study was to determine the magnitude and direction of causality between the volumes of French beans exports and exchange rate volatility. The Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests for unit roots and the Johansen cointegration test was used. The results of the study indicated a negative long-run relationship between exchange rate volatility and demand for French bean exports.

There existed a more than proportionate decrease in demand for French bean exports in the European Union when the Kenyan shilling exchange rate volatility increased. Further, 77% of deviations from equilibrium were corrected in a month. Both this study and the current study use the Johansen cointegration test to determine the level of cointegration. However, the focus of this study is spatial price transmission while the focus of the present study is vertical price transmission.

Laibuni & Omiti (2014) analysed the relationship between price and market structure in Kenya's Irish potato markets. The study focused on two production markets (Nakuru and Eldoret) and two consumption markets (Nairobi and Mombasa). Wholesale monthly data from January 1998 to May 2011 was used. The key objectives of the study were to examine price trends in production and consumption areas and to assess the relationship between prices and market structure of Irish potatoes. Vector Error Correction Model showed the four markets were integrated and had a long run relationship, but the price transmission was incomplete as it ranged between 25 and 29 percent. The Granger causality test indicated unidirectional Granger causality from Mombasa to Eldoret prices. The assessment of market structure showed the Irish potato market was oligopolistic where a few rural brokers and transporters controlled the market. The urban market was controlled by brokers who linked wholesalers to retailers, thereby posing as barriers to entry. This study is similar to the current study in that market structure, market conduct, Granger causality, and market integration is assessed. However, this study focuses on spatially located markets while the focus of the current study is marketing levels.

Musyimi & Bauer (2016) examined regional market integration and price transmission in eight supply and consumer maize markets in Kenya, Tanzania, and Uganda. Monthly wholesale prices from 2006 to 2014 were used. The threshold autoregressive (TAR) cointegration technique was employed to analyse spatial market integration. All the selected markets were found to be integrated. It took between 2 and 11 months for all the price shocks to be transferred from one market to another. Improvement of road networks in rural areas, market information systems, and irrigation schemes was identified as factors that could improve market integration. The use of TAR only allows pairwise analysis of market prices therefore it does not give a general overview of the entire maize marketing system. Transaction cost data is not available, hence the present study uses Johansen cointegration procedures which only requires price data.

In Kenya, Olila et al. (2016) assessed cointegration and Granger causality in indigenous egg markets, namely Nakuru, Nairobi, Eldoret, and Kisumu. Weekly egg prices for the year 2014 were used. The main objective of the study was to determine the degree of market integration. The Johansen cointegration approach was used to test for integration while the Granger causality test was used to determine the direction of price flow. The results of the study revealed that the four indigenous egg markets were integrated. There was a unidirectional Granger causality from Kisumu prices to Eldoret prices while no other market pairs exhibited Granger causality. Distance between markets, access to market information, and availability of credit facilities were mentioned as possible causes of market integration and direction of causality. Just like in this study, the present study uses both the Johansen test for cointegration and Granger causality whose results are complemented by an examination of traders' market structure and conduct. Nevertheless,

spatial price transmission was assessed in the study while the current study analyses vertical price transmission.

Siahi et al. (2018) analysed vertical price transmission in Kenya's sugar supply chain at ex-factory, wholesale, and retail market levels. The study used monthly data from 2003 to 2014. The objectives of the study were to determine the short-run relationships, long-run relationships, and the nature of price transmission between ex-factory, wholesale and retail market levels. Dickey-Fuller test, Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test, and Phillips-Perron (PP) tests showed that the price series were non-stationary. The Granger causality test indicated unidirectional Granger causality from ex-factory prices to wholesale prices and from ex-factory prices to retail prices. Johansen's cointegration test showed no evidence of cointegration between producer, wholesale, and retail sugar market levels. Both this study and the present study assess vertical price transmission. However, the current study not only considers price relations to explain market integration like in this study, but also examines the market structure and conduct to add on to the results from market integration and Granger causality test.

Gitau & Meyer (2019) studied horizontal price transmission in maize markets in Kenya under four policy regimes: fully liberalized maize sector, fertilizer subsidy, import bans for all foodstuffs with genetically modified organisms (GMOs) and zero ratings of import tariff regimes using a vector error correction model (VECM). Monthly wholesale price data for nine markets from January 2000 to December 2016 were used. The markets included two surplus markets (Eldoret and Kitale) and seven deficit markets (Kisumu, Mombasa, Nakuru, Garissa, Machakos, Kisii, and Nairobi). The main objective of the study was to

determine the effects of policies on spatial price transmission between these maize markets. The results of the study showed faster transmission of price signals in the first regime which was characterised by little or no policy interventions compared to the second, third, and fourth regime. There was a strong, long-run relationship between surplus and deficit markets. On average, 0.72% of the price increment in surplus markets were transferred to deficit markets. This study focused on spatial wholesale maize markets and considered policy regime as the only explanation for price transmission, but the present study assesses vertical price transmission at wholesale and retail rice market levels and uses market structure and conduct to explain the transfer of price signals.

## **2.6 Gaps in the literature review**

From the above-reviewed literature, most international and local studies on price transmission and market integration have given more attention to spatial markets (Ojiako et al. 2013; Laibuni & Omiti, 2014; Chege et al. 2014; Olila et al. 2016; Musymi & Bauer, 2018; Gitau & Meyer, 2019). A few studies have focused on marketing levels in a commodity's supply chain (Hosseini & Khalifehmahaleh, 2013; Siahi et al. 2018). In Kenya, a majority of studies have been done on maize, the main staple food, with little attention to other staple food crops like rice (Musymi & Bauer, 2018; Gitau & Meyer, 2019). It is also apparent that the degree of market integration and direction of causality is closely tied to aspects of market structure and market conduct like access to market information and market power (Hosseini & Khalifehmahaleh, 2013; Laibuni & Omiti, 2014). Further, there are conditions in the market that market actors cannot control, but significantly affect market integration and Granger causality like government policies (Chege et al. 2014; Musymi & Bauer, 2018; Gitau & Meyer, 2019). Therefore, this study

assessed vertical price transmission with a particular focus on rice, which is the third most important staple food in Kenya at wholesale and retail market levels (MOA, 2009; Atera et al. 2018). The rice market structure and conduct were also comprehensively examined to augment the findings of vertical price transmission.

## CHAPTER THREE

### RESEARCH METHODOLOGY

#### 3.0 Introduction

This chapter outlines the methods used to collect and analyse data. It describes the study site, research design, population, and sampling procedure. The chapter also describes the type of data collected, sources of data, and methods of data collection. Further, this chapter spells out empirical procedures used to analyse secondary and primary data.

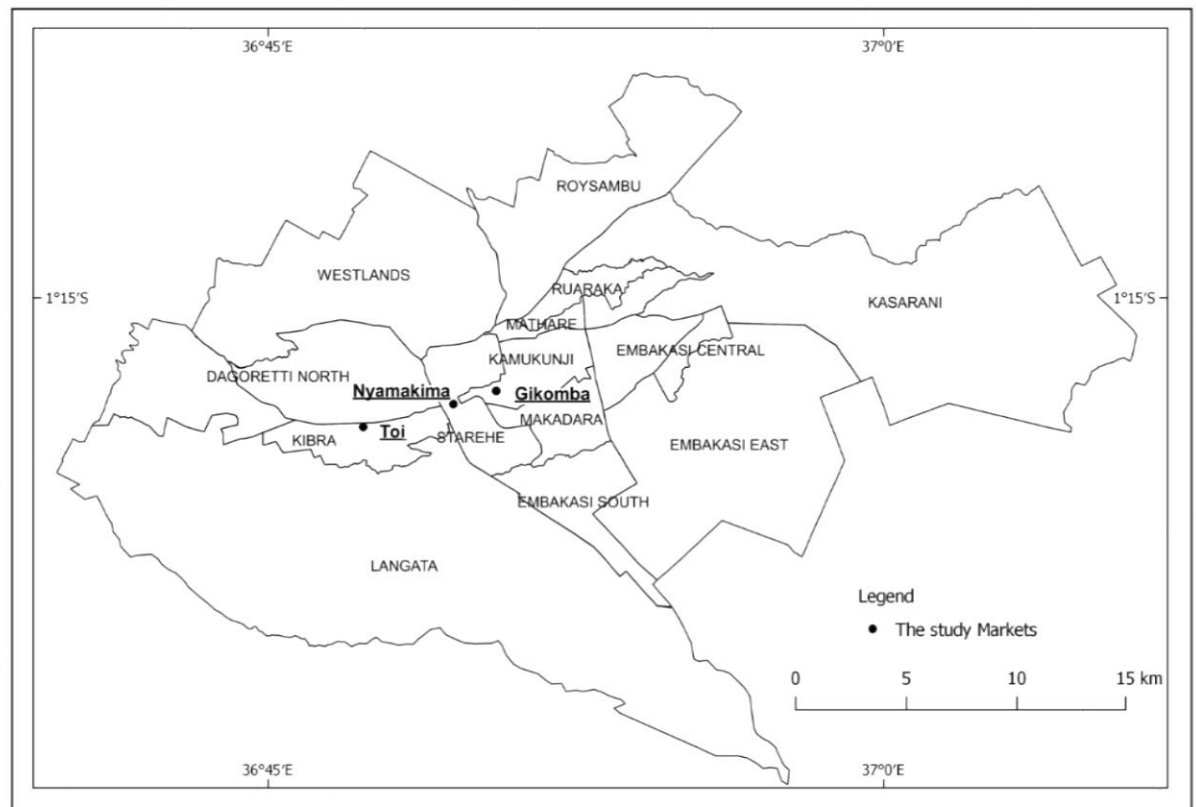
#### 3.1 Study area

The study was done in Nairobi City County, which lies between latitudes  $1^{\circ}18'$  and  $0^{\circ}40'$  South and longitudes  $36^{\circ}45'$  East. It occupies an area of  $696.1 \text{ KM}^2$  at an altitude of 1,798 M above sea level. To the South and East, it borders Kajiado and Machakos Counties respectively, and to the North and East, it borders Kiambu County (ROK, 2013). The agricultural sector contributes 24% to the county's Gross Domestic Product (GDP) hence a key source of food and employment to its population (Owuor et al. 2017). Nairobi City County is the largest capital city of Kenya with the highest population of 4.4 million people (KNBS, 2019). Besides, 60% of this population live in slums (APHRC 2014). Kibra constituency hosts one of the largest slums in the county characterised by the lowest income earners (Owuor et al. 2017).

The informal market accounts for 80% of food purchases in Nairobi City County (Tschirley et al. 2004). Cereal and grains, including rice make up 6% of these purchases (Ahmed et al. 2015). The informal markets comprise retail services performed in allocated market spaces and streets (UN-Habitat, 2006b) while the formal market consist of wholesaling

done in shops (van der Lans et al. 2012). Further, small scale wholesalers within the city acquire their supplies from large wholesalers and sell to wholesale markets surrounding the city (Owuor, 2017). Most retailers buy from the same formal wholesalers and farmers (Voley, 2013). Some retailers repackage their purchases into smaller units and resell. So, no obvious distinction between the functions of retail and wholesale markets (Amenya, 2007).

The Nairobi City County was chosen because it serves as a huge market for rice, which provides rice traders a lucrative trading opportunity (Kilimo Trust, 2013). Further, the study was conducted in Toi and Nyamakima markets. Nyamakima market was purposefully chosen because it is the largest grain market in the city. It also represents a formal rice market near the Central Business District (CBD) (Karoki et al. 2018). Toi market was also purposefully selected for being a critical informal rice market in one of the largest slums in Kenya, Kibra Constituency (Cardosi et al. 2015). The two varied marketing environments offer an incentive for trading in rice.



**Figure 3.1 Map of study area Nairobi City County**

### **3.2 Research design**

The study employed both longitudinal and cross-sectional survey approach. A longitudinal survey was useful in the collection and analysis secondary of data over a lengthy period. The study used weekly wholesale and retail rice prices for the year 2016 from January to December to analyse the degree of vertical market integration and direction of causality.

A cross-sectional survey design was used to collect primary data through questionnaires. The data gave a snapshot of the rice market structure and conduct in the Nairobi City County. Besides, the data were important in explaining the degree of vertical market integration and direction of causality (Mugenda, 2008; Saunders et al. 2009).

### 3.3 Population, sample size, and sampling design

Market reconnaissance showed Nyamakima and Toi markets had 84 and 21 rice traders respectively. The total target population (N) was therefore 105 rice traders.

The sample size consisted of wholesalers and retailers in Nyamakima and Toi markets. The total sample size was determined using the formula below according to Kothari (2004):

$$n = \frac{Z^2 pqN}{e^2(N-1) + Z^2 pq} \dots\dots\dots 3.1$$

Where

n=sample size,

$Z^2$ =standard variate at 95% confidence level (1.96),

p= probability of event = 67%,

q= 33%,

e=the margin of error at 5%

N=the population of rice traders in Nyamakima and Toi

This gave a total sample size of 80 rice traders who were proportionately allocated to Toi and Nyamakima markets using the formula below as outlined by Kothari (2004):

$$n_i = n \times \frac{P_i}{N} \dots\dots\dots 3.2$$

Where;

$n_i$ = Sample size of the specific market,

$n$ = desired sample size,

$P_i$ = Population of the specific market,

$N$ = total population of rice traders in Nyamakima and Toi markets.

The sample size for Nyamakima and Toi markets was 64 and 16 rice traders respectively. According to Market Masters in Nyamakima, wholesalers make up 69% of the market while 31% is retail (Kamau & Azziz, personal communication, March 12, 2018). Thus, there are approximately 44 ( $\frac{69}{100} \times 64 = 44.16$ ) wholesalers and 20 ( $\frac{31}{100} \times 64 = 19.84$ ) retailers. Wholesalers and retailers were sampled randomly from a list provided by Market Masters, and interviewed. In Toi, according to market masters, there are four rice wholesalers while the rest of the traders are retailers (Okoth & Were, personal communication, May 5, 2018). Random sampling method was used to interview 4 wholesalers and 12 retailers.

### **3.4 Types, sources and collection of data**

Secondary data comprised the average prices of local rice (aromatic and non-aromatic) (Atera et al. 2018) at wholesale and retail market levels. The high tendency among rice traders to blend rice varieties to elevate the price of non-aromatic rice varieties and also to lower prices of aromatic rice informed this (MOA, 2009). Price data from the first week of January until the last week of December 2016 were acquired in the year 2017 from the Regional Agricultural Trade Intelligence Network (RATIN). This gave 52 observations averaged from daily price data for every week. Prices were measured in Kenya shillings

per kilogram (Ksh/Kg) per week. It was then used to find the level of market integration and direction of causality in E-views 9.

A questionnaire was used to acquire primary data from rice wholesalers and retailers in Nyamakima and Toi markets in 2018. Data captured socioeconomic, market structure, and market conduct characteristics. A pilot test was done in Gikomba market, another major rice market, using 10 respondents. (Karoki et al. 2018). The data was analysed using SPSS 20. The results were useful in explaining the level of market integration and the direction of price causality.

### **3.5 Methods of data analysis**

#### **3.5.1 Assessment of the degree of vertical market integration between wholesale and retail rice markets**

The degree of market integration between wholesale and retail rice market levels in the Nairobi City County were tested with cointegration method. The method aimed at testing the null hypothesis that wholesale and retail rice market levels were not integrated. The initial step was to perform unit root tests to find the order of integration of wholesale and retail rice price series.

##### **3.5.1.1 Unit root test**

Generally, price time-series data is not static and when used for regression, it leads to spurious results. Therefore, the first step was to perform unit root tests to check for stationarity of wholesale and retail rice prices (Vavra & Goodwin, 2005). According to Enders (2010) and Greene (2012), the use of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests ensure that results are robust. Thus, the study used the

two tests to test for stationarity at level and after first differencing. An extrapolation was used to fill in missing data points. The Schwarz Information Criterion (SIC) was used to choose the optimal lag length, to ensure error terms were serially uncorrelated (Nkoro & Uko, 2016). Prices were transformed into logarithms to prevent individual series from fluctuating over time (Kharin, 2017).

### 3.5.1.1.1 Augmented Dickey-Fuller (ADF) test

Augmented Dickey-Fuller (ADF) test extends the Dickey-Fuller test by adding the first differenced terms of the dependent variables to eradicate serial correlation of error terms. However, the choice of lag values included in the model influences its validity. The test will have autocorrelation if the probability value is too low. Further, the test will be of low power if the probability value chosen is too large (Arltová & Fedorová, 2016). According to Verreth et al. (2015), the ADF test equation is computed as;

$$\Delta z_t = \beta_1 + \beta_2 t + \delta z_{t-1} + \sum_{i=1}^k a_i \Delta z_{t-i} + \varepsilon_t \dots\dots\dots 3.3$$

Where  $\Delta$ =difference operator,  $\beta_1$ =constant and also a drift parameter,  $\beta_2$ =coefficient of time trend,  $z_t$ =variable series (wholesale and retail rice prices),  $\kappa$  =lag order,  $\varepsilon$  = error term,  $t$  = time variable,  $z_{t-1}$  = lagged values of  $z_t$  that are integrated of order one,  $\Delta z_t = z_t - z_{t-1}$ = first differences of  $z_t$ ,  $\delta$ = coefficient of  $z_{t-1}$

The ADF unit root test examines three models; pure random walk without drift, random walk with drift, and deterministic trend with a drift (Pfaff, 2006).

A pure random walk without drift equation is achieved when the constraints  $\beta_1 = 0, \beta_2 = 0$  and  $\delta = 0$  are used. The equation neither has a trend nor an intercept. The variance increases with time, hence represent a non-stationary series.

$$\Delta z_t = \Delta z_{t-1} + \varepsilon_t \dots\dots\dots 3.4$$

A random walk with drift equation has the restrictions  $\beta_2 = 0$  and  $\delta = 0$ . It has an intercept but no trend.

$$\Delta z_t = \beta_1 + \Delta z_{t-1} + \varepsilon_t \dots\dots\dots 3.5$$

The equation becomes a deterministic trend with drift when  $\beta_2 \neq 0$ . It has both an intercept and trend.

$$\Delta z_t = \beta_1 + \beta_2 t + \Delta z_{t-1} + \varepsilon_t \dots\dots\dots 3.6$$

The null hypothesis is  $H_0: \delta = 0$  (non-stationary) against an alternative objective  $H_1: \delta < 0$  (stationary). The null hypothesis is rejected if the test statistic is less than its critical value.

This shows absence of a unit root in  $z_t$  (wholesale/retail price series) and integration of order 1.

**3.5.1.1.2 Phillips-Perron (PP) test**

Phillips-Perron (PP) test uses non-parametric modification of the t-test statistic to take care of serial correlation. The Newey–West (1987) heteroscedasticity test for auto-correlation and heteroscedasticity (Asteriou & Hall, 2015). The asymptotic distribution of the PP test is like that of the ADF test. The PP test does not need specification of the lag length like in the ADF test to correct serial correlation. It is affected by low power and works better in

large samples (Arltova & Fedorova, 2016). The null hypothesis for the PP test is that wholesale and retail prices are non-stationary.

The PP test equation applied was;

$$\Delta z_t = \theta + \delta z_{t-1} + \varepsilon_t \dots \dots \dots 3.7$$

Where  $z_t$ =variable series (wholesale and retail rice prices),  $\theta$ = constant term,  $\delta$ = coefficient of wholesale and retail price series,  $z_{t-1}$  = lagged values of  $z_t$  that are integrated of order one,  $\varepsilon_t$  is stationary error terms (Arltova & Fedorova, 2016).

**3.5.1.2 Co-integration tests for wholesale and retail rice prices**

A cointegration test is performed if wholesale and retail rice prices are found to be non-stationary. The presence of a stable long-run equilibrium in a series is measured by cointegration tests. In the short-run, a series may drift apart but in the long-run, they move together (Abu, 2015).

Granger causality and a Vector Error Correction Model (VECM) are determined if wholesale and retail prices are found to be cointegrated. Granger causality test is only estimated if cointegration is not found (Kharin, 2015).

The study used Johansen's (1988) procedure to test for cointegration because it is not affected by the choice of the dependent variable. All variables are taken to be endogenous. The method also allows for the determination of more than one cointegrating relationship (Bakucs & Ferto, 2005). The starting point is a vector Auto-Regression (VAR) of lag length  $p$ , modeled below according to Ojiako et al. (2013):

$$Z_t = \mu + A_1 Z_{t-1} + A_2 Z_{t-2} \dots + A_p Z_{t-p} + \varepsilon_t \dots \dots \dots 3.8$$

Where  $Z_t = (k \times 1)$  vector of wholesale or retail rice prices,  $\mu = (k \times 1)$  vector of constant terms,  $p =$  number of lags,  $\varepsilon_t = (k \times 1)$  vector of normally distributed error terms,  $A_p = (k \times k)$  matrix of unknown parameters to be estimated,  $Z_{t-p} = (k \times 1)$  vector of  $i^{th}$  lagged values of  $Z_t$

By subtracting  $Z_{t-1}$  from both sides of the equation and where  $I$  represents  $(k \times k)$  identity matrix, the VAR in 3.8 becomes:

$$\Delta Z_t = \mu + (A_1 - I)\Delta Z_{t-1} + (A_2 + A_1 - I)Z_{t-2} + \dots + A_p Z_{t-p} + \varepsilon_t \dots \dots \dots 3.9$$

Equation 3.9 can be rewritten as a VECM in the following format:

$$\Delta Z_t = \mu + \sum_{i=1}^{p-1} \Gamma_i \Delta Z_{t-i} + \Pi Z_{t-p} + \varepsilon_t \dots \dots \dots 3.10$$

Where

$$\Gamma_i = -(I - \sum_{j=1}^i A_j), j = 1, 2, \dots, p - 1 \dots \dots \dots 3.11$$

$$\Pi = -(I - \sum_{i=1}^p A_i) \dots \dots \dots 3.12$$

$\Gamma_i =$  matrix of coefficients of short run adjustments to  $Z_t$ . The value ranges from zero to one with zero indicating absence of adjustment while one signifies instant adjustment;  $\Delta =$  first difference operator;  $\Pi =$  matrix of long run adjustments to  $Z_t$  and represent the number of co-integrating vectors ( $r$ ) and error correction component.  $\Pi = \alpha\beta$  when decomposed, where  $\beta$  is a matrix denoting the number of long run relations (co-integrating vectors) and shows the degree of vertical market integration. The coefficients of  $\beta$  are interpreted as price transmission elasticities when prices are expressed in logs;  $\alpha$  is a matrix denoting the

rate of adjustment (speed);  $\Delta Z_{t-1} = (k \times k)$  matrix of  $Z_{t-1}$  that are integrated of order 1,  $i = 1, 2, \dots, k - 1$  (Ojiako, et al. 2013).

Trace statistics and maximum eigenvalue test are used to estimate the number of cointegrating vectors according to Johansen's approach. Cointegrating vectors show the degree of market integration between wholesale and retail rice market levels (Jena, 2016).

$$\lambda_{\text{trace}}(r) = -P \sum_{i=r+1}^n \ln(1 - \chi_i) \dots\dots\dots 3.13$$

$$\lambda_{\text{max-eigenvalue}}(r, r + 1) = -P \ln(1 - \chi_{r+1}) \dots\dots\dots 3.14$$

Where  $r$  = number of cointegrating vectors,  $P$  = total sample size and  $\chi_i$  = largest  $i^{\text{th}}$  eigenvalue in  $\Pi$  (Matrix of long run adjustment).

The null hypothesis for trace test is that the cointegrating relations are less than or equal to  $r$  against the alternative hypothesis that more than  $r$  cointegrating relations exist. On the contrary, the null hypothesis of the maximum eigenvalue is that there are  $r$  cointegrating relations against the alternative hypothesis that there are  $(r + 1)$  cointegrating relations (Jena, 2016).

The number of variable series is denoted  $n$  while  $r$  denotes rank ( $\Pi$ ). The model can have a maximum of  $n - 1$  cointegrating relationships. If  $r$  is zero, then wholesale and retail prices will not be cointegrated and the model is a VAR in the first difference. Thus, no long run relationship exists between wholesale and retail markets and are not integrated. If  $0 < r < n$ , wholesale and retail rice markets are integrated. If  $r = n$ , it implies that wholesale and retail prices are stationary, therefore no need for a VECM. The model is taken to be a VAR in level (Chang, 2000).

### 3.5.2 Determination of the direction of causality between wholesale and retail rice market levels

The direction of price flow was determined with the Granger causality test. This objective hypothesized that wholesale price does not Granger cause retail price. According to Mandizvidza (2017), Granger causality is modelled as:

$$\ln W_t = A + \sum_{i=1}^n a_i \ln R_{t-i} + \sum_{i=1}^n b_i \ln W_{t-i} + \varepsilon_{t1} \dots \dots \dots 3.15$$

$$\ln R_t = B + \sum_{i=1}^n c_i \ln R_{t-i} + \sum_{i=1}^n d_i \ln W_{t-i} + \varepsilon_{t2} \dots \dots \dots 3.16$$

Where  $\varepsilon_{t1}$  and  $\varepsilon_{t2}$  are uncorrelated disturbances,  $n$  is the maximum lag length,  $a, b, c$  and  $d$  are coefficients,  $\ln$  is the natural logarithm of the price series,  $R_t$  is the retail price at time  $t$ ,  $W_t$  is the wholesale price at time  $t$ ,  $R_{t-i}$  is the lagged retail price,  $W_{t-i}$  is the lagged wholesale price,  $A$  and  $B$  are constant terms.

Unidirectional Granger causality from retail prices to wholesale prices means retail prices increase the prediction of wholesale prices and not the vice versa:  $\sum_{i=1}^n \alpha_i \neq 0$  and  $\sum_{i=1}^n d_i = 0$

Unidirectional Granger causality from wholesale prices to retail prices means wholesale prices increase the prediction of retail prices and not the vice versa:  $\sum_{i=1}^n \alpha_i = 0$  and  $\sum_{i=1}^n d_i \neq 0$

Bi-directional Granger causality means wholesale price increase prediction of retail prices and vice versa is also true:  $\sum_{i=1}^n \alpha_i \neq 0$  and  $\sum_{i=1}^n d_i \neq 0$

If wholesale prices and retail prices are independent, it means no Granger causality in any direction:  $\sum_{i=1}^n \alpha_i = 0$  and  $\sum_{i=1}^n d_i = 0$

### **3.5.3 Assessment of market structure and conduct of wholesale and retail rice market levels**

#### **3.5.3.1 Assessment of socioeconomic characteristics of wholesale and retail market levels**

The age in years, gender (male or female), highest level of education attained, and experience in years were the socioeconomic characteristics used for the study. They were all categorical data (Ike, 2014). Cross-tabulation was used to analyse the data (Kontogeorgos et al. 2015; Stoian et al. 2015). A wholesaler is a trader who sells rice from 25kg and above while a retailer sells for as little as  $\frac{1}{4}$ kg.

#### **3.5.3.2 Assessment of market structure of wholesale and retail rice market levels**

Market concentration, barriers to entry, and product differentiation were used in the assessment of the rice market structure. Percentages were used to examine barriers to entry and product differentiation. The Herfindahl-Hirschman Index (HHI) was used to determine the market concentration. The HHI was calculated by summing the squares of the market shares of firms in an industry (Naldi & Flamini, 2014).

$$HHI = \sum_{i=1}^N (S_i)^2 \dots\dots\dots 3.17$$

Where N is the total number of rice wholesalers or retailers and  $S_i$  is the share of the  $i^{\text{th}}$  rice wholesaler or retailer. The share of the  $i^{\text{th}}$  trader was modelled according to Naldi & Flamini (2014):

$$S_i = \frac{s_i}{\sum_i^n s_i} = \frac{\text{sale of } i^{\text{th}} \text{ trader per month in kg}}{\text{total sales of } N \text{ traders per month in kg}} \dots\dots\dots 3.18$$

The HHI value ranges from 0 and 1. A value of 1 shows pure monopoly while zero indicates pure competition. Values of less than 0.01 show negligible market concentration. Values between 0.01 and 0.15 indicate an absence of concentration. Values between 0.15 and 0.25 show moderate concentration and values above 0.25 indicate high market concentration (Naldi & Flamini, 2014).

### **3.5.3.3 Determination of market conduct of wholesale and retail rice market levels**

Market conduct include the mode of payment, pricing decisions, marketing strategies, and product development (Zeberga, 2010). These variables were broadly classified as buying characteristics, transport characteristics, selling characteristics, and sources of market information. This information was collected from rice wholesalers and retailers through questionnaires and analysed using frequencies.

## CHAPTER FOUR

### RESULTS AND DISCUSSIONS

#### 4.0 Introduction

This chapter presents the findings and discussions of the study. The chapter starts by presenting the descriptive statistics of wholesale and retail rice price data series. The determination of the order of integration of the price series follows. Further, the chapter discusses the findings of the degree of integration and direction of causality between wholesale and retail market levels. Besides, it describes the socioeconomic characteristics, market structure and market conduct of rice wholesalers and retailers. The sources of market information is discussed last.

#### 4.1 Descriptive statistics of wholesale and retail price series data

Table 4.1 shows descriptive statistics of wholesale and retail domestic rice prices, used for the study. The maximum and minimum prices for both wholesale and retail markets were recorded in December and March respectively.

**Table 4.1: Descriptive Statistics of retail and wholesale rice prices**

Variable series	Mean (Ksh/kg) per week	Standard deviation	Max (Ksh/kg) per week	Min (Ksh/kg) per week
Retail prices	122.67	21.63	154.00	90.00
Wholesale prices	96.79	12.04	120.00	79.50

Source: Author's Calculation, 2018

The high rice demand can be linked to the high prices in December festivities. Besides, it is the period when rice is planted hence low market supply. The minimum price in March coincides with the main harvest period which increases market supply.

#### 4.2 Determination of the order of integration of wholesale and retail rice prices

Table 4.2 shows the Augmented Dickey-Fuller (ADF) test results of wholesale and retail market price series at level and first differences. The null hypothesis is that wholesale and retail prices are not stationary. At level, test statistics for wholesale and retail rice prices are more than the critical values at 1%. Thus, the null hypothesis that wholesale and retail prices are non-stationary cannot be rejected. When the series is differenced once, the test statistics become less than the critical values. As a result, the null hypothesis of non-stationarity is rejected at 1% level of significance. Therefore, retail and wholesale prices become stationary after being differenced once and are integrated of order 1.

**Table 4.2: ADF unit root test results at levels and first differences**

ADF results at level (trend and intercept)			ADF results at the first difference (intercept)	
Variable series	Test statistic	Lags	Test statistic	Lags
Retail prices	-1.80	0	-5.33***	0
Wholesale prices	-2.35	0	-7.11***	0

\*\*\* indicates significance at 1%

MacKinnon, (1991) critical values at 1% level of significance:  $-4.14$  for trend and intercept only and  $-3.57$  for intercept only

Source: Author's calculations, 2018

The Phillips-Perron (PP) test was also conducted as a confirmatory unit root test. The null hypothesis is that wholesale and retail prices are non-stationary. Table 4.3 shows the results at level and first differences. The results show that the wholesale and retail rice prices at level are insignificant at 1% level of significance. Hence, the null hypothesis of non-stationarity is not rejected. However, the PP test statistic becomes less than the critical values after differencing once. Thus, the null hypothesis of a unit root is rejected. This

implies the wholesale and retail rice prices become stationary after first differencing. They are integrated of the first order.

**Table 4.3: Phillips-Perron (PP) test at levels and first differences**

PP results at level (trend and intercept)			PP results at the first difference (intercept)	
Variable series	Test statistic	Lags	Test statistic	Lags
Retail prices	-1.94	2	-5.30***	1
Wholesale prices	-2.37	0	-7.14***	3

\*\*\* indicates significance at 1%

MacKinnon, (1991) critical values at 1% level of significance:  $-4.14$  for trend and intercept only and  $-3.57$  for intercept only

Source: Author's calculations, 2018

The ADF and PP tests show similar results that wholesale and retail rice prices are non-stationary at level. However, the prices become stationary after being differentiated once.

As a result, wholesale and retail rice prices are integrated of order one,  $I(1)$ .

#### 4.3 Determination of the degree of vertical market integration

Table 4.4 shows the results of the trace test and the maximum-Eigen value statistic. The null hypothesis of no cointegration ( $r = 0$ ) for both tests is not rejected at 5% level of significance. This shows absence of cointegrating vectors between wholesale and retail rice prices. There is no cointegration between wholesale and retail rice prices. Thus, the wholesale and retail rice market levels in Nairobi City County are not integrated. Further, a Vector Error Correction Model (VECM) could not be formulated since no long-run relation exists.

Conforti et al. (2004) linked the absence of vertical market integration to imperfect market information among market participants. Poor market information leads to a slow or a lack of response to price signals and gainful opportunities between market levels. In addition,

Kharin (2015) argues market power along a supply chain causes the lack of market integration. Market power makes the market inefficient and uncompetitive by inhibiting the seamless flow of price changes between market levels.

**Table 4.4: Trace and maximum eigenvalue test results**

Null hypothesis	Alternative hypothesis	Test statistic	0.05 critical values
Trace statistic			
$r = 0$	$r > 0$	8.26	15.49
$r \leq 1$	$r > 1$	0.12	3.84
Maximum eigenvalue statistic			
$r = 0$	$r = 1$	8.14	14.26
$r = 1$	$r = 2$	0.12	3.84

Source: Author's calculation, 2018

This finding is similar to Bjørndal & Guillen (2018) research who attributed the lack of market integration to product differentiation. This is true in the Kenyan context, where local rice is easy to differentiate from imported rice. Kenya, is a net importer of rice. Imported rice is cheaper and of lower quality than domestic rice. Therefore, when prices of local rice are high or increase, imports provide a ready substitute (MOA, 2009; Atera et al. 2018). This creates unfair competition, distorts market prices, and reduces trading of local rice leading to no price transmission and no market integration between wholesale and retail market levels.

#### **4.4 Determination of the direction of causality between the wholesale and retail price**

Table 4.5 present Granger causality test results. The results show both p- values are insignificant at 5% level of significance. Hence, the null hypothesis that the wholesale price does not Granger-cause retail price is not rejected. Similarly, the null hypothesis that retail price does not Granger-cause wholesale price is not rejected. This indicates an independent

Granger causality between wholesale and retail rice market levels. Price changes in wholesale prices do not affect retail prices. Likewise, changes in retail prices do not influence wholesale prices.

**Table 4.5: Granger Causality test results between retail and wholesale prices**

Null Hypothesis	F-Statistic	Prob.
Wholesale price does not Granger-cause retail price	1.18	0.28
Retail price does not Granger-cause wholesale price	0.21	0.64

Source: Author's Calculation, 2018

These results are identical to those of Mohanasundaram & Karthikeyan (2015) and Mandizvidza (2017). Mandizvidza (2017) attributed independent granger causality to both wholesalers and retailers sourcing from similar suppliers and sources. This reduces trading between them, which limits price interactions and causal relationship between wholesale and retail prices.

#### **4.5 Examination of the role of market structure and conduct in vertical price transmission in rice markets in Nairobi City County**

##### **4.5.1 Descriptive statistics of socioeconomic characteristics**

Table 4.6 presents cross-tabulation analysis of gender by the type of trade in the rice market. The results show female traders dominate the rice market. Further most men are wholesalers while most women are retailers. This finding concurs with that of Atera et al. (2018) and MOA (2009) who found the rice market in Kenya is dominated by women.

The p-value of the Chi-square test is greater than the critical values at the 5% level of significance. This shows that there was no association between the type of trade and gender

in the rice market. Thus, the gender of rice traders was less likely to influence the type of trade.

**Table 4.6: Cross-tabulation of gender by type of trade**

		Gender			
		Male	Female	Total	
Type of trade	Retailer	Count	9	23	32
		Expected Count	12.0	20.0	32.0
		% within Gender	30.0%	46.0%	40.0%
	Wholesaler	Count	21	27	48
		Expected Count	18.0	30.0	48.0
		% within Gender	70.0%	54.0%	60.0%
Total		Count	30	50	80
		Expected Count	30.0	50.0	80.0
		% within Gender	100.0%	100.0%	100.0%
		Value	Degrees of freedom	Asymptotic Significance (2-sided)	
	Pearson Chi-Square	2.000 <sup>a</sup>	1	.157	
	Continuity Correction <sup>b</sup>	1.389	1	.239	
	Likelihood Ratio	2.036	1	.154	
	Linear-by-Linear Association	1.975	1	.160	
	N of Valid Cases	80			

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.00.

b. Computed only for a 2x2 table

Source: Author's calculation, 2018

Table 4.7 shows cross-tabulation of age by the type of trade in the rice market in Nairobi City County. The retail market had the oldest traders in the rice market. Further, the majority of retailers were aged between 26 and 33 years while wholesalers were aged between 50 and 57 years. Therefore, most retailers can be said to be in their productive ages while most wholesalers are old (Ike, 2014).

The Chi-square test p-value is greater than the critical value of 0.05. Consequently, the null hypothesis that age and type of trade are independent cannot be rejected. This implies no association between age and the type of trade in the Nairobi City County. Age does not have any effect on whether a trader is a retailer or a wholesaler.

**Table 4.7: Cross-tabulation of age by type of trade**

		Age					Total	
		26-33 years	34-41 years	42-49 years	50-57 years	Above 57 years		
Type of trade	Retailer	Count	6	9	9	6	2	32
		Expected Count	4.4	7.2	11.2	8.4	.8	32.0
		% within Age	54.5%	50.0%	32.1%	28.6%	100.0%	40.0%
Wholesaler		Count	5	9	19	15	0	48
		Expected Count	6.6	10.8	16.8	12.6	1.2	48.0
		% within Age	45.5%	50.0%	67.9%	71.4%	0.0%	60.0%
Total		Count	11	18	28	21	2	80
		Expected Count	11.0	18.0	28.0	21.0	2.0	80.0
		% within Age	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		Value	Degrees of freedom		Asymptotic Significance (2-sided)			
Pearson Chi-Square		6.583 <sup>a</sup>	4		.160			
Likelihood Ratio		7.278	4		.122			
Linear-by-Linear Association		1.166	1		.280			
N of Valid Cases		80						

a. 3 cells (30.0%) have expected count less than 5. The minimum expected count is .80.  
Source: author's calculation, 2018

Table 4.8 presents a cross-tabulation analysis of the level of education by the type of trade. All wholesalers and retailers had primary education. Most of the retailers had attained a secondary education while most wholesalers had tertiary education. Hence, wholesalers were more educated than retailers. The level of education is vital in the endowment of skills and the use of market information (Ngare, 2014; Phuu, 2016).

The null hypothesis of independence between the type of trade and level of education cannot be rejected. This is because the Chi-square test p-value is greater than the critical

value at 5%. Therefore no significant relationship exists between the type of trade and level of education. The level of education does not influence the type of trade.

**Table 4.8: Cross-tabulation of the level of education and type of trade**

		Highest level of education				
		Primary	Secondary	Tertiary	Total	
Type of trade	Retailer	Count	5	19	8	32
		Expected Count	6.4	15.2	10.4	32.0
		% within Highest level of education	31.3%	50.0%	30.8%	40.0%
	Wholesaler	Count	11	19	18	48
		Expected Count	9.6	22.8	15.6	48.0
		% within Highest level of education	68.8%	50.0%	69.2%	60.0%
Total	Count	16	38	26	80	
	Expected Count	16.0	38.0	26.0	80.0	
	% within Highest level of education	100.0%	100.0%	100.0%	100.0%	
	% within type of trade	20.5%	47.5%	32.5%	100.0%	
		Degrees of freedom				
		Asymptotic Significance (2-sided)				
	Value	2	.221			
Pearson Chi-Square	3.017 <sup>a</sup>	2	.220			
Likelihood Ratio	3.031	2				
Linear-by-Linear Association	.101	1	.751			
N of Valid Cases	80					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.40.  
Source: Author's calculation, 2018

Table 4.9 shows the cross-tabulation analysis of experience by the type of trade. A majority of wholesalers had experiences of between 1 and 10 years while most retailers had over 10 years of experience. Thus, retailers were more experienced than wholesalers. This finding agrees with results from Ike (2014) but contradicts that of Ngare (2014) who found wholesalers were more experience than retailers.

The p-value of the Chi-square test is greater than the critical value at 5% percent level of significance. Thus, the null hypothesis of independence between experience and the type of trade could not be rejected. This indicate the type of trade is not influenced by experience.

**Table 4.9: Cross-tabulation of the experience by type of trade**

		Experience				Total	
		Less than 1 year	Between 1-5 years	Between 5-10 years	More than 10 years		
Type of trade	Retailer	Count	3	12	7	10	32
		Expected Count	4.0	12.4	9.2	6.4	32.0
		% within Experience	30.0%	38.7%	30.4%	62.5%	40.0%
Wholesaler		Count	7	19	16	6	48
		Expected Count	6.0	18.6	13.8	9.6	48.0
		% within Experience	70.0%	61.3%	69.6%	37.5%	60.0%
Total		Count	10	31	23	16	80
		Expected Count	10.0	31.0	23.0	16.0	80.0
		% within Experience	100.0%	100.0%	100.0%	100.0%	100.0%
		Degrees of freedom		Asymptotic Significance (2-sided)			
Pearson	Chi-Square	Value	3	.196			
	Likelihood Ratio	4.647	3	.200			
	Linear-by-Linear Association	2.066	1	.151			
	N of Valid Cases	80					

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 4.00.  
Source: Author's calculation, 2018

## 4.5.2 Assessment of market structure

### 4.5.2.1 Market concentration at retail rice market level

Table 4.10 shows the Herfindahl-Hirschman Index (HHI) for the retail market level. The HHI value is between 0.15 and 0.25 which, according to Naldi & Flamini (2014), indicates

moderate concentration at the retail market. It implies the lack of perfect competition at the retail market. There is market power which inhibits the complete transfer of price signals to and from the wholesale market level. Also, it prevents symmetric flow of market information necessary in efficient response to price changes (Kharin, 2015). This explains the finding of no market integration and independent Granger causality between wholesale and retail market levels in Nairobi City County.

**Table 4.10: HHI for retail rice market level**

Quantity of rice sold (Kg/month)	Monthly sales of the $i^{\text{th}}$ firm ( $s_i$ )	Number of traders	Share of the $i^{\text{th}}$ firm $S_i = (s_i / 43485)$	HHI= $S_i^2$
100-500	3175	12	0.073	0.005
501-1000	1000	1	0.023	0.001
1001-1500	5160	4	0.119	0.014
1501-2000	11220	6	0.258	0.067
2001-2500	14010	6	0.322	0.104
2501-3000	5320	2	0.122	0.015
3001-3500	0	0	0.000	0.000
3501-4000	3600	1	0.083	0.007
Total	43485	32	1	0.213

Source: Author's calculation, 2018

#### 4.5.2.2 Market concentration at retail rice market level

Table 4.11 presents HHI for the wholesale rice market level. The HHI value is higher than 0.25 which implies high concentration at the wholesale market level (Naldi & Flamini, 2014). As a result, wholesalers control the market which leads to inefficient transfer of market information and price signals to and from retail market level. This results in the absence of market integration and Granger causality between wholesale and retail market levels in Nairobi City County.

**Table 4.11: HHI for wholesale rice market level**

<b>Quantity of rice sold (Kg/month)</b>	<b>Monthly sales of the i<sup>th</sup> firm (s<sub>i</sub>)</b>	<b>Number of traders</b>	<b>Share of the i<sup>th</sup> firm S<sub>i</sub> = (s<sub>i</sub> /136870)</b>	<b>HHI =S<sub>i</sub><sup>2</sup></b>
500-2,000	23,010	18	0.168	0.028
2,001-4,000	68,260	23	0.499	0.249
4,001-6,000	18,500	4	0.135	0.018
6,001-8,000	0	0	0	0.000
8001-10,000	27,100	3	0.198	0.039
<b>Total</b>	<b>136,870</b>	<b>48</b>	<b>1</b>	<b>0.334</b>

Source: Author's calculation, 2018

The study concludes that the wholesale and retail rice market levels are not competitive. There is significant market power at both levels, which hinders efficient price transmission and market integration. Nonetheless, the retail market level is more competitive than the wholesale market level because it has a lower HHI value. These results disagree with those of Ike (2014) with the Irvingia seed market in Nigeria who found wholesalers were more competitive than retailers. However, the results are akin to those of Ngare (2014) who found that maize and bean wholesalers were less competitive than retailers in the Central highlands of Kenya. The lower competition in wholesaling than in retailing means wholesalers are less efficient than retailers (Ngare, 2014).

#### **4.5.2.3 Product differentiation**

Product differentiation refers to unique attributes a product possesses which make it different and appealing to a specific market group. In general, the local rice is homogeneous except for a few differences brought by sorting, packaging, and grading mostly at the retail level. Most wholesalers (96%) sell rice without altering its state from the source.

#### **4.5.2.4 Barriers to entry**

Finances are important in starting and running a business. Most of the traders (66.2%) used their savings as start-up capital, others borrowed from the bank (18.8%) while 15% borrowed from friends and relatives. Access to formal credit from the banks and SACCO was limited due to high interest rates and the need for collateral like land title deeds and logbooks (Ayieko, 2014; Ngare, 2014; Phuu, 2016). The limited access to sufficient capital acts as a barrier to entry for traders, especially those without enough savings to start the rice business. Furthermore, it prevents existing traders from expanding business operations (Phuu, 2016).

The rice market in Kenya was liberalized since 1989 to allow free trade. However, the government still controls its activities through issuing trade licenses. Most of the traders (80%) had trade licenses that cost an average of Ksh 10,654 per year. The rest (20%) did not have trading licenses. However, they paid a market fee of Ksh 100 per week remitted to the local government authority. Further, traders need an annual medical test of Ksh 1,000 to handle human food. These government regulations do not allow free trading as they must be met before starting and while in business. Failure to which, the rice business may never exist or maybe de-registered or become illegal.

Traders have to pay rent averaging Ksh 17,553 per month, with the most being Ksh 60,000 and the least being Ksh 1,000. A trader is required to deposit up to three times the monthly rent before occupying a building for the first time. Traders cited that in most cases, the landlords refunded less than even half the deposit when exiting the shop citing repair costs.

Traders also pay watchmen fee of an average of Ksh 23 per night to secure their shops and goods. These fees pose barriers to entry.

The presence of barriers to entry indicates the rice market in Nairobi City County is neither purely competitive nor fully liberal. This provides an explanation for the absence of vertical market integration at wholesale and retail market levels and independent Granger causality.

### **4.5.3 Assessment of Market conduct**

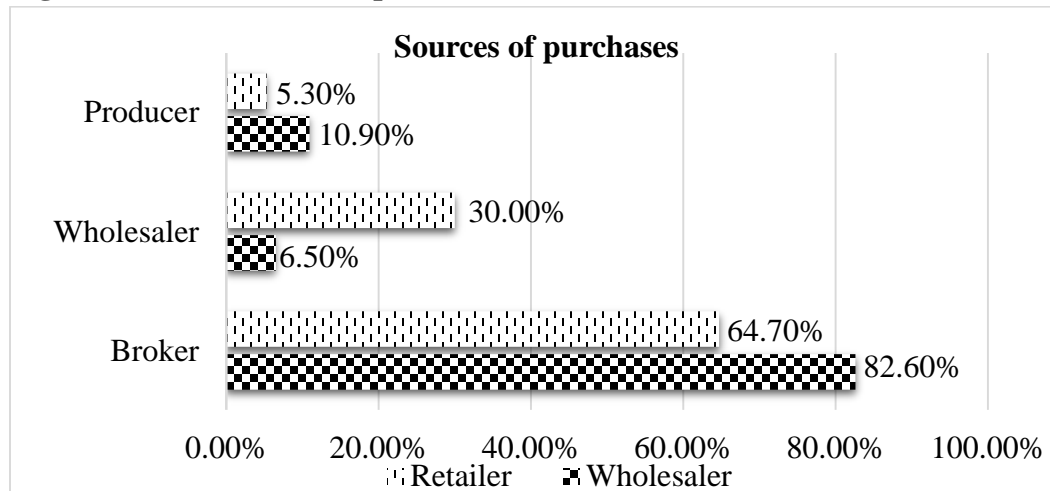
#### **4.5.3.1 Buying Characteristics**

Most traders (53%) made their purchases every week, 41% bought once a month while 6% made purchases in a fortnight. Physical cash payments were the most preferred by 92.3% of traders, while 7.7% used both credit and cash. Figure 4.1 shows the sources of purchases at wholesale and retail market levels. The majority of both wholesalers and retailers used rice brokers to source their purchases. As wholesalers and retailers share a similar source of supplies, the chances of their prices interacting reduce (Mandizvidza, 2017). Consequently, price changes at the wholesale market level do not have any effect on price changes at the retail market level. Likewise, price changes at the retail market level do not affect price changes at the wholesale market level. This explains the lack of market integration and independent Granger causality.

The results also show that rice wholesalers and retailers largely performed similar functions. According to Tollins (2000), this leads to inefficient allocation of resources, increased post-harvest losses and transaction costs, poor standardisation, and lack of a central market for produce. Consequently, the pass-through of market information along a

supply chain, both downstream and upstream is inhibited and cause the absence of market integration and independent Granger causality.

**Figure 4.1. Sources of rice purchases**



Source: Author's calculation, 2018

#### 4.5.3.2 Transport Characteristics

The majority of traders (63.8%), arrange for collective transport from the source with other traders while the rest (36.2%) arranges for transport singly. Collective transport arrangement reduces transport cost and fosters safety of goods during transport. Lorries were the most preferred mode of transport at 61.3%, followed by pickups at 32.5%, head-loads at 3.7%, and public passenger transport at 2.5%. Some traders (36%) owned vehicles used to transport their own and other traders' purchases. Head-loads, handcarts, and wheelbarrows were used for short distances like when offloading, loading, or purchasing from another trader in the market.

#### 4.5.3.3 Selling and storage Characteristics

All traders sold a variety of cereals apart from rice to spread risks. These cereals include beans, maize, groundnuts, and green grams. A majority of the traders (47.5%) did not do

any value addition, 35% sorted and cleaned the rice, 10% did packaging, and 7.5% graded. Traders cited that the sorting, cleaning, packaging, and grading involved mixing rice to reduce the price to enable local rice, which is expensive, to compete favourably with cheap imported rice.

Furthermore, most traders (97.5%) store rice in their shops or stalls only while 2.5% rented stores because their shops or stalls were smaller. Pest infestation was identified by 67.5% of traders as a major hindrance to storing large quantities of rice. Pests significantly contribute to huge post-harvest losses, especially when demand for local rice is low. Other factors that limited the quantities of rice stored included small sales at 15%, price volatility at 7.5%, high cost of renting stores at 5%, poor storage facilities at 2.5%, and theft at 2.5%.

Traders determined the selling price mainly through negotiations with buyers (39%), personalised arrangements with suppliers (37.2%), and forces of demand and supply (23.8%). Cash was found to be the most preferred mode of payment by traders (87.5%) when selling in the form of mobile money transfers or physical cash settlements. Both credit and cash payments were accepted by 15.6% of the traders. Credit arrangements were usually made upon payment of an agreed cash amount or depending on creditworthiness or long term relationship with buyers. Fair treatment was used by 81.3% of traders to attract customers while 11.3% used discounting, and 7.4% used a visible display of products.

The majority of wholesalers (62%) sell to traders from another market, 25% sell to consumers, 6.5% sell to traders in the same market and 6.5% sell to schools. On the other hand, 72.4% of retailers sell to consumers, 8.8% sell to other traders in the same market and 18.8 % sell to traders in another market. This shows that wholesale and retail rice

market level functions were not distinct where wholesalers also did retailing and retailers performed wholesaling.

#### **4.5.3.4 Sources of market information**

Access to reliable market information is important in rapid response to price signals between wholesale and retail market levels. The sources of market information included word of mouth from fellow traders (84%), daily newspapers (6%), mobile phones (5%), National Cereals and Produce Board (2%), and radio (2%). Ngare (2014) and Phuu (2016) also found that most traders used word of mouth to source information. This is attributed to ease of access and availability. Nonetheless, word of mouth does not provide traders with complete information to inform their marketing decisions. This hinders trader participation and reduce quantities traded. Further, price transmission is slowed or prevented (Ngare 2014; Phuu, 2016).

The above discussion gives a general overview of the rice market structure and market conduct in the Nairobi City County in relation to vertical price transmission. The market concentration (Minot 2010; Rashid et al. 2010, Kharin, 2015), sources of purchases (Mandizvidza, 2017) and sources of market information (Minot, 2010) among wholesalers and retailers explained the lack of market integration and independent Granger causality.

## CHAPTER FIVE

### SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

#### 5.0 Introduction

This chapter provides a summary & conclusions of findings from the objectives of the study. The chapter also outlines the policy implications that emanated from the results. Further, it presents propositions for further study.

#### 5.1 Summary and conclusion of findings from the determination of the degree of vertical market integration between wholesale and retail market levels

The determination of the degree of vertical market integration between the wholesale and retail market levels involved two steps. In the first step, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests, were used to establish the order of integration of wholesale and retail rice prices. Both tests showed that weekly wholesale and retail rice prices were integrated of order one,  $I(1)$ . In the second step, the Johansen cointegration test was used to determine the level of vertical integration. The trace statistic and maximum-Eigen values revealed the absence of cointegrating vectors between wholesale and retail prices. This implied the wholesale and retail rice market levels were not cointegrated. Therefore, the study concluded the wholesale and retail market levels in Nairobi City County were not integrated.

#### 5.2 Summary and conclusion of findings from the determination of causality between wholesale and retail market levels

The Granger causality test was applied in determining the direction of price causality between wholesale and retail market levels. The test revealed no causal relationship

between wholesale and retail prices. This led to the conclusion of independent Granger causality.

### **5.3 Summary and conclusion of findings from the examination of the role of market structure and conduct in vertical price transmission**

Cross-tabulation was used to describe socioeconomic characteristics at wholesale and retail rice market levels. The results revealed the retail market was dominated by female traders while the majority of male traders were wholesalers. Besides, the retailers were more experienced than wholesalers. Further, most wholesalers were older and more educated than retailers.

The Herfindahl-Hirschman Index (HHI) for the wholesale market level was 0.33 while the HHI for the retail market levels was 0.21. This indicated high concentration in the wholesale market and moderate concentration in the retail market. Therefore, both market levels had significant market power. Market power hinders the efficient transfer of price changes and market information between wholesale and retail market levels.

The assessment of market conduct showed wholesalers and retailers shared a similar source (brokers) for their rice purchases. This caused limited trading and price interaction between the wholesale and retail market levels. Consequently, there were minimal chances for price changes between wholesale and retail market levels to integrate or Granger cause one another. Furthermore, results indicated word of mouth was the main source of market information among traders. Even though the information is cheap and easily accessible, it could be distorted, unreliable, and asymmetric.

The study concludes the lack of market integration and presence of independent Granger causality between wholesale and retail rice market levels was due to presence of market power, use of a similar source of rice supplies, and use of word of mouth to source market information.

#### **5.4 Policy implications**

The major finding of this study was absence of market integration between the wholesale and retail rice market levels. This suggests the rice market is not competitive and inefficient. The government and Nairobi City County should develop policies that encourage the development of a centralised formal information system. This will enable traders to access up to date and accurate market information to enhance market competition and efficiency.

Traders should also be sensitised on the use of Information and Communication Technology (ICT) like cell phones to improve market integration. For instance, the provision of free subscription to a mobile phone-based market information services by the government. This will increase access to information that is more reliable than word of mouth. Further, cell phones improve efficiency by providing easy access to formal financial services through mobile money services and financial institutions.

#### **5.5 Propositions for further research**

A marketing system consists of many players whose functions collectively contribute to market integration and efficiency. Thus, research in the future should include other market actors like farmers, brokers, and importers for insights into a whole rice marketing system. Horizontal price transmission at wholesale and retail markets should also be explored.

Further, switching regime models which take into account both price data and transaction cost data should be used in future.

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### Appendix 1.1: Questionnaire for rice wholesalers and retailers

I am Irene Cheronon Letting, a student from Kenyatta University pursuing a Master of Science degree in Agribusiness Management. I am conducting a study on the role of market structure and market conduct on price transmission along the rice supply chain. Your participation in filling the questionnaires will be highly appreciated and the information obtained will be confidential.

#### TO BE COMPLETED BY THE INTERVIEWER

Trader name.....Name of the market..... Interview date.....

#### TO BE COMPLETED BY RESPONDENT

##### A. GENERAL INFORMATION

1 a) What type of trade do you engage in?

1=retail, 2=wholesale, 3=both

b) Which is the **MAIN** trade that you engage in?

1=retail, 2=wholesale

2. Gender of the trader: 1=male, 2=female

3. Age of trader:

A= 18 – 25, B= 26 – 33, C=34-41, D=42-49, E= 50 – 57, F=others, please specify

4. Which is the **HIGHEST** education level attained:

0=none, 1=primary, 2=secondary, 3=college/university

5. How long have you been in business? 1=less than 1 year, 2=between 1-5 years, 3=between 5-10 years, 4=more than 10 years

6. Where do you live? (Name of place)

##### B. FINANCIAL INFORMATION

7 a) How much did you use to start up your business?

b) What was the source of your **START-UP CAPITAL**?

1=loan 2=borrowing from friends and relatives, 3=own savings, 4=others, please specify

8 a) If the source of initial capital was a **LOAN/CREDIT**, where did you get it?

1=bank, 2= SACCO, 3= relatives/ friends, 4=informal lenders, 5= others, please specify

b) What conditions were needed for you to get the loan? **1=membership to a group/organization, 2=membership to SACCO, 3=Collateral, 4=others, please specify**

c) What can be done to improve access to loans/credit?

### C. MARKET INFORMATION

9 a) Where do you get market information?

Source of PRICE information	Tick where appropriate
daily newspaper,	
NCPB	
Word of mouth	
Mobile phone,	
radio	
Others, please specify	

b) What can be done to increase reliability of market information?

### D. BUYING CHARACTERISTICS

10 a) How do you source for rice? **1=collectively with other traders in the market, 2=singly, 3=other, please specify**

b) Please state the possible reasons for the choice in 12 a) above?

11. Where do you buy **MOST** of the local rice that you sell? **1=farm gate, 2= brokers, 3= wholesaler, 4=open air market, 5=other, please specify**

b) How **OFTEN** do you buy rice from the **MAIN** source? **1=daily, 2=weekly, 3= every two weeks, 4=monthly, 5= other, please specify**

12 a) Which units do you **MOSTLY** use when buying rice? **1= 10 kg, 2=25 kg bag, 3=50, 4=100 kg bag, 5=other, please specify**

b) What is the **average, number of bags** of rice that you **BUY** during each purchase? (Number)

13 a) What mode of payment do you **MOSTLY** use when **buying** rice? **1=cash, 2=credit, 3=both, 4=other, please specify**

b) If on **CREDIT**, how are credit arrangements made? **1=upon payment of half the price of quantities purchased, 2=upon completion of arrears of former purchases, 3=purchase of a certain quantity of goods, 4=other, please specify**

**14 a)** How are transport arrangements made? **1=singly, 2=collectively with other traders, 3=other, please specify**

b) Do you have your own means of transport? 1=Yes, 2=No

c) What mode of transport do you mostly use from the **MAIN** source to the market? **1=head load, 2=wheelbarrow, 3=hand drawn cart (mkokoteni), 4= lorry, 5=pick up, 6=public passenger transport, 7=other, please specify**

d) What determines the mode of transport chosen? **1=volume of goods, 2=availability, 3=weather conditions, 4= transport cost, 5=distance, 6=affordability, 7=other, please specify**

**15 a)** What is the average transport cost per bag from the source to the market? **Ksh.....per.....kg bag**

c) What is the cost of loading the bag of rice? Ksh

d) What is the average cost of off-loading the bag of rice? Ksh

**16 a)** Where do you store your rice? **1=in my shop/stall, 2=at home, 3=hired go-down, 4=own go-down, 5=rented house, 6=other, please specify**

b) What hinders you from storing a large quantity of rice? **1=high cost of renting a store, 2=small sales, 3=pest infestation, 4=lack of good storage facilities, 5=theft, 6=price volatility, 7=other, please specify**

### **E. SELLING CHARACTERISTICS**

**17** Who buys the **MOST** from you? **1=hotels and restaurants, 2=schools, 3=traders in this market, 4=hospitals, 5=traders from other markets, 6=processors, 7=consumers, 8=other, please specify**

**18. Apart from rice**, which other cereals do you sell? Please list them

**19 a)** What **UNIT** do you **MOSTLY** use when selling? **1=per one kg, 2= per 90 kg bag, 3=per 50 kg bag, 4=other, please specify combine with who buys**

b) **ON AVERAGE**, how much rice do you sell in a **WEEK**? Number of bags

c) What mode of payment do you use when selling rice? **1=credit, 2=cash, 3=both, 4=other, please specify**

**20.** How do you arrive at your selling rice? **1=negotiations with buyers, 2=negotiations with suppliers, 3=forces of demand and supply, 4=trade associations, 5=prices of other traders, 6=other, please specify**

**21. How do you ATTRACT more customers? 1=advertising, 2=discounting, 3=repackaging, 4=fair treatment, 5=other, please specify**

**22. Which value addition activities do you engage in? 0=none, 1=sorting and cleaning, 2=grading, 6=other, please specify**

**23 a) Do you have a trading license? 1=YES, 2=NO**

**b) How much is a trading license? Ksh**

**c) How often do you renew your trading license? 1=weekly, 2=monthly, 3=yearly, 4=other**

**24. Please indicate constraints that you encounter in marketing of rice.**

<b>Problems</b>	<b>Tick where appropriate</b>
Poor transport	
Limited access to formal credit	
Poor storage facilities	
Limited access to market information	
Theft	
Excess rainfall	

**Appendix 1.2 VAR Lag Selection Criteria**

<b>Lag</b>	<b>AIC</b>	<b>SIC</b>	<b>HQ</b>
0	-6.484691	-6.403591	-6.454615
1	-11.10514*	-10.86184*	-11.01491*
2	-11.06716	-10.66166	-10.91678

\* indicates lag order selected by the criterion at five per cent significance level.

Source: Author's calculations, 2018

**Appendix 1.3: Daily wholesale and retail price series for Nairobi City County**

<b>Market</b>	<b>Product</b>	<b>Country</b>	<b>Date</b>	<b>Retail</b>	<b>Wholesale</b>
Nairobi	Rice	Kenya	2016-01-05	106	91
Nairobi	Rice	Kenya	2016-01-07	100	90
Nairobi	Rice	Kenya	2016-01-08	100	90
Nairobi	Rice	Kenya	2016-01-11	100	90
Nairobi	Rice	Kenya	2016-01-13	101	91
Nairobi	Rice	Kenya	2016-01-14	111	91
Nairobi	Rice	Kenya	2016-01-15	111	91
Nairobi	Rice	Kenya	2016-01-19	116	91
Nairobi	Rice	Kenya	2016-01-20	111	91
Nairobi	Rice	Kenya	2016-01-21	111	91
Nairobi	Rice	Kenya	2016-01-22	113	92
Nairobi	Rice	Kenya	2016-01-25	110	90
Nairobi	Rice	Kenya	2016-01-26	110	90
Nairobi	Rice	Kenya	2016-01-27	111	91
Nairobi	Rice	Kenya	2016-01-29	105	88
Nairobi	Rice	Kenya	2016-02-01	107	92
Nairobi	Rice	Kenya	2016-02-02	106	91
Nairobi	Rice	Kenya	2016-02-03	105	90
Nairobi	Rice	Kenya	2016-02-04	102	90
Nairobi	Rice	Kenya	2016-02-05	100	90
Nairobi	Rice	Kenya	2016-02-08	102	92
Nairobi	Rice	Kenya	2016-02-09	100	90
Nairobi	Rice	Kenya	2016-02-10	100	90
Nairobi	Rice	Kenya	2016-02-11	105	90
Nairobi	Rice	Kenya	2016-02-12	105	90
Nairobi	Rice	Kenya	2016-02-15	106	91
Nairobi	Rice	Kenya	2016-02-16	107	92
Nairobi	Rice	Kenya	2016-02-17	107	92
Nairobi	Rice	Kenya	2016-02-18	102	92
Nairobi	Rice	Kenya	2016-02-19	97	92
Nairobi	Rice	Kenya	2016-02-22	102	92
Nairobi	Rice	Kenya	2016-02-23	102	92
Nairobi	Rice	Kenya	2016-02-24	102	92
Nairobi	Rice	Kenya	2016-02-25	102	92
Nairobi	Rice	Kenya	2016-02-26	99	92
Nairobi	Rice	Kenya	2016-02-29	102	92
Nairobi	Rice	Kenya	2016-03-01	97	92
Nairobi	Rice	Kenya	2016-03-02	102	92

Nairobi	Rice	Kenya	2016-03-04	90	80
Nairobi	Rice	Kenya	2016-03-07	90	80
Nairobi	Rice	Kenya	2016-03-11	90	80
Nairobi	Rice	Kenya	2016-03-14	90	80
Nairobi	Rice	Kenya	2016-03-15	90	80
Nairobi	Rice	Kenya	2016-03-16	90	80
Nairobi	Rice	Kenya	2016-03-17	90	80
Nairobi	Rice	Kenya	2016-03-18	95	80
Nairobi	Rice	Kenya	2016-03-21	90	80
Nairobi	Rice	Kenya	2016-03-22	88	79
Nairobi	Rice	Kenya	2016-03-23	93	79
Nairobi	Rice	Kenya	2016-03-24	90	80
Nairobi	Rice	Kenya	2016-03-29	92	81
Nairobi	Rice	Kenya	2016-03-30	90	80
Nairobi	Rice	Kenya	2016-03-31	95	80
Nairobi	Rice	Kenya	2016-04-05	100	80
Nairobi	Rice	Kenya	2016-04-06	100	80
Nairobi	Rice	Kenya	2016-04-07	90	80
Nairobi	Rice	Kenya	2016-04-08	98	79
Nairobi	Rice	Kenya	2016-04-12	95	80
Nairobi	Rice	Kenya	2016-04-13	98	79
Nairobi	Rice	Kenya	2016-04-14	100	80
Nairobi	Rice	Kenya	2016-04-15	100	80
Nairobi	Rice	Kenya	2016-04-18	100	80
Nairobi	Rice	Kenya	2016-04-19	100	80
Nairobi	Rice	Kenya	2016-04-20	100	80
Nairobi	Rice	Kenya	2016-04-21	100	80
Nairobi	Rice	Kenya	2016-04-22	100	80
Nairobi	Rice	Kenya	2016-04-25	100	80
Nairobi	Rice	Kenya	2016-04-26	100	80
Nairobi	Rice	Kenya	2016-04-27	100	80
Nairobi	Rice	Kenya	2016-04-28	100	80
Nairobi	Rice	Kenya	2016-04-29	100	80
Nairobi	Rice	Kenya	2016-05-03	100	80
Nairobi	Rice	Kenya	2016-05-04	100	80
Nairobi	Rice	Kenya	2016-05-05	100	80
Nairobi	Rice	Kenya	2016-05-06	105	80
Nairobi	Rice	Kenya	2016-05-09	100	80
Nairobi	Rice	Kenya	2016-05-10	100	80
Nairobi	Rice	Kenya	2016-05-11	100	80
Nairobi	Rice	Kenya	2016-05-12	100	80

Nairobi	Rice	Kenya	2016-05-13	100	98
Nairobi	Rice	Kenya	2016-05-16	105	98
Nairobi	Rice	Kenya	2016-05-17	105	98
Nairobi	Rice	Kenya	2016-05-18	105	98
Nairobi	Rice	Kenya	2016-05-19	100	98
Nairobi	Rice	Kenya	2016-05-20	100	98
Nairobi	Rice	Kenya	2016-05-24	105	98
Nairobi	Rice	Kenya	2016-05-25	109	97
Nairobi	Rice	Kenya	2016-05-26	115	98
Nairobi	Rice	Kenya	2016-05-27	115	98
Nairobi	Rice	Kenya	2016-05-30	115	98
Nairobi	Rice	Kenya	2016-05-31	115	98
Nairobi	Rice	Kenya	2016-06-02	114	98
Nairobi	Rice	Kenya	2016-06-03	100	80
Nairobi	Rice	Kenya	2016-06-06	115	98
Nairobi	Rice	Kenya	2016-06-07	115	98
Nairobi	Rice	Kenya	2016-06-08	116	98
Nairobi	Rice	Kenya	2016-06-09	115	98
Nairobi	Rice	Kenya	2016-06-10	120	98
Nairobi	Rice	Kenya	2016-06-13	115	98
Nairobi	Rice	Kenya	2016-06-14	113	96
Nairobi	Rice	Kenya	2016-06-15	115	98
Nairobi	Rice	Kenya	2016-06-16	115	98
Nairobi	Rice	Kenya	2016-06-17	115	98
Nairobi	Rice	Kenya	2016-06-20	115	100
Nairobi	Rice	Kenya	2016-06-21	115	100
Nairobi	Rice	Kenya	2016-06-22	115	100
Nairobi	Rice	Kenya	2016-06-24	125	100
Nairobi	Rice	Kenya	2016-06-27	120	98
Nairobi	Rice	Kenya	2016-06-28	125	98
Nairobi	Rice	Kenya	2016-06-29	120	98
Nairobi	Rice	Kenya	2016-06-30	120	98
Nairobi	Rice	Kenya	2016-07-01	120	98
Nairobi	Rice	Kenya	2016-07-05	125	80
Nairobi	Rice	Kenya	2016-07-06	125	80
Nairobi	Rice	Kenya	2016-07-08	125	98
Nairobi	Rice	Kenya	2016-07-11	120	98
Nairobi	Rice	Kenya	2016-07-12	125	98
Nairobi	Rice	Kenya	2016-07-13	125	98
Nairobi	Rice	Kenya	2016-07-14	125	98
Nairobi	Rice	Kenya	2016-07-15	125	98


Nairobi	Rice	Kenya	2016-07-18	125	98
Nairobi	Rice	Kenya	2016-07-19	126	98
Nairobi	Rice	Kenya	2016-07-20	125	98
Nairobi	Rice	Kenya	2016-07-21	125	98
Nairobi	Rice	Kenya	2016-07-22	125	98
Nairobi	Rice	Kenya	2016-07-25	125	98
Nairobi	Rice	Kenya	2016-07-26	125	98
Nairobi	Rice	Kenya	2016-07-27	125	98
Nairobi	Rice	Kenya	2016-07-28	125	100
Nairobi	Rice	Kenya	2016-07-29	125	98
Nairobi	Rice	Kenya	2016-08-01	125	98
Nairobi	Rice	Kenya	2016-08-02	121	98
Nairobi	Rice	Kenya	2016-08-03	125	98
Nairobi	Rice	Kenya	2016-08-04	120	98
Nairobi	Rice	Kenya	2016-08-05	120	98
Nairobi	Rice	Kenya	2016-08-08	125	98
Nairobi	Rice	Kenya	2016-08-09	130	98
Nairobi	Rice	Kenya	2016-08-10	125	98
Nairobi	Rice	Kenya	2016-08-11	130	98
Nairobi	Rice	Kenya	2016-08-12	125	98
Nairobi	Rice	Kenya	2016-08-15	130	100
Nairobi	Rice	Kenya	2016-08-16	130	100
Nairobi	Rice	Kenya	2016-08-17	135	100
Nairobi	Rice	Kenya	2016-08-18	130	98
Nairobi	Rice	Kenya	2016-08-19	130	100
Nairobi	Rice	Kenya	2016-08-22	130	98
Nairobi	Rice	Kenya	2016-08-23	130	98
Nairobi	Rice	Kenya	2016-08-24	130	98
Nairobi	Rice	Kenya	2016-08-25	130	98
Nairobi	Rice	Kenya	2016-08-26	135	98
Nairobi	Rice	Kenya	2016-08-29	137	99
Nairobi	Rice	Kenya	2016-08-30	134	97
Nairobi	Rice	Kenya	2016-08-31	134	98
Nairobi	Rice	Kenya	2016-09-01	135	98
Nairobi	Rice	Kenya	2016-09-02	140	98
Nairobi	Rice	Kenya	2016-09-05	140	98
Nairobi	Rice	Kenya	2016-09-06	140	98
Nairobi	Rice	Kenya	2016-09-07	140	98
Nairobi	Rice	Kenya	2016-09-08	140	98
Nairobi	Rice	Kenya	2016-09-09	140	98
Nairobi	Rice	Kenya	2016-09-13	145	98

Nairobi	Rice	Kenya	2016-09-14	148	98
Nairobi	Rice	Kenya	2016-09-15	145	98
Nairobi	Rice	Kenya	2016-09-16	147	98
Nairobi	Rice	Kenya	2016-09-19	148	98
Nairobi	Rice	Kenya	2016-09-20	151	98
Nairobi	Rice	Kenya	2016-09-21	150	98
Nairobi	Rice	Kenya	2016-09-22	150	98
Nairobi	Rice	Kenya	2016-09-23	150	98
Nairobi	Rice	Kenya	2016-09-26	148	98
Nairobi	Rice	Kenya	2016-09-27	150	98
Nairobi	Rice	Kenya	2016-09-28	150	98
Nairobi	Rice	Kenya	2016-09-29	150	98
Nairobi	Rice	Kenya	2016-09-30	150	98
Nairobi	Rice	Kenya	2016-10-03	150	98
Nairobi	Rice	Kenya	2016-10-04	150	98
Nairobi	Rice	Kenya	2016-10-05	150	98
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Nairobi	Rice	Kenya	2016-10-07	150	98
Nairobi	Rice	Kenya	2016-10-10	150	98
Nairobi	Rice	Kenya	2016-10-11	150	98
Nairobi	Rice	Kenya	2016-10-12	150	98
Nairobi	Rice	Kenya	2016-10-13	150	98
Nairobi	Rice	Kenya	2016-10-14	150	98
Nairobi	Rice	Kenya	2016-10-17	150	98
Nairobi	Rice	Kenya	2016-10-18	150	105
Nairobi	Rice	Kenya	2016-10-19	150	105
Nairobi	Rice	Kenya	2016-10-24	150	110
Nairobi	Rice	Kenya	2016-10-25	150	110
Nairobi	Rice	Kenya	2016-10-26	150	115
Nairobi	Rice	Kenya	2016-10-27	150	115
Nairobi	Rice	Kenya	2016-10-28	150	115
Nairobi	Rice	Kenya	2016-10-31	150	115
Nairobi	Rice	Kenya	2016-11-01	148	115
Nairobi	Rice	Kenya	2016-11-02	150	115
Nairobi	Rice	Kenya	2016-11-03	150	115
Nairobi	Rice	Kenya	2016-11-04	150	115
Nairobi	Rice	Kenya	2016-11-07	150	115
Nairobi	Rice	Kenya	2016-11-08	150	115
Nairobi	Rice	Kenya	2016-11-09	150	115
Nairobi	Rice	Kenya	2016-11-10	150	115
Nairobi	Rice	Kenya	2016-11-11	150	115

Nairobi	Rice	Kenya	2016-11-14	150	115
Nairobi	Rice	Kenya	2016-11-15	150	115
Nairobi	Rice	Kenya	2016-11-16	150	115
Nairobi	Rice	Kenya	2016-11-17	150	115
Nairobi	Rice	Kenya	2016-11-18	150	115
Nairobi	Rice	Kenya	2016-11-21	150	115
Nairobi	Rice	Kenya	2016-11-22	150	115
Nairobi	Rice	Kenya	2016-11-23	150	115
Nairobi	Rice	Kenya	2016-11-24	150	115
Nairobi	Rice	Kenya	2016-11-25	150	115
Nairobi	Rice	Kenya	2016-11-28	150	115
Nairobi	Rice	Kenya	2016-11-29	150	120
Nairobi	Rice	Kenya	2016-11-30	150	120
Nairobi	Rice	Kenya	2016-12-01	150	120
Nairobi	Rice	Kenya	2016-12-02	150	120
Nairobi	Rice	Kenya	2016-12-05	150	120
Nairobi	Rice	Kenya	2016-12-06	150	120
Nairobi	Rice	Kenya	2016-12-07	148	120
Nairobi	Rice	Kenya	2016-12-08	150	120
Nairobi	Rice	Kenya	2016-12-09	150	120
Nairobi	Rice	Kenya	2016-12-13	150	120
Nairobi	Rice	Kenya	2016-12-14	150	120
Nairobi	Rice	Kenya	2016-12-15	150	120
Nairobi	Rice	Kenya	2016-12-16	150	120
Nairobi	Rice	Kenya	2016-12-19	150	115
Nairobi	Rice	Kenya	2016-12-20	151	115
Nairobi	Rice	Kenya	2016-12-21	150	120
Nairobi	Rice	Kenya	2016-12-22	150	120
Nairobi	Rice	Kenya	2016-12-23	150	120
Nairobi	Rice	Kenya	2016-12-29	154	119
Nairobi	Rice	Kenya	2016-12-30	154	119

Source: EAGC, 2017

### Appendix 1.4: Research Authorization Letter



**KENYATTA UNIVERSITY  
GRADUATE SCHOOL**

E-mail: [dean-graduate@ku.ac.ke](mailto:dean-graduate@ku.ac.ke) P.O. Box 43844, 00100  
 Website: [www.ku.ac.ke](http://www.ku.ac.ke) NAIROBI, KENYA  
 Tel. 8710901 Ext. 57530

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Our Ref: A152/CTY/PT/29327/2014 DATE: 1<sup>st</sup> March, 2018

Director General,  
 National Commission for Science, Technology  
 & Innovation  
 P.O. Box 30623-00100,  
 NAIROBI

Dear Sir/Madam,


**RE: RESEARCH AUTHORIZATION FOR IRENE CHERONO LETTING – REG. NO. A152/CTY/PT/29327/2014**

I write to introduce Ms. Irene Cherono Letting who is a Postgraduate Student of this University. She is registered for M.Sc degree programme in the Department of Agribusiness Management and Trade.

Ms. Cherono intends to conduct research for an M.Sc Proposal entitled, “Assessment of Vertical Price Transmission in Rice Markets in Nairobi City County, Kenya”.

Any assistance given will be highly appreciated.

Yours faithfully,



**MRS. LUCY N. MBAABU  
 FOR: DEAN, GRADUATE SCHOOL**

JL/own

## Appendix 1.5: NACOSTI Letter



### NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471,  
2241349, 3310571, 2219420  
Fax: +254-20-318245, 318249  
Email: dg@nacosti.go.ke  
Website: www.nacosti.go.ke  
When replying please quote

NACOSTI, Upper Kabete  
Off Waiyaki Way  
P.O. Box 30623-00100  
NAIROBI-KENYA

Ref. No. **NACOSTI/P/18/75305/22450**

Date: **7<sup>th</sup> August, 2018**

Irene Cheron Letting  
Kenyatta University  
P.O. Box 43844-00100  
**NAIROBI.**

#### **RE: RESEARCH AUTHORIZATION**

Following your application for authority to carry out research on *“Assessment of vertical price transmission in rice markets in Nairobi City County”* I am pleased to inform you that you have been authorized to undertake research in **Nairobi County** for the period ending **6<sup>th</sup> August, 2019.**

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

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

**DR. STEPHEN K. KIBIRU, PhD.**  
**FOR: DIRECTOR-GENERAL/CEO**

Copy to:

The County Commissioner  
Nairobi County.

The County Director of Education  
Nairobi County.